



House of Commons  
Environmental Audit Committee

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**Net zero and  
UK shipping**

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**Seventh Report of Session 2023–24**

*Report, together with formal minutes relating  
to the Report*

*Ordered by the House of Commons  
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## Environmental Audit Committee

The Environmental Audit Committee is appointed by the House of Commons to consider to what extent the policies and programmes of government departments and non-departmental public bodies contribute to environmental protection and sustainable development; to audit their performance against such targets as may be set for them by His Majesty's Ministers; and to report thereon to the House.

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## Summary

In December 2023 we reported on the progress the Government was making on policy to reduce the greenhouse gas emissions from UK aviation to meet interim and overall net zero targets set by Ministers. In this report we examine the progress the Government is making in respect of UK domestic and international shipping. We cannot report on progress against targets because Ministers have as yet set no detailed targets for the sector.

International shipping emissions are subject to regulatory standards laid down in treaties adopted by the International Maritime Organization (IMO) and implemented by its member States. UK legislation to limit shipping emissions therefore follows the standards set at the IMO. Progress at the IMO in delivering more robust standards for the carbon intensity and greenhouse gas emissions from ships has been criticised by campaigners, but the findings of the most recent IMO study on GHG emissions from shipping appear to have led to genuine progress: the IMO's current five-year strategy for reducing emissions, adopted in September 2023, was more ambitious than many expected. The IMO strategy still fails to align with a pathway consistent with achieving Paris targets for limiting warming to no more than 1.5°C by 2050, and the target date for achieving net zero emissions is vague: these are matters to be addressed not later than the next iteration of the strategy. The UK must work to deliver agreement at the IMO on regulatory measures which will at a minimum deliver the strategy's goals, and provide support to other IMO States in their implementation of such measures.

One measure under active discussion at the IMO is the introduction of a global greenhouse gas emissions levy, which appears to be gaining support among IMO States. This global levy would effectively supersede the inclusion of shipping in the EU Emissions Trading Scheme, an amendment to the scheme which took effect in January 2024. The UK Emissions Trading Scheme Authority has as yet declined to extend the UK ETS to cover shipping. This raises a potential risk of carbon leakage from the EU's greenhouse gas reduction regime. To mitigate this risk the UK ought to press for early adoption of the IMO pricing measure and implement it for UK shipping without delay.

The Government has announced its intention to include the UK's share of international aviation and shipping emissions in the emissions to be reckoned against the Sixth Carbon Budget for the period 2033 to 2037, and is considering whether to include these emissions in the UK's Nationally Determined Contribution for 2035 to be submitted to the United Nations under the Paris Agreement process. Legislation to give statutory effect to this commitment, made in April 2021, has still not been presented to Parliament for approval. The current method of reckoning the UK's share of greenhouse gas emissions from international shipping is based on the UK's reporting of fuel sales to the sector. This method risks underestimating the true proportion of GHG emissions attributable to international shipping from UK ports, as a disproportionately large amount of refuelling for voyages to and from the UK is undertaken at Rotterdam and other overseas ports. We heard that a voyage-based measure was more likely to give an accurate picture of the proportion of international shipping emissions attributable to the UK. The Government should undertake an urgent assessment of the merits of a voyage-based measure for reckoning UK shipping emissions, and should introduce the legislation necessary to include international aviation and shipping emissions in the Sixth Carbon Budget without further delay.

Government policy on reducing emissions from UK shipping is in danger of drifting unless Ministers seize the opportunity to set a clearer course for the sector. A refresh of the Clean Maritime Plan, the Government's principal strategy for decarbonising shipping, was initially promised in 2022 and is yet to be published. UK SHORE, the unit established within the Department for Transport to drive emissions reduction policy, appears to have no specific objectives or targets set, and its funding after March 2025 has not yet been guaranteed. There have been worrying slippages in the implementation of promising policies, such as the development of capacity in clean maritime clusters for the manufacture of zero-emission maritime fuels, and the provision of electrified shore power in UK ports. Ministers have not yet set overall and interim targets for reductions in UK shipping emissions: without these it will be more challenging to drive emission reductions across the sector.

The Government has allocated over £200 million in match funding to research and development initiatives for reducing maritime emissions from 2019 to 2025. This funding is welcome: but it compares unfavourably with the treatment of the aviation sector. Funding for development of zero-emission shipping initiatives must be guaranteed until at least 2030.

The Government appears hesitant in its commitment to developing manufacturing capacity for zero-emission fuels in the UK. Studies show that establishing production facilities dedicated to serving particular clusters of shipping routes could bring dividends from first-mover advantage and could kick-start the production of zero-emission fuels on a commercial basis. Ministers should develop a strategy to support the manufacture of zero-emission maritime fuels in the UK and should consult on the introduction of a revenue support mechanism to incentivise early-stage production.

The overall Government targets for reducing emissions from UK shipping must be supported by stretching targets for improving operational efficiencies: greater efficiency is essential to reducing overall fuel consumption and limiting the volume of fuel storage required on board vessels. The UK should maximise its advantages as the jurisdiction of choice for international shipping law, and as the home of the UK Hydrographic Office, to leverage measures to increase shipping route optimisation. Ministers ought to consider the benefits of requiring vessels to meet a carbon intensity standard before being allowed to enter UK ports. Measures to deliver shore power from renewables to UK ports must be proceeded with swiftly. Initiatives to establish green shipping corridors originating from UK ports should be supported to the fullest extent possible.

The refresh of the Government's Clean Maritime Plan is long overdue. The revised Plan must respond positively to the IMO's increased ambition for decarbonising international shipping, and set stretching yet deliverable objectives and actions for UK shipping. It ought at a minimum to contain specific overall and interim targets for decarbonising shipping, together with a credible plan to achieve them. The plan ought to comprise a strategy for developing hydrogen-based zero-emission maritime fuel production in the UK, with associated transmission and storage facilities; a strategy to maximise the UK's contribution to international shipping route optimisation; and a plan to deliver decarbonised shore power to UK ports. The new Clean Maritime Plan should be issued not later than September 2024.

## About this report

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1. In March 2021 we launched a major inquiry to examine how the Government was approaching the challenge of reducing emissions from the two transportation sectors considered to be the hardest to abate—civil aviation and shipping. We examined both sectors together in the course of the oral evidence we took, though we have chosen to report on them separately.

2. Our objective in this inquiry, in respect of shipping, was to examine the scope for technological innovation, changes in fuelling and operational efficiencies to reduce the emissions from UK shipping, and to establish the action required to be taken by the UK Government at national and international level to achieve the emissions targets it has set.<sup>1</sup>

3. For shipping, we set out to examine the following issues:

- the contribution operational efficiencies could make to reduce emissions from ships, and the timescale over which these might be expected to have an effect;
- the pathway to commercialisation for zero carbon shipping fuels; the role of the UK Government in driving progress to commercialisation, and the potential role of transitional fuel technologies such as alternative hydrocarbons;
- the pathways to development of zero emission technology for shipping, and the likely timescale for commercialisation of zero emission vessels;
- the role of the UK Government in supporting industry in the development and uptake of technologies, fuels and infrastructure to deliver net zero shipping;
- whether any policy mechanisms could reduce the UK's reliance on shipping;
- the action needed by the International Maritime Organization to drive emissions reductions, and the steps the UK Government ought to take to drive international action to reduce emissions;
- the effectiveness of the UK and EU emissions trading schemes, in stimulating technology improvement, behaviour change, or both to reduce emissions from shipping, and
- how the UK should define its ownership of international shipping emissions in order to include them in future statutory carbon budgeting.

4. In this report we examine the overall challenges that face the maritime sector as it moves to decarbonise. We make recommendations to the UK Government on the steps it needs to take now to ensure it can reliably meet its targets for the contribution of the maritime sector to net zero.

5. We received 72 written evidence submissions and held five public evidence sessions, hearing from 32 witnesses including academics, professional bodies, manufacturers, NGOs, representatives from the finance, aviation and shipping industries and Government advisers. To conclude the oral evidence, we heard from Robert Courts MP, the then

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<sup>1</sup> The terms of reference of the inquiry are set out on the Committee's website at <https://committees.parliament.uk/call-for-evidence/542/>

Parliamentary-Under Secretary of State at the Department for Transport, and Lee Rowley MP, the then Parliamentary Under-Secretary of State at the then Department for Business, Energy and Industrial Strategy. We are very grateful to everyone who submitted written evidence, who provided oral evidence and who otherwise assisted us in this inquiry.<sup>2</sup> We would in particular like to thank Dr Edmund Hughes, appointed as specialist adviser to this inquiry, whose insight and expertise have been invaluable.<sup>3</sup>

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2 The Chair of the Committee, Rt Hon Philip Dunne MP, declared his registered interest as a non-executive director of Reaction Engines at the opening session of oral evidence in the inquiry ([Q1](#)). Following the announcement on 5 November 2021 by Reaction Engines of a project involving partnership with the Science and Technology Facilities Council, which receives funding from the UK Government, he withdrew from the inquiry and has taken no further part in the Committee's proceedings in relation to the inquiry or this report.

3 Edmund Hughes has declared the following relevant interests:  
Former official at the International Maritime Organization (IMO); now a Director of Green Marine Associates Ltd. that provides consultancy services including to the International Chamber of Shipping (ICS) and the International Bunker Industry Association (IBIA).



# 1 Decarbonising commercial shipping

6. The world's oceans are the primary conduit for the conduct of the world's trade. International shipping lines transport global supply chains of food, fuel and consumer goods amounting to over 80% of global trade by volume.<sup>4</sup> The most recent global study of shipping activity, undertaken by the International Maritime Organization (IMO), the United Nations agency responsible for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships, found that shipping accounted for about 2.9% of global carbon dioxide emissions.<sup>5</sup> If the global shipping sector were a state, it would be the sixth highest global emitter of carbon dioxide, with a level of emissions similar to that of Germany and double that of the UK.<sup>6</sup>

7. The IMO study confirmed that the sector is overwhelmingly reliant on fossil fuels: of the global fleet of vessels, 97% are fuelled by heavy fuel oil (HFO) or marine diesel.<sup>7</sup> Greenhouse gas (GHG) emissions from global shipping are projected to increase by up to 50% above 2018 levels by 2050 if no action is taken.<sup>8</sup> Like aviation, on which we reported in December 2023, the maritime sector is being challenged to innovate and develop new technologies to operate on a zero-emission basis. To meet pathways consistent with the Paris Agreement goal of restricting global warming to 1.5°C, the sector is under pressure to reduce its absolute emissions and to reach, at a minimum, net zero emissions by 2050.

8. In July 2023 the IMO adopted a strategy seeking a reduction in total annual GHG emissions from international shipping of at least 20% on 2008 levels by 2030 and at least 70% by 2040.<sup>9</sup> Some analysts have suggested that, to achieve a pathway consistent with Paris goals, emissions from international shipping must fall much more rapidly: by between 34 and 45% from 2008 levels by 2030.<sup>10</sup> Delivery of a rate of change consistent with any of these goals will entail substantial changes in the sector, challenging the operators of the existing fleet to make substantial cuts in their greenhouse gas emissions in this decade and the next. In parallel, the development of maritime zero emissions technologies and their associated supply chain infrastructures are under pressure to accelerate. The International Chamber of Shipping has observed that the technological revolution required will need to reach maturity in fewer than three decades.<sup>11</sup>

## Uncertainty

9. A transition to net zero emissions, let alone absolute zero emissions, presents the sector with a number of technical and structural challenges. To accelerate the shift to zero-emission shipping, fuels and technologies which are currently in the early stages of

4 United Nations Conference on Trade and Development, [Review of Maritime Transport 2022: Navigating stormy waters](#), November 2022

5 The International Maritime Organization's [Fourth GHG Study](#), issued in 2020, estimated that GHG emissions from shipping in 2018 had accounted for some 2.89% of global anthropogenic GHG emissions, and that such emissions could represent between 90% and 130% of 2008 emissions by 2050.

6 [Q51](#)

7 International Maritime Organization, [Fourth IMO GHG Study](#), 2020. See also Bullock, S., Mason, J. and Larkin, A., 'The urgent case for stronger climate targets for international shipping', *Climate Policy*, vol. 22 no. 3 (2022), pp. 301–309. The current international standard for maritime fuels derived from hydrocarbons is [ISO 8217:2017](#).

8 International Maritime Organization, [Fourth IMO GHG Study](#), 2020.

9 International Maritime Organization, [2023 IMO Strategy on Reduction of GHG Emissions from Ships](#), July 2023

10 Parliamentary Office of Science and Technology, [International shipping and emissions](#), POSTNote 665, January 2022

11 International Chamber of Shipping, [A zero emission blueprint for shipping](#), November 2021

technological readiness will need to be developed at pace to reach large scale deployment. The International Chamber of Shipping has identified that “significant and long-term, high-risk investments will be required to trigger the step-change to advance technology readiness levels” so as to deliver the zero emission shipping that will be required to meet the maritime sector’s contribution to global Paris Agreement ambitions.<sup>12</sup> A report for the Chamber, undertaken by engineering consultants Ricardo and submitted to the IMO’s Marine Environment Protection Committee, identified more than 260 areas where research and development are required to overcome the systemic and technological challenges presented in the sector’s transition to net zero.<sup>13</sup>

10. Connected Places Catapult told us that present uncertainty around emerging technology options was proving a barrier to investment:

To invest in new technologies, shipping operators need confidence in the technology to perform as required—and that the supporting infrastructure (such as servicing and refuelling) will be available at the relevant ports of call. This has created a well-known ‘chicken and egg’ effect, whereby infrastructure won’t be committed until future fuel decisions are made, where those future fuel decisions are to a large extent reliant on the future infrastructure being available. This environment can sometimes create perverse incentive pressures to be second rather than first in investing in new technologies.<sup>14</sup>

The Society of Maritime Industries observed substantial uncertainty as to the technologies and infrastructure which are to be available in the future, pointing out the likelihood of development of several different routes or intermediate stages towards carbon neutrality.<sup>15</sup>

11. Shipping is considered a ‘hard to abate’ sector, characterised as high-capital and infrastructure-heavy, where assets have long lifetimes. The principal assets—the vessels used in international shipping—are expensive and require large amounts of capital to build, operate and maintain. They have an average economic lifespan of between 20 and 30 years. Investment decisions are typically taken on the basis that a vessel will be able to operate globally for the entirety of its economic life. Decarbonising the global shipping industry will entail substantial investment in commissioning or refitting vessels for shipping fleets: to meet the emissions reduction trajectories contemplated above, vessels capable of using new zero or near-zero GHG emission maritime fuels, new technologies and novel energy sources must begin to enter the fleet from 2030 and form a significant proportion of new builds from then on.<sup>16</sup>

12. The most significant barriers to the introduction of zero-emission vessels into the fleets of major shipping operators are likely to be the cost and global availability of zero-emission fuels. Lloyd’s Register, a global professional services company specialising in engineering and technology for the maritime industry, has observed that the business case for full industry uptake of zero-emission fuels remains weak. Regulatory intervention, as

12 *Ibid.*

13 International Chamber of Shipping et al., [Reduction of GHG Emissions from Ships: a comprehensive analysis of R&D projects to be supported by an International Maritime Research and Development Board to rapidly increase Technology Readiness Levels and decarbonize international shipping](#), submission to the IMO Marine Environment Protection Committee, August 2021

14 Connected Places Catapult ([ZAS0069](#))

15 Society of Maritime Industries ([ZAS0050](#))

16 International Chamber of Shipping, [A zero emission blueprint for shipping](#), November 2021

well as collaboration across the entire supply chain—between shipping companies and fuel suppliers, cargo owners, governments, and port authorities—will be required to secure decarbonising measures.<sup>17</sup>

13. Researchers from the University of Oxford told us that a significant barrier to large-scale private investment and adoption of clean fuels was the high relative cost of new fuels compared to existing fuels, and the absence of a mechanism (such as a carbon pricing regime) to reflect the environmental damage caused by the latter. Other barriers cited included high perceived risks from adopting new technologies and a lack of supporting infrastructure, project pipelines, and stable and scalable fuel supplies.<sup>18</sup> Further costs arise from the development of zero-emission infrastructure to support decarbonised shipping. Neither shipping companies nor port operators alone are expected to be able to access the level of funding necessary to achieve the decarbonisation of shipping.

14. Shipping industry leaders have demanded regulatory intervention. At COP26, hosted by the UK in Glasgow in 2021, the Government secured the Clydebank Declaration, an intergovernmental agreement to develop the green shipping corridors which we examine in greater detail in Chapter 5. Reports quoted Jan Dieleman, president of ocean transportation at Cargill, one of the world’s biggest ship charterers, as saying that the real challenge was “to turn any statements [at COP26] into something meaningful”:

The majority of the industry has accepted we need to decarbonise. Industry leadership needs to be followed up with global regulation and policies to ensure industry-wide transformation. We will not succeed without global regulation.<sup>19</sup>

Christian Ingerslev, chief executive of the Danish-led multinational tanker management company Maersk Tankers, was reported to have said that governments around the world needed to help create zero-emissions fuels at scale: the only way for that to work, in his view, was through a carbon tax.<sup>20</sup>

15. Guy Platten, of the International Chamber of Shipping, corroborated these views. He observed that at COP26 the industry had been demanding greater regulatory certainty and stronger government signals to industry:

One very senior shipowner stood up at this conference and said, ‘we want more regulation,’ which is highly unusual for a businessman to say, but it is true because without that regulation, without that certainty, it is holding back the investment we need to put in to achieve a zero carbon future [... I] t is a strange situation where the political leadership is falling behind what the industry wants to do.<sup>21</sup>

We examine below the international, regional and domestic regulatory responses to these demands.

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17 Lloyd’s Register, [First movers in shipping’s decarbonisation: a blueprint for getting started](#), December 2021

18 Dr Matthew Ives, Lukas Larsson and Alex Clark, University of Oxford ([ZAS0037](#))

19 Reuters, [‘Countries at COP26 launch plan for net-zero shipping lanes’](#), 10 November 2021

20 *Ibid.*

21 [Q172](#)

## 2 Global and regional regulation of shipping emissions

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### Global emissions regulation: the International Maritime Organization's MARPOL Convention

16. The International Maritime Organization (IMO), headquartered in London, provides an overarching regulatory structure for international shipping activity. The 176 States which are signatories to the International Maritime Organization Convention and members of the IMO have all undertaken to implement the provisions of IMO treaties in their national legislation. The IMO therefore provides consistent regulation of global shipping activity, including regulation of the current international emissions requirements on vessels.

17. The international nature of the maritime sector presents challenges for consistent regulation, since it often requires the alignment of or agreement between many states with different interests. While the IMO regulates ships and does not discriminate by flag state, approximately two-thirds of seaborne trade is by or with low- and middle-income countries, and the Paris Agreement recognises that developed and developing countries do not share the same obligations when it comes to addressing climate change.<sup>22</sup> Continued reconciliation of these two principles is therefore crucial to the IMO's regulatory work.

18. There has been significant international pressure on the IMO to address the substantial contribution of international shipping to global emissions. Before the UNFCCC COP26 summit held in Glasgow in 2021, for example, all the G7 nations, including the UK, were party to submissions to the IMO calling for a net zero target by 2050,<sup>23</sup> and over 150 companies and organisations from across the maritime, finance and energy sectors called on the IMO to commit to the full decarbonisation of shipping by 2050. The signatories included the banks Citi and Société Générale, major port authorities and energy suppliers.<sup>24</sup>

19. The UCL Energy Institute told us that the IMO must provide sufficient incentive for action through an ambitious (Paris-aligned) and enforceable standard.<sup>25</sup> It recognised the UK's role in influencing the IMO:

... The UK, as other countries with large economies and a significant shipping industry (e.g., USA, Japan, South Korea, etc.) can play a significant role in moving the IMO's decarbonisation agenda forward.<sup>26</sup>

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22 Lloyd's List, '[IMO agrees to cut emissions by at least 50% by 2050](#)', 13 April 2018

23 Department for Business, Energy & Industrial Strategy et al., '[G7 Climate and Environment: Ministers' Communiqué](#)', 21 May 2021

24 Lloyd's List, '[Call for market-based measures by 2025 to ensure shipping hits 2050 green target](#)', 21 September 2021

25 Smith, T et al., '[Reducing the Maritime Sector's Contribution to Climate Change and Air Pollution: Scenario Analysis: Take-up of Emissions Reduction Options and their Impacts on Emissions and Costs. A report for the Department for Transport](#)', July 2019

26 UCL Energy Institute, Decarbonising UK Freight Transport, Centre for Research into Energy Demand Solutions, UMAS ([ZAS0042](#)), para 20

It recommended that the UK lead by example, by setting ambitious domestic shipping decarbonisation goals and by working closely with partners at the IMO to increase ambition and enforcement of current IMO measures.<sup>27</sup>

### **IMO emissions standards for international shipping**

20. The primary measures put in place by the IMO to regulate shipping have been a series of energy efficiency and operational carbon intensity standards, implemented through revisions to existing treaties governing maritime pollution.

21. Amendments to the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) have provided for regulatory standards to be applied to vessels as follows:

- From January 2013:
  - **Energy Efficiency Design Index (EEDI)**. An energy efficiency standard placed on newly built ships, which aims to promote the use of more energy efficient (less polluting) equipment and engines. The EEDI requires a minimum energy efficiency level per capacity mile (e.g. tonne mile) for different ship type and size segments.
  - **Ship Energy Efficiency Management Plan (SEEMP)**. An optional plan to improve the operational efficiency of a vessel, with guidelines that suggest a variety of options to improve fuel efficiency, including measures such as speed optimisation, optimised weather routing, hull maintenance and engine load efficiency.<sup>28</sup>
- From January 2023:
  - **Energy Efficiency Existing Ship Index (EEXI)**. An energy efficiency standard which all vessels in service are required to meet.
  - **Carbon Intensity Index (CII)**. A rating placed on a ship based on the efficiency of its design and operation.

These standards have been transposed into UK law by the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, which have been periodically amended to keep pace with amendments to IMO treaties.<sup>29</sup>

27 *Ibid.*

28 International Maritime Organisation, [Resolution MEPC.203\(62\): Amendments to the Annex of the Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto](#), July 2011. See also IMO briefing, [‘Improving the energy efficiency of ships’](#) (last accessed 12 May 2024).

29 S.I. 2008/2924, as amended: principal amending Regulations have been S.I. 2019/940 and S.I. 2023/384. Further detail on the UK’s implementation of IMO emissions control requirements is provided in guidance note [MGN 683 \(M+F\): IMO carbon reduction measures](#), issued by the Marine and Coastguard Agency in April 2023.

22. The IMO's current regulatory standards have been criticised for lack of ambition and a failure to align with the Paris Agreement's goal of limiting warming to 1.5°C.<sup>30</sup> The IMO has undertaken to review its "short-term" legislative measures—primarily the EEXI and CII—by 1 January 2026 in line with the requirements of its current Greenhouse Gas Strategy. Progress towards this revision was most recently discussed at the 81st meeting of the IMO's Marine Environment Protection Committee in London in March 2024.

### *IMO Greenhouse Gas Strategies*

23. Since international shipping emissions were not expressly included in the Paris Agreement under the UN Framework Convention on Climate Change, the IMO is currently the sole multilateral body to set global international emissions objectives and targets for the maritime sector. The IMO has undertaken to develop a series of strategies which will set progressively more challenging targets for international shipping every five years. These are to be implemented in due course through amendments to the relevant IMO treaty, given effect through domestic legislation.

### *The IMO 2018 Greenhouse Gas Strategy*

24. The initial IMO Greenhouse Gas Strategy, adopted in April 2018, set the following targets:

- to reduce annual greenhouse gas emissions from international shipping by at least 50% from 2008 levels by 2050, and
- to achieve at least a 40% reduction in carbon intensity of ships by 2030.

The IMO also undertook to work towards the phasing out of GHG emissions from shipping entirely "as soon as possible" in the current century.

25. The initial Strategy was widely criticised by a variety of stakeholders for its apparent lack of ambition: many IMO States, including the UK, have supported a 2050 goal of net zero maritime GHG emissions. The IMO's fourth greenhouse gas study, published in 2020, indicated that the sector had already made progress in controlling emissions, as global emissions from shipping in 2018 were found to be roughly level with those of the 2008 baseline. The study's projections of future emissions by 2050 showed emissions increasing from about 90% of 2008 levels in 2018 to between 90 and 130% of 2008 levels by 2050. These projections are far beyond the target set in the initial strategy, and considerably higher than would be required for the industry to reach a net zero target.<sup>31</sup>

26. The Climate Change Committee said in 2020 that the IMO's 2050 ambition should be strengthened, given the potential for much deeper reductions in global shipping emissions from the use of ammonia or other hydrogen-based fuels. It said more stretching targets should be introduced for new ship and fleet efficiencies, given that fleet carbon intensities in 2018 had already improved by 30% from 2008 levels.<sup>32</sup>

30 Bullock, S., Mason, J. and Larkin, A., 'The urgent case for stronger climate targets for international shipping', *Climate Policy*, vol. 22 no. 3 (2022), pp. 301–309; The Maritime Executive news story, 'Let's Be Honest': UN Secretary-General Slams IMO's Progress on CO<sub>2</sub>', 18 October 2021; Parliamentary Office of Science and Technology, *International shipping and emissions*, POSTNote 665, January 2022.

31 International Maritime Organization, *Fourth IMO GHG Study*, 2020

32 Climate Change Committee, *The Sixth Carbon Budget: Shipping*, December 2020

### The IMO 2023 Greenhouse Gas Strategy

27. In July 2023 the IMO adopted a greenhouse gas strategy superseding the one agreed in 2018.<sup>33</sup> This strategy set increased levels of ambition for IMO Member States. The IMO says that it “represents a framework for Member States, setting out the future vision for international shipping, the levels of ambition to reduce GHG emissions and guiding principles” and that it “includes candidate mid- and long-term further measures with possible timelines and their impacts on States.”<sup>34</sup>

28. While the new strategy retains the 2018 commitment to reduce the carbon intensity of international shipping on average by at least 40% by 2030 from the 2008 baseline, it introduces significant new levels of ambition for the overall pathway to net zero emissions from shipping “by or around” 2050, including for the first time interim indicative checkpoints and stretch goals as follows:

- By 2030: a reduction of total annual GHG emissions from international shipping by at least 20% (striving for 30%) on the 2008 baseline, and
- By 2040: a reduction of total annual GHG emissions from international shipping by at least 70% (striving for 80%) on the 2008 baseline.

The strategy now also includes a target of at least 5% uptake of zero or near-zero GHG emission technologies, fuels, and/or energy sources by 2030, with a stretch goal of 10%.

29. The basis for calculation of emissions against the strategy’s ambitions and targets has changed: the new strategy takes a “well-to-wake” approach to GHG emissions that reckons the full lifespan of maritime fuels, from production to combustion, rather than the “tank-to-wake” reckoning in the 2018 strategy.

**Table 1: Comparison of the 2018 and 2023 IMO GHG Strategies**

	2018 initial GHG strategy	2023 revised GHG strategy
Absolute emission reduction	2050: at least–50%	2030:–20%, striving for–30% 2040:–70%, striving for–80% ~2050:–100%
Emission intensity	2030: at least–40% 2040: at least–70%	2030: at least–40%
Fuel uptake target	—	2030: 5% striving for 10%
Just and equitable transition	—	Measures included
Policy measures	Lists potential short-term, medium-term and long-term measures	Commits to the adoption of mid-term measures by 2025, including technical and economic measures
Scope	Tank-to-wake carbon emissions	Well-to-wake GHG emissions

Source: Global Maritime Forum briefing note, [The implications of the IMO Revised GHG Strategy for shipping](#), July 2023

33 International Maritime Organization, [2023 IMO Strategy on Reduction of GHG Emissions from Ships](#), July 2023

34 IMO briefing, [‘2023 IMO Strategy on Reduction of GHG Emissions from Ships’](#), July 2023 (last accessed 12 May 2024)

30. In addition, the text commits IMO States to pursuing efforts towards phasing out GHG emissions from international shipping consistent with the 1.5°C goal of the Paris Agreement, and includes references to ensuring “a just and equitable transition”, measures not included in the IMO’s initial GHG strategy.

31. The UK Government has lobbied strongly for an ambitious revision of the IMO Strategy. In September 2021 the then Transport Secretary, Rt Hon Grant Shapps MP, signalled his ambition for international shipping to meet an absolute zero target by 2050 rather than a net zero target (which would entail the use of offsetting residual emissions).<sup>35</sup> In evidence to us in advance of the 2023 summit the then Minister for Maritime, Robert Courts MP, confirmed the UK’s intention to push for ambitious outcomes from the summit to agree the Strategy.<sup>36</sup> Maritime UK chair, Sarah Kenny, told us that the Government’s “leadership on global shipping targets will be welcomed across the sector”.<sup>37</sup>

### **Further IMO measures on shipping emissions**

32. The IMO’s 2023 Strategy is said to have been more ambitious than many had expected.<sup>38</sup> Its success nevertheless depends on the successful adoption of the mid-term regulatory measures envisaged during the five years the Strategy is to run, and their effective implementation by IMO States and the international maritime industry.

33. IMO policy measures aimed at delivering the ambitions of the revised strategy are already in preparation:

- The IMO has committed to adopting a holistic regulatory framework for the implementation of the strategy by 2025, expected to come into force in 2027, which is to be fuel-agnostic (i.e. not committed to any particular future fuel technology).
- Member States have also agreed to the development of a “basket of mid-term measures”, to include both a technical (fuel standard) and an economic element through a GHG emissions pricing mechanism.
  - The **fuel standard** is expected to mandate the maximum GHG intensity of maritime fuels, and is to ratchet the maximum permitted intensity periodically downwards. The intention is described as “send[ing] a clear and unambiguous message to shipowners and fuel suppliers that the uptake of near-zero and zero-emission fuels must rapidly increase between now and 2040”, and that “both a compatible fleet and sufficient production volumes of fuel need to be able to match this demand”.<sup>39</sup>

35 Department for Transport news story, ‘[UK calls for zero global shipping emissions by 2050 as greenest ever London International Shipping Week begins](#)’, 13 September 2021

36 [Qq380, 412, 428](#)

37 Business Green news story, ‘[UK government calls for ‘absolute zero’ target for international shipping industry](#)’, 13 September 2021

38 Smith T et al, [Implications of the Revised IMO GHG Strategy for national, regional and corporate action](#), UMAS, September 2023

39 Global Maritime Forum briefing note, [The implications of the IMO Revised GHG Strategy for shipping](#), July 2023



- The **GHG emissions pricing mechanism** is expected to provide a further incentive to reduce emissions, though since it does not seek to cap emissions but increase the cost of emitting, the overall effect on emissions reductions is less easy to gauge.

34. At the 81st meeting of the IMO Marine Environment Protection Committee, held in London in March 2024, agreement was reached on an illustration of a possible net zero framework for IMO-led reduction in GHG emissions from international shipping. The measures contemplated include regulations to be introduced or amended under the MARPOL Convention to provide a new global fuel standard to reduce the GHG emissions from maritime fuel and an economic mechanism (or mechanisms) “to incentivize the transition to net-zero”.<sup>40</sup>

35. It has been widely reported that one of the economic incentive mechanisms contemplated is a global carbon pricing mechanism for maritime emissions. A pricing mechanism is expected to be further considered at the next meeting of MEPC, scheduled to take place in September 2024.

## Regional regulation: the European Union’s FuelEU Maritime Regulation

36. In June 2023 the EU adopted a new regulation for carbon emissions from the maritime sector—the so-called FuelEU Maritime or FEUM Regulation—as part of the ‘Fit for 55’ legislative package originally proposed by the European Commission in July 2021. FEUM will apply from 1 January 2025.<sup>41</sup> Its provisions include measures to require the greenhouse gas intensity of fuels used by the shipping sector to decrease over time, starting with a reduction of 2% in 2025: a reduction of up to 80% by 2050 is envisaged. Monitoring of the regulation’s implementation will be undertaken through the European Commission’s reporting and review process.

37. This measure is intended to complement the inclusion of shipping in the EU’s Emissions Trading System (EU ETS). In January 2024 the EU ETS was extended to cover CO<sub>2</sub> emissions from all “large ships” (of 5000 gross tonnage and above) entering ports in the EU, regardless of flag state. We address the UK’s planned extension of the UK ETS to maritime emissions in greater detail in chapter 6.

38. The overall EU package therefore uses a mix of different strategies—both carbon trading and regulation—to tackle emissions from shipping. The European Commission argued that the costs of abatement were currently so high that market-based solutions were insufficient in themselves to drive the necessary emissions reductions: a clearer regulatory framework is expected to provide the clarity needed to invest in emerging technologies.<sup>42</sup>

39. The Commission noted in its overarching Communication that the EU will both pursue domestic policy and continue working with partners at international level through the IMO. Simon Bullock told us that the EU had warned that it would take independent action, including the extension of its own emissions trading scheme to cover maritime emissions, if it did not see progress from the IMO:

40 International Maritime Organization, [Media summary of the Marine Environment Protection Committee 81st session \(MEPC 81\), 18–22 March 2024](#), March 2024

41 Apart from articles 8 and 9, which will apply from 31 August 2024.

42 Analysis provided by the International Affairs Unit, Select Committee Team, House of Commons

It would be preferable to have a global solution, but we do not live in that ideal world. We cannot wait any longer for the IMO to get its act together. I strongly suggest the EU's ETS approach is not perfect but pragmatic and realistic, it will drive some change and hopefully galvanise the IMO to take the action it needs to as well.<sup>43</sup>

### *Our view*

40. The entry into force of the EU's FuelEU Maritime regulation in January 2025, and following the inclusion of international shipping in the EU ETS in January 2024, creates a policy challenge for Ministers. The regional measures adopted by the EU appear to support more ambitious global IMO regulatory action to limit maritime emissions. They introduce requirements on GHG fuel intensity and on the use of shore power which are more stringent than the IMO (and therefore the UK's) requirements.

41. The UK might therefore secure a competitive advantage by maintaining a more permissive regulatory regime for international shipping pending the adoption of global regulations by the IMO. This could attract vessels not compliant with EU regulations to UK ports, where from 2030 they would be able to tie up without using shore power, and where they would not have to meet more stringent EU GHG fuel intensity measures.

42. Set against the competitive advantage for the UK is the prospect of undermining EU decarbonisation measures for short-term economic gain. The UK's leadership position at the IMO is likely to be compromised if Ministers in effect promote 'carbon leakage' from a neighbouring region, even if the UK is pressing for global maritime regulations which are more stringent overall.

43. The period to 2028 will be one of intense negotiation to secure more ambitious global measures to control shipping emissions at the IMO. The UK has been at the forefront of coalitions pressing for effective IMO action on maritime decarbonisation: its leadership at the IMO is said to be experienced and respected.

**44. We welcome the International Maritime Organization's adoption in 2023 of a revised Greenhouse Gas Strategy and the clearer signals it provides to IMO States and the shipping industry on the pathway to achieving net zero ambitions from shipping by 2050.**

**45. The UK's influence over and contribution to international shipping activity is considerable. We commend the UK Government on its contribution to date in securing a global strategy which is far more ambitious than that initially adopted by the IMO in 2018.**

**46. We nevertheless observe that the strategy adopted by the IMO does not currently align with a pathway consistent with the Paris Agreement target of limiting global warming to 1.5°C, and that its ambition is limited to achieving net zero emissions "by or around" 2050.**

**47. The period to 2028 and the expected adoption of a further GHG Strategy will be a crucial one for international shipping emissions, as agreement is reached on regulatory measures to implement the 2023 Strategy and as IMO States seek consensus**

on further decarbonisation plans. The outcome of discussions at the 81st meeting of the IMO Marine Environment Protection Committee in March 2024 appears to have been positive, but work is clearly required to consolidate and raise IMO ambitions on global emissions regulation. Continuity in the UK Government's approach and the maintenance and strengthening of the coalition of ambition at the IMO is essential.

*48. We recommend that the Government continue to work at the IMO for adoption of effective regulatory measures to implement the 2023 Strategy. In tandem with this, Ministers must press for a 2028 Greenhouse Gas Strategy which consolidates the ambition of the 2023 Strategy while striving for reductions in line with the UK Government's stated goal of absolute zero emissions from international shipping by 2050.*

*49. Prompt and effective implementation of IMO conventions will be essential to the delivery of meaningful reductions in shipping emissions in line with Paris goals and national net zero pathways. We therefore urge the UK to work with those flag States with substantial shipping registries to ensure full and thorough implementation of IMO conventions on maritime GHG reductions, supporting capacity-building where necessary.*

### 3 The UK Government's approach to delivering net zero shipping

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50. Around 185,000 people are employed in the UK maritime sector, which includes port facilities, the shipping fleet, maritime business services, engineering, and the leisure marine sector.<sup>44</sup> The sector contributes some £40 billion to the UK economy.<sup>45</sup>

51. The UK's influence over global shipping, reckoned on the basis of the UK Ship Registry, is relatively small: at the end of 2022 the UK-registered trading fleet was the 23rd largest in the world. Measured by deadweight tonnage, the UK's share of the world trading fleet at the end of 2023 was 0.44% and by gross tonnage, the UK's share was 0.61%.<sup>46</sup> The UK can therefore exert relatively little direct influence over global shipping emissions through its application of IMO-derived regulation to UK-registered vessels. Several of our witnesses nevertheless recognised the contribution which the UK—as a country with a large economy and a significant shipping sector—could make in promoting the reduction of emissions from shipping.<sup>47</sup>

52. We examine below the policies the UK is pursuing to address the reduction of emissions from domestic shipping and to develop technologies to contribute to global emissions reductions.

#### The Government's targets for domestic and international shipping emissions

53. Shipping emissions attributable to the UK have been on a slow downward trend over the past three decades: in 2021, the latest year for which figures are available, emissions from domestic shipping were at 37% below 1990 levels and those from international shipping had dropped by 21%.<sup>48</sup>

54. The Government's Transport Decarbonisation Plan, issued in 2021, committed it to achieving net zero in maritime “as soon as possible”: “with new technologies now reaching the stage of demonstration and initial deployment—we must increase the pace to enable significant fleet-wide emissions reductions in the 2030s.”<sup>49</sup>

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44 Transport Committee, [Maritime 2050](#), Fifth Report of Session 2022–23, HC 160, March 2023

45 “[The industry](#)”, Warsash Maritime School, Solent University [accessed 30 March 2024]

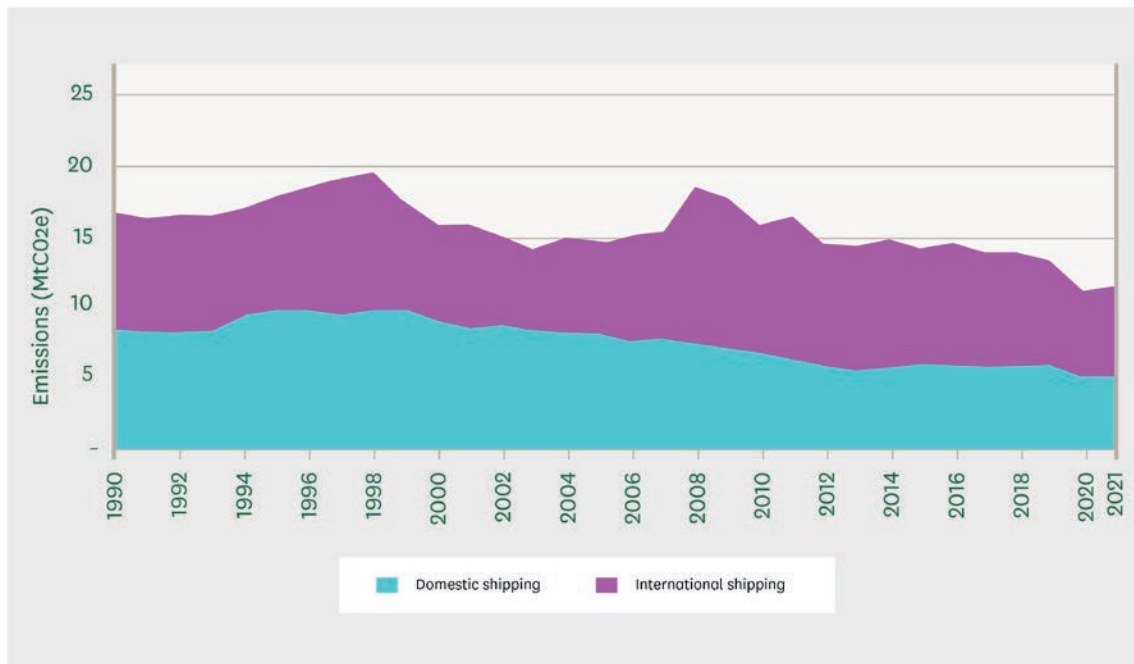
46 Department for Transport, [Shipping fleet statistics: data tables](#), March 2024, tables FLE0501 and FLE0502. Deadweight tonnage is a measure of how much weight a ship can carry; gross tonnage is a measure of a ship's overall internal volume.

47 For instance, UCL Energy Institute, Decarbonising UK Freight Transport, Centre for Research into Energy Demand Solutions, UMAS ([ZAS0042](#))

48 Department for Transport, [Energy and environment data tables](#) (December 2023), table ENV0201

49 Department for Transport, [Decarbonising Transport – A Better, Greener Britain](#), July 2021

Figure 1: UK greenhouse gas emissions from shipping, 1990–2021



Source: Department for Transport, [Energy and environment data tables](#) (December 2023), table ENV0201

### Accounting for international shipping emissions

55. In April 2021 the Government announced that it was including international shipping and aviation emissions in the UK’s net zero target, in line with advice from the Climate Change Committee. From 2033 the international shipping emissions attributable to the UK will be reckoned as emissions to be included within the overall Sixth Carbon Budget ceiling. In June 2021, the Government said it was aiming to introduce the necessary legislation to include these emissions “within the next year”, but in response to our recent report on net zero aviation Ministers now indicate that they will introduce the legislation “when parliamentary time allows”.<sup>50</sup> The Government is also considering whether international aviation and shipping is to be reckoned in the Nationally Determined Contribution (NDC) for 2035 to be submitted to the United Nations under Paris Agreement commitments: it is not included in the UK’s 2030 NDC.<sup>51</sup>

56. The equitable allocation of international shipping emissions between national inventories is a complex issue on which there is not yet full consensus. States currently report their share of international shipping emissions to the International Energy Agency on the basis of the fuel supplied to vessels, known as bunker fuel sales. Tyndall Manchester said that this methodology was “particularly unhelpful” in allocating to the UK its fair share of international shipping emissions. Its research showed the UK’s share of international shipping emissions were estimated to be 7 MtCO<sub>2</sub> per year under a bunker fuel reporting

50 Official Report, [Second Delegated Legislation Committee](#), 21 June 2021, col. 3; Environmental Audit Committee, [Net zero and the UK aviation sector: Government Response to the Committee’s Third Report](#), Sixth Special Report of Session 2023–24, HC 622, April 2024, p. 3

51 Oral evidence taken before the Environmental Audit Committee on 31 January 2024, Outcomes of UNFCCC COP28, [Q2](#)

regime, but around 42 MtCO<sub>2</sub> when apportionment was based on the freight imported. This difference is partly due to the ease of fuel bunkering at Rotterdam and other non-UK ports, which significantly skews the allocation away from the UK.

57. The IMO has begun to use a voyage-based approach for calculating international shipping emissions: this was used as the basis for its most recent study of the impact of GHG emissions from shipping.<sup>52</sup> Tyndall indicated it was likely that a voyage-based approach to apportioning international shipping emissions would begin to be more widely adopted, and suggested that the UK ought to adopt this approach early on, the better to understand the scale of the challenge arising from its international shipping emissions.<sup>53</sup> The UK Chamber of Shipping said that there needed to be a fair allocation of shipping emissions in the UK's national budgets that avoided any double counting.<sup>54</sup>

58. The CCC has already indicated that if an alternative methodology for reckoning international emissions is developed and agreed, it is likely that the proportion of international shipping emissions attributed to the UK will increase.<sup>55</sup> In its 2023 progress report the CCC recommended exploring a change to the emissions accounting approach for international shipping.<sup>56</sup> This was to ensure that “a fair share” of emissions for voyages to and from the UK was captured within the UK's inventory even if vessels refuelled in other jurisdictions. In response the Government indicated that a new emissions model for UK domestic shipping emissions was expected to be finalised in 2023. Following this, options for developing an activity-based measure of UK international shipping emissions would be explored.<sup>57</sup>

**59. The current method for allocating international shipping emissions between states appears unsustainable as a basis for making UK policy on international shipping emissions and determining the maximum emissions permissible from the UK's international shipping in the Sixth Carbon Budget. The International Maritime Organization has already moved away from the bunker sales measure to a voyage-based measure. This appears to give a more accurate picture of the overall contribution of international shipping activity to GHG emissions worldwide.**

**60. We recommend that the Government urgently assess the merits of introducing a voyage-based measure of the UK's contribution to international shipping emissions, so as to provide a sounder basis for developing policy on reducing that contribution. It is in the interests of the industry and policymakers alike that the matter is swiftly clarified, and that the legislation to include international aviation and shipping emissions in the Sixth Carbon Budget is brought before Parliament for approval without further delay.**

52 International Maritime Organization, [Fourth IMO GHG Study](#), 2020

53 Tyndall Manchester ([ZAS0041](#))

54 UK Chamber of Shipping ([ZAS0032](#))

55 Climate Change Committee, [The Sixth Carbon Budget: Shipping](#), December 2020

56 Climate Change Committee, [Progress in reducing emissions: 2023 Report to Parliament](#), recommendation R2022–265, p. 423

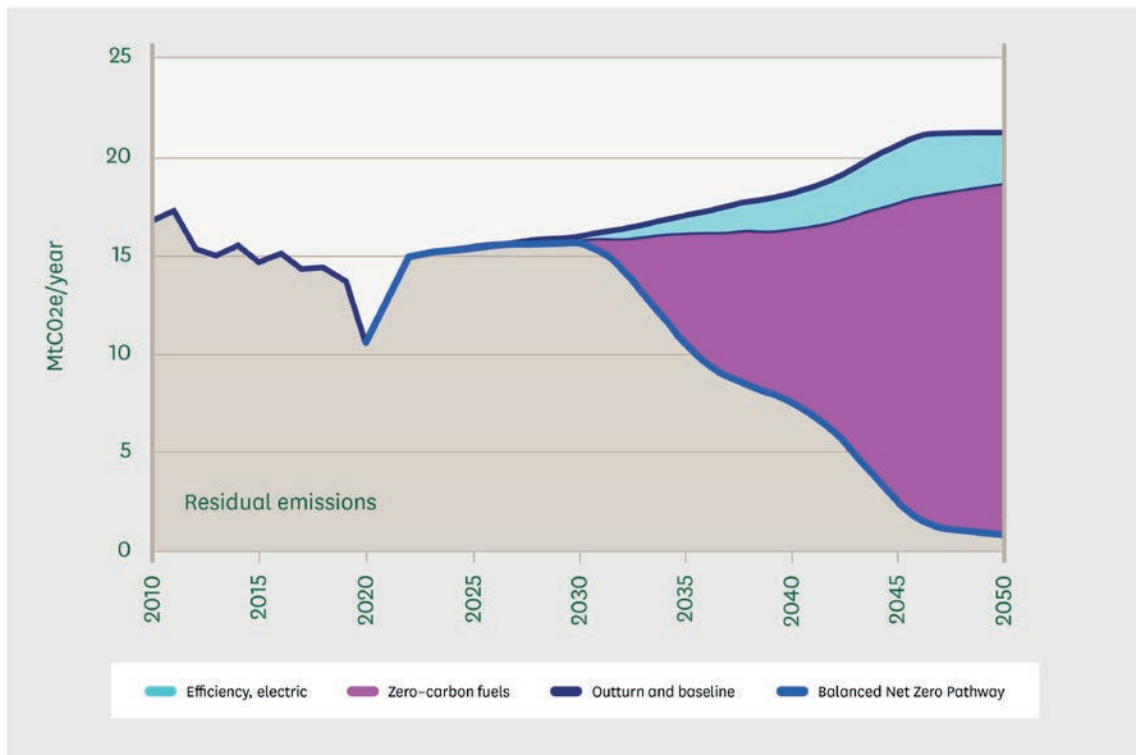
57 Department for Energy Security & Net Zero, [Responding to the Climate Change Committee's 2023 Annual Progress Report to Parliament](#), HC 1919, October 2023, R2022–265, p. 118

### The Sixth Carbon Budget

61. The CCC’s advice to Government on the Sixth Carbon Budget presented a ‘balanced pathway’ of measures to deliver emissions reductions consistent with a carbon budget ceiling of 965 MtCO<sub>2</sub>e for the period 2033 to 2037. For shipping, the CCC’s balanced pathway scenario was itself based on a scenario prepared for the Department for Transport by a research consortium led by the consultancy UMAS: the research was published by the Department alongside the Clean Maritime Plan in 2019.<sup>58</sup>

62. The CCC projects, for its balanced pathway, a scenario where the unabated level of domestic and international shipping emissions attributable to the UK increases from 11.5 MtCO<sub>2</sub>e in 2021 to 21 MtCO<sub>2</sub>e in 2050. With abatement measures, the CCC projects that the residual emissions from shipping will have fallen to 1 MtCO<sub>2</sub>e by 2050. The bulk of the projected abatement (86%) is to be delivered through the implementation of zero-emission fuels; the remainder is projected to be delivered through electrification and other efficiency measures. We discuss these measures in greater detail in chapter 4.

**Figure 2: Sources of abatement for the shipping sector in the CCC’s Balanced Net Zero Pathway for the Sixth Carbon Budget**



Source: Climate Change Committee, The Sixth Carbon Budget, figure 3.8.a

63. The Government has not yet published a full projection of how it expects international shipping to contribute to the delivery of the Sixth Carbon Budget and to net zero by 2050. This is in contrast with the Government’s detailed scenarios for international aviation set out in its Jet Zero Strategy in 2022. In many of the figures published in the March

58 Smith, T et al., [Reducing the Maritime Sector’s Contribution to Climate Change and Air Pollution: Scenario Analysis: Take-up of Emissions Reduction Options and their Impacts on Emissions and Costs. A report for the Department for Transport](#), July 2019

2023 Carbon Budget Delivery Plan the emissions reductions expected from international shipping are aggregated with those of international aviation attributable to the UK: indicative decarbonisation targets and policy interventions are yet to be specified.<sup>59</sup>

64. The only quantified policy in the Plan relates to Government policy for domestic maritime decarbonisation across vessels and ports, to be delivered through the UK Emissions Trading Scheme and research and development funding. Average annual emissions savings are expected to be 0.02 MtCO<sub>2</sub>e per annum over the Fourth Carbon Budget period, 0.3 MtCO<sub>2</sub>e per annum over the Fifth and 3 MtCO<sub>2</sub>e per annum over the Sixth.<sup>60</sup> Unquantified measures in the Plan which are projected to reduce emissions from domestic and international shipping include leadership in the multinational Net Zero Shipping initiative of the intergovernmental Mission Innovation 2.0 coalition, driving enhanced international action and investment in research and innovation for clean energy solutions.<sup>61</sup>

65. In their 2023 inquiry into Maritime 2050, the Government's overall strategy for the UK maritime sector, our colleagues on the Transport Committee heard many requests for clarity on the emissions targets the Government was likely to set. Maritime UK had asked what emissions the Government was reckoning in targets for domestic shipping and how they would be calculated, Tyndall Manchester observed that a lack of overall goals and interim targets was hampering policy development and the multinational shipping operator Maersk sought policy certainty from Government rather than aspirational goals.<sup>62</sup>

## Domestic policy initiatives

### *Maritime 2050 and the Clean Maritime Plan*

66. Maritime 2050, issued in January 2019, represents the Government's current strategy for development of the UK maritime sector. In the strategy the Government set out several 'visions' for policies to be achieved by 2050. That for zero-emission shipping was:

In 2050, zero emission ships are commonplace globally. The UK has taken a proactive role in driving the transition to zero emission shipping in UK waters and is seen globally as a role model in this field, moving faster than other countries and faster than international standards. As a result, the UK has successfully captured a significant share of the economic, environmental and health benefits associated with this transition.

The strategy acknowledged the substantial capital cost barriers faced by maritime asset owners and operators in decarbonising shipping.<sup>63</sup>

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59 Department for Energy Security & Net Zero, [Carbon Budget Delivery Plan](#), HC 1269, March 2023

60 *Ibid.*

61 *Ibid.*

62 Transport Committee, [Maritime 2050](#), Fifth Report of Session 2022–23, HC 160, March 2023, para 53.

63 Department for Transport, [Maritime 2050: navigating the future](#), January 2019, chapter 8.2



67. The Clean Maritime Plan, issued under the Maritime 2050 strategy in July 2019, is the Government’s national action plan for decarbonisation of the sector. At the time of issue it was expected to be refreshed in 2022, but a revision has not yet been published, a matter we discuss in greater detail below.<sup>64</sup>

68. The initial Plan provided a roadmap for reducing emissions in line with the initial IMO GHG Strategy issued in 2018. It was also designed to complement the Government’s Clean Air Strategy issued in January 2019, which also aimed to reduce airborne pollutants such as nitrogen oxides and particulate matter which have adverse impacts on health: emissions of these types from vessels in ports have a significant negative effect on local air quality.

69. In the Plan, Ministers set out four zero-emission ambitions for the maritime sector:

- by 2025 all vessels in UK waters are to operate with maximum energy efficiency measures.
- by 2025 the UK will have begun developing ports and coastal localities into ‘clean maritime clusters’ to provide zero emission infrastructure, including ‘bunkering’ (refuelling facilities) with low- or zero-emission fuel;
- by 2035 these clusters will have been completed and low- or zero- emission fuel bunkering will be widely available across the UK;
- by 2050 the UK will have established itself as a global leader in the zero-emission maritime sector and that the UK Ship Register will be a global leader in clean shipping.

70. In the Plan Ministers committed to examining non-tax incentives to support the transition to zero-emission shipping, to consulting on incentives for the use of sustainable maritime fuels, to providing information to the industry about funding opportunities and investment potential, to examining the potential for UK zero-emission shipping clusters, and to supporting clean maritime innovation in the UK, including through grant support for early stage research projects related to clean maritime. The initial Plan did not provide a minimum threshold for the consumption of zero emission fuels, arguing that further consultation was required before economic incentives could be introduced to increase the availability of zero carbon fuels.

### *The Transport Decarbonisation Plan*

71. In the Government’s overall Transport Decarbonisation Plan, published in July 2021, the Department said that there was evidence that the maritime sector might be able to achieve net zero earlier than 2050: indeed, such a transition might be possible in the 2040s.<sup>65</sup> The Plan included several commitments intended to demonstrate the Government’s approach to the decarbonisation of the sector. Overall the Government sought to ensure it had “the right information to regulate emissions, and to judge the effectiveness of the steps we are taking in the UK and at the IMO.”

64 Clean Maritime Plan, [HCWS1708](#), 11 July 2019. The Plan was drawn up between the Department for Transport and the Clean Maritime Council, an advisory body set up in October 2018 to devise a strategy to reduce greenhouse gas emissions from the UK maritime sector and to improve air quality on and around UK waterways, ports and shipping lanes.

65 Department for Transport, [Decarbonising Transport – A Better, Greener Britain](#), July 2021

### *The Course to Zero consultation*

72. In July 2022 the Department for Transport initiated a consultation on the intermediate steps required for the maritime sector to reach the overall net zero goal of 2050.<sup>66</sup> This detailed consultation, which closed in October 2022, was intended to inform the revision of the Clean Maritime Plan. A summary of responses was published in July 2023, but the Government has yet to respond to its consultation.<sup>67</sup>

### *Streamlining maritime strategy: the Maritime Council*

73. The Transport Committee, in its report on the overall Maritime 2050 strategy published in March 2023, criticised the number of initiatives and ambitions contained in the strategy and the difficulty in distinguishing between Government ambitions and deliverable plans:

To ensure the continued success of the Maritime 2050 strategy, the Government should review the current recommendations and set out key performance indicators and targets for each so that it is possible to track and assess where progress has or has not been made. The same constructive Government-industry dialogue that produced the strategy should also be used to streamline and prioritise its 184 recommendations, so that it becomes a more useful tool for tracking progress and accountability.<sup>68</sup>

In response, Ministers agreed that streamlining was necessary, but argued that detailed delivery mechanisms were set out in the accompanying ‘route maps’ to the strategy, of which the Clean Maritime Plan is one. Recognising the importance of tracking progress, however, the Government agreed to establish a Maritime Council as a forum for Government and industry to review progress on Maritime 2050 recommendations and to consider how to take them forward:

It will consider which of these are aspirational or ongoing, and which would benefit from clearer performance indications, success measures or targets for completion.<sup>69</sup>

The Maritime Council has held two meetings to date: an inaugural meeting on 21 June 2023, and a further meeting on 24 January 2024.<sup>70</sup>

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66 Department for Transport, [UK Domestic Maritime Decarbonisation—Consultation: Plotting the Course to Zero](#), July 2022

67 Department for Transport, [Domestic maritime decarbonisation: the course to net zero emissions—summary of responses](#), July 2023

68 Transport Committee, [Maritime 2050](#), Fifth Report of Session 2022–23, HC 160, March 2023, para 14

69 Transport Committee, [Maritime 2050: Government Response to the Committee’s Fifth Report](#), Fifth Special Report of Session 2022–23, HC 1420, June 2023, p. 2

70 Minutes of [Maritime Council meetings](#) can be obtained on request from the [Council Secretariat](#). At the June 2023 meeting Council members were briefed on the review of the Clean Maritime Plan, which was expected to set “clear targets” for emissions reductions: task and finish groups were proposed to be established on a number of subjects, including on the establishment of green shipping corridors and the development of maritime fuels. Council members discussed means of accessing green finance for decarbonisation initiatives, prospects for future fuel regulation, the use of emissions trading schemes and ways to stimulate innovation in the use of vessels.

## Clean Maritime Plan policies

74. The Government's initiatives to progress the decarbonisation of domestic and international shipping have arisen from the initial Clean Maritime Plan.

### *Maritime fuels in the Renewable Transport Fuel Obligation (RTFO)*

75. In March and April 2021 the Government consulted on options to amend the domestic Renewable Transport Fuel Obligation (RTFO) in order to increase the carbon savings to be derived from it.<sup>71</sup> A subsidiary 'deep dive' consultation examined the impact the RTFO could have on shipping emissions through supporting fuels with the highest potential to deliver greenhouse gas savings in the maritime industry and requiring that, in order to be eligible for such support, maritime fuels must be derived from renewable energy.<sup>72</sup>

76. The RTFO rewards producers of renewable fuels included in the scheme by issuing renewable transport fuel certificates (RTFCs) which they can sell to suppliers of conventional fuels to meet their annual carbon obligation as transport fuel suppliers.<sup>73</sup>

77. The Government responded to the consultation in July 2021, indicating support for the inclusion of renewable fuels of non-biological origin (RFNBOs) such as renewable hydrogen, ammonia and methanol in the RTFO. Producers of such fuels will be eligible to receive RTFCs.<sup>74</sup> The relevant legislation underpinning the RTFO was amended and the price support for maritime RFNBOs took effect on 1 January 2022.<sup>75</sup> Ministers declined to extend the scheme to maritime biofuels since such fuels did not meet the criteria for Government support.<sup>76</sup> The use of electricity as a low-emission transport fuel is not covered under the RTFO, although respondents to the consultation indicated the likely contribution of electricity as a fuel source for low- and zero-emission shipping, alongside RFNBOs.<sup>77</sup>

78. The Government observed the importance, highlighted in a large number of consultation responses, of joining up policy at IMO, domestic and regional levels, and for wider Government interventions to achieve net zero in shipping.<sup>78</sup> In response Ministers indicated that many of these questions were expected to be addressed in the refresh of the Clean Maritime Plan, which at that point was planned to begin in the summer of 2022.

### *The UK Shipping Office for Reducing Emissions (UK SHORE)*

79. Since March 2022 the Government's policy initiatives to decarbonise shipping have largely been organised through the UK Shipping Office for Reducing Emissions (UK SHORE), a unit established within the Department for Transport with a remit "to

71 Department for Transport, [Targeting net zero—next steps for the Renewable Transport Fuels Obligation: Government response](#), July 2021

72 Department for Transport, [The Role of the RTFO in Domestic Maritime: Deep dive consultation](#), March 2021

73 Department for Transport, [The Renewable Transport Fuel Obligation – an essential guide \(2024\)](#), last accessed 12 May 2024

74 Department for Transport, [Targeting net zero—next steps for the Renewable Transport Fuels Obligation: Government response](#), July 2021, p. 86

75 [The Renewable Transport Fuel Obligations \(Amendment\) Order 2021 \(legislation.gov.uk\)](#) SI 2021/1420, amending SI 2007/3072

76 Department for Transport, [Targeting net zero—next steps for the Renewable Transport Fuels Obligation: Government response](#), July 2021, p. 84

77 *Ibid.*, p. 84

78 *Ibid.*, p. 83

implement a comprehensive research and development programme [ ... ] to work in partnership with industry to tackle supply and demand issues with shipbuilding and help build greener vessels [and ... to] help develop the infrastructure to enable zero emission technologies and the physical infrastructure needed” to provide power to new-generation vessels.<sup>79</sup>

80. The Minister for Maritime set out the UK SHORE programme in May 2022.<sup>80</sup> The new unit was to drive forward work on:

- the first round of a multi-year Clean Maritime Demonstration Competition (CMDC) in succession to an initial CMDC run in 2021: the purpose of the CMDC was to fund feasibility studies and pre-deployment trials in innovative clean maritime solutions, thereby enabling full-scale technology demonstrations;
  - A strand of the CMDC was to fund feasibility studies exploring green shipping corridors, implementing commitments in the Clydebank Declaration for green shipping corridors announced at COP26 in 2021;
- exploration of initiatives on green shipbuilding skills in partnership with the Department for Education and its UK shipbuilding skills taskforce, and in collaboration with the National Shipbuilding Office;
- work with the devolved administrations to support a zero-emission ferries programme for intra-UK ferry routes, thereby facilitating domestic green shipping corridors;
- the issue in 2022 of plans for a Centre for Smart Shipping (CSmart), a commitment under the Maritime 2050 strategy. Providing a co-ordinating function in new and emerging technologies, CSmart was expected to coordinate new and emerging net zero maritime technologies, enabling innovation hubs to support regional clusters of expertise, and
- establishment of grant schemes for early research projects delivered by UK universities, in partnership with the UK Research and Innovation Supergen programme and marine industrial stakeholders.

81. The Minister for Maritime stressed to us the “step change” in approach which Government support for UK SHORE represented, both in the provision of £206 million for research and development activity from 2022 to 2025 and the “holistic plan, through the Transport Decarbonisation Plan and the Clean Maritime Plan that sits underneath it” for the decarbonisation of shipping.<sup>81</sup> Ministers could not, however, identify to us any specific objectives and targets which had been set for UK SHORE to deliver.<sup>82</sup>

82. The Transport Committee welcomed the establishment of UK SHORE as a “positive first step” towards decarbonisation of the domestic maritime sector. They recommended, as further steps towards the overall net zero target, that the Government commit to long-term investment, targeting some funding at the commercialisation of mature technologies

79 Department for Transport news story, “[DfT launches UK SHORE to take maritime ‘back to the future’ with green investment](#)”, 10 March 2022.

80 Department for Transport, [UK Shipping Office for Reducing Emissions](#), HCWS50, 24 May 2022

81 [Q381](#)

82 [Qq382-384](#)

to help reach the net zero target. In response, Ministers declined to give commitments to long-term public funding, suggesting that, while UK SHORE would continue to support decarbonisation initiatives until March 2025, further investment beyond that date would be dependent on future Budget decisions.<sup>83</sup>

## *Technology development initiatives*

### *The Clean Maritime Demonstration Competition*

83. The first round of the Clean Maritime Demonstration Competition (CMDC) was launched in March 2021 and ended in March 2022. It allocated up to £23.3 million in matching funding to 55 projects across the UK to deliver feasibility studies and technology trials in clean maritime solutions. The projects engaged 208 partners from across the UK: in total £33.5 million was invested in the successful projects. Following the outcome of the initial competition, it was reconstituted as a regular initiative. To date the competition, now in its fifth round, has committed £128.3 million of the UK SHORE budget on CMDC initiatives, attracting total investment of £193.5 million.<sup>84</sup>

### *The Zero Emission Vessels and Infrastructure (ZEV) competition*

84. In January 2023 UK SHORE and the Government innovation agency Innovate UK opened a competition to provide £77 million in matching funding to support research into close-to-commercial clean maritime technology at a high level of technological readiness.<sup>85</sup> The funding to cover the construction and set-up of projects is to will extend to March 2025: project partners are expected to fund all further costs in the demonstration phase until the close of the competition in March 2028.<sup>86</sup>

### *The Clean Maritime Research Hub (Durham)*

85. In September 2023 the University of Durham was announced as the home of the UK National Clean Maritime Research Hub (UK-MaRes Hub), a national research partnership to decarbonise the UK maritime sector which is expected to focus on the decarbonisation and elimination of air pollution from maritime activity in ports and at sea. The hub is expected to research sustainable marine fuels and their safe use, low-GHG power and propulsion systems for shipping, decarbonised port operations and infrastructure, and improved maritime operations and vessel efficiency. It is to run from September 2023 to March 2027 and will be supported by £21.3 million of Government funding over that period.

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83 Transport Committee, [Maritime 2050, Fifth Report of Session 2022–23](#), HC 160, March 2023, para 69, and [Maritime 2050: Government Response to the Committee's Fifth Report](#), Fifth Special Report of Session 2022–23, HC 1420, June 2023, p. 7

84 Department for Transport transparency release, [Multi-year clean maritime demonstration competition](#) (last accessed 12 May 2024)

85 The Government indicates that the purpose of the programme is “to reduce innovation risk and encourage the private investment needed to progress clean maritime technologies, whilst providing valuable evidence on their efficacy to unlock further private investment and inform future policy and regulation”. Transport Committee, [Maritime 2050: Government Response to the Committee's Fifth Report](#), Fifth Special Report of Session 2022–23, HC 1420, June 2023, p. 7

86 Department for Transport guidance note, [Zero Emission Vessels and Infrastructure \(ZEV\) competition](#), 6 February 2023

## Observations on the Government's approach

### *The Climate Change Committee*

86. In September 2019 the then Chair of the Climate Change Committee (CCC), Lord Deben, told Ministers that achieving zero-emission or near zero-emission shipping in the UK by 2050 was likely to be “feasible and cost-effective” through the use of alternative fuels such as zero-emission hydrogen or ammonia. In order to make a full contribution to the IMO’s initial greenhouse gas objective of a 50% reduction in greenhouse gas emissions from a 2008 baseline by 2050, the CCC advised that the UK’s transition to these fuels would need to be well under way before 2050, with “refuelling infrastructure established and a substantial fraction of the fleet already switched.”<sup>87</sup> As with aviation, reaching the net zero target would mean reducing actual emissions from shipping, together with some use of greenhouse gas removals to offset remaining emissions: the CCC stipulated that such removals ought not to be a substitute for genuine emissions reductions.

87. In its 2020 advice to Government on the Sixth Carbon Budget the CCC observed that the Government’s progress in decarbonising shipping had been slow over the previous decade: changes in emissions had primarily been driven by changes in demand along with some improvements in efficiency.<sup>88</sup> It identified several gaps in the Government’s approach to decarbonising shipping, including a lack of incentives for the commercial use of zero-emission fuels in shipping, and a lack of deployment support both for port infrastructure changes and for the construction of plants to manufacture zero-emission maritime fuels.<sup>89</sup>

88. In its most recent annual progress report on reducing emissions, issued in June 2023, the CCC has noted that, in the continued absence of an updated Clean Maritime Plan incorporating the Government’s response to the detailed Course to Zero consultation, there was “no clear strategy” for decarbonising the sector.<sup>90</sup> While it noted the progress which had been made in stimulating research and development activity through UK SHORE, and significant progress in a number of other areas of maritime decarbonisation policy, the CCC listed a number of policy undertakings which the Government had not yet fulfilled and CCC recommendations which were yet to be addressed, several of which echoed observations made in its advice on the Sixth Carbon Budget:

- No phase-out date had yet been set for the sale of new non-zero-emission domestic vessels;
- The Government was yet to commit to requiring the clean maritime clusters envisaged in the Clean Maritime Plan to provide at least 2 TWh per year of zero-emission fuels by 2030;
- The Government was yet to set out, in strategic terms, the role of low- and zero-emission fuels in the shipping sector;

87 Letter from the Climate Change Committee Chairman, Lord Deben, to the Secretary of State for Transport, Rt Hon Grant Shapps MP, concerning [net-zero and the approach to international aviation and shipping emissions](#), 24 September 2019

88 Climate Change Committee, [The Sixth Carbon Budget: Shipping](#), December 2020

89 *Ibid.*

90 Climate Change Committee, [Progress in reducing emissions: 2023 Report to Parliament](#), table 11.1, p. 294

- There was no plan to deliver the roll-out of electricity infrastructure at major UK ports of in a way which would support the widespread use of electricity as a power source for ships in port which currently power themselves from their own fuel bunkers;
- The Centre for Smart Shipping (CSmart), intended to oversee and coordinate the Government’s existing and future work on maritime technology and innovation, was yet to be established.

89. While the Government response to the CCC progress report’s recommendations sought to indicate progress and plans for further action, the significant policy gaps identified by the CCC have not yet been adequately filled.

- Ministers have said in terms that the Government is “unable to commit” to the requirement for clean maritime clusters to produce at least 2 TWh of zero-emission fuels annually by 2030: instead the Government has suggested a number of other actions underway under the original Clean Maritime Plan which might achieve a similar outcome;<sup>91</sup>
- UK SHORE is supporting the development of clean fuel technologies for the domestic maritime sector; the refreshed Clean Maritime Plan is to set out policies to increase the use of low carbon maritime fuels; and the Government is to issue a Low Carbon Fuels Strategy covering low carbon fuels deployment across several transport modes “to further support investments in low carbon fuels”.<sup>92</sup> Ministers called for ideas to shape this strategy in 2022 but it is yet to be issued;
- Ministers are no longer pursuing a policy of mandating the provision of shore power in ports, following the call for evidence in 2022: the Government is instead planning a call for evidence on net zero ports, which is to take a technology-neutral approach to the “technologies, infrastructure and other changes that may be required at ports to enable ships to reduce their emissions whilst at berth and to help them decarbonise more broadly.”. The policy is likely to continue to include electrified shore power “alongside other alternatives that can provide the same outcomes.”;<sup>93</sup>
- The Department for Transport is “currently working on preparations for launching a new competition, such as CSmart, and is exploring funding options, including via UK SHORE, that will continue to develop after [September 2023].”<sup>94</sup>

The phase-out of non-zero-emission domestic vessels was not addressed in the Government response to the CCC’s report: no date appears to have been set for ending domestic sales of these vessels.

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91 Department for Energy Security & Net Zero, [Responding to the Climate Change Committee’s 2023 Annual Progress Report to Parliament](#), HC 1919, October 2023, R2022–267, pp 119–120

92 *Ibid.*, R2023–135, pp 178

93 *Ibid.*, R2022–266, pp 118–19

94 *Ibid.*, R2023–134, pp 177–78

### Industry stakeholders

90. Sarah Kenny, Chair of Maritime UK, told us that the Government’s plans to decarbonise shipping ‘signpost[ed] the right strategy’<sup>95</sup> but that swifter and more decisive action was required: for example, a Government decision on the low carbon fuel technology to be used in ports would send an investment signal to industry for the development of appropriate infrastructure.<sup>96</sup> Dr Tristan Smith, Reader in Energy and Shipping at the UCL Energy Institute, and a member of the Government’s Clean Maritime Council, said that the Government’s plans represented “a missed opportunity” to provide either a clearer policy direction or a stronger signal on funding and its use: both had a crucial role in unlocking private investment.<sup>97</sup> Guy Platten, from the International Chamber of Shipping, praised the Government’s strategies but sought practical action: “investment in infrastructure [and] investment in research and development and in production of clean fuels.”<sup>98</sup>

91. University of Oxford researchers told us that the Maritime 2050 strategy contained “the foundational building blocks of a government-backed maritime sector focused ‘green financing’ program that will contribute to the broader UK green transition plan and competitive positioning of the UK as a green finance hub”.<sup>99</sup>

92. The UK Chamber of Shipping told us that out of all UK transport sectors, the maritime transport sector had received least funding for research and development of decarbonisation technologies. Compared to countries like Norway, Germany and Singapore, the UK was behind in providing a level of financial and fiscal support for the decarbonisation of the shipping industry.<sup>100</sup> As a matter of priority, the Chamber considered that the UK Government should ‘level up’ the shipping industry to the levels of investment into its automotive and aviation counterparts, so as to provide investment for accelerated projects which could support the industry to decarbonise. In particular the Chamber sought substantial funding to assist with research and development and the deployment of zero-emission shipping technologies and green port infrastructure.<sup>101</sup>

### Our view

93. The Government’s establishment of a dedicated unit—UK SHORE—to promote comprehensive research and development for net zero shipping in the UK is welcome.

**94. We welcome the Government’s initiative to establish UK SHORE as a dedicated unit to promote research into green maritime technology and the reduction of emissions from UK shipping. We are nevertheless concerned to note that no specific objectives or targets have been set for the unit, and are alarmed to learn that the Department for Transport is unable to guarantee the unit’s funding beyond the end of the current Spending Review period in March 2025. It is worrying to note the slippage in policy on**

95 [Q70](#)

96 *Ibid.*

97 [Q171](#) (Dr Tristan Smith)

98 *Ibid.*

99 Dr Matthew Ives, Lukas Larsson and Alex Clark, University of Oxford ([ZAS0037](#))

100 UK Chamber of Shipping ([ZAS0032](#))

101 *Ibid.*



**clean maritime clusters and zero-emission fuels and the provision of shore power in ports. At this stage of the Government's strategy to achieve net zero from UK shipping, Ministers must ensure that the sector has certainty about policy direction.**

**95. Net zero offers the UK an unrivalled opportunity to secure benefits for the UK maritime sector and the UK's research and manufacturing base. *It is now high time for Ministers to advance to the next stage of policy development by setting stretching but achievable interim targets for UK domestic and international shipping emissions, consistent with carbon budget requirements and the overall 2050 net zero target.***

**96. In chapters 4 to 6 we examine in greater detail the UK's implementation of measures to support the decarbonisation of shipping, and UK SHORE's role in delivery. In Chapter 7 we examine the measures which ought to be brought forward in the refreshed Clean Maritime Plan.**

## 4 Technical measures to decarbonise shipping: renewable marine fuels

97. Unlike in the aviation sector—where, as we reported in December 2023, sustainable aviation fuels appear to be on a pathway to commercial production—none of the technologies needed to achieve net zero-emission goals for shipping appear to have reached commercialisation.

98. Full decarbonisation of maritime transport will require the application of several new technological approaches across a variety of applications. Methods under development to reduce shipping emissions are typically either technical, focussing on energy savings through improvements to ship design, or operational, seeking to reduce emissions.<sup>102</sup>

99. The primary mitigation options to reduce emissions from shipping are:

- **Zero-emission fuels:** these fuels are intended to displace fossil-derived marine fuels. They have zero CO<sub>2</sub> emissions on combustion, but typically require either engine retrofits or new propulsion and energy storage systems. Alternative fuels include ammonia and hydrogen.<sup>103</sup>
- **Fleet efficiency improvements:** these include variations on ‘slow steaming’ (management of voyage speeds), operational optimisation, improvements in ship hull design and engine efficiency, and onboard renewable power generation and wind propulsion systems.
- **Electrification:** electricity is currently used to power onboard batteries and motors in a limited range of hybrid and full electric propulsion vessels, primarily those engaged in short-sea trades where operational range is less of a barrier, and more widely used to provide shore power to vessels in port.

We set out below the options for delivering these mitigations and examine the measures the Government is taking to support implementation of these options.

### Zero-emission fuels

100. In the Climate Change Committee’s advice on the Sixth Carbon Budget, zero-emission fuels comprise the large majority (87%) of the emissions savings expected to be required from shipping between 2033 and 2037. Research undertaken by the maritime consultancy UMAS shows that even at the lowest ‘level of ambition’ set by the IMO in 2018 (a 50% GHG reduction by 2050), low- or zero-emission fuels such as ammonia would have to become the dominant fuel in order for shipping to be aligned with the IMO’s strategy.<sup>104</sup>

102 Evert A. Bouman, Elizabeth Lindstad, Agathe I. Riialand, Anders H. Strømman, ‘[State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping – A review](#)’, *Transportation Research Part D: Transport and Environment*, Volume 52, Part A, 2017, pp. 408–421

103 Climate Change Committee, [The Sixth Carbon Budget: Shipping](#), December 2020

104 Raucci, C et al., [Aggregate investment for the decarbonisation of the shipping industry](#), UMAS, January 2020

## Zero-emission fuel technologies

101. Zero-emission fuels are not currently available at a fully commercial scale anywhere in the world, though a number of demonstration projects are operational. According to the Royal Institution of Naval Architects (RINA), the availability of zero-emission fuels in targeted key hubs and centres was ‘a decade away’: even if that level of availability were secured, the industry needed fuel supply in all locations to be able to guarantee safe commercial operations.<sup>105</sup>

## Hydrogen

102. Hydrogen is initially being explored for short journeys where energy storage requirements are low. Hydrogen fuel cells at lower power densities are already available, and hydrogen combustion engines up to around 2 MW are available commercially—but, as RINA reminded us, multiples of 10 MW of power will be required to power transoceanic vessels.<sup>106</sup> Breakthroughs in hydrogen storage technology with significantly improved volumetric density are thought to be possible by 2050, although such developments would take time to be commercialised and deployed.<sup>107</sup> RINA observed that the use of hydrogen in shipping carries significant safety risks.

103. Hydrogen is capable of being used as a zero-emission fuel on its own, but it is also a necessary feedstock in the processes to make marine ammonia and marine synthetic methanol. The Government’s Hydrogen Strategy envisages a significant role for hydrogen in UK shipping.<sup>108</sup> Previous modelling has estimated that the domestic demand for maritime hydrogen alone could reach between 15 and 20 TWh annually by 2035: the Government acknowledges that this may now be an underestimate, and promises to publish updated estimates in the forthcoming Clean Maritime Plan refresh. 40 of the projects funded under the first three rounds of the Clean Maritime Demonstration Competition since 2021 have related to hydrogen or to hydrogen-derived fuels.

## Ammonia

104. Ammonia combustion engines capable of powering the full range of commercial ships were expected to be ready “by the middle of the 2020s”. The significant safety risks associated with the use of hydrogen as fuel are also present with ammonia: the substance also presents a considerable toxicity risk. RINA observed that progress on establishing the regulatory safety framework was lagging.<sup>109</sup> We note that the IMO is expected to finalise interim guidelines for the safety of ships using ammonia as fuel by the end of 2024.<sup>110</sup>

105. Zero-emission vessels powered by ammonia have now been commissioned by a number of shipping lines for some commercial freight applications. CMI Jiangsu, a Chinese shipyard, has been commissioned to build 12 ammonia-powered vessels for the Norwegian car and truck transporter Høegh Autoliners: the vessels are expected to enter

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105 Royal Institution of Naval Architects ([ZAS0059](#))

106 *Ibid.*

107 Climate Change Committee, [The Sixth Carbon Budget: Shipping](#), December 2020

108 Department for Energy Security & Net Zero, [Hydrogen Strategy Delivery Update: Hydrogen Strategy Update to the Market: December 2023](#)

109 Royal Institution of Naval Architects ([ZAS0059](#))

110 Private communication from specialist adviser

service in August 2024.<sup>111</sup> The Norwegian shipping operator North Sea Container Line, in partnership with the fertiliser producer Yara and its clean ammonia operation, intends to use zero-emission vessels powered by ammonia on the freight shipping route between Oslo and Hamburg from 2026.<sup>112</sup>

106. Transporting ammonia is significantly cheaper overall than transporting hydrogen. The CCC anticipates that if this market continues to develop and costs fall, ammonia stored onboard ships will become increasingly attractive as a fuel source.<sup>113</sup> The additional cost from switching to ammonia will depend heavily on the cost trajectories both of hydrogen and of any future improvement in processing plant capital and operating costs.

107. The maritime consultancy UMAS and the engineering and design consultancy Arup have developed a case study illustrating how the establishment of an ammonia production facility in the North East of England, supplying the ferries operating from Immingham, Teesside and Newcastle, could deliver emission savings aligned with the IMO's most ambitious scenarios for the uptake of zero emission fuels by 2030. UMAS and Arup indicate that current uncertainty over the initial demand for zero-emission marine fuels, concerns over how swiftly it will scale, and uncertainty over the cost-effectiveness of developing production and supply infrastructure is hampering confidence among the principal industry actors and obstructing the necessary investment. Supplying zero emission ammonia to the ferries on the six routes identified would substitute well over 10% of the area's current demand for conventional maritime fuels. While there would be a cost premium associated with ammonia manufacture from a new facility in the North East, they argue that this is outweighed by the initial costs incurred in establishing the infrastructure to import lower-cost ammonia in bulk from overseas producers.<sup>114</sup>

### *Green methanol*

108. Zero-emission synthetic methanol is a further fuel option. Synthetic methanol is capable of being produced from hydrogen and CO<sub>2</sub>; the latter can potentially be sourced from direct air capture installations. The process to produce synthetic methanol is currently significantly more expensive than that to produce ammonia or hydrogen as marine fuels. Nevertheless one of the two projects being funded to demonstration phase under the Government's Zero Emissions Vessels and Infrastructure competition (ZEVI) is based on methanol.

109. In 2021 the Danish multinational shipping operator Maersk was reported to have placed a major order for eight container vessels that can run on green methanol.<sup>115</sup> Maersk plans to run the vessels on green methanol, rather than fossil fuels, as soon as possible, but is said to have conceded that this would be challenging in the short term because it would require a significant increase in the production of "proper carbon neutral methanol".<sup>116</sup>

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111 Inside Marine news story, "[Deltamarin Signs contract for Höegh Autoliners Aurora class PCTCS](#)" (last accessed 12 May 2024)

112 Yara International ASA news release, "[The world's first clean ammonia-powered container ship](#)", 30 November 2023

113 Climate Change Committee, [The Sixth Carbon Budget: Shipping](#), December 2020

114 UMAS and Arup, [Opportunities for the UK to kick-start shipping's transition to zero greenhouse gas emission fuel](#) (last accessed 12 May 2024)

115 Business Green news story, '[UK government calls for 'absolute zero' target for international shipping industry](#)', 13 September 2021

116 The Guardian. [Shipping firm Maersk spends £1bn on 'carbon neutral' container ships](#), 24 August 2021

## Interim fuel technologies

### Biofuels

110. Biofuels—fuels manufactured from biomass—are potential alternatives to the current petroleum-based fuels used in shipping. Fuels such as biodiesel can be used as “drop-in” fuels which do not require engine modifications. Many sectors besides shipping are targeting the future use of biomass to provide heat, power, transport fuels and chemicals.<sup>117</sup>

111. Whereas, as we reported in December 2023, biofuels (termed ‘sustainable aviation fuel’ or SAF) are a substantial element of the aviation industry’s decarbonisation strategy, there are challenges to developing biofuels for maritime use. Biofuel feedstocks are in increasing demand worldwide, a phenomenon which poses an inherent risk to biodiversity if not responsibly managed: the UK Government has specified that SAF feedstocks sourced in the UK are not to be obtained from land with high biodiversity value or land with high carbon stocks.

112. The CCC’s analysis for the Sixth Carbon Budget showed that the use of biofuels in shipping was not likely to be an optimal use of bioenergy by 2050, as using a carbon-free fuel such as ammonia was likely to result in significantly lower overall emissions.<sup>118</sup>

### Other alternative fuels

113. The use of liquefied natural gas (LNG) as an alternative to petroleum-based fuels has recently gained traction, since the use of LNG (together with methanol) is considered to have significant air quality benefits: its use is therefore in line with IMO policy goals for the improvement of air quality in ports and coastal areas. The long-term contribution of LNG as a shipping fuel to climate change mitigation depends heavily on technological development. The introduction of renewable liquefied methane, either from biological or synthetic sources, could eventually lead to LNG-powered vessels that are effectively carbon-neutral. Japanese shipping companies are currently developing a project for the use of carbon-recycled methane as a carbon-neutral substitute for LNG.<sup>119</sup>

114. Tyndall Manchester recommended avoiding LNG as a transitional fuel for shipping. Although they observed it was sometimes cited as an appropriate option, “it will lock in further fossil fuel infrastructure at a time when the ambition for shipping decarbonisation needs to be significantly strengthened”. Since the asset lifetimes of ships can be around 25 years, Tyndall considered that there was insufficient time for LNG fuel infrastructure to be developed as a transitional fuel and then retired as a stranded asset.<sup>120</sup> RINA warned of issues around the zero carbon credentials of hydrogen and ammonia when manufactured from LNG rather than the use of electricity from renewable sources.<sup>121</sup>

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117 Tyndall Manchester ([ZAS0041](#))

118 Climate Change Committee, [The Sixth Carbon Budget: Shipping](#), December 2020

119 UK Chamber of Shipping ([ZAS0032](#)); Mitsui O.S.K. Lines news release, “[Successful Sea Trial on A Domestic LNG-fueled Vessel for Use of Liquefied Biomethane as Marine Fuel—Achieving Net Zero Emissions in Ocean Transport](#)”, 21 June 2023

120 Tyndall Manchester ([ZAS0041](#))

121 Royal Institution of Naval Architects ([ZAS0059](#))

### *Nuclear energy as a low-carbon fuel generator and as an energy source*

115. The Government’s ‘Ten-Point Plan for a Green Industrial Revolution’, issued in September 2021, signalled an ambition to produce low- and zero- carbon fuels from nuclear power.<sup>122</sup> Greater detail on the Government’s ambition was provided in the January 2024 Civil Nuclear Roadmap, which indicated the future role for advanced nuclear technologies in the UK’s energy and technology mix at small modular reactor scale. The advanced reactors envisaged by Ministers for eventual deployment at sites in England and Wales are capable of operating at over 800°C and the high-grade heat available is considered capable of unlocking efficient production of hydrogen and synthetic fuels.<sup>123</sup> Advanced reactors of the type envisaged are not yet in commercial production or deployment anywhere in the world, and this Committee has observed that the first small modular reactor of any type to be commissioned by Ministers will not be contributing power to the UK’s energy mix, let alone providing energy to generate low-carbon fuels, until at least 2035.<sup>124</sup>

116. Small modular reactors are also capable of providing a zero-emission energy source on vessels. The IMO has agreed regulatory standards on nuclear propulsion, in force since 1981 as Chapter VIII of the International Convention for the Safety of Life at Sea (SOLAS). Following a consultation in October 2021, in March 2022 Ministers proposed draft legislation to implement SOLAS Chapter VIII into UK law.<sup>125</sup> The secondary legislation entered into force in November 2022.<sup>126</sup>

117. Although the UK’s regulations now align with international regulation on the use of nuclear power in civilian shipping, the Government does not appear to have developed policies to promote further use of nuclear options in shipping. We nevertheless note that in April 2024 the Nuclear Energy Maritime Organization (NEMO), “a global group of leading companies with a common interest in developing nuclear energy solutions for the maritime sector”, was established in London.

### *Rate of progress*

118. The UK Chamber of Shipping told us that, given the 20- to 30-year lifetime of ships and the global reach of the industry, the commercial deployment of zero-emission fuels, vessels and global fuel infrastructure ought to begin by 2030 at the latest. In the Chamber’s view, the pilot and demonstration projects underway in the UK and elsewhere in 2021 aiming at a zero-emission future were not of the scale required to ensure the commercialisation of zero-emission fuels and ships by 2030: they estimated that around 66 zero-emission pilot and demonstration projects for shipping were in operation globally,

122 HM Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020, p. 12

123 Department for Energy Security & Net Zero, [Civil Nuclear: Roadmap to 2050](#), CP 1009, January 2024

124 Letter from the Chair of the Environmental Audit Committee to the Secretary of State for Energy Security and Net Zero, relating to [small modular reactors in the transition from fossil fuels](#), 13 February 2024

125 Maritime and Coastguard Agency, [Consultation Document: The draft Merchant Shipping \(Nuclear Ships\) Regulations 2021](#), Summer 2021, and [Summary of responses to the consultation on the draft Merchant Shipping \(Nuclear Ships\) Regulations 2022](#), March 2022

126 The Merchant Shipping (Nuclear Ships) Regulations 2022 ([SI 2022/1169](#)). The Regulations contain an ambulatory provision which provides for automatic updating to include future revisions to Chapter VIII agreed to by the UK at the IMO.

most involving hydrogen fuels and ammonia.<sup>127</sup> Support from the Clean Maritime Demonstration Competition has since increased the number of such projects in the UK, but the 2030 timescale remains challenging.<sup>128</sup>

119. The scale of production and of availability of low- and zero-emission shipping fuels are both significantly constrained. The green alternatives made from zero-carbon electricity sources via electrolysis of water (green hydrogen, green ammonia and green methanol) are presently heavily constrained in quantity. Until UK hydrogen production is scaled up, there will be significant competition for this scarce and expensive resource as a shipping fuel.<sup>129</sup> RINA told us that, in the near term, point-to-point supply for specific vessels powered by new fuels might be available, though the industry needed widespread availability of such fuels to allow for commercial operation.<sup>130</sup>

120. A further constraint arises from fuel storage requirements at ports. Given the substantially lower energy density of several of the fuels under development, a significant expansion in storage capacity and refuelling infrastructure at UK ports will be required if those ports are to service zero-emission vessels.<sup>131</sup>

121. The shipping sector itself, and the traders which rely on shipping for cargo transportation, have a significant role in driving demand for zero-emission fuels at commercial scale. In 2021 a group of nine large multinational trading companies, including Amazon, Ikea and Unilever, committed to using exclusively zero-emission ships to transport their cargo by 2040. The pledge, driven forward by the Shipping Decarbonization Initiative of the Aspen Institute, has been regarded as a significant boost to the confidence of shipping groups and other stakeholders to invest in the vessels, infrastructure and fuels needed to eliminate the sector's greenhouse gas emissions. Amazon said its goal would apply to any cargo it handled, including that of third-party sellers which make up most of the sellers, with many based in China. The group of companies said fuels used to hit the 2040 target must be sufficiently scalable and have zero greenhouse gas emissions on a lifecycle basis including production, not just during use. They explicitly ruled out the use of ships that run on liquefied natural gas.<sup>132</sup>

### **Measures to incentivise investment in zero-emission fuels**

122. At present each of the alternative propulsion energy sources are more costly than conventional maritime fuels. The leading candidates for large-scale adoption, including green ammonia and hydrogen, have substantial upfront investment costs for the development of production facilities. New marine fuels will entail costs to ship owners of retrofitting their vessels or purchasing new vessels; investment in the research and development of new propulsion technology will also be required.

123. Researchers from the University of Oxford observed that, in order for zero-emission fuels to be taken up by the shipping industry, it was essential that they achieve a trading price similar to, or less than, the prevailing price for conventional marine fuels: the global

127 UK Chamber of Shipping ([ZAS0032](#))

128 Department for Transport transparency release, [Multi-year clean maritime demonstration competition](#) (last accessed 12 May 2024)

129 Royal Institution of Naval Architects ([ZAS0059](#))

130 *Ibid.*

131 *Ibid.*

132 Financial Times, [Amazon, Ikea and Unilever commit to zero-emission shipping by 2040](#), 19 October 2021

Marine Gas Oil benchmark rate.<sup>133</sup> They suggested that a contract for difference (CfD) price support mechanism would stimulate the development and uptake in the UK of technologies and fuels for zero-emissions shipping.<sup>134</sup>

#### Box 1: Contracts for difference

A contract for difference (CfD) is a subsidy mechanism intended to reduce the price gap between old and new technologies. It is currently used as the Government's main mechanism for supporting low-carbon electricity generation and has been very successful. It works by guaranteeing the developers of renewable energy a flat (indexed) rate for the electricity they produce over a certain period. This incentivises the development of schemes by providing developers of projects with high upfront costs and long lifetimes with direct protection from volatile wholesale prices.

124. Currently the only price support offered by the Government to developers of zero-emission marine fuels is the issue of tradable certificates issued to renewable fuels of non-biological origin under the Renewable Transport Fuel Obligation. The aviation industry is being supported in the development of alternative fuels from biomass—so-called 'sustainable aviation fuels' or SAF—by Government policy to mandate the use of SAF in airline fuel by 2025, and legislation for a revenue certainty mechanism to support SAF production in the UK. We gave our views on this policy in our December 2023 report.<sup>135</sup>

125. There appears to be no comparable policy support for the development of a zero-emission marine fuel industry in the UK. As we note above, the Government has said it is unable to commit to obliging clean maritime clusters to produce at least 2 TWh of zero-emission fuels annually by 2030, and the overall development of zero-emission fuel production appears to be awaiting the completion of an overall low carbon fuel strategy.

126. Alex Clark, of the Smith School of Enterprise and the Environment at the University of Oxford, argued that a CfD could provide appropriate support to develop zero-emission marine fuels. He explained that by introducing a CfD mechanism to support zero-emission fuel production, the UK would benefit from a first-mover advantage, supported by considerable experience in operating CfD markets for renewable generation. There was keen interest in the European Union for the use of CfD schemes to decarbonise shipping fuels, and the UK was "well-poised" to be a significant initial provider of zero-emissions fuel in the region, given the relative abundance of low-cost green energy in the form of electricity from renewables.<sup>136</sup>

127. He had explored two models in detail to support a technology-neutral incentive programme for the decarbonisation of international shipping:

- **A "Fuel-only" CfD**, which provides shippers with zero-emission fuels at the same price as Marine Gas Oil (MGO). "This is the simplest and most popular solution with stakeholders. While it may not cover 100% of the costs of switching to zero-emission shipping, or necessarily provide support for infrastructure and retrofitting costs, it can be applied transparently and equally across all shipping

133 Dr Matthew Ives, Lukas Larsson and Alex Clark, University of Oxford ([ZAS0037](#))

134 Clark, A et al, [Zero-Emissions Shipping: Contracts-for-difference as incentives for the decarbonisation of international shipping](#), Smith School for Enterprise and the Environment, University of Oxford, June 2021

135 Environmental Audit Committee, [Net zero and the UK aviation sector](#), Third Report of Session 2023–24, HC 404, December 2023, paras 109–115

136 Dr Matthew Ives, Lukas Larsson and Alex Clark, University of Oxford ([ZAS0037](#))



segments (e.g., bulk carriers, tankers, container ships, cruise passenger ships). But it does not favour ‘non-fuel’, highly capital-intensive options like nuclear powered or wind assisted ships.”<sup>137</sup>

- A **“Total Cost of Ownership” (TCO)-based CfD**, which covers all incremental costs associated with building and running a zero-emission ship compared to a standard ship: “this option is administratively much more difficult to manage and would likely require many variants to cover all shipping segments.”<sup>138</sup>

### **Government support for measures to deliver zero-emission fuels**

128. Ministers have stressed to us the importance of supporting research and development of options for zero-emission marine fuels prior to providing policy backing to any one option. Robert Courts MP, then the Minister responsible for maritime policy at the Department for Transport, drew a parallel with the development of lower-carbon fuel sources for aviation, where substantial research and development work had preceded Government backing for an industry decarbonisation strategy based on lower-carbon biofuels:

[... M]uch as with SAF, R&D comes before everything else. You must get the R&D and find out what is going to work as a technology before you take the next steps.<sup>139</sup>

129. As we reported above, the Government’s support for research and development activity is focused on the funding of early-stage technology projects on a match-funding basis to attract industry investment. Ministers have declined to commit to any funding of research and development activity past March 2025. Other than the inclusion of producers of renewable fuels of non-biological origin as beneficiaries of the Renewable Transport Fuel Obligation, there appears to be no current prospect of support for the further development and commercialisation of zero-emission marine fuels.

### **Our view**

130. The development in the UK of measures to support the production of zero-emission marine fuels appears to be at least a policy cycle behind the development of measures to support low-carbon aviation. This is explained in part by the relatively nascent state of development of low- and zero-emission marine fuels. Unlike in aviation, where the industry has backed a lower-carbon ‘drop-in’ fuel technology based on biofuels, the maritime industry appears to be backing the development of zero-emission fuels. These will undoubtedly deliver significantly greater carbon savings once introduced into the global shipping fleet at scale: but the current pace of development, against national and global decarbonisation targets and regulatory requirements, appears worryingly slow. Uncertainty over the fuel technology most likely to prevail in the market, together with concern over the costs of storage and infrastructure development, appear to be inhibiting commercial investment at scale in the facilities necessary for production of zero-emission marine fuels in the UK.

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137 *Ibid.*

138 *Ibid.*

139 [Q381](#)

131. The Government is, on current evidence, significantly behind on progress towards its declared ambition to support the delivery of net zero shipping by 2050, let alone zero carbon shipping. Ministers are assessing the relative merits of successive rounds of small-scale demonstrator projects at early stages of technological readiness, when the sector is demanding a clear lead in removing uncertainty and promoting investment in domestic production, storage and transmission infrastructure so that zero-emission vessels can fuel at UK ports.

132. Government support for the domestic development of early-stage zero-emission marine fuels is at present time-limited to March 2025, pending longer-term budgetary decisions. Overall public funding committed to the UK SHORE programme between 2022 and 2025 is £206 million. Over the same period, £685 million of public money was committed to the Aviation Technology Institute as the Government's contribution to co-funding of aviation research and development over that period, continuing a stream of Government funding which began in 2013. This funding settlement represented an increase of £235 million on the previous tranche of public money committed to aviation research and development. In the Autumn Statement delivered in November 2023 the Chancellor of the Exchequer announced a further £975 million of funding for ATI for the period from 2026 to 2030.<sup>140</sup>

**133. The provision of up to £206 million of matching funding for research into low- and zero-emission shipping is to be applauded, and no doubt represents a step change in Government investment in the field. It is, however, dwarfed by the sums of public money committed to research and development into aviation technologies, including low-carbon aviation, since 2013.**

134. The Government's current refusal to guarantee funding for research and development into maritime decarbonisation beyond March 2025 is regrettable. We note that the Aviation Technology Institute has received a guarantee of funding to 2030, no doubt reflecting the importance to the economy, and to decarbonisation targets, of rapid progress in reducing emissions from domestic and international aviation. By failing to guarantee Government support for research and development into reducing domestic and international shipping emissions, Ministers risk stifling progress in this sector. Although decarbonisation of domestic and international shipping is less advanced than decarbonisation of aviation, it is just as challenging to undertake, and demands significant investment decisions from Government and industry in the short term if net zero goals are to be met.

*135. The Government must send clear and unambiguous signals to the UK maritime sector that it is committed to supporting its transition to net zero. We recommend that Ministers urgently review the funding perspectives for decarbonisation of UK shipping and, no later than the next fiscal event, provide a commitment to further matching funding for research and development to at least 2030.*

136. As with low-carbon aviation fuel, the development of manufacturing capacity for zero-emission marine fuels is vital for the security of the UK's maritime trade and for the establishment of green shipping corridors. It is disappointing that the Government says it is "not yet able to commit" to the establishment of manufacturing facilities in

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140 HM Treasury, [Autumn Statement 2023](#), November 2023, para 4.71

clean maritime clusters so as to deliver up to 2 TWh of zero-emission marine fuels annually by 2030. Accelerating support for these facilities would bring significant benefits from first mover advantage.

137. We note with interest the recent modelling undertaken by UMAS and Arup, examining how a domestic clean ammonia facility could significantly benefit the take up of zero-emission maritime fuels for ferries operating across the North Sea from Newcastle, the Tees Estuary and Immingham. This holistic assessment of the business case for new facilities demonstrates a refreshing approach to balancing the challenges and opportunities arising from maritime decarbonisation.

138. *As part of the updated Clean Maritime Plan the Government must develop a strategy to support the development in UK maritime clusters of facilities for the manufacture of zero-emission marine fuels. This strategy must be supported by a delivery plan which sets clear production milestones.*

139. *We recommend that Ministers consult on the introduction of a revenue support mechanism to incentivise the commercial production of zero-emission marine fuels in the UK.*

## 5 Technical measures to decarbonise shipping: efficiency improvements

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### Increasing energy efficiency

140. Using technology to improve the energy efficiency of vessels can deliver immediate reductions in fuel consumption and GHG emissions without a significant impact on the capacity of the sector. Enhancing the energy and operational efficiency of the fleet will mitigate future demand for zero-emission fuels to an extent, and will play a crucial role in minimising the space on board vessels which is allocated to the storage of zero-emission fuels with low energy densities.

141. The IMO says that the carbon intensity of international shipping reduced by 30% between 2012 and 2018: this is largely attributable to an increase in the average size and capacity of new ships, a reduction in operating speeds and reductions in the average number of days at sea.<sup>141</sup> Some efficiency measures are already mature and deployed on ships: E.A. Gibson Shipbrokers told us that ship operators were already incentivised to operate efficiently in order to reduce fuel consumption and minimise costs.<sup>142</sup>

142. As we noted above, since 2013 the IMO MARPOL convention has stipulated that new build vessels must meet minimum efficiency design performance levels under the Energy Efficiency Design Index (EEDI). The EEDI measures the CO<sub>2</sub> emitted based on ship design and engine performance data. The maximum EEDI level is tightened incrementally every five years: an initial CO<sub>2</sub> reduction level of 10% was set for the first phase (2015–2020), 20% for the second phase (2020–2025) and a 30% reduction mandated from 2025 to 2030.<sup>143</sup> In June 2021 the IMO agreed a ‘robust framework’ for addressing the energy efficiency of ships: the Energy Efficiency Existing Ship Index (EEXI) and the Carbon Intensity Indicator (CII), both of which entered into force on 1 January 2023.

143. The CII framework, which provides for a ship’s carbon intensity to be rated on an ascending scale from A to E, provides tools for administrations, ports and other stakeholders, including the financial sector, to provide incentives to the most energy efficient ships. Dr Tristan Smith, from the UCL Energy Institute, was critical of the ambition set by the IMO here, but indicated that nothing prevented individual states from setting more challenging carbon intensity requirements for ships seeking to berth in their ports:

[... T]he carbon intensity indicator [is a measure whereby the] whole operational carbon intensity, the emissions per unit of transport supplier, are wrapped into a metric and that is mandated at a certain level of reduction. Unfortunately, because of a multilateral discussion that required everyone to agree—not everyone, but consensus—that is not very strong. However, the framework and the metric do not prevent individual countries from requiring a higher level of compliance.<sup>144</sup>

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141 International Maritime Organization, *Fourth IMO GHG Study*, 2020

142 E.A. Gibson Shipbrokers Ltd ([ZAS0008](#))

143 IMO briefing, ‘[Improving the energy efficiency of ships](#)’ (last accessed 12 May 2024)

144 [Q177](#)

144. The UK Government expects that all new vessels being ordered for use in UK waters will be designed with zero emission propulsion capability by 2025. Anna Ziou, then of the UK Chamber of Shipping, told us that this would allow the shipping industry to address some emissions in the short term, in line with the IMO's target of improving the efficiency of the industry by at least 40% by 2030, but pointed out that in the long term "a complete systematic change in the industry" was required through the use of zero emission fuels and infrastructure in order to meet the 2050 target.<sup>145</sup> Simon Bullock, of Tyndall Manchester, agreed, explaining that operational measures would be the big driver of emissions reductions while alternative fuels are "scaled up to a point where they make a difference."<sup>146</sup>

145. RINA told us that since 2008 the trajectory of shipping emissions had been decoupled from that of trade growth due to a combination of operational efficiencies and the introduction of newer, larger and more efficient ships to the fleet.<sup>147</sup> RINA nevertheless warned that operational efficiencies were subject to the law of diminishing returns, and that as long as global trade increased, operational efficiencies alone would not lead to any reduction in emissions.<sup>148</sup> The UK Chamber of Shipping said that between 2009 and 2020 the global shipping industry had reduced its share of global CO<sub>2</sub> from 3.2% to 2.4% whilst at the same time facilitating a 30% increase in global trade. The Chamber attributed this to the optimisation of ship operations and investment in technology and alternative fuels.<sup>149</sup>

146. The Society of Maritime Industries told us that the shipping industry was already employing speed reduction and route optimization to reduce emissions, driven primarily by the IMO Carbon Intensity Indicator (CII) measure:

Operational efficiencies on their own will be insufficient to reduce the emissions set by the IMO, EU and others, but they are already making important contributions to reduced emissions and they can be increased in the short term (0–3 years) with careful incentivisation.<sup>150</sup>

### ***Approaches to improving energy efficiency***

147. We examine below some of the primary means of improving energy efficiency and reducing emissions from ships.

#### ***Slow steaming***

148. 'Slow steaming' is the practice of operating cargo ships at significantly less than their maximum speed. Lowering a vessel's speed reduces its fuel consumption, because the force of drag on a vessel imparted by a fluid increases quadratically with increase in speed. Consequently, for a vessel to travel twice as fast requires four times as much energy and therefore fuel for a given distance. Marine engine manufacturer Wärtsilä has calculated

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145 [Q57](#)

146 [Q54](#)

147 Royal Institution of Naval Architects ([ZAS0059](#))

148 *Ibid.*

149 UK Chamber of Shipping ([ZAS0032](#))

150 Society of Maritime Industries ([ZAS0050](#))

that a cargo vessel's fuel consumption can be reduced by 59% by reducing its speed from 27 to 18 knots (from 31 to 21 mph), equivalent to an additional week's sailing time on routes between Asia and Europe.<sup>151</sup>

149. The UCL Energy Institute told us that current standard voyage charterparty clauses in shipping contracts stipulated that vessels are required to proceed as fast as possible towards a port, regardless of the port's readiness to receive the vessel. This operational model, known as "Sail Fast, Then Wait" or "Rush-to-Wait", whereby ships sail to their destination at their service speed, without regard for the local conditions, and then wait at the anchorage until a berth becomes available, is operationally inefficient.<sup>152</sup> Elimination of this practice is estimated to reduce GHG emissions from a voyage by up to 15%.<sup>153</sup>

150. Guy Platten, from the International Chamber of Shipping, told us that optimising speeds, or sailing from a port at the optimal speed to get to the other port, berth and discharge your cargo without a wait, was "low hanging fruit" and a step that the industry could take now.<sup>154</sup>

### Route optimisation

151. Route optimisation is choosing the best route for fuel consumption avoiding storms, strong undercurrents and high waves. Route optimisation technology, such as Wärtsilä's Fleet Operations Solutions, connects to a vessel's information systems to provide real-time weather forecasts and auto-optimised speed and routes that give the best fuel efficiency while ensuring voyage safety.<sup>155</sup> It also provides information about what is causing extra fuel consumption during the voyage so that corrective actions can be taken. In some cases, this information has been shown to be capable of reducing fuel consumption during a voyage by up to 10 tonnes.<sup>156</sup>

152. Stephenson Harwood LLP and the Finnish shipping operator Napa Oy told us that the ocean journeys of cargo ships were not systemically optimised:

While there has been great progress in the last 30 years in satellite coverage, communications, weather forecasting, and data processing, all of which have enabled the development of sophisticated and effective weather routing and voyage planning systems, this has only led to the optimization of the voyages of individual ships. Optimization of cargo vessels as a system remains elusive.<sup>157</sup>

They point to the example of the grounding of the vessel Ever Given in the Suez Canal, where "congestion seemed to increase without any apparent co-ordination attempt amongst ships to adjust their speed".<sup>158</sup> The incident, which lasted for six days in March 2021, caused a backlog of more than 400 ships and cost billions in global trade.<sup>159</sup>

151 Wärtsilä Voyage ([ZAS0025](#))

152 UCL Energy Institute, Decarbonising UK Freight Transport, Centre for Research into Energy Demand Solutions, UMAS ([ZAS0042](#))

153 MarineLog briefing, "[Tackling the problem of "sail fast, then wait"](#)", July 2022

154 [Qq176-177](#)

155 Wärtsilä Voyage ([ZAS0025](#))

156 Wärtsilä briefing, "[Does your ship need a digital double?](#)", November 2020

157 Stephenson Harwood LLP, Napa Oy ([ZAS0070](#))

158 *Ibid.*

159 BBC News story, "[Suez Canal traffic jam caused by stuck ship Ever Given 'cleared'](#)", 3 April 2021

153. Stephenson Harwood and Napa Oy are coordinating a consortium of international commercial bodies and organisations in the development and implementation of a system termed the “Blue Visby Solution” for the dry bulk and tanker fleets. Blue Visby seeks to address the “systemic operational inefficiency” of the “sail fast, then wait” model through systems redesign, addressing the complex contractual conventions, obligations and assumptions which govern international shipping in order to optimise voyages. Route optimisation is to be achieved through collaboration with the comprehensive global charting resources of the UK Hydrographic Office.<sup>160</sup>

154. The consortium claims that implementation of Blue Visby will achieve average GHG emission reductions of between 9 and 14%: applied across the dry bulk and tanker fleets currently in operation, this would deliver annual emissions reductions of 45 million MtCO<sub>2</sub>e, roughly equivalent to Finland’s total emissions from all sources in 2019 (43 million MtCO<sub>2</sub>e).<sup>161</sup>

### *Vessel design*

155. Changes in vessel design can improve the efficiency of ships, primarily through reducing the resistance of the hull in the water. There are many fuel saving technologies which are either available now or at an advanced stage of development. Some of these can be retrofitted to existing vessels, whilst others need to be incorporated at the ship design stage.<sup>162</sup>

156. These technologies include high efficiency rudders, heat recovery systems, smart electrical controls for pumps, the fitting of fins and ducts to the stern, novel solar panel technologies and advanced antifouling coatings. The Society of Maritime Industries told us that individually, or in combination and under the right conditions, they were capable of returning reductions in power requirements in the order of between 5 and 30%.<sup>163</sup>

157. Shell told us that they had introduced air lubrication, a method of reducing the resistance between the ship’s hull and seawater using air bubbles, to their fleet from October 2020. This technology has been found to deliver a reduction in fuel consumption and associated emissions of between 5 and 8%.<sup>164</sup>

### *Wind propulsion*

158. Ships can be retrofitted with wind propulsion technology, which includes a range of sails, wings and rotors, that could provide very significant reductions in emissions in the short-term if combined with voyage optimisation and slow steaming. Wind assisted shipping saves fuel and tackles other pollutants at the same time, such as sulphur. A Tyndall Manchester study showed savings in emissions of as high as 40% for bulk carriers by ships being redirected towards beneficial winds—if there were some flexibility in arrival times.<sup>165</sup>

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160 Stephenson Harwood LLP, Napa Oy ([ZAS0070](#))

161 *Ibid.*

162 Society of Maritime Industries ([ZAS0050](#))

163 *Ibid.*

164 Shell UK Ltd ([ZAS0015](#))

165 Tyndall Manchester ([ZAS0041](#))

159. E.A Gibson Shipbrokers told us that Flettner rotor sails—tall cylinders fixed on the decks of vessels, which rotate via the wind and propel the ship forward—had already been installed on several vessels.<sup>166</sup>

160. Tyndall Manchester told us that there is a need for real-world wind-propulsion demonstration ships to gather data and provide a wider variety of ‘proof of concept’ designs.<sup>167</sup> RINA said the UK has several companies engaged in bringing wind technologies to market that are in need of significant support from the Government to progress. Wind propulsion technologies have the advantage that landside infrastructure is not needed, and projects can start now.<sup>168</sup>

### *Electrification*

161. Electricity is used in a limited number of niche hybrid and full electric propulsion vessels, using onboard batteries and motors, such as domestic short-distance passenger or car ferries<sup>169</sup>. The Climate Change Committee’s analysis says that for electric propulsion using batteries to play a role in shipping, significant breakthroughs in battery capacity and cost will be needed by 2050 in order to out-compete liquid fuels in the larger ships and longer journeys that make up the majority of UK emissions.<sup>170</sup>

### *Government action*

162. The National Oceanography Centre told us that there had been “little practical direction for those building, designing and operating zero emission or low emission ships”. They welcomed the Government’s development of UK SHORE, which they hoped would help to coordinate an approach to fleet design, build and maintenance policies.<sup>171</sup>

### *Our view*

163. The research and development efforts being promoted through UK SHORE can make a significant contribution to technological measures which will improve efficiencies in ship design and operation. These can be achieved not only through incorporation into the UK’s domestic shipbuilding industry, but through the development of applications and techniques by UK manufacturers which will be of global applicability. The early-stage technology development being fostered by the Clean Maritime Demonstration Competition, and the later-stage vessel development promoted through the Zero Emission Vessels and Infrastructure competition, are both important initiatives. As we have observed above, UK SHORE should have its medium-term funding guaranteed at the earliest opportunity, so as to continue the coordinating approach to overall net zero maritime policies which had been lacking prior to its establishment, and to give the industry confidence that successful technologies will be backed to commercial maturity.

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166 E.A. Gibson Shipbrokers Ltd ([ZAS0008](#))

167 Tyndall Manchester ([ZAS0041](#))

168 Royal Institution of Naval Architects ([ZAS0059](#))

169 Climate Change Committee, [The Sixth Carbon Budget: Shipping](#), December 2020

170 *Ibid.*

171 The National Oceanography Centre ([ZAS0007](#))



164. The current Clean Maritime Plan sets no clear or measurable objectives for the UK's contribution to operational efficiencies from domestic and international shipping.

165. *The refreshed Clean Maritime Plan must set stretching interim targets for the emissions savings to be achieved from operational efficiencies in UK domestic shipping to 2050, together with a detailed plan for how these savings are to be achieved through measures such as route and speed optimisation.*

166. The UK's influence in international shipping is considerable and extends beyond its prominent position at the IMO. The basis of the majority of international shipping contracts is English law. The UK Hydrographic Office provides unrivalled resources to support vessels in optimising their voyages so as to maximise energy efficiency. This 'soft power' is an invaluable resource for the decarbonisation of global shipping.

167. *We recommend that, as part of the refreshed Clean Maritime Plan, Ministers commission a workstream to examine how the efficiency of international shipping operations can be further optimised by the appropriate development of the expertise in the UK Hydrographic Office.*

168. IMO standards for existing ship efficiency provide progressively more stringent measures to require the existing fleet to reduce its emissions. Current measures have been criticised for a lack of ambition. While the amendments to the MARPOL Convention currently being contemplated at the IMO may further ratchet up efficiency requirements, there are potential emissions benefits to be gained from a more stringent UK approach.

169. *We recommend that Ministers consult on the emissions benefits to be achieved through regulating the maximum carbon intensity of vessels allowed to enter UK ports, with a view to permitting only those vessels rated 'A' to 'C' for carbon intensity under the current IMO Energy Efficiency Existing Ship index to enter.*

## Ports and maritime infrastructure

170. As we observed above, ports will in future need to be able to store low- and zero-emission fuels: due to the lower energy density of these fuels, a significant expansion in storage capacity and refuelling infrastructure will be required.<sup>172</sup> Associated British Ports observed that LNG fuel was currently not readily available in UK ports, while ports and supply chain logistics were likely to have to adapt in order to accommodate alternative fuels. They saw no clear roadmap for adoption of such fuels.<sup>173</sup>

171. Much of the equipment used in ports, such as cranes, currently use polluting diesel engines. Ports also have a substantial impact on their hinterland: the onward transport of goods is most often undertaken by road rather than by rail, adding to the overall carbon footprint of maritime trade.<sup>174</sup>

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172 Royal Institution of Naval Architects ([ZAS0059](#))

173 Associated British Ports ([ZAS0061](#))

174 Private communication from specialist adviser

## Shore power

172. Associated British Ports noted that shore power projects were difficult and expensive, and few if any were being developed ahead worldwide without Government support: the number of vessels capable of utilising the technology was low and the costs of implementation were extremely high.<sup>175</sup>

173. Ports are often constrained by a lack of energy network capacity in their area and by complex regulation of the energy system.<sup>176</sup> The provision of grid connections to electrify the UK's net zero infrastructure is an issue we considered in our recent report into *Enabling sustainable electrification of the economy*.<sup>177</sup>

174. The UK Major Ports Group, the British Ports Association and the UK Chamber of Shipping said that a successful approach to reducing emissions (at berth) would require a combination of public funding support with a technology neutral, goal-based approach to delivering infrastructure where required.<sup>178</sup> Sarah Kenny from Maritime UK told us that

... the generation of electricity domestically also needs to be factored into this. We must not just push the problem somewhere else. I am not saying that lets shipping off the hook, but we need ships that have infrastructure that can accept electric charging.<sup>179</sup>

175. In February 2022 Ministers called for evidence on the use of maritime shore power in the UK, fulfilling a commitment in the Transport Decarbonisation Plan: a summary of responses was published in July 2023.<sup>180</sup> The Government is yet to issue its response: the then Minister for Maritime told us that he expected the Government's position to be set out in the revised Clean Maritime Plan.<sup>181</sup> Since then the Government has indicated that it now favours a technology neutral approach to changes that may be required at ports to enable berthed ships to reduce their emissions.<sup>182</sup> This is likely to continue to include shore power, but will also entail other alternatives that can provide the same outcomes.

176. According to Simon Bullock from Tyndall Manchester, the provision of shore power has accelerated in Europe but has been held back in the UK by high electricity taxes and a lack of Government support. While governments in France, Germany, Norway, Denmark and Sweden had been helping their ports deploy shore power, with grants for investment and reductions in electricity taxes, the UK had not.<sup>183</sup>

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175 Associated British Ports ([ZAS0061](#))

176 Bullock, S, [Barriers and solutions for UK shore-power](#), Tyndall Centre for Climate Change Research, University of Manchester, December 2020

177 Environmental Audit Committee, [Enabling sustainable electrification of the economy](#), Sixth Report of Session 2023–24, HC 278, May 2024

178 Associated British Ports ([ZAS0061](#))

179 [Q59](#)

180 Department for Transport, [Call for evidence on shore power Implementing maritime commitments in the Transport Decarbonisation Plan](#), February 2022

181 [Qq406–408](#)

182 Department for Energy Security & Net Zero, [Responding to the Climate Change Committee's 2023 Annual Progress Report to Parliament](#), HC 1919, October 2023, R2022–266, pp 118–119

183 Tyndall Manchester ([ZAS0041](#)); Associated British Ports ([ZAS0061](#))

## Our view

177. Government strategic oversight of the development of decarbonised port infrastructure is essential, to ensure that the provision of infrastructure to support the UK's ports and their operators is undertaken in a timely and effective manner. The provision of decarbonised infrastructure presents substantial strategic challenges given the additional requirements for bunkering zero-emission fuels and the need to ensure additional grid connections of the appropriate calibre for the provision of shore power.

**178. It is regrettable that the Government has changed course on its policy on the provision of shore power to UK ports. In a period where grid connections are currently at a premium and demand for electricity supply is increasing, the delay in determining policy on how to provide power to the zero-emission ports of the future is unwelcome.**

*179. We recommend that Ministers launch their planned consultation on net zero ports without further delay, so as to gather signals from the ports industry and the wider maritime sector at the earliest opportunity as to what infrastructure is likely to be required to minimise the emissions from ships at berth in UK ports, to provide for bunkering and refuelling with low- or zero-emission fuels and to develop a suitable structure for funding infrastructure development. Ministers must send the clearest signals possible about the likely requirements for port electrification so as to enable early planning for potential grid connections.*

## Green shipping corridors: implementing the Clydebank Declaration

180. At the COP26 climate summit in Glasgow in November 2021 the UK announced the launch of the Clydebank Declaration, in which signatory states declared their ambition and intent to support the establishment of green shipping corridors—zero-emission shipping routes between two ports.

181. The Declaration was designed to complement the IMO's work on zero-emission shipping. Signatories—including Australia, Canada, France, Germany, the Republic of Ireland, the US and the UK—expressed 'great concern' at the rate of increase of global shipping emissions, agreed on the need for action to go further and faster in maritime decarbonisation than had, at that point, been contemplated by the IMO, and agreed to support the establishment of at least six green shipping corridors by 2025.<sup>184</sup> The establishment of such corridors requires the development, at each port of call on a corridor, of supplies of zero-emission fuels, of the infrastructure required for decarbonisation and of regulatory frameworks to support zero-emission shipping.

182. Signatories pledged to:

- facilitate the establishment of partnerships, with participation from ports, operators and others along the value chain, to accelerate the decarbonisation of the shipping sector and its fuel supply through green shipping corridor projects;

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<sup>184</sup> The initial signatories of the Declaration were Australia, Belgium, Canada, Chile, Costa Rica, Denmark, Fiji, Finland, France, Germany, Republic of Ireland, Italy, Japan, Republic of the Marshall Islands, Morocco, Netherlands, New Zealand, Norway, Spain, Sweden, the UK and the USA. Palau and Singapore signed in April 2022 and Lithuania, the Republic of Korea and the United Arab Emirates signed in December 2023.

- identify and explore actions to address barriers to the formation of green corridors. This could cover, for example, regulatory frameworks, incentives, information sharing or infrastructure;
- consider the inclusion of provisions for green corridors in the development or review of National Action Plans, and
- work to ensure that wider consideration is taken for environmental impacts and sustainability when pursuing green shipping corridors.<sup>185</sup>

183. At COP27, held in Sharm El-Sheikh in November 2022, the United Kingdom, the United States, Norway and the Netherlands pledged to roll out green shipping corridors between the countries. The UK and US agreed to launch a special Green Corridor Task Force focused on bringing together experts to conduct research and development projects.<sup>186</sup> At COP28, held in Dubai in December 2023, the UK and the United States announced plans for a consortium to establish a green shipping corridor between the two countries.<sup>187</sup> A feasibility study is to be undertaken to help identify the most effective and viable routes for such a corridor. In April 2024, the Government announced measures and international partnerships aimed at establishing green shipping corridors between the UK, the Netherlands, Norway, Denmark, and Ireland.<sup>188</sup>

184. The UCL Energy Institute said that green corridors were a “critical tool” for enabling early adoption of the long-run solutions that would be needed in international shipping: they would provide a means to develop important operational experience, reduce costs, and address safety issues of low- and zero-emission fuels. Analysis from UCL researchers at the maritime consultancy UMAS had been used to underpin the evidence and identify the most favourable routes as early movers and bilateral commitments. The Institute considered that there was a “good chance” that through such initiatives “at least 5% of shipping’s energy use [would be] scalable zero emission fuels by 2030”. Achievement of this target had been shown to be capable of putting shipping on a pathway to full decarbonisation by 2050.<sup>189</sup> UK Chamber of Shipping CEO Sarah Treseder told us that green corridors could play an essential role in stimulating early action for the adoption of low- and net zero-emission technologies and fuels.<sup>190</sup>

185. The Declaration noted that voluntary participation by operators would be a significant element for successful green shipping corridors.<sup>191</sup> Robert Courts MP, then Maritime Minister, was quoted as saying that governments alone would not be able to decarbonise

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185 UN Climate Change Conference (COP26), [Clydebank Declaration for green shipping corridors](#), 10 November 2021.

186 Department for Transport news story, “[Maritime sector given green boost with major COP27 pledge](#)”, 7 November 2022

187 Department for Transport policy paper [COP28: US and UK joint statement on green shipping corridor collaboration](#), 1 December 2023

188 Department for Transport news story, “[New green international shipping routes backed by government funding](#)”, 5 April 2024

189 UCL Energy Institute news story, “[UCL analysis supports launch of Clydebank Declaration for green shipping corridors at COP26](#)”, 10 November 2021

190 Department for Transport news story, “[Maritime sector given green boost with major COP27 pledge](#)”, 7 November 2022

191 UN Climate Change Conference (COP26), [Clydebank Declaration for green shipping corridors](#), 10 November 2021

shipping routes without the commitment of private and non-governmental sectors.<sup>192</sup> Ben Murray, then Chief Executive of Maritime UK, was reported to have said that the success of green corridors would depend on government support and co-investment.<sup>193</sup>

### *Our view*

**186. The initial Clydebank Declaration, and the consolidation and development of initiatives for green shipping corridors since COP26, represent considerable progress in collaboration between governments, and between the Government and industry, in the practical measures required to make decarbonised shipping a reality. Ministers are to be commended for the initiative in pressing for the Declaration and for subsequent work to develop partnerships to establish these corridors.**

**187. The UK, as a leading proponent of this multilateral approach, is demonstrating how green corridors can be implemented on domestic, regional and intercontinental routes. We welcome the recent announcement of collaborations to establish green corridors between the UK, the Netherlands, Norway, Denmark, and Ireland, and we look forward to further positive developments.**

***188. In its response to this report we expect Ministers to set out the current state of each of the green corridor feasibility studies UK SHORE is engaged in, and the state of discussions with the USA, Canada, Singapore and other relevant Clydebank signatories on the requirements for implementing bilateral green corridors with each.***

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192 Reuters news story, "[Countries at COP26 launch plan for net-zero shipping lanes](#)", 10 November 2021

193 UK Ports news release, "[Clydebank Declaration for green shipping corridors launched at COP26](#)", 10 November 2021

## 6 Economic measures to decarbonise shipping

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### Shipping in emissions trading schemes

189. Shipping until this year had fallen outside the remit of national and regional efforts to put a price on carbon, such as the cap-and-trade emissions trading systems operated by the UK and by the European Union.

190. Emissions trading schemes are designed as a market mechanism to give effect to the ‘polluter pays’ principle. Carbon emitters receive an allocation of, or are obliged to purchase, tradeable permits for the right to pollute. The overall availability of permits is capped. Those that can reduce emissions below their quota can sell their permits to those that exceed allotted targets, potentially at a profit.<sup>194</sup> We reported above that a global maritime GHG emissions pricing mechanism is now thought to be a candidate measure for implementation by 2028 as part of the revised 2023 IMO GHG strategy.<sup>195</sup>

191. The UCL Energy Institute told us that carbon pricing schemes and the EU ETS and could play an important role in closing the price gap between alternative and current fuels. If revenues generated by a carbon pricing mechanism were reinvested into the industry through subsidies to low- or zero-emission fuels and associated infrastructure, the carbon price necessary to close the price gap between fossil fuels and low- or zero-emission fuels could be significantly reduced.<sup>196</sup>

192. The UK Chamber of Shipping said the shipping industry saw regional schemes (such as the EU ETS) as an ineffective way of regulating international emissions, as they covered only a fraction of global emissions and risked provoking carbon leakage—in this context the transfer elsewhere of carbon-intensive shipping activity.<sup>197</sup> Proliferation of regional or national emission trading schemes could result in a lack of harmonisation of carbon pricing, undermining price signals to support investment in alternative low- and zero-emission fuels for shipping, distracting from the IMO’s initiatives and potentially leading to market distortions.<sup>198</sup> The Chamber favoured the urgent introduction of an international market-based measure set at IMO level that would effectively put a cost on the impact of the existing fuels on the environment and would encourage the transition towards decarbonisation.<sup>199</sup>

193. Simon Bullock, of Tyndall Manchester, told us that a carbon pricing mechanism for shipping emissions would stimulate the production and take up of cleaner maritime fuels. Failure to achieve agreement on market-based measures at the IMO to date had in his view been the biggest barrier to development of the clean maritime sector.<sup>200</sup>

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194 Lloyd’s [Shipping being considered for UK emissions trading scheme, minister confirms](#), 23 March 2021

195 See paragraph 35.

196 UCL Energy Institute, *Decarbonising UK Freight Transport*, Centre for Research into Energy Demand Solutions, UMAS ([ZAS0042](#))

197 UK Chamber of Shipping ([ZAS0032](#))

198 *Ibid.*

199 UK Chamber of Shipping ([ZAS0032](#)); [Q66](#)

200 [Q63](#)

194. The UCL Energy Institute said that a uniform market-based mechanism for international shipping could be part of the policy solution at the IMO. The level of the carbon price which would have to be applied would depend on many factors, including the potential for revenue ‘recycling’ (i.e., investing the collected carbon pricing revenue back into the shipping industry), other measures and technological maturity.<sup>201</sup>

## The treatment of shipping in the UK and EU Emissions Trading Schemes

195. In January 2024 the EU brought the domestic and international shipping of its member states within the scope of the EU ETS. The UK has indicated its intention to bring UK domestic shipping only within the UK Emissions Trading Scheme (UK ETS) from 2026: so, as matters stand, shipping between UK and EU ports is subject to the EU ETS only (and will remain so from 2026). Until a global measure is agreed at the IMO and implemented, shipping between the UK and non-EU ports will not be subject to any emissions trading scheme.

### *Shipping in the UK ETS*

196. In July 2023 the UK Emissions Trading Scheme (ETS) Authority, on behalf of the UK Government and the governments of the devolved administrations, announced its intention to expand the UK ETS to cover domestic maritime activity of vessels above 5000 gross tonnage from 2026.<sup>202</sup> A final decision on the proposal is to be taken following the outcome of further technical consultations which ran from December 2023 to March 2024.<sup>203</sup> The UK ETS Authority indicates that it recognises the importance of achieving a globally applicable policy measure to reduce emissions from international shipping: rather than aligning immediately with the EU ETS it has decided to focus its efforts on supporting the work of the IMO in global reduction of greenhouse gas emissions from shipping.

### *Shipping in the EU ETS*

197. In January 2024, the EU’s Emissions Trading System (EU ETS) was extended to cover CO<sub>2</sub> emissions from all ships with 5000 gross tonnage and above entering ports in the EU, regardless of flag State. Emissions from maritime transport are included in the overall ETS cap, which defines the maximum amount of greenhouse gases that can be emitted under the system. The overall cap is to be reduced over time: the declared policy intention is to ensure that all ETS sectors contribute to the EU’s climate objectives. The European Commission observes that “in practice, shipping companies will have to purchase and

201 UCL Energy Institute, Decarbonising UK Freight Transport, Centre for Research into Energy Demand Solutions, UMAS ([ZAS0042](#))

202 UK Government, Scottish Government, Welsh Government and Department of Agriculture, Environment and Rural Affairs for Northern Ireland, [Developing the UK Emissions Trading Scheme: Main Response](#), July 2023

203 UK Government, Scottish Government, Welsh Government and Department of Agriculture, Environment and Rural Affairs for Northern Ireland, [UK Emissions Trading Scheme: Future Markets Policy consultation](#) and [UK Emissions Trading Scheme: free allocation review consultation](#), December 2023

surrender EU ETS emission allowances for each tonne of reported CO<sub>2</sub> (or CO<sub>2</sub> equivalent) emissions in the scope of the ... system.”<sup>204</sup> Responsibility for compliance will rest with the authorities in EU Member States which administer the ETS.

### *Our view*

198. As we have observed above, the UK has a significant policy choice to make, given the development of regional economic measures which are already likely to affect the choices made by shipping. As matters stand the UK does not intend to subject international shipping to emissions trading measures similar to the EU ETS: operators wishing to ship goods to and from Europe can largely avoid the EU emissions trading scheme by using UK ports to ship goods to and from EU destinations. Failure to align the UK ETS with the EU ETS provisions for international shipping risks the promotion of carbon leakage.

**199. We welcome the inclusion of domestic shipping in the UK Emissions Trading Scheme from 2026. We also note the initial decision of the UK ETS Authority not to extend the UK ETS to cover international shipping. The Authority’s position is subject to further consultation.**

**200. *The Government must press for a global market-based measure for international shipping to be adopted and implemented at IMO level by the end of the current GHG Strategy period in 2028. To avoid ‘double counting’, any IMO measure ought to be drafted so as not to impede the operation of any national or regional economic measures that are equivalent in both scope and ambition to its own global measure.***

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204 European Commission information page, ‘[Reducing emissions from the shipping sector](#)’, last accessed 25 February 2024



## 7 Relaunching the Clean Maritime Plan

201. The Government has undertaken to publish a review of the Clean Maritime Plan which will incorporate its policy response to the detailed Course to Zero stakeholder consultation undertaken in 2022. The revised Plan was expected to be issued in 2023 (delayed from 2022): its revision was eagerly anticipated by Ministers when they gave evidence to us.<sup>205</sup> Yet by the time we considered our report, some four months into 2024, the revised Plan had not yet been issued.

202. While Ministers have been revising the Clean Maritime Plan, there have been significant developments in the policy landscape. The International Maritime Organization's new five-year emissions reduction strategy, adopted in July 2023, is more ambitious than many expected: it envisages the adoption at the IMO, by 2028, of more stringent mandatory emissions reduction requirements as amendments to the relevant IMO conventions. The outcome of the March 2024 meeting of the IMO's Maritime Environment Protection Committee indicates that IMO States are looking to make progress on this agenda. Flag States responsible for implementing IMO regulations, national governments planning to develop industries to support low- and zero-emission shipping, and ship owners and operators who are seeking a means to decarbonise their operations are all therefore likely to face significant challenges to meet IMO ambitions, should the measures under discussion be adopted by 2028.

203. Meanwhile, the suite of policy measures to be set out in the Clean Maritime Plan has burgeoned as consultations await a Government response. The revised Plan is expected to contain:

- greater detail on how Government policy on net zero shipping at IMO, domestic and regional levels is being joined up;
- the Government's policy positions in response to the call for evidence on the use of maritime shore power in the UK which closed in April 2022 and to the detailed Course to Zero consultation which closed in October 2022;
- policies to increase the use and availability of low carbon maritime fuels;
- updated estimates for domestic demand for hydrogen based maritime fuels;
- pathways and scenarios for the UK shipping sector to achieve net zero;
- interim decarbonisation goals for the domestic maritime sector; and
- clear targets for emissions reductions from UK domestic and international shipping.

**204. The Clean Maritime Plan—the element of the Government's Maritime 2050 strategy focused on decarbonising shipping—was issued in its initial form in 2019. At the time of publication, it was envisaged that the Plan would be reviewed in 2022. The revision was later deferred to 2023: even on that timetable it is now substantially delayed.**

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205 [Q381](#) ff

205. The revised Plan will represent a significant policy statement from Ministers in response to the IMO's revised GHG strategy. It must be cast so as to outstrip the ambition of the IMO's current strategy, while setting out stretching yet deliverable policy objectives and actions for the UK maritime sector. At a minimum we expect it to contain:

- *interim and overall targets for emissions from UK domestic and international shipping to 2050, together with a detailed plan to achieve the targets and details of the modelling and assumptions underpinning the targets;*
- *a strategy to supply UK domestic and international shipping with zero-emission fuels derived from hydrogen, together with a strategy to develop facilities for the production, transmission and storage of such fuels, so as to outstrip IMO targets for the replacement of conventional fuels;*
- *measures to leverage the UK's expertise in shipping law and hydrography so as to support route optimisation measures in global shipping, and*
- *measures to deliver decarbonised shore power to vessels berthed in UK ports, so as to reduce their emissions and improve port air quality.*

206. *The delay in publication of the revised Clean Maritime Plan is highly undesirable, particularly in the light of recent intensification of international dialogues on maritime decarbonisation. Stakeholders understandably demand policy certainty before making substantial investment decisions on decarbonisation strategies. Ministers must therefore update Parliament as soon as possible in the next session on their progress in finalising the review of the Clean Maritime Plan, and commit to a date, not later than three months from the date of State Opening, by which the revision of the Plan will be issued. The update to Parliament must set out the issues which the revised Plan will address, including the Government responses to all outstanding consultations and calls for evidence relevant to maritime decarbonisation.*

# Conclusions and recommendations

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## Global and regional regulation of shipping emissions

1. We welcome the International Maritime Organization's adoption in 2023 of a revised Greenhouse Gas Strategy and the clearer signals it provides to IMO States and the shipping industry on the pathway to achieving net zero ambitions from shipping by 2050. (Paragraph 44)
2. The UK's influence over and contribution to international shipping activity is considerable. We commend the UK Government on its contribution to date in securing a global strategy which is far more ambitious than that initially adopted by the IMO in 2018. (Paragraph 45)
3. We nevertheless observe that the strategy adopted by the IMO does not currently align with a pathway consistent with the Paris Agreement target of limiting global warming to 1.5°C, and that its ambition is limited to achieving net zero emissions "by or around" 2050. (Paragraph 46)
4. The period to 2028 and the expected adoption of a further GHG Strategy will be a crucial one for international shipping emissions, as agreement is reached on regulatory measures to implement the 2023 Strategy and as IMO States seek consensus on further decarbonisation plans. The outcome of discussions at the 81st meeting of the IMO Marine Environment Protection Committee in March 2024 appears to have been positive, but work is clearly required to consolidate and raise IMO ambitions on global emissions regulation. Continuity in the UK Government's approach and the maintenance and strengthening of the coalition of ambition at the IMO is essential. (Paragraph 47)
5. *We recommend that the Government continue to work at the IMO for adoption of effective regulatory measures to implement the 2023 Strategy. In tandem with this, Ministers must press for a 2028 Greenhouse Gas Strategy which consolidates the ambition of the 2023 Strategy while striving for reductions in line with the UK Government's stated goal of absolute zero emissions from international shipping by 2050.* (Paragraph 48)
6. *Prompt and effective implementation of IMO conventions will be essential to the delivery of meaningful reductions in shipping emissions in line with Paris goals and national net zero pathways. We therefore urge the UK to work with those flag States with substantial shipping registries to ensure full and thorough implementation of IMO conventions on maritime GHG reductions, supporting capacity-building where necessary.* (Paragraph 49)

## The UK Government's approach to delivering net zero shipping

7. The current method for allocating international shipping emissions between states appears unsustainable as a basis for making UK policy on international shipping emissions and determining the maximum emissions permissible from the UK's international shipping in the Sixth Carbon Budget. The International Maritime

Organization has already moved away from the bunker sales measure to a voyage-based measure. This appears to give a more accurate picture of the overall contribution of international shipping activity to GHG emissions worldwide. (Paragraph 59)

8. *We recommend that the Government urgently assess the merits of introducing a voyage-based measure of the UK's contribution to international shipping emissions, so as to provide a sounder basis for developing policy on reducing that contribution. It is in the interests of the industry and policymakers alike that the matter is swiftly clarified, and that the legislation to include international aviation and shipping emissions in the Sixth Carbon Budget is brought before Parliament for approval without further delay.* (Paragraph 60)
9. We welcome the Government's initiative to establish UK SHORE as a dedicated unit to promote research into green maritime technology and the reduction of emissions from UK shipping. We are nevertheless concerned to note that no specific objectives or targets have been set for the unit, and are alarmed to learn that the Department for Transport is unable to guarantee the unit's funding beyond the end of the current Spending Review period in March 2025. It is worrying to note the slippage in policy on clean maritime clusters and zero-emission fuels and the provision of shore power in ports. At this stage of the Government's strategy to achieve net zero from UK shipping, Ministers must ensure that the sector has certainty about policy direction. (Paragraph 94)
10. Net zero offers the UK an unrivalled opportunity to secure benefits for the UK maritime sector and the UK's research and manufacturing base. *It is now high time for Ministers to advance to the next stage of policy development by setting stretching but achievable interim targets for UK domestic and international shipping emissions, consistent with carbon budget requirements and the overall 2050 net zero target.* (Paragraph 95)

### Technical measures to decarbonise shipping: renewable marine fuels

11. The provision of up to £206 million of matching funding for research into low- and zero-emission shipping is to be applauded, and no doubt represents a step change in Government investment in the field. It is, however, dwarfed by the sums of public money committed to research and development into aviation technologies, including low-carbon aviation, since 2013. (Paragraph 133)
12. The Government's current refusal to guarantee funding for research and development into maritime decarbonisation beyond March 2025 is regrettable. We note that the Aviation Technology Institute has received a guarantee of funding to 2030, no doubt reflecting the importance to the economy, and to decarbonisation targets, of rapid progress in reducing emissions from domestic and international aviation. By failing to guarantee Government support for research and development into reducing domestic and international shipping emissions, Ministers risk stifling progress in this sector. Although decarbonisation of domestic and international shipping is less advanced than decarbonisation of aviation, it is just as challenging to undertake, and demands significant investment decisions from Government and industry in the short term if net zero goals are to be met. (Paragraph 134)

13. *The Government must send clear and unambiguous signals to the UK maritime sector that it is committed to supporting its transition to net zero. We recommend that Ministers urgently review the funding perspectives for decarbonisation of UK shipping and, no later than the next fiscal event, provide a commitment to further matching funding for research and development to at least 2030. (Paragraph 135)*
14. As with low-carbon aviation fuel, the development of manufacturing capacity for zero-emission marine fuels is vital for the security of the UK's maritime trade and for the establishment of green shipping corridors. It is disappointing that the Government says it is "not yet able to commit" to the establishment of manufacturing facilities in clean maritime clusters so as to deliver up to 2 TWh of zero-emission marine fuels annually by 2030. Accelerating support for these facilities would bring significant benefits from first mover advantage. (Paragraph 136)
15. We note with interest the recent modelling undertaken by UMAS and Arup, examining how a domestic clean ammonia facility could significantly benefit the take up of zero-emission maritime fuels for ferries operating across the North Sea from Newcastle, the Tees Estuary and Immingham. This holistic assessment of the business case for new facilities demonstrates a refreshing approach to balancing the challenges and opportunities arising from maritime decarbonisation. (Paragraph 137)
16. *As part of the updated Clean Maritime Plan the Government must develop a strategy to support the development in UK maritime clusters of facilities for the manufacture of zero-emission marine fuels. This strategy must be supported by a delivery plan which sets clear production milestones. (Paragraph 138)*
17. *We recommend that Ministers consult on the introduction of a revenue support mechanism to incentivise the commercial production of zero-emission marine fuels in the UK. (Paragraph 139)*

### Technical measures to decarbonise shipping: efficiency improvements

18. The current Clean Maritime Plan sets no clear or measurable objectives for the UK's contribution to operational efficiencies from domestic and international shipping. (Paragraph 164)
19. *The refreshed Clean Maritime Plan must set stretching interim targets for the emissions savings to be achieved from operational efficiencies in UK domestic shipping to 2050, together with a detailed plan for how these savings are to be achieved through measures such as route and speed optimisation. (Paragraph 165)*
20. The UK's influence in international shipping is considerable and extends beyond its prominent position at the IMO. The basis of the majority of international shipping contracts is English law. The UK Hydrographic Office provides unrivalled resources to support vessels in optimising their voyages so as to maximise energy efficiency. This 'soft power' is an invaluable resource for the decarbonisation of global shipping. (Paragraph 166)

21. *We recommend that, as part of the refreshed Clean Maritime Plan, Ministers commission a workstream to examine how the efficiency of international shipping operations can be further optimised by the appropriate development of the expertise in the UK Hydrographic Office. (Paragraph 167)*
22. IMO standards for existing ship efficiency provide progressively more stringent measures to require the existing fleet to reduce its emissions. Current measures have been criticised for a lack of ambition. While the amendments to the MARPOL Convention currently being contemplated at the IMO may further ratchet up efficiency requirements, there are potential emissions benefits to be gained from a more stringent UK approach. (Paragraph 168)
23. *We recommend that Ministers consult on the emissions benefits to be achieved through regulating the maximum carbon intensity of vessels allowed to enter UK ports, with a view to permitting only those vessels rated 'A' to 'C' for carbon intensity under the current IMO Energy Efficiency Existing Ship index to enter. (Paragraph 169)*
24. It is regrettable that the Government has changed course on its policy on the provision of shore power to UK ports. In a period where grid connections are currently at a premium and demand for electricity supply is increasing, the delay in determining policy on how to provide power to the zero-emission ports of the future is unwelcome. (Paragraph 178)
25. *We recommend that Ministers launch their planned consultation on net zero ports without further delay, so as to gather signals from the ports industry and the wider maritime sector at the earliest opportunity as to what infrastructure is likely to be required to minimise the emissions from ships at berth in UK ports, to provide for bunkering and refuelling with low- or zero-emission fuels and to develop a suitable structure for funding infrastructure development. Ministers must send the clearest signals possible about the likely requirements for port electrification so as to enable early planning for potential grid connections. (Paragraph 179)*
26. The initial Clydebank Declaration, and the consolidation and development of initiatives for green shipping corridors since COP26, represent considerable progress in collaboration between governments, and between the Government and industry, in the practical measures required to make decarbonised shipping a reality. Ministers are to be commended for the initiative in pressing for the Declaration and for subsequent work to develop partnerships to establish these corridors. (Paragraph 186)
27. The UK, as a leading proponent of this multilateral approach, is demonstrating how green corridors can be implemented on domestic, regional and intercontinental routes. We welcome the recent announcement of collaborations to establish green corridors between the UK, the Netherlands, Norway, Denmark, and Ireland, and we look forward to further positive developments. (Paragraph 187)
28. *In its response to this report we expect Ministers to set out the current state of each of the green corridor feasibility studies UK SHORE is engaged in, and the state of discussions with the USA, Canada, Singapore and other relevant Clydebank signatories on the requirements for implementing bilateral green corridors with each. (Paragraph 188)*

## Economic measures to decarbonise shipping

29. We welcome the inclusion of domestic shipping in the UK Emissions Trading Scheme from 2026. We also note the initial decision of the UK ETS Authority not to extend the UK ETS to cover international shipping. The Authority's position is subject to further consultation. (Paragraph 199)
30. *The Government must press for a global market-based measure for international shipping to be adopted and implemented at IMO level by the end of the current GHG Strategy period in 2028. To avoid 'double counting', any IMO measure ought to be drafted so as not to impede the operation of any national or regional economic measures that are equivalent in both scope and ambition to its own global measure.* (Paragraph 200)

## Relaunching the Clean Maritime Plan

31. The Clean Maritime Plan—the element of the Government's Maritime 2050 strategy focused on decarbonising shipping—was issued in its initial form in 2019. At the time of publication, it was envisaged that the Plan would be reviewed in 2022. The revision was later deferred to 2023: even on that timetable it is now substantially delayed. (Paragraph 204)
32. The revised Plan will represent a significant policy statement from Ministers in response to the IMO's revised GHG strategy. It must be cast so as to outstrip the ambition of the IMO's current strategy, while setting out stretching yet deliverable policy objectives and actions for the UK maritime sector. At a minimum we expect it to contain:
  - *interim and overall targets for emissions from UK domestic and international shipping to 2050, together with a detailed plan to achieve the targets and details of the modelling and assumptions underpinning the targets;*
  - *a strategy to supply UK domestic and international shipping with zero-emission fuels derived from hydrogen, together with a strategy to develop facilities for the production, transmission and storage of such fuels, so as to outstrip IMO targets for the replacement of conventional fuels;*
  - *measures to leverage the UK's expertise in shipping law and hydrography so as to support route optimisation measures in global shipping, and*
  - *measures to deliver decarbonised shore power to vessels berthed in UK ports, so as to reduce their emissions and improve port air quality.* (Paragraph 205)
33. *The delay in publication of the revised Clean Maritime Plan is highly undesirable, particularly in the light of recent intensification of international dialogues on maritime decarbonisation. Stakeholders understandably demand policy certainty before making substantial investment decisions on decarbonisation strategies. Ministers must therefore update Parliament as soon as possible in the next session on their progress in finalising the review of the Clean Maritime Plan, and commit to a date, not later than three months from the date of State Opening, by which the revision of the Plan will be*

*issued. The update to Parliament must set out the issues which the revised Plan will address, including the Government responses to all outstanding consultations and calls for evidence relevant to maritime decarbonisation. (Paragraph 206)*



# Formal minutes

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## Net zero aviation and shipping

The following declarations of interest relating to the inquiry were made:

### 27 October 2021

Philip Dunne declared the following pecuniary interest: Non-Executive Director of Reaction Engines Ltd (engineering technology developer), Building F5, Culham Science Centre, Abingdon OX14 3DB. From 24 July 2021 until further notice, I receive £3,400 a month.

James Gray declared the following non-pecuniary interests: honorary life member of the Baltic Exchange, and a Younger Brother in the Fraternity of Trinity House.

### 17 November 2021

Philip Dunne declared the following pecuniary interest: Non-Executive Director of Reaction Engines Ltd (engineering technology developer), Building F5, Culham Science Centre, Abingdon OX14 3DB, which, since his declaration of 27 October 2021, had formed a joint venture technology company with partners including the Science and Technology Facilities Council to develop ammonia technologies for use in hard to decarbonise sectors; and declared that he would take no further part in the inquiry.

## Thursday 24 May 2024

### Members present

Duncan Baker

Sir Christopher Chope

Jerome Mayhew

Cherilyn Mackrory

Anna McMorris

Dr Matthew Offord

[...]

In the absence of the Chair, Jerome Mayhew was called to the chair.

The Committee deliberated.

Draft Report (*Net zero and the UK shipping sector*), proposed by Jerome Mayhew, brought up and read.

Paragraphs 1 to 203 read and agreed to.

Motion made and Question put, That the Report be the Seventh Report of the Committee to the House.

The Committee divided.

**Ayes, 4**

Duncan Baker

Cherilyn Mackrory

Anna McMorrin

Dr Matthew Offord

**Noes, 1**

Sir Christopher Chope

Question accordingly agreed to.

*Resolved*, That the Report be the Seventh Report of the Committee to the House.

*Ordered*, That Jerome Mayhew make the Report to the House.

[...]

### **Adjournment**

The Committee adjourned.

## Witnesses

The following witnesses gave evidence. Transcripts can be viewed on the [inquiry publications page](#) of the Committee's website.

### Wednesday 27 October 2021

**Dr Andy Jefferson**, Programme Director, Sustainable Aviation; **Dr Chika Miyoshi**, Reader in Environmental Systems for Aerospace, Cranfield University; **Chris Young**, Group Chief Engineer, Rolls-Royce [Q1–45](#)

**Simon Bullock**, Research Associate, Tyndall Centre for Climate Change Research, University of Manchester; **Sarah Kenny**, Chair, Maritime UK; **Anna Ziou**, Policy Director, UK Chamber of Shipping [Q46–80](#)

### Wednesday 01 December 2021

**Matt Gorman**, Director of Carbon Strategy, Heathrow Airport; **Glenn Llewellyn**, Vice President, Zero Emission Aircraft, Airbus; **Val Miftakhov**, Founder & CEO, ZeroAvia; **Hannah Tew**, Director of Air Mobility, Connected Places Catapult [Q81–129](#)

**Leo Murray**, Director of Innovation, Possible; **Tim Johnson**, Director, Aviation Environment Federation [Q130–169](#)

### Wednesday 26 January 2022

**Mike McCartain**, Group Director of Safety, Marine and Engineering, Associated British Ports; **Guy Platten**, Secretary General, International Chamber of Shipping; **Dr Tristan Smith**, Reader in Energy and Shipping, UCL Energy Institute [Q170–215](#)

**Alex Clark**, Researcher, Smith School of Enterprise and Environment, University of Oxford; **Katharine Palmer**, Global Head of Sustainability, Lloyd's Register, High-Level Climate Champion's Shipping Lead, United Nations; **Michael Parker**, Chairman, Global Shipping, Logistics & Offshore, Citi [Q216–253](#)

### Wednesday 30 March 2022

**Helena Bennett**, Senior Policy Adviser, Green Alliance; **Andy Cornell**, Representative, Renewable Transport Fuel Association, CEO, Advanced Biofuel Solutions; **Dr Neville Hargreaves**, Vice President, Waste to Fuels, Velocys; **Paddy Lowe**, Founder and CEO, Zero Petroleum [Q254–293](#)

**Jonathon Counsell**, Group Head of Sustainability, International Airlines Group; **Mr Jonathan Hinkles**, Chief Executive, Loganair; **Hemant Mistry**, Director of Energy Transition, International Air Transport Association; **David Morgan**, Director of Flight Operations, easyJet [Q294–336](#)

### Wednesday 18 May 2022

**Emma Gilthorpe**, CEO, Jet Zero Council; **Sophie Lane**, Chief Relationships Officer, Aerospace Technology Institute [Q337–360](#)

**Robert Courts MP**, Parliamentary Under-Secretary of State, Department for Transport; **Eamonn Beirne**, Deputy Director: Maritime Environment, Technology and International, Department for Transport; **Holly Greig**, Deputy Director: Aviation Decarbonisation Division, Department for Transport; **Lee Rowley MP**,

Parliamentary Under-Secretary of State (Minister for Industry), Department for Business, Energy and Industrial Strategy; **Paul Griffiths**, Head of Aerospace Team, Department for Business, Energy and Industrial Strategy

[Q361-429](#)

## Published written evidence

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The following written evidence was received and can be viewed on the [inquiry publications page](#) of the Committee's website.

ZAS numbers are generated by the evidence processing system and so may not be complete.

- 1 ADS Group Ltd ([ZAS0018](#))
- 2 Aerospace Technology Institute ([ZAS0044](#))
- 3 Airbus ([ZAS0052](#))
- 4 Airlines UK ([ZAS0017](#))
- 5 Airport Operators Association ([ZAS0055](#))
- 6 Associated British Ports ([ZAS0061](#))
- 7 Aviation Environment Federation (AEF) ([ZAS0043](#))
- 8 BRULIC Ltd ([ZAS0003](#))
- 9 Ballard Power Systems Europe A/S ([ZAS0020](#))
- 10 Blakey, Dr Simon (Senior Lecturer, University of Birmingham) ([ZAS0027](#))
- 11 Bristol Airport ([ZAS0054](#))
- 12 Buss, Dr Grahame ([ZAS0019](#))
- 13 Carbon Capture and Storage Association ([ZAS0034](#))
- 14 Carbon Engineering ([ZAS0026](#))
- 15 Connected Places Catapult ([ZAS0069](#))
- 16 Cranfield University ([ZAS0065](#))
- 17 Department for Transport ([ZAS0053](#), [ZAS0073](#))
- 18 E.A. Gibson Shipbrokers Ltd ([ZAS0008](#))
- 19 GKN Aerospace Services Ltd ([ZAS0062](#))
- 20 Green Alliance ([ZAS0022](#))
- 21 HACAN (Heathrow Association for the Control of Aircraft Noise) ([ZAS0004](#))
- 22 Heathrow Airport Limited ([ZAS0048](#))
- 23 HyPulJet Ltd ([ZAS0001](#))
- 24 International Air Transport Association ([ZAS0051](#))
- 25 International Chamber of Shipping ([ZAS0068](#))
- 26 International Consolidated Airlines Group (IAG) ([ZAS0035](#))
- 27 Liquid Gas UK ([ZAS0005](#))
- 28 Loganair Limited ([ZAS0072](#))
- 29 Logistics UK ([ZAS0064](#))
- 30 London Luton Airport ([ZAS0057](#))
- 31 Magway Limited ([ZAS0029](#))
- 32 Manchester Airport Group ([ZAS0010](#))
- 33 Met Office ([ZAS0030](#))

- 34 NATS ([ZAS0058](#))
- 35 No 3rd Runway Coalition ([ZAS0013](#))
- 36 Nuclear Industry Association ([ZAS0028](#))
- 37 Pinks, Captain Melbourne ([ZAS0002](#))
- 38 Possible ([ZAS0012](#))
- 39 Prospect ([ZAS0033](#))
- 40 Rae, Mr Anthony ([ZAS0046](#))
- 41 Reaction Engines ([ZAS0036](#))
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- 49 Southampton Marine and Maritime Institute, University of Southampton ([ZAS0063](#))
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- 51 Stephenson Harwood LLP; and Napa Oy ([ZAS0070](#))
- 52 Straightline Aviation ([ZAS0024](#), [ZAS0071](#))
- 53 The European Marine Energy Centre Ltd (EMEC); Orcades Marine; Highlands and Islands Airports Limited (HIAL) – Kirkwall Airport; Loganair; Northlink Ferries; and Orkney Islands Council ([ZAS0006](#))
- 54 The Manufacturing Technology Centre ([ZAS0009](#))
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