Department for Transport

Maritime Decarbonisation Strategy

Department for Transport
Great Minster House
33 Horseferry Road
London SW1P 4DR

Contents

Foreword by Secretary of State for Transport & Minister for Aviation, Maritime and Security

The UK has a strong maritime history and, to this day, we rely on the sector across our economy, whether that is in providing transport for most of the goods arriving to our shores, acting as a critical enabler for UK manufacturing, connecting people across our islands and nations, or providing high-value jobs. As the Secretary of State and the Minister for Maritime, it has been a privilege to engage with such a vital and vibrant sector, a sector that is fundamental to supporting this Government's national missions to kickstart the economy and create jobs and opportunity across the country. And a sector that has a clear ambition for change, moving towards the green economy, leading the way in making the UK a clean energy superpower.

The UK maritime sector has always kept an eye on the future, and we have been encouraged that it sees the need for a green future as central to its success. We see the global transition to clean shipping as both a key opportunity and challenge for our shared future.

The scale of this transition is not one the UK can make alone in an inherently international sector, and we are proud of all that we have achieved, and will continue to strive for, at the International Maritime Organization (IMO). This includes past successes, like the ambitious 2023 Greenhouse Gas (GHG) Strategy which set the international shipping sector on the pathway to net zero. Now, the work of the IMO is on agreeing the measures to deliver the goals of its 2023 GHG Strategy, which we believe is best done through a global fuel standard alongside a levy on emissions, giving emissions their true costs with proceeds going to tackle climate change and cut emissions even further.

But international action alone cannot overcome the challenge to reduce emissions in our domestic maritime sector.

We need to put the UK at the forefront, as a world leader in both maritime and the environment. This is why we are proud to be setting our own UK domestic maritime emission reduction goals to match the highest end of the IMO's targets of a 30% GHG emissions reduction by 2030 and an 80% GHG emissions reduction by 2040 (compared to 2008 levels), ahead of an ambition for zero GHG emissions by 2050.

This Maritime Decarbonisation Strategy affirms our commitment to a clean maritime future and sets out the pathway to meet our goals, providing certainty and clarity for the sector. It is critical to not only address the impact of our sector on the environment, including the health benefits of better air quality, but to kickstart economic growth, create skilled jobs right across the country, to make the UK a clean energy superpower and to deliver greener transport. This builds on the £30 million we announced in January of this year, to continue to support the UK's world-leading maritime innovation sector.

Our plan to deliver GHG emission reductions focuses on five key policies. These will see us introduce new regulation to increase the use of clean maritime fuels, place a price on GHG emissions, consider how best to reduce GHG emissions from vessels at berth, set out how we will support all vessels, regardless of size, to decarbonise, and improve the energy efficiency of vessels. In developing these policies, we will ensure alignment between international and domestic policies, recognising the nature of the sector. Many of these policies will need to be developed further and it is here that we look to the sector to support us on delivering effective action. The challenge ahead is not small, but neither are the opportunities, which, together, we can seize for the benefit of the maritime sector and for the UK.

Mike Kane MP
Minister for Aviation, Maritime & Security, Department for Transport

Heidi Alexander MP
Secretary of State for Transport, Department for Transport

Executive Summary

The maritime sector is vital to the UK, with over 95% of cargo imports and exports, by weight, moving by sea[1]. Whilst UK maritime GHG emissions have declined by 30% since 1990[2], in 2022 maritime contributed 8% of total UK transport GHG emissions, relatively evenly split between domestic and international maritime[3]. 2024 saw significant progress in tackling international emissions including the UK taking a leading role at the IMO, pushing for an ambitious fuel standard and a global levy on international shipping emissions – a sector that emits more GHGs than most countries[4]. This builds on the 2023 IMO GHG Strategy which set ambitious goals for GHG emission reductions and include an agreement to develop technical and economic measures to deliver them[5].

As an international climate leader, the UK was the first major economy to legislate for net zero, making it a legal imperative to reduce our domestic GHG emissions by at least 100% by 2050[6], with five-yearly 'carbon budgets'. In line with these targets, this *Strategy* sets the pathway for our domestic maritime sector to reach zero fuel lifecycle GHG emissions by 2050 and provides regulatory certainty for the maritime sector.

Aligned with the highest level of international ambition in the 2023 IMO GHG Strategy, our goals are for UK domestic maritime to aim for zero fuel lifecycle GHG emissions by 2050, with at least a 30% reduction by 2030 and an 80% reduction by 2040, relative to 2008 levels. This will once again show how increased domestic action can be used to catalyse high international ambition.

Our policies are underpinned by guiding principles to enable their success and designed to help deliver the Government's missions.

Supporting the Government's missions:

- **Making Britain a clean energy superpower:** In addition to accelerating progress to net zero, the maritime sector can be a critical enabler of clean energy uptake. Whether as a reliable early offtaker of clean power and low carbon fuels such as hydrogen, a supplier of energy, by decentralising energy systems through generation at ports, or by servicing and unlocking the Government's ambition to rapidly develop offshore wind to 43-50 GW by 2030, the sector is a vital part of achieving this mission.

- **Kickstarting economic growth:** The maritime sector already plays a vital role in the UK economy, and global efforts to decarbonise the sector will create green growth opportunities in the future. We will support UK industry to make the most of these opportunities, building on our leadership in maritime finance and law, and other maritime professional services, and by helping to deliver the skills it needs for success.

- **Building an NHS fit for the future:** Through the Government's health mission prevention is front and centre, enabling people to live longer, healthier lives. The maritime sector can play an important role in supporting this mission, by driving down emissions of air pollutants as it decarbonises, whilst we continue to improve our evidence base on how shipping emissions impact air quality.

Guiding principles

- **Building on UK expertise and innovation:** From learning gained through our £206 million UK Shipping Office for Reducing Emissions (UK SHORE) research and development (R&D) programme, the further £30 million of investment we will spend through UK SHORE in the coming year, and the Maritime and Coastguard Agency's (MCA) regulatory activities, to our state-of-the-art modelling, we aim to use the best evidence available to implement this *Strategy* and draw on the UK's world-leading expertise and innovation.

- **Coordinating our approach across government, regulators, international organisations and the maritime sector:** We will reflect international agreements at the IMO, and regional approaches through the European Union (EU) and push for ambitious global action. We will also align with wider UK government priorities such as on air quality and energy provision, reflect cross-economy considerations on fuel sustainability criteria and availability of supply, and we will work collaboratively to tackle system barriers to reduce cost and administrative burdens on industry and minimise our environmental impact.

- **Creating the right framework for investment decisions:** In recognising that there is no "one size fits all" option to decarbonise the sector, we aim to provide policy flexibility to industry to help them identify the most suitable decarbonisation route, and a regulatory framework that is fit for the future, supports growth and innovation, and maintains safety.

These goals are intentionally ambitious, and to set us on the right course for 2050 we have developed these five key policy measures in this *Strategy*:

- **Regulate fuel use**, by pushing for a global GHG intensity fuel standard at the IMO in 2025, alongside domestic regulation of maritime technologies, fuels and energy sources. Reducing GHG emissions will require a wholesale switch from conventional fuels to the fuels of the future. Regulation will be key to driving this change and will provide certainty to producers and suppliers of fuels, as well as those investing in vessels. We will formally consult on our approach to regulation from 2026.

- **Place a price on emissions**, through the expansion of the UK ETS to maritime and by pushing for a global levy on GHG emissions at the IMO in 2025. Pricing emissions is a cost-effective decarbonisation tool, demonstrated by the success of the UK ETS in other sectors to date. Collectively, placing a price on emissions, either domestically via the UK ETS or through global action at the IMO, will increasingly incentivise reductions in GHG emissions as we move to a zero-emission world in 2050. Whilst there is the potential for overlap between the UK ETS and IMO emissions pricing mechanisms, we will work to understand how these schemes interact, and to avoid any double charging of emissions.

- **Consider a requirement for zero or near-zero GHG emissions from vessels whilst at berth**. Almost half of the GHG emissions from UK domestic maritime (excluding inland waterways) come from vessels at berth in our ports, and we want to establish the right incentives and requirements to encourage the uptake of the technology needed to reduce these emissions. This can also improve air quality to the benefit of people working at and living near ports. A call for evidence has been published alongside this *Strategy*, and we will formally consult on proposed measures where required from 2026.

- Introduce proportionate measures to support **smaller vessels to decarbonise and accelerate uptake in targeted subsectors**. We need to reduce emissions from the whole sector, not only the largest emitters, to meet our goals. Recognising the barriers faced by small businesses and the time required to plan for change, we will build our evidence base and work closely with the sector to develop bespoke interventions that support decarbonisation across the different subsectors of our maritime sector. A call for evidence has been published alongside this *Strategy* and, subject to the results of this, we will formally consult on proposed measures. At the outset, we expect to focus on vessels with a clear route to decarbonisation, such as offshore wind vessels, whereas measures for harder-to-decarbonise vessels may not be required until the mid to late 2030s.

- Increase the **energy efficiency** of maritime operations. Increased energy efficiency reduces emissions whilst also minimising operational costs which are likely to increase when using zero and near-zero GHG emission fuels. Driven by existing measures from the IMO, increased uptake of energy efficiency technologies and practices will be key to short term reductions. We will work at the IMO to identify and agree how these measures can be updated and strengthened and consider whether any domestic measures are required.

These policies will take time to implement. The first phase of our *Strategy* will rely on existing IMO regulation to increase the efficiency of vessels between now and 2030. In the second phase, with a focus on larger vessels, we will narrow the price gap with conventional fuels through expansion of the UK ETS to maritime from 2026 and an IMO pricing mechanism, such as a global levy, from 2027. We will also increase the use of low carbon and zero and near-zero GHG emission fuels with international regulation from 2027, with domestic regulation following. Informed by calls for evidence, we will develop policies that support ports to play a key role in reducing at berth emissions, and develop proportionate measures to reduce emissions from smaller vessels and in targeted subsectors – with an initial focus on vessels with a clear route to decarbonisation. Alongside and within these interventions we will help reduce the wider impact of the sector on the environment, maximising the co-benefits across both nature and human health from action on climate, pollution and biodiversity.

The sector is important to the economy and needs direction and certainty to plan ahead. Decarbonisation is the future, and we want to ensure that UK businesses can make the most of green maritime growth opportunities. The sector directly contributed around £18.7 billion to UK gross value added (GVA) and directly supported around 227,000 skilled jobs in 2019[7]. We are continuing to support the green transition through our renewed investment of a further £30 million of funding in UK SHORE, which will see the continued development and deployment of clean maritime solutions in UK waters and in UK ports.

We have also made wider commitments to support our goals more broadly. This includes working with industry to deliver the green skills it needs and stimulating green growth opportunities. We will measure the impact of our policies through our newly developed maritime emissions model, which provides state-of-the-art analysis of maritime emissions out to 2050. We also commit to monitor our progress and revise our actions in line with international policymaking at the IMO, and our strengthened evidence base.

Having the right regulatory environment and framework in place will be key to delivering the ambitions in this *Strategy*. To achieve this, the MCA will create a new globally leading UK Maritime Innovation Hub (MIH) to encourage innovation, research and development, and support economic growth. The Unit will help innovators navigate the regulation system, supporting the development and ultimately safe use of new technologies in the sector. We will work with the MCA, classification societies and all relevant UK regulators to build a flexible regulatory environment, that enables innovation in the UK and the trialling and safe use of future fuels. Internationally, we will work to develop global regulations for safe use, ensuring there is not a patchwork of regulations that add barriers to investment in maritime decarbonisation.

Change of this magnitude cannot be achieved by government and regulators alone. We need the support and partnership of industry, academia and energy providers. The Government will work closely with the maritime sector and we are confident that industry will step up and rise to the challenge of this change.

We are committing to take the following actions to address the UK's maritime GHG emissions:

Policy Area	Commitment
Regulating the GHG intensity of maritime fuels	Subject to consultation in 2026, we will introduce domestic fuel regulations to drive the uptake of zero and near-zero GHG emission fuels and energy sources, following global fuel regulations to be implemented from 2027 and supported by increased modelling capability.
Putting a price on emissions	We will introduce domestic GHG emissions pricing through the UK ETS from 2026, alongside continued work to push for emissions pricing globally, to be introduced from 2027, underpinned by improved modelling capability.
Port decarbonisation & emissions at berth	We will take action to reduce emissions at berth and support the future energy demand of ports, informed by our call for evidence and subject to consultation from 2026 in some areas.
Measures for small vessels and accelerating uptake in targeted subsectors	Informed by our call for evidence and stakeholder engagement, we will develop proportionate measures to reduce emissions from smaller vessels, and to accelerate the uptake of zero and near-zero GHG emission fuels and technologies where there are clear technological pathways, subject to formal consultation from 2026 in some areas.
Increasing the efficiency of maritime operations	We will support IMO short-term measures to further incentivise energy efficiency, to be implemented from 2026, and explore domestic measures.
Innovative regulatory environment	The MCA will create a new globally leading UK Maritime Innovation Hub to encourage innovation, research and development and support economic growth.
Green skills	We will work with industry and across government to meet the maritime sector's future green skills needs.
Continuing R&D support through UK SHORE	We will continue to deliver UK SHORE through the sixth round of the Clean Maritime Demonstration Competition (CMDC), to support zero and near-zero GHG emission fuels and technology, shoreside infrastructure and the wider supply chain.
Green corridors	We will aim to develop at least one international green corridor from the UK by the end of 2027/28 and three domestic green corridors in the same timeframe.
Emission Control Areas and air quality	We will work with neighbouring Atlantic coastal states to designate a North Atlantic Emission Control Area (ECA) through the IMO, and consider the needs for further air pollution specific policies alongside maritime decarbonisation.
Government shipbuilding procurement	The National Shipbuilding Office (NSO) will support the goals of this *Strategy* through future government procurement.
Future review	We will continue to strengthen our maritime emissions modelling, analytical and data capabilities, and to publish reviews of this *Strategy* following the adoption of mid-term measures at the IMO and five years post publication.

Maritime Zero Emissions Timeline

Key

International Policy

Domestic Policy

If primary legislation required:
- UK Fuel regulations
- Zero Emissions Berth requirement
- Measures for small vessels and accelerating uptake in targeted subsectors
- IMO mid-term measures

2050
Zero Emission Maritime

2040
80% Interim Goal

IMO 70%–80% International Target

Second UK Domestic Interim Goal

2040–2050

Some global measures increase in stringency

Some UK measures increase in stringency

Earliest date from which IMO mid-term GHG reduction measures could enter into force

Clean Maritime Hub closes

2030
30% Interim Goal

IMO 20%–30% International Target

First UK Domestic Interim Decarbonisation Goal

UK domestic fuel regulation enters into force

2030s

Anticipated IMO GHG 2028 Strategy revision

Anticipated IMO revision of midterm measures

UK fuel regulations introduced

Potential measures for at berth emissions introduced

Proportionate measures aimed at smaller vessels introduced where appropriate

2028

IMO GHG 2023 Strategy Revision

Proposed UK ETS threshold review

ZEVI projects complete self-funded 3-year demonstration

2027
MDS Review

2026

Earliest point from which measures aimed at targeted subsectors could be introduced

2025
MDS

IMO GHG negotiations

International Green Corridor Fund and Clean Maritime Demonstration Fund run until March 2025

CMDC6 launches

Technical consultation on expanding the UK ETS to domestic maritime

Call for evidence on:
- Net Zero Ports
- Measure for small vessels and accelerating uptake in targeted subsectors

2025

IMO Approval and Adoption of mid-term GHG reduction measures

FuelEU implementation

2026

UK ETS comes into force, proposed for vessels over 5000GT

Consultation on at berth measure

Consultation on measures for targeted subsectors

Final evaluation report of UK SHORE 1.0

First formal consultation on UK fuel regulations

This timeline is indicative and illustrates the likely pathway to 2050. Policy and regulation will be subject to consultation and in some cases Parliamentary time, which will affect timing.

CHAPTER 1

Introduction

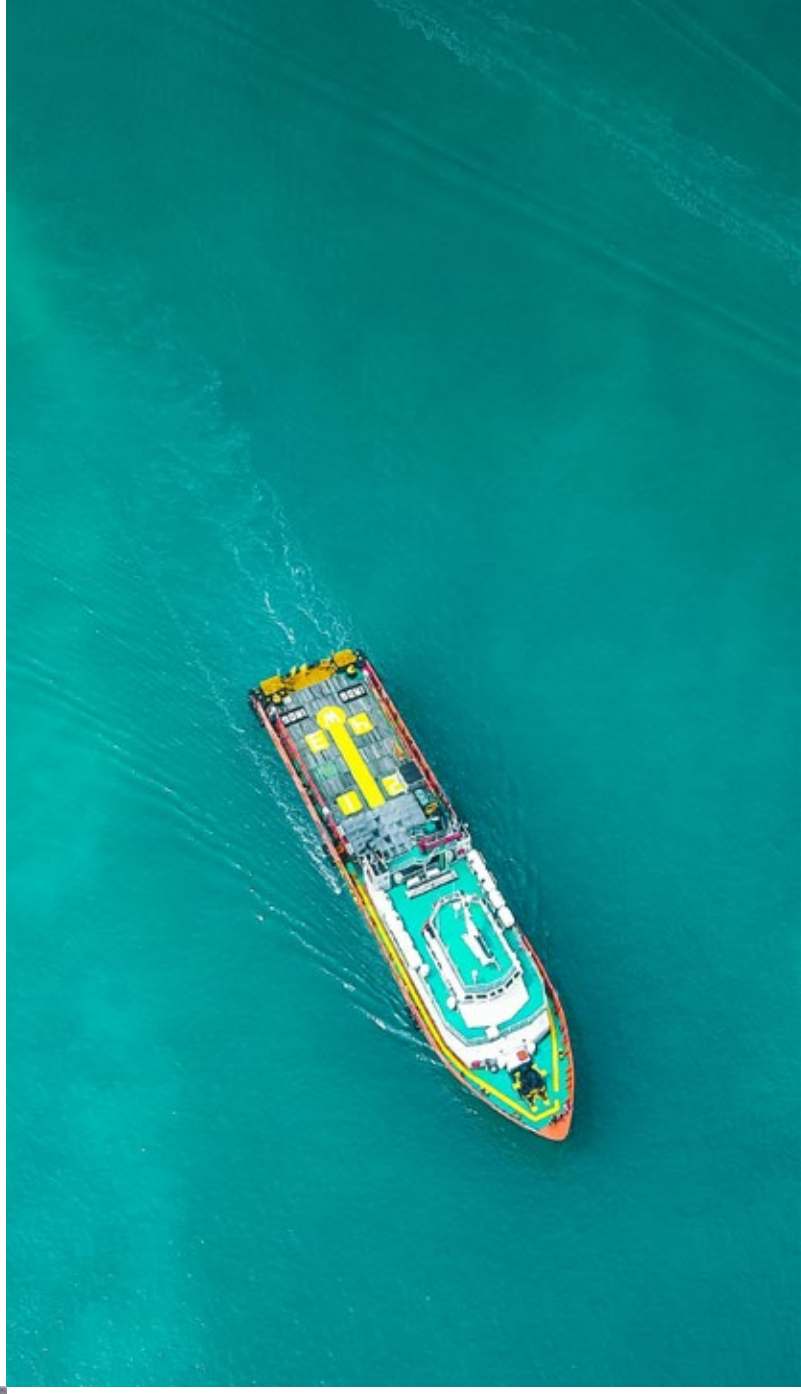
This chapter sets out our objective of reducing the UK domestic maritime sector's fuel lifecycle GHG emissions to zero by 2050, with interim goals for a 30% reduction by 2030 and an 80% reduction by 2040, compared to 2008 levels.

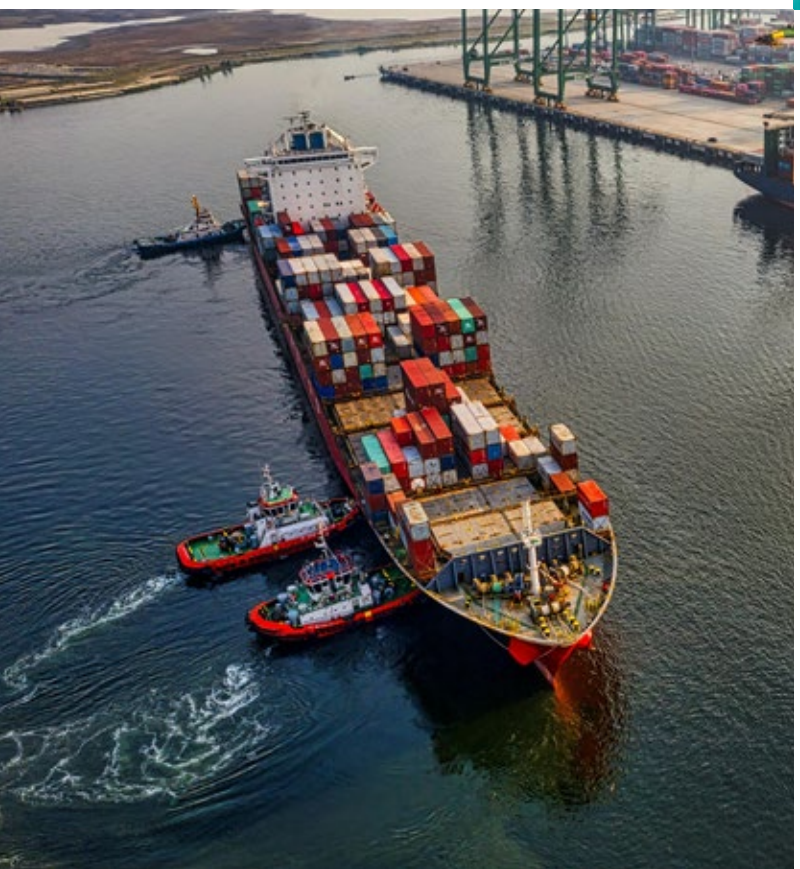

IDA

1.1 Purpose

The UK was the first major economy to legislate for net zero, making it a legal imperative to reduce our domestic GHG emissions by at least 100% by 2050, compared to 1990[8]. The UK is not alone in taking action, and there is international support for limiting global warming to 1.5°C.

A green future for maritime directly supports the government's missions. The sector is distributed across the country, and kickstarting economic growth in ports will see jobs and growth across the country. This green growth will also support our mission for the UK to become a clean energy superpower, through demand for and supply of, energy, underpinning the Government's ambition for offshore wind development. We have seen huge progress in the plans to tackle international maritime emissions, such as the 2023 IMO GHG Strategy[9]. Now, we must also set a bold course aiming for UK domestic maritime fuel lifecycle GHG emissions to reach zero in line with the Government's overall target of net zero by 2050 and the Paris Agreement goal to limit global average temperature increases[10].





1.2 Background

Progress has been made on maritime decarbonisation in recent years, including through agreement of a more ambitious 2023 IMO GHG Strategy[11], the initial launch of the £206 million UK SHORE funding programme now supported with a further £30 million, the establishment of a National Clean Maritime Research Hub, and the drive towards greener vessels across the government shipbuilding pipeline. This *Strategy* sets out our principles, goals and the actions that will be needed to decarbonise UK domestic maritime going forward.

1.3 Overarching goals

This *Strategy* sets clear and ambitious goals for reducing GHG emissions from the UK domestic maritime sector (including seagoing vessels, inland waterways and leisure craft), with the objective of reducing the sector's fuel lifecycle GHG emissions to zero by 2050, with interim goals for at least a 30% reduction by 2030 and at least an 80% reduction by 2040, compared to 2008 levels.

These goals are aligned with the highest level of ambition in the 2023 IMO GHG Strategy[12], which apply to all international maritime GHG emissions, including those from the UK.

BOX 1 Decarbonisation goals for UK domestic maritime

01

An **interim goal** for the fuel lifecycle greenhouse gas emissions from UK domestic maritime to be

reduced by

30%

by 2030

compared to 2008

02

An **interim goal** for the fuel lifecycle greenhouse gas emissions from UK domestic maritime to be

reduced by

80%

by 2040

compared to 2008

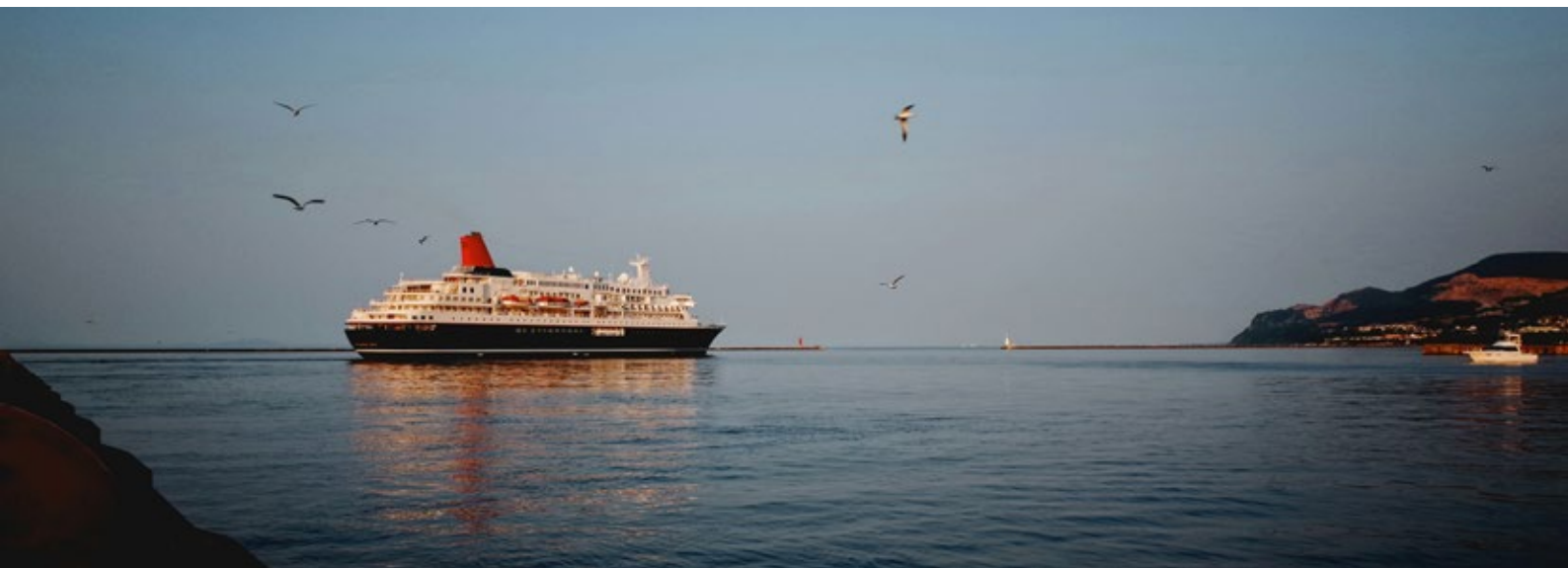
03

An **overarching goal** for the fuel lifecycle greenhouse gas emissions from UK domestic maritime to

reach

zero emissions

by 2050



CHAPTER 2

Government Missions & Guiding Principles

This chapter explains how the *Strategy* supports the Government's missions to:

- Make Britain a clean energy superpower
- Kickstart economic growth
- Build an NHS fit for the future

It also sets out the guiding principles that inform our strategic approach:

- Building on UK expertise and innovation
- Coordinating our approach across government, regulators, international organisations and the maritime sector
- Creating the right framework for investment decisions

2.1 Supporting the Government's missions

Delivering greener transport is one of the five key priorities for the Secretary of State for Transport and the maritime sector is at the heart of delivering the government's missions.

2.1.1 Make Britain a clean energy superpower

To make Britain a clean energy superpower, our electricity system needs to transition to clean energy by 2030, and we need to accelerate the reduction of the UK's total GHG emissions to net zero by 2050. One of the government's first acts to make this a reality was to appoint Chris Stark to lead Mission Control and to ask the National Energy System Operator (NESO) for advice on the pathway towards 2030[13].

The maritime sector will play an important role in the UK's transition to a zero-GHG emissions electricity grid by 2030. Offshore wind energy, one of the cornerstones of this transition[14], relies heavily on maritime infrastructure and service vessels for installation, maintenance and operations, which facilitate the expansion of offshore wind farms and ensure their efficient operation. The deployment and scaling up of these vessels is crucial for unlocking the Government's ambition to rapidly develop offshore wind to 43–50 GW by 2030. This is a sector that has a clearer route to decarbonisation and can act as an at-scale demonstration of zero and near-zero GHG emission technology in action. The design, build and maintenance of these Crew Transfer Vessels (CTVs) and Service Operation Vessels (SOVs) also provides a significant economic growth opportunity for the UK.

In addition to being an enabler of the clean energy transition, the maritime sector itself is a substantial consumer of fuel; for example, 2.2bn litres were supplied from UK marine bunkers for international journeys in 2023[15]. The shift towards decarbonisation within the sector can act as a catalyst for investment in the broader production of both low carbon and zero and near-zero GHG emission fuels and in ports as clean energy hubs. As a high-volume user, maritime can provide the necessary certainty in demand to unlock supply-side development, benefitting operators in the sector but also creating a positive co-benefit across transport modes and the wider UK economy. By committing to early adoption and high-volume usage of low carbon and, ultimately, zero or near-zero GHG emission fuels, the maritime sector can stimulate the market, encouraging investment in sustainable fuel production and infrastructure. This proactive uptake of fuels can not only benefit the maritime sector, but may also help to kickstart further economic growth for the UK.

To aid this transition, we will work closely with the IMO and UK regulators, such as the MCA, to create a strong and forward-looking regulatory framework to support the development, growth and use of zero or near-zero GHG emission fuels in the UK. Our goal is to ensure that the required standards and regulations are established to encourage innovation, including in clean maritime technologies.

2.1.2 Kickstart economic growth

The maritime sector already plays a vital role in the UK economy, providing jobs in the UK. As an island nation, around 95% of freight traded with the UK (by weight) was moved by sea in 2023[16]. In 2019, the sector directly contributed around 227,000 jobs and around £18.7 billion[17] to UK GVA, including a shipbuilding industry that is supported by a vast supply chain, directly supporting 35,000 skilled jobs in both the civil and defence sectors across the country and responsible for adding £2 billion[18] to UK GVA.

Looking to the future, global efforts to decarbonise the sector will create significant green growth opportunities for the UK. We estimate that UK maritime decarbonisation could support around £130–180 million of GVA and around 1,400–2,100 jobs in the UK on average in each year between now and 2050 in respect to the provision of on-board technologies, fuel storage and engines alone[19]. Globally, research commissioned by the Global Maritime Forum has estimated that trillions of dollars of investment could be required to develop the necessary infrastructure for clean fuel production, supporting millions of green jobs[20]. The investments required on land to support the decarbonisation of the sector, including for the production of zero and near-zero GHG emission fuels and energy sources, the transport and storage of these fuels and the installation of clean energy infrastructure, are also expected to further support UK economic activity and jobs. Furthermore, the NSO is identifying the commercial market segments where the UK could become globally competitive in green shipbuilding, including transport and research vessels, CTVs, SOVs, workboats and leisure vessels.

As previously set out, UK SHORE is a high-profile R&D programme established to accelerate the fuels and technologies necessary to decarbonise the sector. The programme has provided valuable learnings about technologies and fuels that are likely to form part of the future for maritime decarbonisation, such as developing understanding around the operational requirements for shore power at ports or creating new systems to charge offshore wind farm service vessels. As well as developing innovative new technologies, the programme also enables the UK to capitalise on the opportunities of the emerging international

clean maritime market, which will support green economic growth in the UK. By developing these markets in the UK, it also helps reduce UK reliance on the development of fuels and technologies overseas, which could lead to missed economic opportunity as well as affecting the UK's ability to meet its own environmental obligations. Moving forward, we will ensure that the lessons learned from the demonstrators UK SHORE has funded are made available to industry, to provide information on the efficacy of available technology options and to unlock investment and decarbonisation at a faster pace.

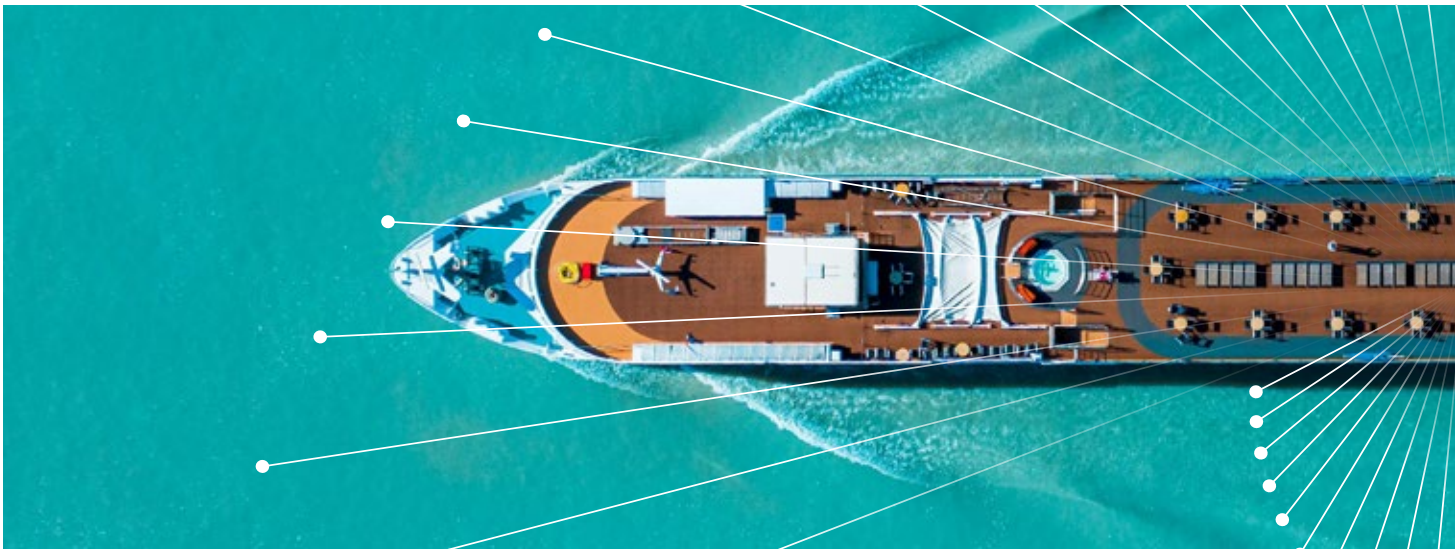
These opportunities will have implications for future skills requirements, representing high-skilled jobs that will attract the next generation of designers, engineers and seafarers into maritime careers in the UK. Government will work with industry to ensure that the green skills training offer is relevant and accessible, ensuring high-quality jobs are available across the sector to support its transition to decarbonisation (see section 6.2).

Centring the government's mission of kickstarting economic growth ensures that policies to drive investment in and uptake of clean maritime solutions act to encourage strategic maritime investment in infrastructure and technology development and procurement activities. This is while ensuring that there are no perverse incentives for investments that do not focus on growing the UK market, particularly during the early stages of technological development where the UK may have the opportunity to capture a significant share of the global market by being an early adopter.

As we develop our policies through to implementation, we will continue to work closely across government, from R&D through to supply chain mapping, export opportunities and foreign direct investment.

2.1.3 Build an NHS fit for the future

The Government's mission to build an NHS fit for the future will mean a much stronger focus on prevention to tackle the causes of ill health. Alongside reducing GHG emissions, the transition to a green maritime sector can also address air pollution. For example, improved energy efficiency directly supports both objectives, and the transition to low carbon and zero or near-zero GHG emission fuels may also reduce certain air pollutant emissions. However, we need to build our understanding of the ways in which new fuels, such as ammonia, may present new air pollution risks. To that end, we will ensure that air pollutant emissions considerations are included in our maritime emissions model and throughout the policy development process. Within government, addressing wider environmental challenges such as air quality, biodiversity, water quality, noise and climate change adaptation, and maximising the co-benefits of the sector's green transition are a priority, and we have developed this *Strategy* with these wider factors in mind. For example, the Government has set legally binding targets to reduce exposure to the most harmful air pollutants for human health, such as fine particulate matter (PM2.5)[21], which will necessitate action from the maritime sector.



2.2 Guiding principles

We have developed a set of guiding principles that support the Government's missions for the country.

2.2.1 Building on UK expertise and innovation

As we transition towards our ambition for UK domestic maritime fuel lifecycle GHG emissions to reach zero, we will build on the UK's extensive maritime knowledge, expertise and capacity for innovation.

We have developed a cutting-edge new maritime emissions model, informed by evidence from government and industry, which provides a wide range of functionality, and enables us to better understand historical emissions and test the potential impact of new policy measures on emissions. The model also provides evidence on the cost implications of new policies and on the technological and fuel changes that are expected to be required.

Beyond modelling, we have also learned from the wealth of evidence generated through our £236 million UK SHORE programme[22], which represents the single biggest UK government investment in R&D in the UK's commercial maritime sector and has ensured the UK is in prime position to maximise the global maritime decarbonisation opportunity. UK SHORE has unlocked investment in green shipping and supported innovation and it is producing evidence at all stages of the R&D pipeline. This includes multi-year real-world demonstrators through the CMDC[23] and Zero Emission Vessels and Infrastructure (ZEVI) competition[24].

We have also established a Clean Maritime Research Hub[25], funded by UK SHORE and the Engineering and Physical Sciences Research Council (EPSRC). Additionally, public funding and support has been provided through UK Research and Innovation (UKRI) such as the £5.5 million EPSRC and academia-funded MariNH3 research programme[26] considering green ammonia as a marine fuel. These initiatives bolster the research undertaken by the UK's world-class universities on maritime decarbonisation, focusing on the R&D challenges facing the sector and the policy responses needed to accelerate decarbonisation.

For further information on the evaluation of UK SHORE so far, please refer to the UK SHORE Interim Evaluation Report, which is published alongside this Strategy.

This push to accelerate these future fuels and technologies through R&D has required significant regulatory involvement through the MCA. As well as helping to shape UK SHORE competitions with technical expertise and

regulatory understanding, the MCA has been directly involved in projects, providing them with the regulatory advice required for success. This involvement has mutually benefitted the MCA by providing them with greater understanding of future technologies and fuels, helping it to shape existing regulations to ensure they support innovation and keep pace with technological advancement.

The outputs of our UK SHORE projects, combined with our extensive internal evidence base and the evidence from our world-leading academic sector, provide us with a strong foundation on which to build and implement our policies and ensure a regulatory framework that is fit for purpose.

2.2.2 Coordinating our approach across government, regulators, international organisations and the maritime sector

A core principle in developing this *Strategy* is to coordinate action across government, regulators and international organisations, to increase our joint impact and reduce administrative and cost burdens on UK operators.

We are reflecting internationally agreed action in our domestic plans, for example by aligning our reporting and monitoring processes with those of the IMO and EU, applying any new regulations consistently and following the IMO's focus on in-sector emission reductions and lifecycle emissions. We are also designing our policies with an awareness of the international picture, for example to mitigate the risk of international carbon leakage (where domestic emission reductions are realised by increasing emissions in places with lower climate obligations).

Global action through the IMO is the most effective way to reduce international maritime GHG emissions, and we will continue to advocate for ambitious measures at the IMO, to help keep the Paris Agreement temperature goal of 1.5°C within reach. However, should multilateral action through the IMO be delayed or prove insufficient, the UK will develop bespoke domestic measures to address our share of these international emissions, in line with our legal commitment to net zero.

It will be equally important to ensure that we maintain the UK's standards for sustainability of low carbon and zero or near-zero GHG emission fuels as applied across the economy and different transport sectors and that we consider both the availability of these fuels, and their scalability for use in the maritime sector.

Similarly, we will work across government to seize opportunities in, and tackle wider issues that pose a barrier to, decarbonising the sector, such as energy provision and security. The provision of electricity at ports, for example, requires a strong coordinated effort to understand future demand, to ensure that the right policies are in place to support port infrastructure and connection.

To establish the right regulatory landscape for the safe use of future fuels and energy, we are working closely with the MCA, including in setting up the new UK Maritime Innovation Hub, as well as other regulatory bodies such as the Health and Safety Executive (HSE) and the Environment Agency.

2.2.3 Creating the right framework for investment decisions

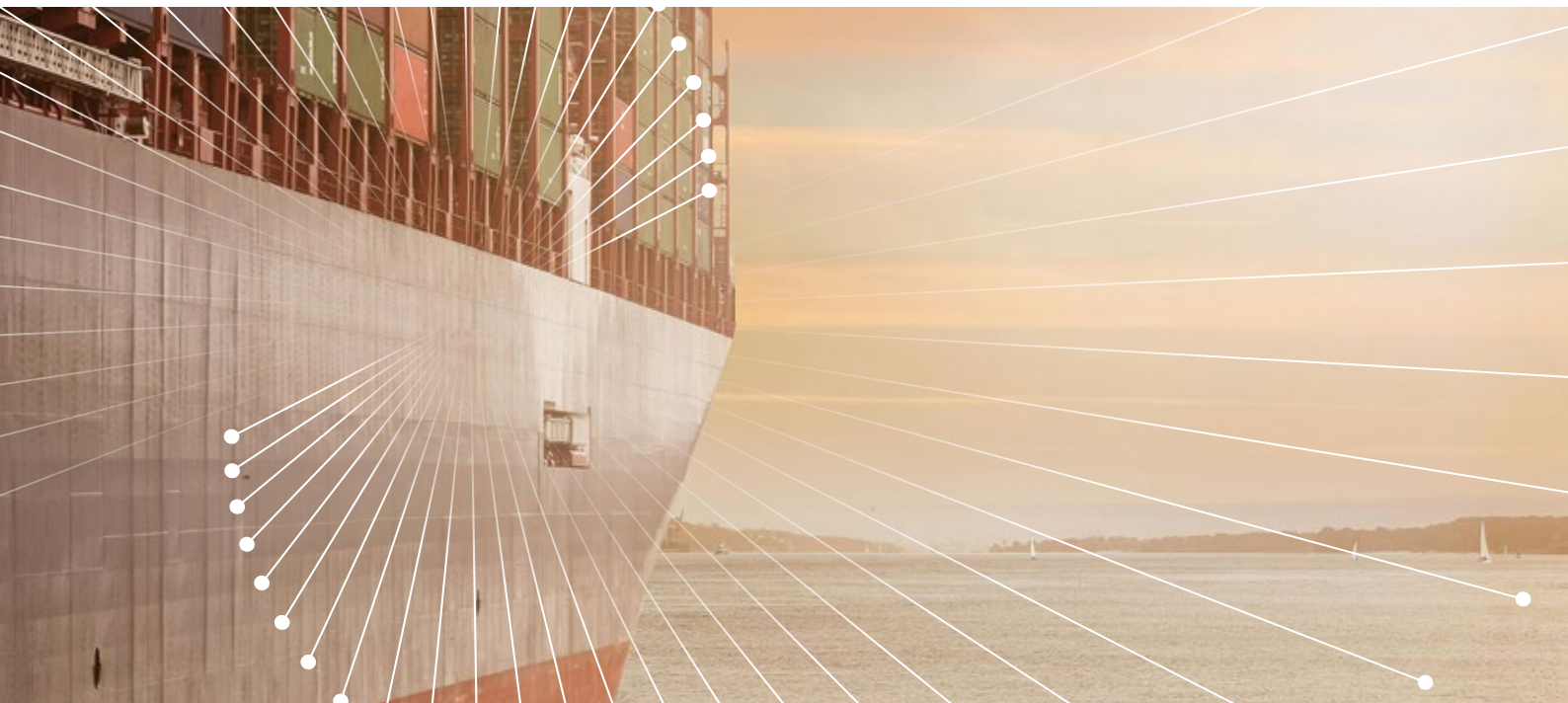
The transition towards zero GHG emissions relies on increasing energy efficiency, combined with a move to low carbon and, ultimately, zero and near-zero GHG emission fuels and energy sources. We recognise that maritime decarbonisation is complex and there is no “one size fits all” solution to cover the breadth of vessel types, sizes and operations. We have also taken a coherent view of the solutions required for both international and domestic maritime operations.

Many new vessels being designed and built now will still be operating in 2050. The very long asset lives of such vessels, combined with high individual unit costs (particularly for larger vessels), mean that some companies are already starting to make decisions about the right decarbonisation route for their businesses.

The chosen decarbonisation technology pathway will vary based on a vessel’s operations, where it operates, its design and build dates and when it will enter service. This creates variability and poses a risk of stranded assets if investments are made into technologies that are not widely adopted in the market. We believe that industry is best placed to decide its own decarbonisation route and our approach is to remain technology and fuel neutral, providing the right policy and regulatory framework to drive the transition whilst supporting innovation and investment. However, we are cognisant of the demand for alternative fuels across all transport modes and recognise that fuel supply and feedstocks availability will be a key consideration.

Additionally, it is critical that GHG emission reductions are not made at the expense of other environmental outcomes and that operators are aware of the full environmental impact of their fuel and technology choices. We recognise the challenge industry will face in this transition, particularly where there is limited evidence on the real-world operational impact of new technologies and fuels. We are committed to expanding our technical expertise on air pollutant emissions, primarily through development of our modelling capacity to include robust air pollutant emissions estimates.

The UK SHORE programme, our support for demonstrators, and the MCA’s new UK Maritime Innovation Hub will help address these challenges as well as informing our regulatory landscape, helping the MCA ensure it is fit for the future and supporting innovation and investments. Our aim is for the UK’s policy and regulations to provide a supportive framework for investment, be it in R&D, vessels or bringing operations and business to the UK, while minimising the wider environmental impacts of the sector.



CHAPTER 3

Maritime Emissions

This chapter explains the emissions context guiding, and work undertaken in developing this *Strategy*, including the following key points:

- The UK domestic maritime sector produced an estimated 8 million tonnes of carbon dioxide equivalent ($MtCO_2e$) in 2019 (well-to-wake emissions).
- The UK's share of international maritime emissions was an estimated 9 $MtCO_2e$ in 2019 (well-to-wake emissions).
- Meeting our domestic goals will require fundamental changes to the UK domestic maritime sector, necessitating strong policy action.
- There is significant uncertainty regarding the future fuel and energy mix, which reflects the diverse needs of the sector.

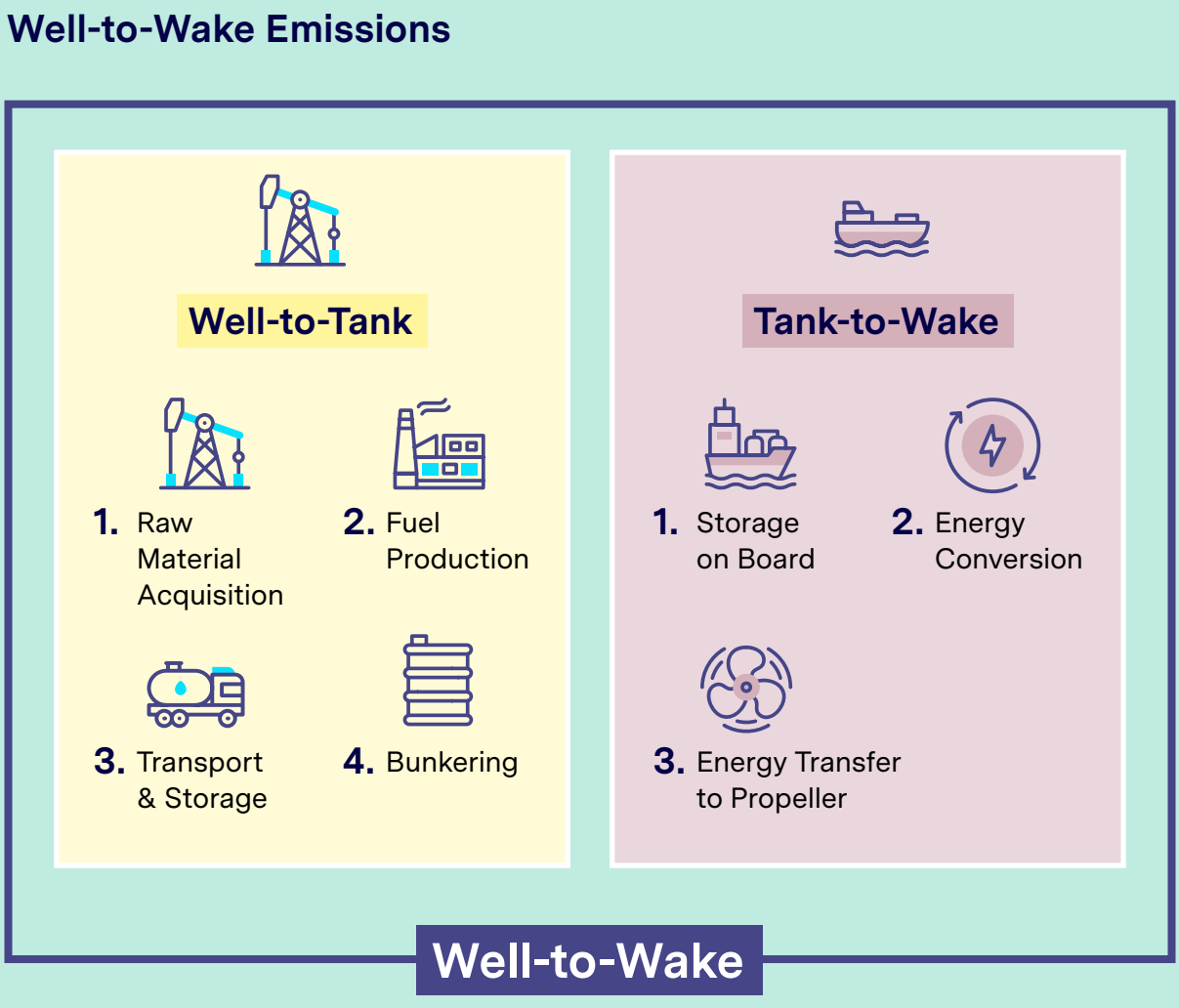
3.1 Definitions

Our UK domestic maritime emission reduction goals cover the lifecycle GHG emissions of the fuels and other energy sources, such as electricity, used by UK domestic maritime, also known as fuel lifecycle or well-to-wake (WtW) GHG emissions.

Meeting these goals will require deep cuts in both:

- GHG emissions from the production and distribution of the fuels and other energy sources, such as electricity, used by maritime vessels, also known as upstream or well-to-tank (WtT) GHG emissions; and
- GHG emissions from operating maritime vessels, also known as operational or tank-to-wake (TtW) GHG emissions.

Figure 1: The different emission sources and how they combine to make WtW emissions.



Box 2 below provides a summary of the GHG emissions that count towards our UK domestic maritime emissions. Further details can be found in the Analytical Annex. The UK's share of international maritime emissions is discussed further in Section 3.3.

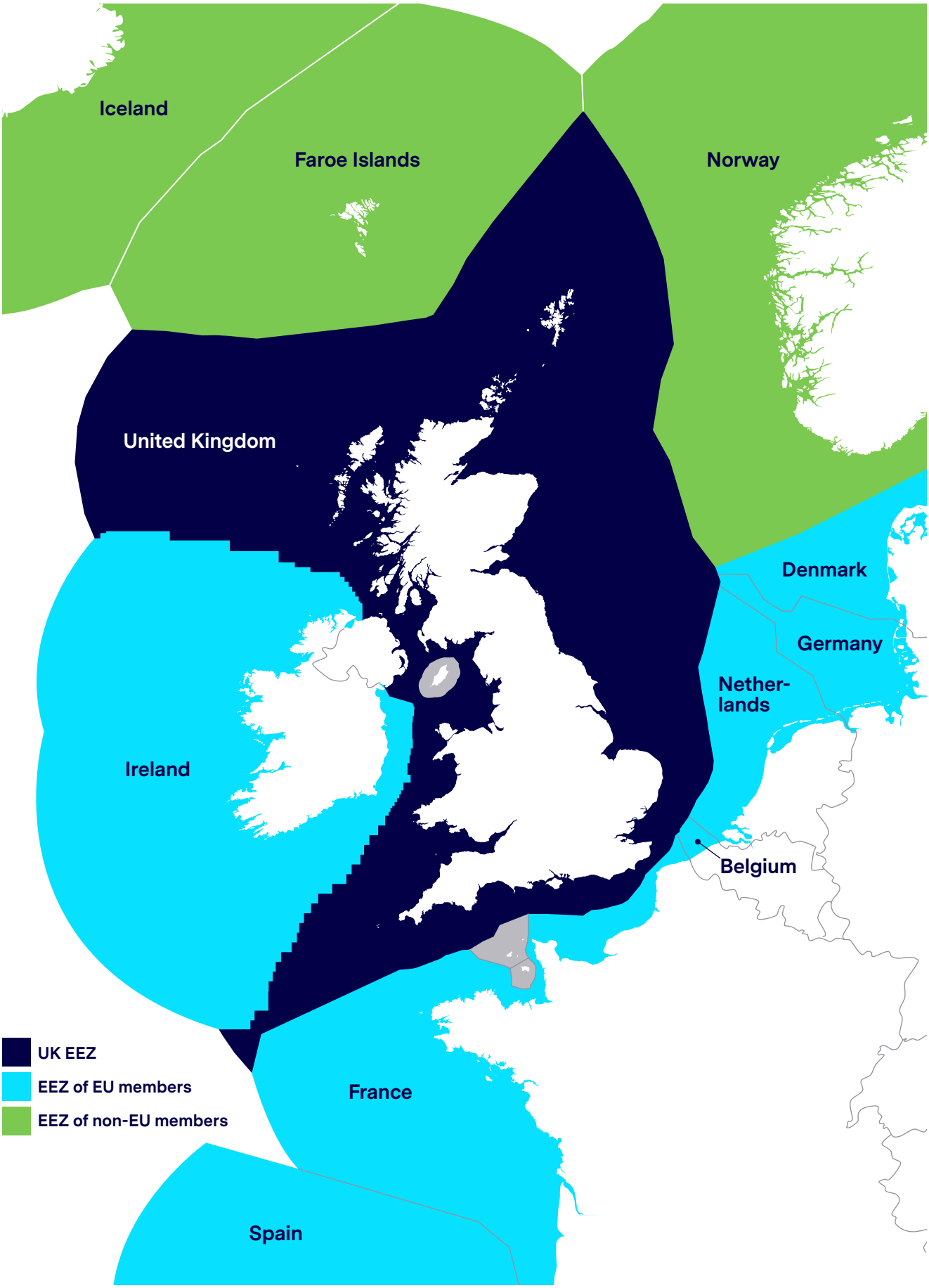
BOX 2 Which emissions are counted towards the GHG emissions from UK domestic maritime?

In this *Strategy*, the fuel lifecycle GHG emissions from UK domestic maritime are defined as:

- the fuel lifecycle GHG emissions from journeys between two UK ports or offshore installations in the UK's Exclusive Economic Zone (EEZ), shown in Figure 2, including when part of a longer international journey;
- the fuel lifecycle GHG emissions from journeys from one UK port or offshore installation in the UK's EEZ returning to the same port or installation; and
- the fuel lifecycle GHG emissions from vessels at berth in a UK port or at an installation in the UK's EEZ (including those from vessels performing international journeys), with a vessel being 'at berth' when it is securely moored or anchored in a UK port or at an installation in the UK's EEZ.

However, this excludes vessels making journeys within the waters of Crown Dependencies and Overseas Territories or within their ports.

Figure 2: The UK's Exclusive Economic Zone (EEZ), which shows the regional extent wherein maritime activities are counted within the UKs domestic maritime emissions.



BOX 3 Low Carbon Fuels and Zero and Near-Zero GHG Emission Fuels

Over the last two decades, low carbon fuels (LCFs), supported by policy measures such as the Renewable Transport Fuel Obligation (RTFO)[27], have been one of the main decarbonisation measures across the UK transport sector, and this terminology reflects uses across our domestic transport road, rail and aviation sectors. They include different liquid and gaseous fuels, such as biofuels or renewable fuel of non-biological origin (RFNBOs), which offer GHG savings relative to fossil fuels when considered over their whole lifecycle.

By contrast, as an inherently international sector, the terminology most familiar to the maritime sector is that used at the IMO. Emerging frameworks at the IMO frequently refer to 'zero or near-zero GHG emission technologies, fuels and/or energy sources', the exact definition of which is still subject to negotiation and international agreement.

Notably, while there have been some proposals on definitions, such as the proposal from the EU and Japan that zero and near-zero GHG emission fuels 'should be defined as fuels which emit less than [10] g CO2eq per MJ on a WtW basis and meet the sustainability attributes set by the LCA Guidelines', the IMO is yet to finalise its definition. The UK will continue to support the development of a definition at the IMO that meets the highest levels of both GHG reductions and sustainability.

For the purposes of this document, when using the term 'low carbon fuels', we are referring to fuels with lower lifecycle emissions than conventional marine fuels. For the term 'zero and near-zero GHG emission fuels and energy sources', we are referring to the current meaning as under development at the IMO, such as that proposed by the EU and Japan, given the international nature of the sector. We will review the use of these terms as firm definitions are developed, to ensure alignment with the UK's standards on sustainability.

The most commonly discussed future maritime fuels and their production routes are shown in Figure 7 (chapter 4).

3.2 Emissions modelling

The goals set out in this *Strategy* have been informed by our newly developed maritime emissions model, which uses big data to provide state-of-the-art analysis of maritime emissions over the period from 2019 to 2050.

The model draws on the best available evidence and analyses a vast amount of detailed ship tracking data, which captures most of the UK domestic maritime sector's GHG and air pollutant emissions. Some segments of the sector are not captured as they are not included in ship tracking data, including inland waterways. An overview of the inland waterways sector is set out in Box 4. We will fill these evidence gaps through direct engagement with stakeholders and commissioning of research and will aim to expand the model following the adoption of IMO mid-term GHG reduction measures in 2025.

BOX 4 Overview of the inland waterways sector

Inland waterway vessels represent a discrete group of craft that operate within the UK on our lakes and our 7,000 miles of rivers and canals. These vessels do not go to sea and are normally designed for specific purposes, such as narrowboats operating on canals. While we are currently unable to model emissions from these vessels due to the complexities of collecting the necessary data on them, we have included them in our goals as we believe there is a viable route to decarbonise the sector. These vessels are also eligible for support under the RTFO.

The Inland Waterways Association estimates that there are in the region of 80,000 powered vessels on the UK's inland waterways, the vast majority of which use hydrocarbon-based fuels. Compared to seagoing vessels, many of the UK's inland waterways fleet is made up of older vessels, with the relatively benign weather conditions allowing them to remain in service for extended periods.

The inland waterways sector is a complex mixture of smaller craft, including houseboats, hire boats, small cargo vessels, passenger craft, pleasure vessels, tugs and barges. Given this variety, it is likely that a range of technological decarbonisation solutions will be required.

Further details of the GHG emissions from the inland waterways sector can be found in the Analytical Annex.

3.3 Current emissions from the sector

It is estimated that the GHG emissions generated by domestic maritime in 2019 were around 8 $MtCO_2e$, on a Well-to-Wake basis, with around 7 $MtCO_2e$ accounted for by the vessels captured in the emissions model (which does not currently include inland waterways and leisure craft). On a Tank-to-Wake basis, the 2019 emissions from domestic maritime were 6.9 MtCO2e. This is equivalent to around **5.5% of total UK domestic transport emissions**, more than buses (3.0 $MtCO_2e$), rail (1.9 $MtCO_2e$), and domestic aviation (1.4 $MtCO_2e$) combined[28].

Figure 3: The domestic maritime sector's emissions compared to other modes of transport.

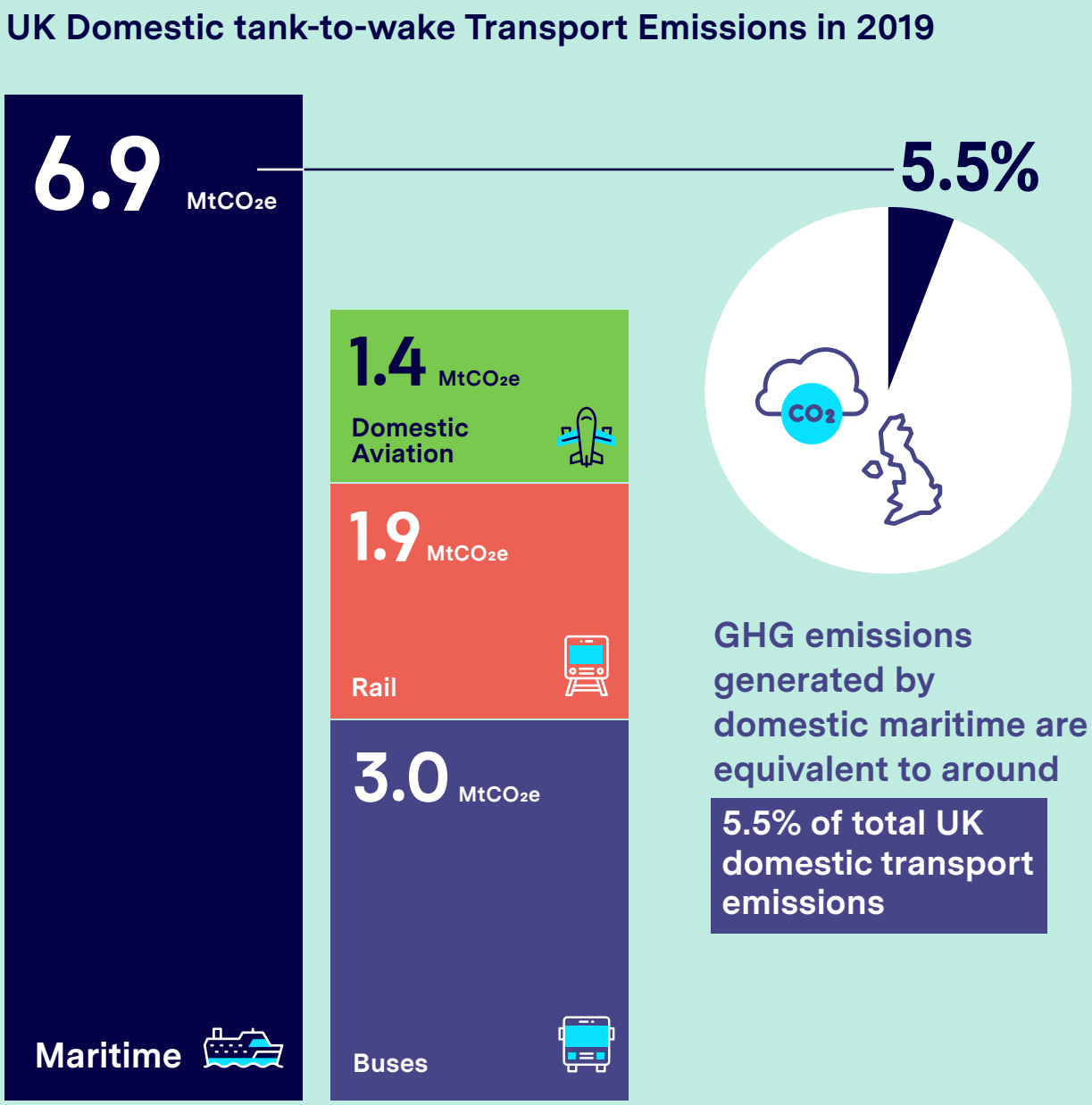


Figure 4 shows the estimated GHG emissions from UK domestic maritime in 2019, split by the type of vessel from which they were derived. It illustrates the diversity of activities performed within the UK domestic maritime sector, and shows that ferries, oil tankers and offshore vessels[29] were the three vessel types with the largest GHG emissions (together making up just under 50% of total UK domestic maritime GHG emissions on a WtW basis). GHG emissions from inland waterways and leisure craft are measured on a TtW basis due to a lack of data on their WtW emissions, but are still included in Figure 4 in green to illustrate their contribution to our domestic maritime GHG emissions.

Figure 4: Estimated GHG emissions from UK domestic maritime in 2019 by vessel type ($MtCO_2e$)

Note: Figure 4 shows the estimated GHG emissions produced by UK domestic maritime in 2019, split by vessel type. The amount of emissions produced by each subsector is indicated by the size of the box, with the estimate for each subsector provided in units of $MtCO_2e$. Shown in blue are the subsectors that are within scope of the maritime emissions model, measured on a WtW basis. Shown in green are the inland waterways and other subsectors which are currently outside of the scope of the maritime emissions model but still contribute towards UK domestic maritime GHG emissions. These are presented on a TtW basis, due to a lack of evidence on the WtW emissions from these subsectors. Further information on the treatment of the inland waterways subsector is provided in Box 3 above and in the Analytical Annex.

The approach we have taken to the treatment of the UK's share of international maritime GHG emissions in our analysis is in line with the recommendations of the Climate Change Committee's 2022 Progress Report[30]. This is defined as 50% of total emissions produced on voyages between the UK and other countries, which amounts to 9.38 $MtCO_2e$ on a WtW basis. Further information is set out in the Analytical Annex.

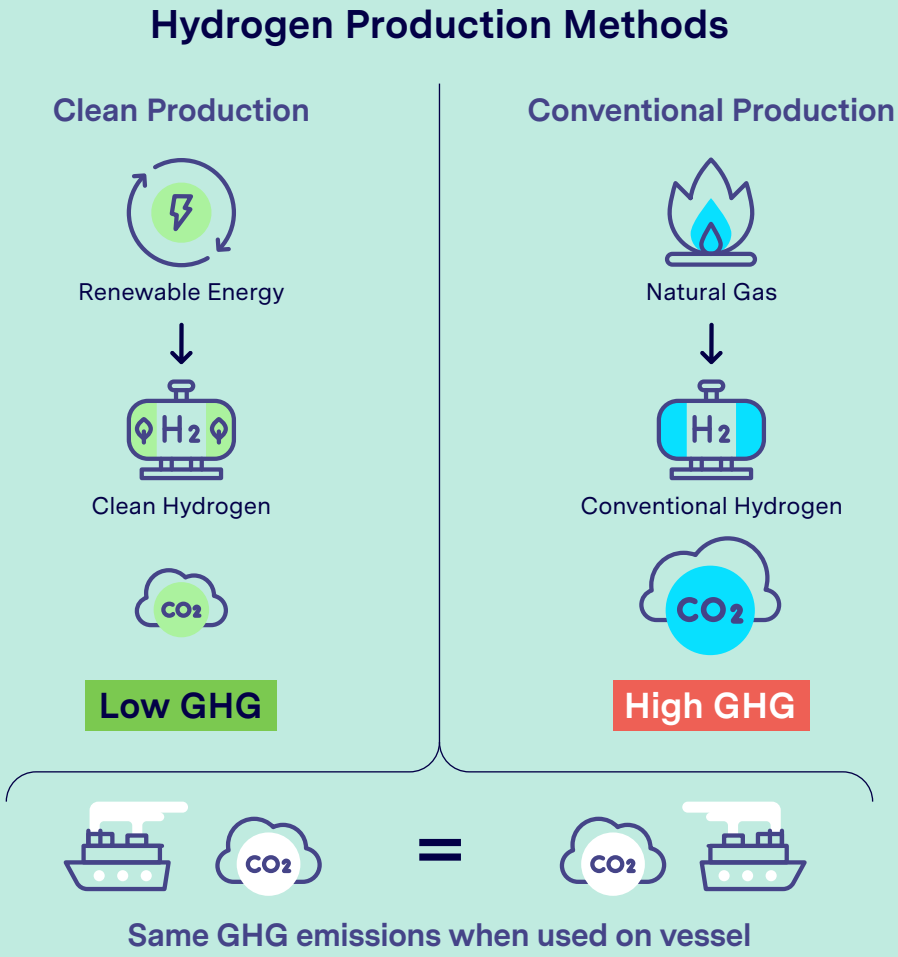
3.4 Setting our goals

We have set the ambitious goal of reducing the UK domestic maritime sector's fuel lifecycle GHG emissions to zero by 2050, with interim goals for at least a 30% reduction by 2030 and at least an 80% reduction by 2040, compared to 2008 levels. These goals align with the upper ambitions of the IMO, and will be met by the suite of policies set out in this *Strategy*.

Meeting our goal of zero fuel lifecycle GHG emissions by 2050 requires ending the contribution to climate change made by the fuels and energy sources consumed by UK domestic maritime from when they are produced to when they are used on board vessels[31]. As we intend to achieve these goals without recourse to out-of-sector offsets any residual GHG emissions will need to be balanced by GHG removals from the energy system of UK domestic maritime.

We are targeting fuel lifecycle GHG emissions to ensure that genuine emissions reductions are achieved, helping to mitigate any trade-offs by accounting for GHGs emitted during both fuel production and the point at which the fuel is used. Accounting for GHG emissions generated during the fuel production process itself, which can vary depending on the fuel production method, helps ensure optimal incentives and minimises the risk of transferring either GHG or air pollutant emissions to other parts of the UK economy or offshoring emissions. This approach reflects the UK's support for ambitious climate action and aligns with targets for international shipping set out in the IMO's 2023 GHG Strategy.

Figure 5: How TtW emission may have very different WtW emissions.



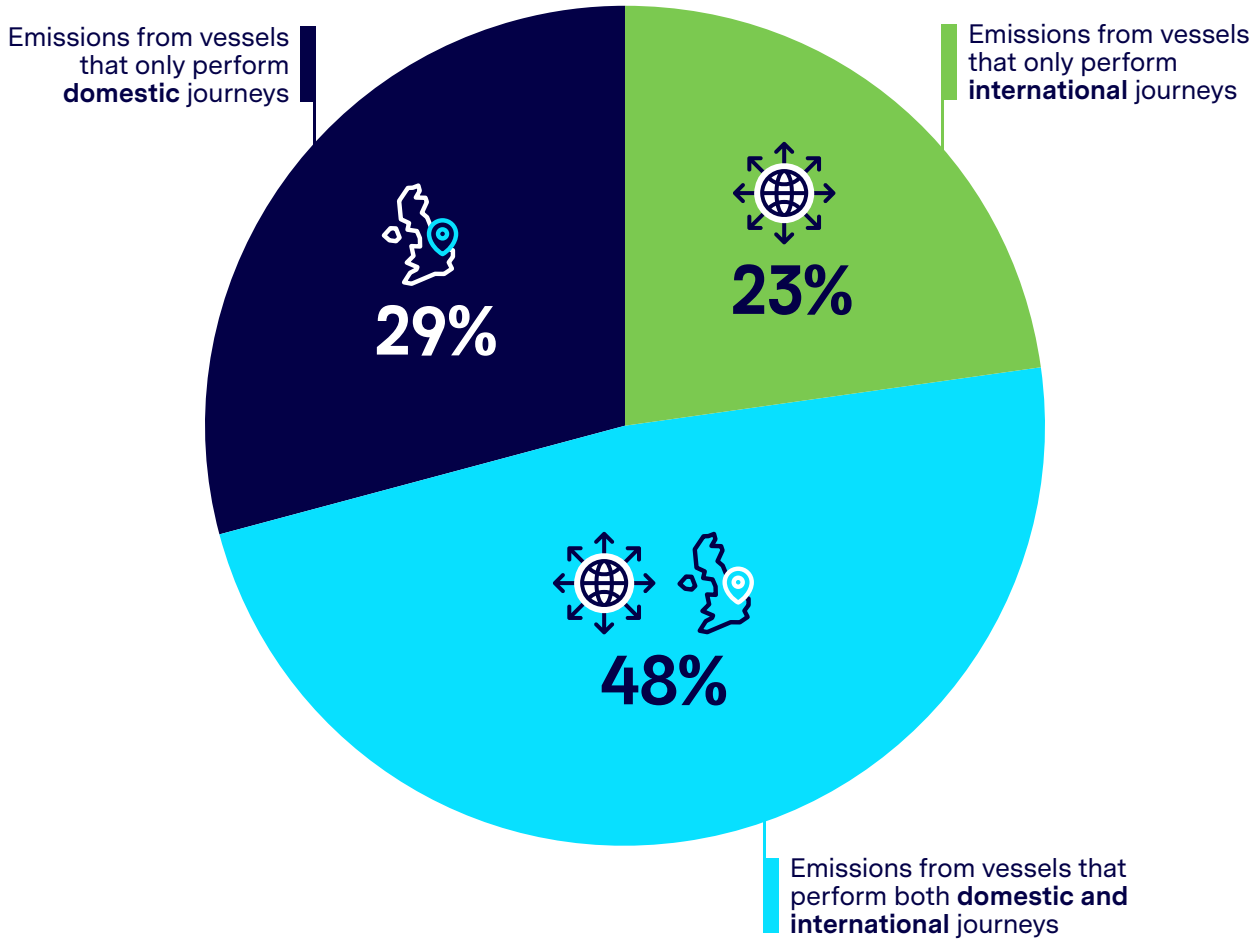
A key example of differences in the level of GHG emissions generated during the fuel production process is hydrogen and hydrogen-derived fuels (such as ammonia and methanol). These fuels can be produced in clean ways (such as from renewable electricity) that satisfy the UK Low Carbon Hydrogen Standard[32] or by using existing methods (such as from natural gas or methane), which generates significant GHG emissions. In either of these production processes, the same GHG emissions are generated at the point at which they are used on board a vessel. However, when the production route is considered, the amount of GHG emissions generated can differentiate them.

Whilst our primary focus is on fuel lifecycle emissions, operational, or TtW, emissions are still an important consideration, as they are broadly the basis on which the UK's legally-binding carbon budgets are accounted. Box 5 in the Analytical Annex presents our new analysis on a TtW basis and discusses how this compares to the analysis that fed into the Carbon Budget Delivery Plan (CBDP).

The maritime sector is inherently international. Vessels often operate across different jurisdictions, and are designed, built and operated globally. As such, many vessels perform a mix of domestic and international voyages each year, and there is a strong link between international and domestic maritime with policy measures affecting emissions from both remits.

International action will play an important role in decarbonising the domestic maritime sector. Figure 6 shows that, in 2019, almost three quarters of the total UK domestic maritime GHG emissions (excluding inland waterways) came from vessels that operated on international voyages at least some of the time.

Figure 6: Estimated WtW GHG emissions from UK domestic maritime in 2019, split by operating profile of vessels (excluding inland waterways)



Note: Figure 6 shows the proportion of 2019 UK domestic maritime GHG emissions split by the operating profile of the vessel, on a WtW (fuel lifecycle) basis. The operating profiles include vessels that only performed domestic journeys, as defined in Box 1, vessels that performed only international journeys, and vessels that performed a mix of domestic and international journeys. Each segment of the chart represents the proportion of total UK domestic maritime emissions in 2019 that were produced by each operating profile. This figure does not include emissions produced by vessels on inland waterways.

Key international policies, such as fuel standards and emissions pricing mechanisms announced or in development by the EU and the IMO, have been included in our decarbonisation scenarios. For details of the assumptions under our upper and lower bound emissions scenarios, refer to the Analytical Annex. We will continue to review how interactions between domestic measures and international regulation implemented by the IMO impact our modelling and our domestic maritime GHG emissions.

CHAPTER 4

Key Policy Measures

This chapter details our five key policy measures:

- fuel regulation
- emissions pricing
- decarbonisation at ports and while at berth
- measures for smaller vessels and accelerating uptake in targeted subsectors
- energy efficiency

The pathway to decarbonisation will not be linear, and there are many interdependencies between the policy interventions set out in the rest of this chapter.

4.1 Regulating the GHG intensity of maritime fuels and energy sources

A transition away from conventional fuels to low carbon and, ultimately, zero or near-zero GHG emission fuels and energy sources is critical for the decarbonisation of the maritime sector (see Box 3 for definitions).

Accelerating the uptake of these fuels for maritime operators can both drive faster decarbonisation of the sector and act as an early, large-scale offtaker of these fuels, providing the certainty of demand that can catalyse production, both of which support making the UK a clean energy superpower.

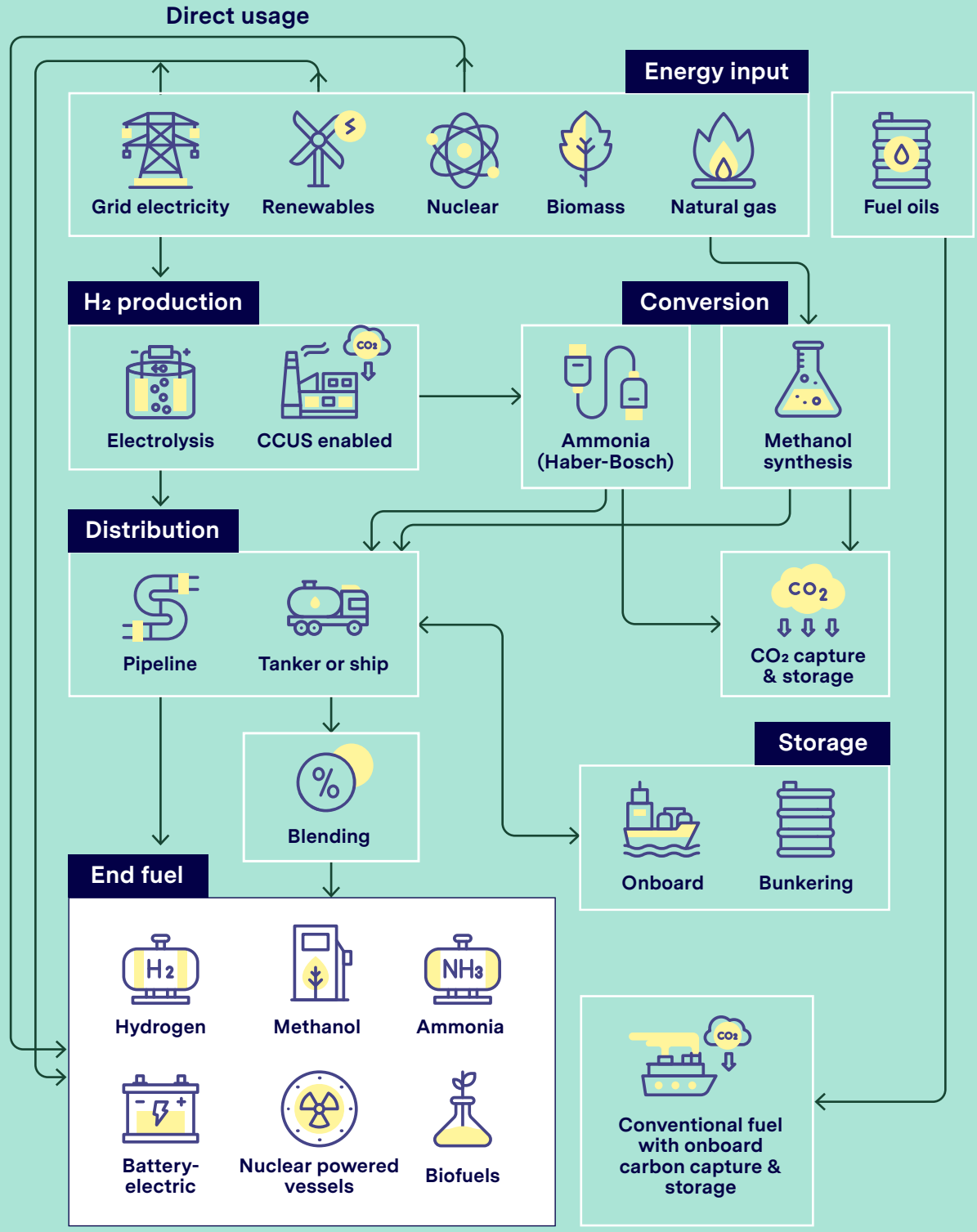
We know this transition is not simple given the range of candidate fuels and energy sources that have the potential to play a role in the future, including hydrogen, methanol, ammonia, biofuels and electricity – see Figure 7 on page 39.

Commitment

Subject to consultation from 2025, we will introduce domestic fuel regulations to drive the uptake of zero and near-zero GHG emission fuels and energy sources, following global fuel regulations to be implemented from 2027 and supported by increased modelling capability. We will continue to develop our technical capacity to analyse the impacts of an IMO fuel standard on both UK domestic and UK international maritime GHG emissions, including through the development of our modelling capability.

Figure 7:

Production routes for future maritime fuels/energy sources



However, the use of these fuels is growing, supported by demonstrations through the UK SHORE programme, such as the hydrogen project described in Box 5.

BOX 5 Case Study of Hydrogen-Based Propulsion: TransShip II

The TransShip II project, led by O.S. Energy, aims to retrofit the 35-metre offshore research and survey vessel, Research Vessel (RV) Prince Madog, with a hydrogen-based propulsion system.

For a one-month demonstration period, the project plans to:

1. Install hydrogen storage and a hydrogen fuel cell and battery system on-board, integrated with the existing drive train, to provide slow speed and silent operation up to 6 knots from zero GHG emission fuel.
2. Install an innovative, nature-inspired propellor and duct design on the vessel, aiming to significantly reduce the energy requirements of the vessel.
3. Conduct regular refuelling of the RV Prince Madog using hydrogen infrastructure at the Port of Holyhead.

It aims to demonstrate a) zero emission operations, spanning vessel and technology integration, b) vessel operation (performing scheduled marine science work and student teaching trips in cooperation with Bangor University post project completion), and c) regulatory approval with the DNV and shoreside bunkering infrastructure.

The TransShip II project received £4.2 million from CMDC Round 3 as part of UK SHORE.[33]

(Information provided by the project as part of their UK SHORE bid.)

It is important that we better understand the environmental impacts of different fuels and factor this into the future regulatory framework. We will seek to maximise co-benefits such as tackling air pollution, while minimising and mitigating any potential knock-on disbenefits.

Currently, biofuels represent one of the most technologically mature and commercially available options for maritime decarbonisation. However, we will look to ensure that alternative, complementary technologies and fuels are able to scale up to avoid overdependency on biofuels. This is particularly important when considering their wider environmental impacts, such as air pollution, and that the availability of biofuels is likely to be significantly constrained due to strong competition from other modes and sectors.

Fuel regulation at the International Maritime Organization

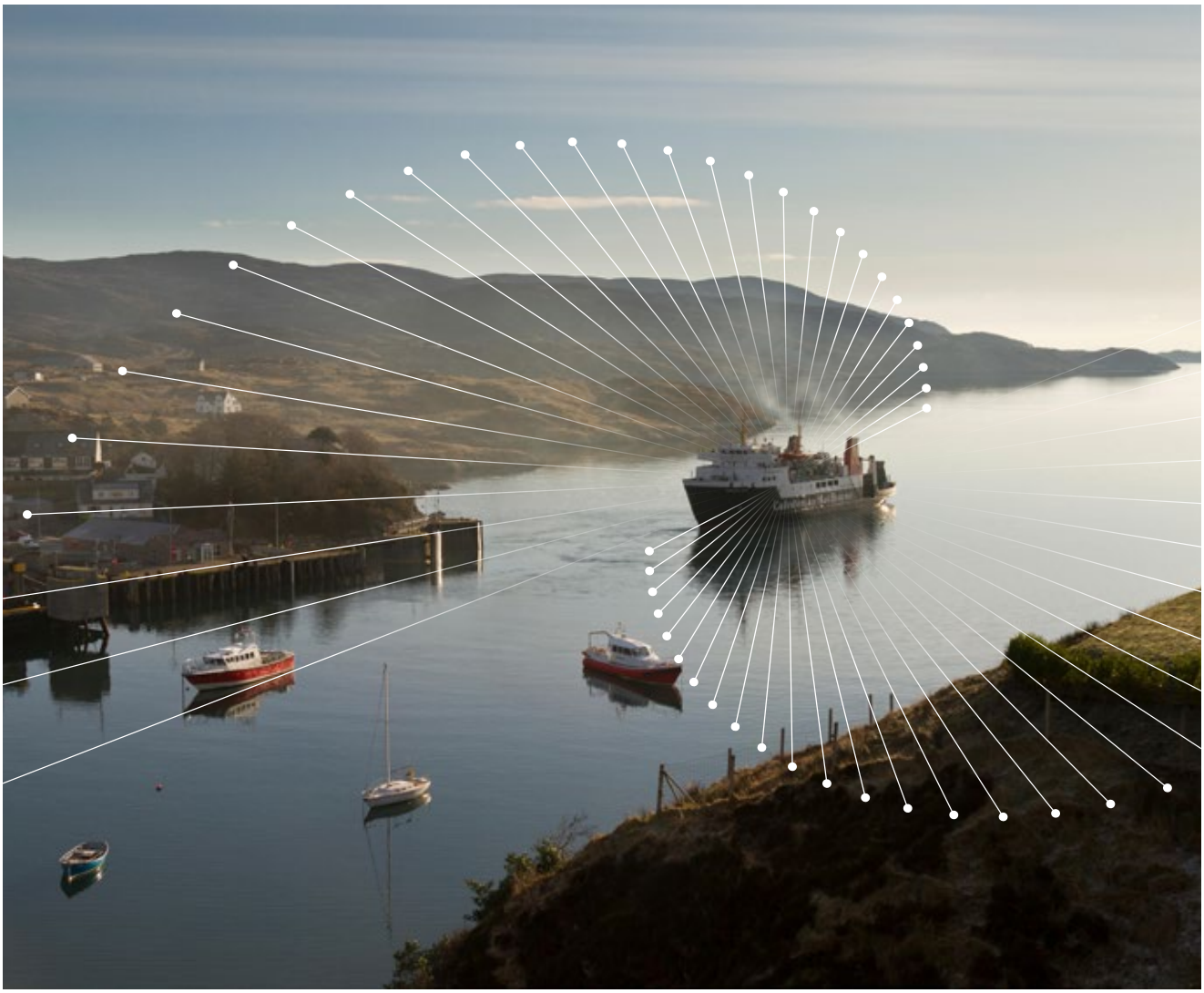
The IMO is currently exploring options for a global fuel standard as part of its ‘mid-term measures’. The UK is pushing for agreement on an ambitious fuel standard, which is expected at the Marine Environment Committee (MEPC) meetings in 2025, with the regulations to come into force from 2027. This is essential to meeting the goals agreed in the 2023 IMO GHG Strategy, and a strong example of the UK’s high ambition role in climate leadership.

At present, multiple options remain under consideration at the IMO on how the fuel standard should be designed.

Remaining decisions include how to account for TtW versus WtW emissions; whether and how to include financial or reward factors to help accelerate the scale-up of zero and near-zero GHG emissions fuels; whether and how to build a system of compliance units as part of a flexibility mechanism; and how to enforce the fuels standard through monitoring and verification.

The UK is advocating for a fully WtW fuel standard that includes 'flexible' compliance, as we consider it is the most cost-effective option, allowing for a smoother transition for the world fleet. However, 'flexibility' does not mean that compliance is optional or that the standard is less ambitious, instead it enables greener ships that over-comply to redeem or sell their compliance units and under-compliant ships to acquire these units from greener ships or from the IMO.

The UK supports rigorous WtW GHG accounting and strong sustainability criteria, underpinned by the IMO framework on lifecycle assessment (LCA) of maritime fuel emissions[34]. The specific design and targets within the fuel standard must also reflect constraints on the availability of low carbon fuels and feedstocks and avoid driving unsustainable feedstock consumption.



Regulating fuels domestically

Given the international nature of shipping, we expect that global regulations will help reduce GHG emissions in the UK. However, this will not be enough to meet our domestic GHG emission reduction goals.

From 2026 we will formally consult on a range of options to regulate domestic maritime fuel use to increase the demand for low carbon, and ultimately, zero and near-zero GHG emission fuels from operators, and to explore other measures, for example regulations that incentivise action by fuel suppliers. The IMO global fuel standard will provide a solid blueprint for this work, and we will consider how to ensure that these different regulatory regimes are as cohesive as possible, reducing the burden on operators of a regulatory patchwork and allowing for alignment where possible.

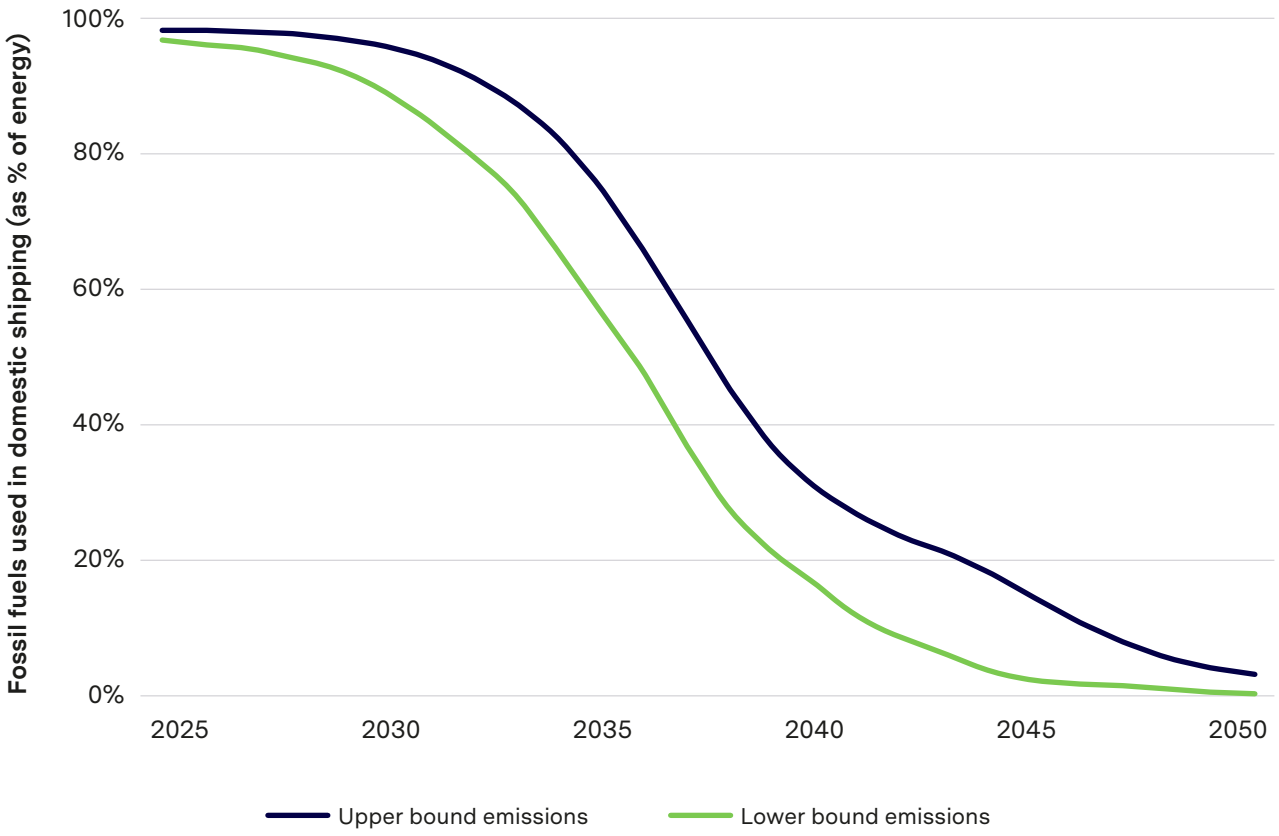
Noting that any future UK domestic fuel regulation will be subject to future consultation, there are a number of initial considerations, including a recognition that maritime is not the only sector looking to use low carbon, or zero and near-zero GHG emission fuels, or the feedstocks from which they are derived. Given limited availability and competing demand, the UK will need to consider maritime demand as part of a holistic cross-economy picture of low carbon fuel use in both the domestic and international contexts. The implementation of robust sustainability criteria, in line with similar domestic and international policies for other modes and sectors, and internationally agreed standards, will also be essential. This will include the emerging work at the IMO on the implementation of LCA Guidelines[35] and the Biomass Strategy[36] commitment to consult on developing a cross-sector sustainability framework. However this is achieved, the government is clear that any UK regulation must deliver uptake of fuels with the highest credentials for sustainability and must set the sector on a pathway that delivers long-term decarbonisation.

We also need to consider how a UK domestic fuel regulation would interact with other policies, in the first instance with the IMO fuel standard, but also wider policies such as the RTFO (which already covers inland waterways vessels), the Sustainable Aviation Fuel (SAF) Mandate[37] (which will incentivise the use of low carbon fuels in aviation) or with existing regulation in broader sectors of the UK and international economies. It is a complex picture, and working through these interactions carefully will be essential to the successful implementation of any measures. Furthermore, where there is overlap with existing regulation, we intend to remain as consistent as possible in the design of those regulations. In the first instance, this means ensuring that any measure is aligned with domestic and international maritime policies, for example the requirements for monitoring and reporting emissions under the UK ETS. Broader environmental impacts will also need to be considered and minimised, wherever possible, in the development of future fuel regulation.

Evidence

Regardless of which fuel or energy source is used, it is clear that the use of traditional fossil fuels will need to decline rapidly, as shown in Figure 8, which shows the amount of conventional fossil fuel used by UK domestic maritime over time in our decarbonisation scenarios.

Figure 8: Estimated percentage of conventional fossil fuels in use by UK domestic maritime vessels (excludes inland waterways) in our core range of illustrative decarbonisation scenarios.



Note: Figure 8 shows the estimated use of conventional fossil fuels by UK domestic maritime vessels between 2025 and 2050 within the core range of our illustrative decarbonisation scenarios, under the Balanced Mix fuel mix scenario. This is presented as the proportion of the total energy used by domestic maritime vessels that is supplied by conventional fossil fuels in a given year. Information on the fuels included and the assumptions underpinning the fuel mix scenarios is set out in the Analytical Annex. The upper and lower (referring to GHG emissions) bound emission scenarios vary the stringency, start date and threshold changes of each of the policies, for more information, refer to the Analytical Annex.. This graph does not include emissions from vessels on inland waterways.

We know there are barriers to the uptake of low carbon and zero and near-zero GHG emission fuels and energy sources. These include the availability of fuels, knowing which fuels will be appropriate for each maritime subsector and the co-ordination needed across the sector to deliver investment in these fuels and energy sources.

The existing evidence, both from industry-led policy analysis and through our maritime emissions model, indicates that regulation placed on vessel operators would drive significant uptake of zero and near-zero GHG emission fuels, underpinning the mission to make Britain a clean energy superpower. This is the approach we have seen developed internationally, for example the global fuel standard being developed as part of the

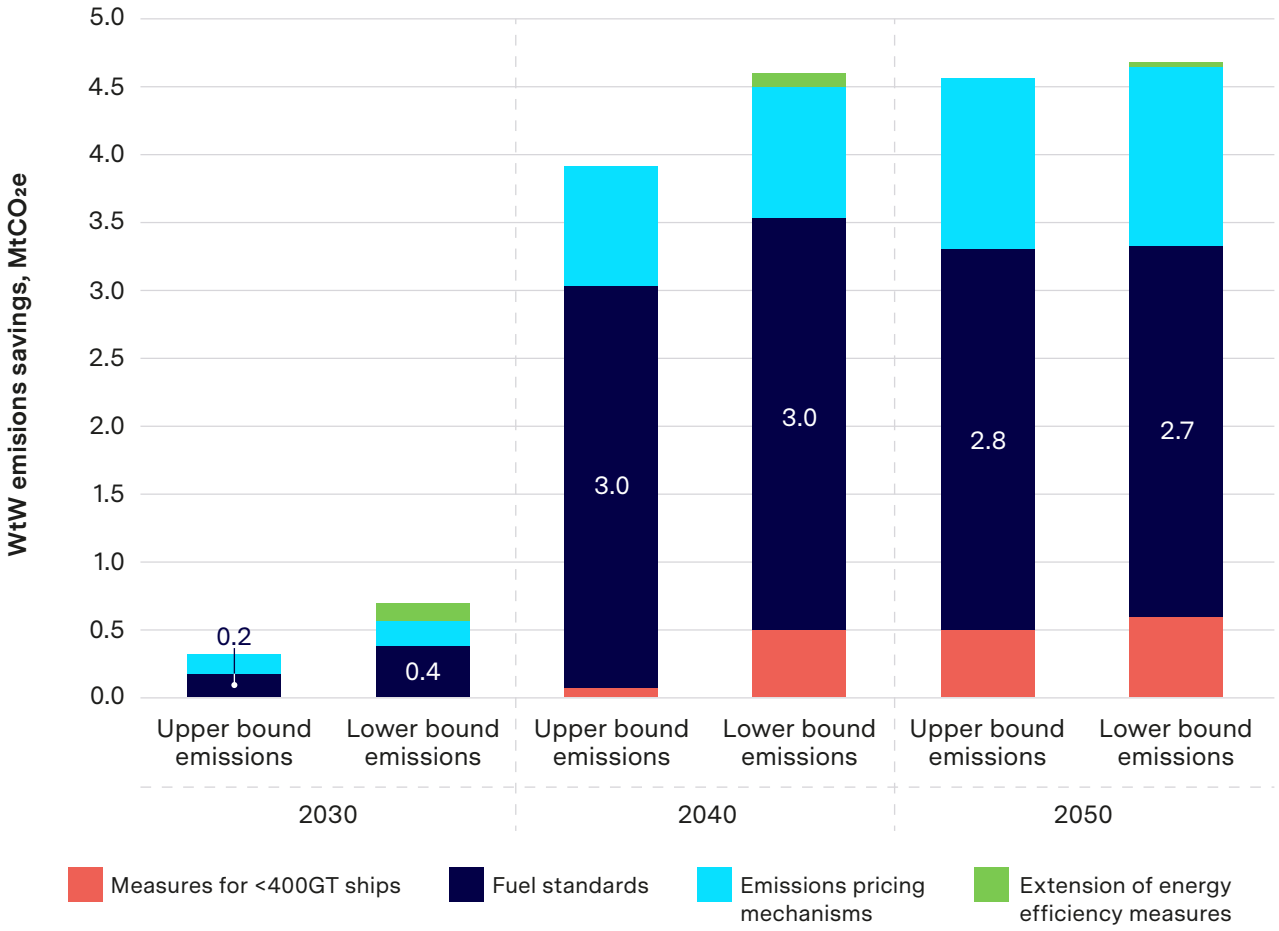
'mid-term measures' at the IMO. Measures to increase the supply of these zero and near-zero GHG emission fuels will require further evidence and analysis.

We have modelled the impact of a package of proposed fuel regulations estimating the emissions savings that could be achieved by 2030, 2040 and 2050. This package of measures includes a UK regulation placed on the fuels and energy sources used by vessel operators[i], the EU's FuelEU Maritime[38] regulation and an IMO fuel standard (see below).

This analysis, set out in Figure 9, shows the range of GHG emission savings that can be delivered from fuel regulation in our decarbonisation scenarios. It shows that the combined impact of UK and international fuel regulation measures reduces the WtW GHG emissions from UK domestic maritime by around 0.2–0.4 MtCO2e in 2030, by around 3 MtCO2e in 2040, and by around 2.7–2.8 MtCO2e in 2050.

i This is modelled as a UK fuel standard, which could involve regulation on vessel operators to reduce the GHG emissions per unit, i.e. the GHG intensity, of the fuel used by the domestic maritime sector.

Figure 9: Estimated contribution of fuel regulations to the total modelled WtW emissions savings in 2030, 2040 and 2050, under our range of illustrative decarbonisation scenarios (excludes inland waterways).



Note: Figure 9 shows the estimated contribution of a package of fuel regulation measures to UK domestic maritime GHG emission reductions in 2030, 2040 and 2050. The package of measures includes a UK fuel regulation, FuelEU and a potential IMO fuel standard. The upper and lower bound emission scenarios vary the stringency, start date and threshold changes of each of the policies. This graph does not include emissions from inland waterways. The allocation of emissions reductions to policies is dependent on the order in which policies are implemented in the model, due to the overlapping impacts of policies. This analysis allocates emissions reductions to policies in the following order: extension of energy efficiency measures, emissions pricing mechanisms, fuel standards, measures for <400 GT ships.


P&O

4.2 Putting a price on emissions

Currently, the price of maritime fuels does not reflect the costs of the associated GHG emissions and environmental impacts. Without action, there are few incentives for industry to invest in cleaner technology and reduce GHG emissions.

Emissions pricing can act as a significant driver of emission reductions. This includes pricing emissions both domestically, through the expansion of the UK ETS, and internationally through both the EU ETS and an IMO GHG pricing mechanism, such as a global levy.

Commitment

We will introduce domestic GHG emissions pricing through the UK ETS from 2026, alongside continued work to push for emissions pricing globally, to be introduced from 2027, underpinned by improved modelling capability.

Expanding the UK ETS to maritime from 2026

In July 2023, the UK ETS Authority (consisting of the UK government, Scottish Government, Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland) confirmed the expansion of the UK ETS to domestic maritime from 2026[39].

BOX 7 UK Emissions Trading Scheme

The UK ETS was launched in January 2021 and replaced the UK's participation in the EU ETS. The scheme works on the 'cap and trade' principle, where a cap is set on the total amount of GHGs that can be emitted by sectors covered by the scheme. This limits the total amount of GHGs that can be emitted and, as it decreases over time, will make a significant contribution to how we meet our legally binding net zero by 2050 target.

Within this cap, participants may receive free allowances and/or buy emission allowances at auction or on the secondary market, which they can trade with other participants as needed. Each year, operators covered by the scheme must surrender allowances to cover their reportable emissions. The cap is reduced over time, so that total emissions must fall.

The UK ETS currently covers UK domestic flights, flights between the UK and Gibraltar, flights departing the UK to EEA states and Switzerland, installations within the power sector and energy intensive industries. The maritime sector will join from 2026 and energy from waste and waste incineration from 2028 (preceded by a two-year Monitoring, Reporting and Verification (MRV) only period from 2026).

The UK ETS Authority's 'minded to' position is that the UK ETS will apply to vessels over 5,000 gross tonnes (GT) making domestic journeys and at berth in UK ports. This will require maritime participants to monitor their emissions from eligible journeys, report their emissions for these journeys and surrender sufficient allowances to cover their emissions. UK Monitoring, Reporting and Verification (MRV) regulations already apply to vessels over 5,000 GT that are transporting cargo and/or passengers, and that are operating to, from, between and within UK ports. The UK ETS implementation will benefit from the existing experience of much of the sector in undertaking MRV under the UK MRV regulations. We will, alongside the UK ETS Authority, consider the feedback gathered by respondents to the second, technical, consultation on the expansion of the UK ETS to cover UK domestic maritime, which closed in January 2025.

Emissions pricing at the International Maritime Organization

To ensure effective global action on maritime emissions, emissions pricing is needed across the sector. At the IMO, the UK has joined a number of States pushing for a levy on all GHG emissions from international shipping. When combined with a complementary WtW fuel standard, we believe this package of measures will give us the best chance of delivering the highest ambition goals of the 2023 IMO GHG Strategy.

A levy will also promote a just and equitable transition, energy efficiency gains and green growth, whilst providing the necessary incentives and revenues to rapidly accelerate the uptake of zero and near-zero GHG emission fuels and technologies globally.

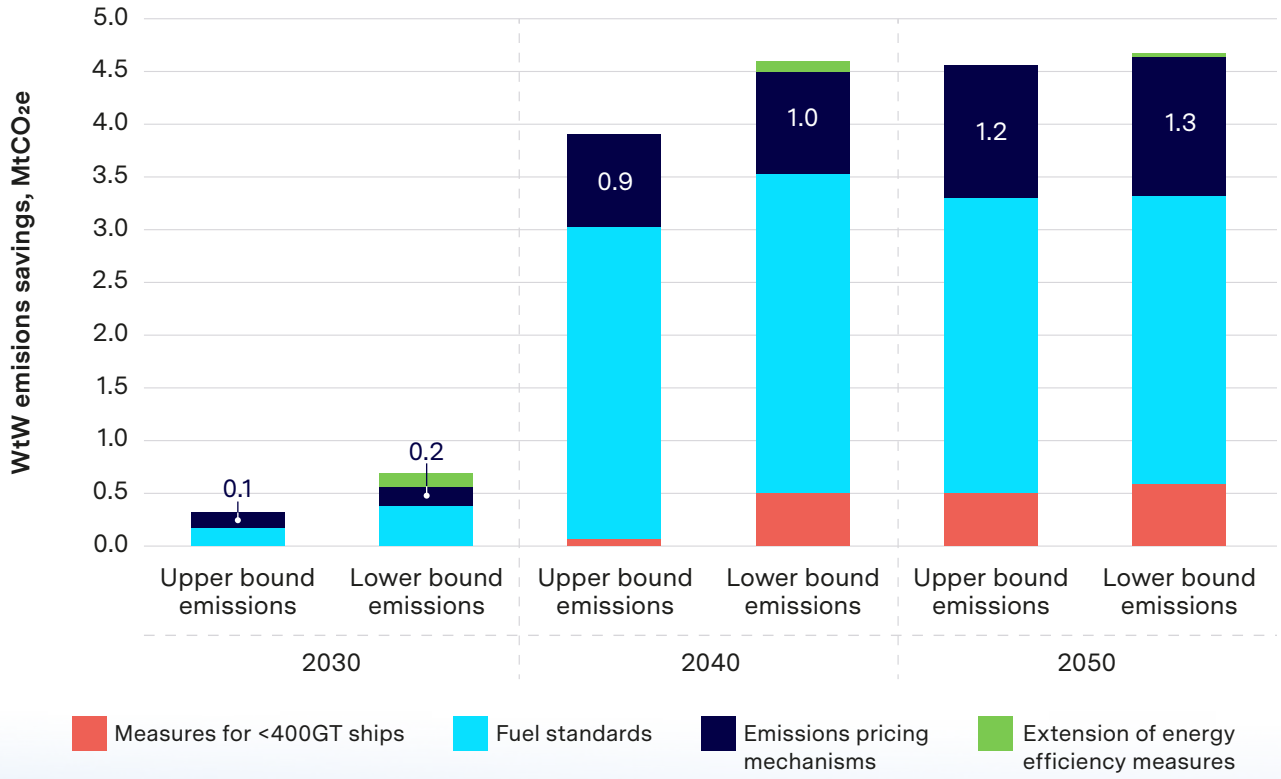
This package of measures can, and should, be agreed in 2025 and come into effect from 2027. Not only is regulatory certainty critical for industry to derisk and unlock investment, putting the measures in place as soon as possible gives the sector the highest probability of meeting our international climate commitments.

As with our work on fuel regulation, we recognise that the primary route to addressing international emissions remains multilateral action taken at the IMO and will take any necessary steps to avoid double counting or double charging of emissions across multiple schemes or adverse impacts on UK operators.

Evidence

Under our modelled scenarios, it is estimated that the combination of UK ETS, EU ETS and an anticipated IMO pricing mechanism could incentivise reductions in the fuel lifecycle GHG emissions from UK domestic maritime by around 0.1-0.2 MtCO2e in 2030, by around 0.9-1.0 MtCO2e in 2040 and around 1.2-1.3 MtCO2e in 2050. This is demonstrated in Figure 10, which shows the range of GHG savings from emissions pricing policies relative to other policy measures in 2030, 2040 and 2050.

Figure 10: Estimated contribution of emissions pricing measures to the total modelled WtW GHG emissions savings from UK domestic maritime vessels in 2030, 2040 and 2050, under our range of illustrative decarbonisation scenarios (excludes inland waterways).



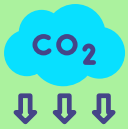
Note: Figure 10 shows the estimated contribution of a package of emissions pricing measures to UK domestic maritime GHG emission reductions in 2030, 2040 and 2050. The package of measures includes the expansion of the UK ETS to maritime, EU ETS expansion to maritime and a potential IMO GHG pricing mechanism. The upper and lower bound emission scenarios vary the stringency, start date and threshold changes of each of the policies. This graph does not include emissions from inland waterways. The allocation of emissions reductions to policies is dependent on the order in which policies are implemented in the model, due to the overlapping impacts of policies. This analysis allocates emissions reductions to policies in the following order: extension of energy efficiency measures, emissions pricing mechanisms, fuel standards, measures for <400 GT ships.

4.3 Port decarbonisation and emissions at berth

In line with the UK's net zero by 2050 target, many ports have already set and published their own decarbonisation goals and interim trajectories. The Government welcomes the proactivity of ports in planning how they will decarbonise their operations and we encourage ports to begin planning for decarbonisation if they have not already done so. Beyond the direct emissions from port operations, almost half our domestic maritime GHG emissions (excluding inland waterways) come from vessels at berth, and it is vital that these emissions sources are targeted, in line with our ambitious goals.

Climate change and more extreme and frequent weather events also pose risks to port infrastructure, such as refuelling facilities. New and existing infrastructure should be resilient to current and future climate impacts. These risks should be identified by infrastructure operators conducting climate risk assessments of port assets and operations, with action taken to mitigate any impacts identified.

Commitment



We will take action to reduce emissions at berth and support future energy demand of ports, informed by our call for evidence and subject to formal consultation from 2026.

Considering a zero, or near zero, GHG emission at berth requirement

Alongside this *Strategy*, we have launched a call for evidence on Net Zero Ports. Using the information gathered, alongside the development of our modelling capability and ongoing stakeholder engagement, we will consider introducing a requirement for zero or near-zero GHG emissions from vessels at berth. Subject to formal consultation, this could come into effect in the late 2020s or 2030s, dependent on the legislative powers available.

As far as possible, such a requirement would remain technology neutral, allowing ports and operators to make the most effective technological choices for at berth GHG emission reduction, based on the operational needs of their customers, rather than requiring any one specific technology. This might be through the deployment of shore power or electric charging infrastructure, technology we have previously supported through UK SHORE (see Box 7), or through the provision and use of low carbon and, ultimately, zero and near-zero GHG emission fuels whilst at berth. We will also remain mindful of existing policies, such as those agreed internationally, to avoid creating a regulatory patchwork of requirements.

BOX 7 Case Study: Port of Aberdeen: Shore Power in Operation

A project led by the Port of Aberdeen comprises the installation and demonstration of a shore power system in the Port of Aberdeen's North Harbour. Implementing shore power at the proposed berths aims to save 62,000 tonnes of CO2e over the scheme lifetime (20 years). This would equate to an 82% reduction in carbon emissions compared to the counterfactual of burning marine fuel whilst at berth and equivalent to 8% of total harbour emissions[40].

The project aims to prove the technical and economic viability of shore power and support Aberdeen's journey to becoming a Net Zero Green Port, through a three-year demonstration. The project's technical and commercial assessments could form the basis from which the roll out of shore power can be achieved at the Port of Aberdeen and across other UK ports.

This project is one of many being supported through the UK SHORE programme and was awarded over £3 million in government R&D funding through the ZEVI competition[41]. The project follows the previously completed feasibility study by the Port of Aberdeen in the CMDC1[42], showing the successful acceleration of projects along the Technology Readiness Level (TRL) pipeline. The projected build completion date is March 2025, and the project will self-fund an operational trial until March 2028.

(Information provided by the project as part of their UK SHORE bid)

As we explore a potential requirement for zero or near-zero GHG emissions at berth, we need to consider the wider environmental impact of different technology and fuel pathways. This includes the impact on air and water quality, on local noise levels in ports and on biodiversity. The contribution of these pollutants from vessels at berth and the role of the maritime sector will need to be recognised in respect of meeting our legal obligations on air quality, alongside any impacts on those who work in and live near ports. We will, therefore, consider how any port emissions requirement can maximise the co-benefits from tackling pollutant emissions alongside GHGs.

Future port energy demands

As ports, their tenants and vessels decarbonise, energy demand is likely to change and increase. It is, ultimately, the responsibility of ports to strategically forecast and plan for their future electricity requirements, including those that will help them and their tenants and customers to decarbonise. The Government welcomes instances where individual ports have already strategically planned their future electricity demand such as the work of the British Ports Association and UK Major Ports Group to gather further information on future electricity needs at ports[43]. We expect the shipping industry to work closely with ports on their current and future energy requirements, and as part of the Net Zero Ports Call for Evidence, we are exploring how government could further support this activity.

However, we know ports face barriers to decarbonisation. Like other sectors of the economy, many are facing long connection timeframes to secure additional electricity capacity from their Distribution Network Operator(s) (DNOs). Great Britain's electricity network is owned and operated by private companies that, as regional monopolies, are regulated by Ofgem, the independent energy regulator. Network operators are required to provide connection agreements to all customers as set out in their licence conditions, ensuring that all parties are treated equally as part of the connection process and no technology or sector is prioritised to the detriment of another party. However, this first-come, first-served process has resulted in a lengthy connection queue, causing unviable connection timescales for many projects. Government is working at pace with Ofgem and the network companies to accelerate network build and to reform the connections process.

In recognition that energy infrastructure is another barrier, government has established a new body, the Clean Power 2030 Unit, and published the Clean Power 2030: Action Plan[44], to accelerate the delivery of critical, clean energy infrastructure. With a mandate to lead bold action in collaboration with industry, Ofgem, the National Energy System Operator (NESO) and other delivery bodies to remove obstacles and resolve issues as they arise, it will speed up the connection of new power infrastructure to the grid and accelerate Britain's pathway towards greater energy independence.

Strategic planning of energy networks will also play an important role. Recently brought into public ownership, NESO will be responsible for strategically planning electricity, natural gas and hydrogen systems. Following the Ofgem consultation that closed in October 2024, NESO will lead the Regional Energy Strategic Plan, which will coordinate development of the energy system across multiple vectors, provide confidence in system requirements and enable network infrastructure investment ahead of need. Regional energy strategic planners will work with organisations at a local level, including with local government, electricity and gas networks and industry, to improve understanding of the infrastructure needed in different parts of the country. Mapping of future electricity demand by ports will support this work.

Finally, we encourage ports to increase their own electricity capacity, including by producing their own renewable energy on site and making use of battery storage technology. There may also be opportunities for ports to explore the use of private wire connections, with direct connections to nearby renewable energy projects. This could be faster than connecting to the licensed electricity network, though ports will have to balance the benefits of accelerated decarbonisation with any potential costs and risks of private wire arrangements.

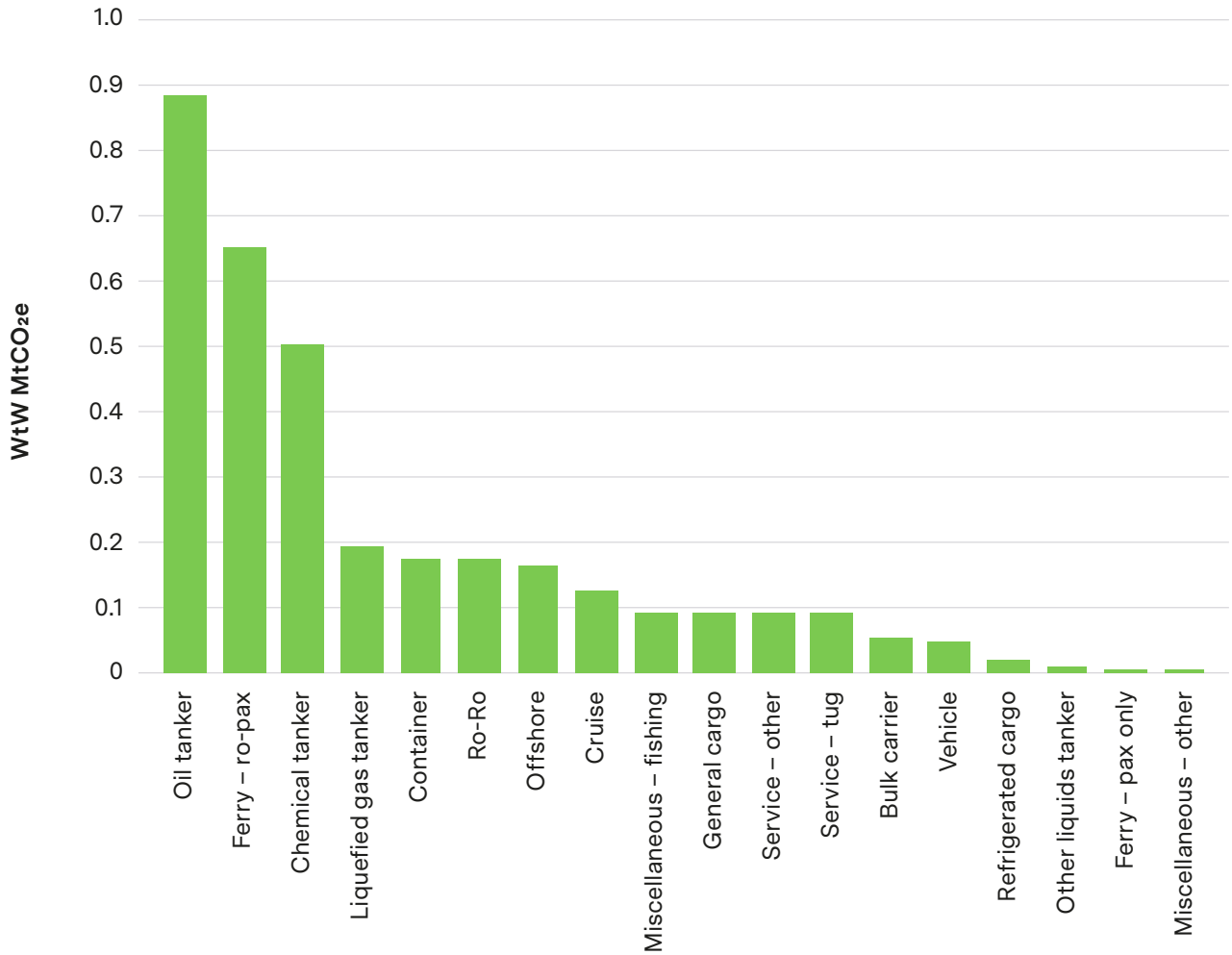
The National Wealth Fund (NWF) and Great British Energy (GBE)

Recognising the vital role they play, broader efforts are underway to support ports to be key enablers of decarbonisation. The government has launched the NWF to support the UK's world-leading clean energy and growth industries and support the delivery of the new Industrial Strategy[45]. With a total capitalisation of £27.8 billion, it will catalyse investment that would not have otherwise taken place. At least £5.8 billion of the NWF's capital will focus on the five sectors announced in the manifesto: green hydrogen, carbon capture, ports, gigafactories and green steel. In addition, GBE set out in its Founding Statement[46] that, in its role as a new publicly owned energy company, it will drive forward investment in ports and clean energy supply chains.

Evidence

Vessels at berth in ports contribute to a significant share of domestic maritime emissions. The maritime emissions model estimates that, in 2019, emissions from vessels while at berth comprised around 46% of domestic maritime fuel lifecycle GHG emissions (excluding inland waterways) and was highly variable between different operations, as shown in Figure 11.

Figure 11: Estimates of the fuel lifecycle (WtW) GHG emissions from vessels at berth at UK ports in 2019 (excludes inland waterways), split by vessel type.



Note: Figure 11 shows the estimates of the fuel lifecycle (WtW) GHG emissions from vessels while at berth at UK ports in 2019, split by vessel type. This includes both domestic and international vessels, as any emissions produced while at berth are included in UK domestic maritime emissions, as set out in Box 2. This graph does not include emissions produced by inland waterways.

4.4 Measures for smaller vessels and accelerating uptake in targeted subsectors

Fuels regulation and emissions pricing will drive the majority of GHG emission reductions to meet our goals in 2030 and 2040. However, these core policies do not cover smaller vessels (below 400 GT), including those where there is a clear or advanced technological pathway to decarbonise.

Reducing GHG emissions from smaller vessels

This subsector is very diverse, including vessels with clear routes to decarbonisation, such as offshore wind vessels, and others, such as fishing vessels, for which decarbonisation will be more challenging and will take longer. As a first step, we need to build our evidence base to develop an effective way forward that is both impactful and proportionate for this very diverse set of vessels. Alongside this *Strategy*, we have published a call for evidence on Emission Reduction Measures for Small, Sub-400 GT Vessels and Accelerating Uptake in Targeted Subsectors, and we plan to engage thoroughly with stakeholders across the smaller vessels fleet.

This engagement aims to improve our understanding of the unique challenges faced by the various smaller vessel subsectors. Due to the diversity of the fleet of vessels below 400 GT and the variable nature of their operations (both technically and commercially), it is likely that a range of different interventions will need to be implemented throughout the late 2020s and early 2030s to address their emissions – and it is possible that in some instances, workable solutions may not be identified. The evidence we collate will help us understand potential implementation dates, which may vary depending on the type of intervention required and the dependence on primary legislation.

Commitment

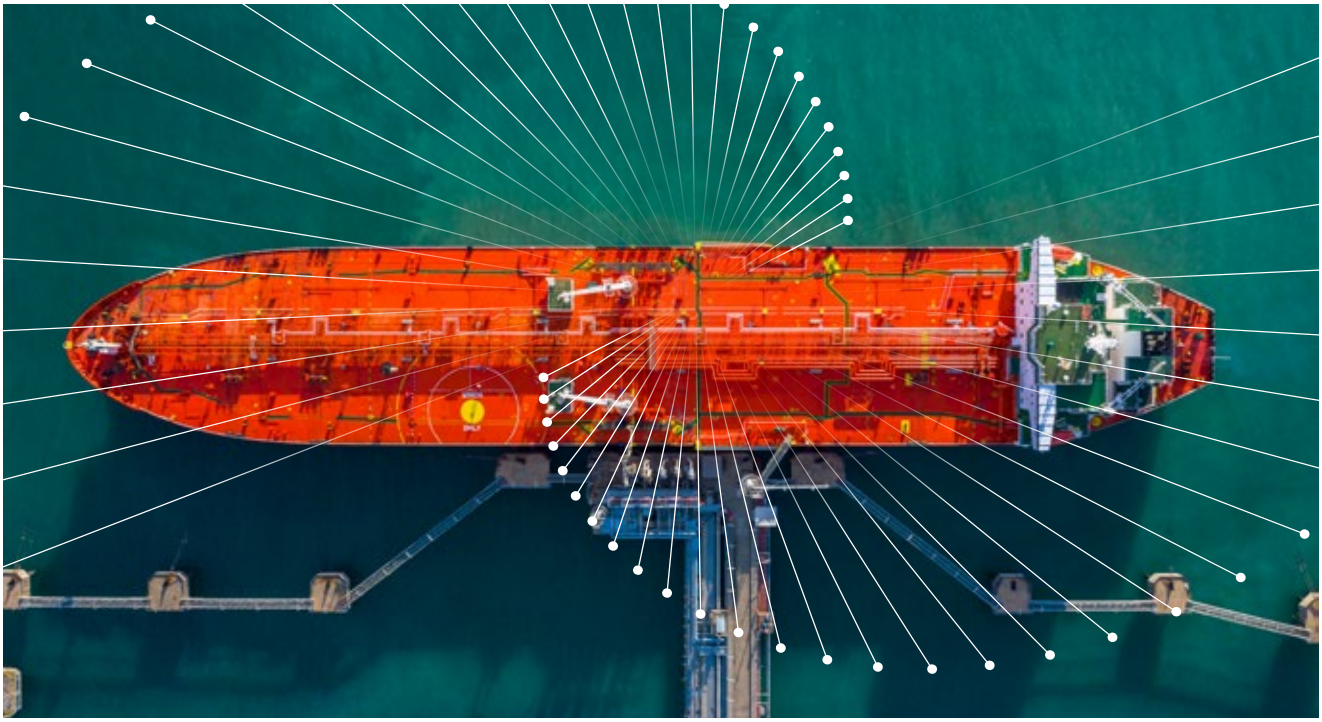
Informed by our call for evidence and stakeholder engagement, we will develop proportionate measures to reduce emissions from smaller vessels, and to accelerate the uptake of zero and near-zero GHG emission fuels and technologies where there are clear technological pathways, subject to formal consultation from 2026 in some areas.

Accelerating uptake of zero, and near-zero, emission technologies in targeted subsectors

There are examples of zero and near-zero GHG emission solutions already in use, or being trialled, by smaller vessels including as part of our UK SHORE programme. These trials demonstrate that technological solutions exist for certain sectors, in particular those able to switch to battery-electric power, or vessels using hybrids between batteries and zero and near-zero GHG emission fuels. The call for evidence will explore these areas, and subsequent policy development will focus on vessels with both a clear or advanced decarbonisation pathway, where it is possible to scale and commercialise technology today, and on those that face barriers preventing their uptake of decarbonisation solutions at scale, where we recognise that the transition will take place at a later stage. This may not be limited to sub 400 GT vessels.

The growing offshore wind service vessel fleet may provide an ideal example of one such sector. As part of the Government's clean energy superpower mission, Clean Power by 2030 will herald in a new era of clean energy independence. Successful delivery will require rapid deployment of new clean energy capacity across the whole of the UK. The Clean Power 2030 Action Plan shows that we have high ambitions and a clean power capacity range for 43–50 GW from offshore wind by 2030[47].

This presents an excellent opportunity for both the growth of the UK's offshore wind sector and for broader maritime decarbonisation as demand grows for operations and maintenance vessels (both CTVs and SOVs), the majority of which currently use marine gas oil. We will continue to work with the offshore wind sector and welcome coordinated efforts through forums such as Operation Zero, which is the industry-led partnership, launched by the UK at the 26th UN Climate Change Conference of the Parties (COP26) and which has pledged to make zero emission operations and maintenance vessels a reality in the North Sea this year. Additionally, the NSO is exploring capability gaps acting as barriers to building offshore wind vessels and where incentives or regulatory change are needed to support UK vessel builds or more UK content in the supply chain. We will use the call for evidence to explore how this subsector can be supported to move quickly.

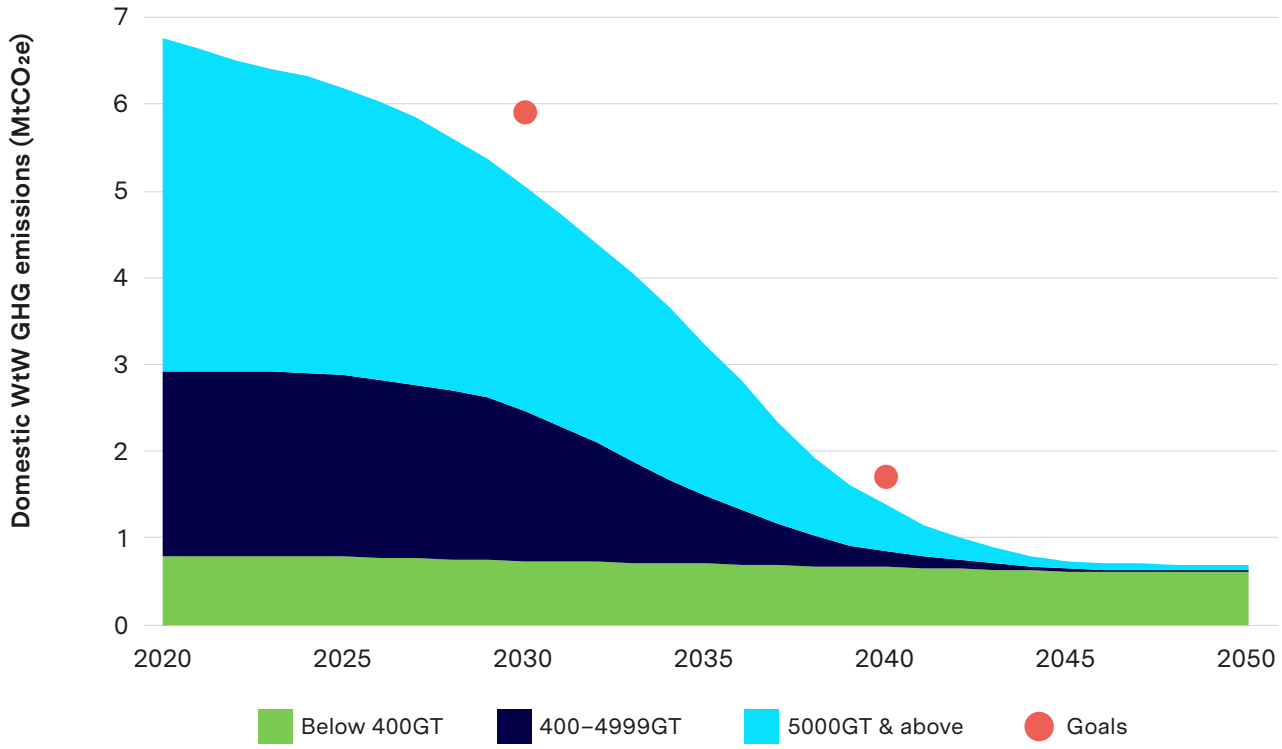


Evidence

Current evidence on emissions from these vessels is limited, as many of them are below the thresholds requiring Automated Identification Systems transponders to be fitted. However, our maritime emissions model shows that these vessels could remain responsible for emitting around 0.6 MtCO2e in 2050.

Figure 12 below shows the estimated residual emissions from these smaller vessels if we do not introduce targeted measures. It shows that, whilst their share of emissions was relatively small compared to emissions in 2019, without action, they will become an increasingly large share of domestic maritime emissions, leading to much larger residual GHG emissions in 2050.

Figure 12: Estimated residual (WtW) GHG emissions from UK domestic maritime vessels by size in a scenario without any measures for vessels below 400 GT (excludes inland waterways).

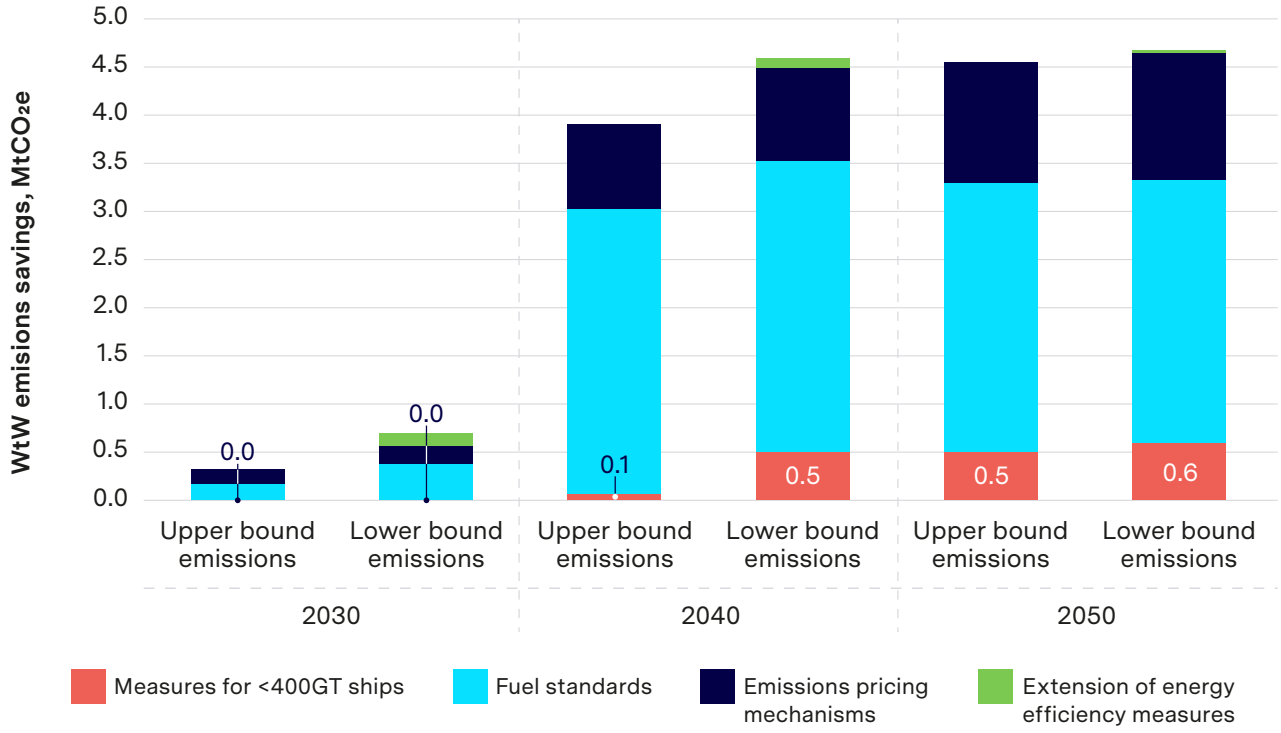


Note: Figure 12 shows the estimated contribution of residual GHG emissions from UK domestic maritime vessels, split by vessel size. This graph uses the upper bound emissions scenario, but removes policy targeting vessels under 400 GT to indicate the size of the residual emissions from this sector if they are not tackled by policy. This graph does not include emissions produced by inland waterways, many of which may also be below 400 GT.

Additionally, many vessels within the inland waterway and leisure craft subsectors are currently out of scope of our maritime emissions model, in part due to the lack of high-quality data available on their operations. Many of these vessels will fall below 400 GT and contribute to domestic maritime emissions. Meeting our decarbonisation goals will depend on addressing these emissions through targeted policies that are proportionate, workable and introduced at the right time, as set out above.

Figure 13 shows the potential impact of targeted policy for vessels under 400 GT on reducing GHG emissions. Indicative analysis using our maritime emissions model shows that these policies could save up to 0.5 MtCO2e in 2040 and up to 0.6 MtCO2e in 2050. However, as our modelling excludes the inland waterways sector, which has a higher proportion of smaller vessels, this is likely to be an underestimate of the impact of these policies.

Figure 13: Estimated contribution of policy measures for vessels under 400 GT to the total modelled WtW GHG emissions savings from UK domestic maritime vessels in 2030, 2040 and 2050, under our range of illustrative decarbonisation scenarios (excludes inland waterways)



Note: Figure 13 shows the estimated contribution of a package of measures to tackle emissions from vessels below 400 GT to UK domestic maritime GHG emission reductions in 2030, 2040 and 2050. As the design of policy in this area is to be informed by the accompanying call for evidence, the measures included in our modelling are simply proxy measures that vary the level of ambition of policy. The specific design of the proxy measures is detailed in the Analytical Annex. The upper and lower bound emission scenarios vary the stringency, start date and threshold changes of each of the policies. This graph does not include emissions from inland waterways. The allocation of emissions reductions to policies is dependent on the order in which policies are implemented in the model, due to the overlapping impacts of policies. This analysis allocates emissions reductions to policies in the following order: extension of energy efficiency measures, emissions pricing mechanisms, fuel standards, measures for <400 GT ships.

4.5 Increasing the efficiency of maritime operations

Increasing energy efficiency, either through the installation of technological solutions or through operational changes, is a no-regrets way to reduce GHG emissions and air pollutants from shipping, and reduces operating costs.

In the longer term, given that zero and near-zero GHG emission fuels and energy sources have lower energy densities than conventional fuels, increasing the energy efficiency of vessels will help increase their operational range. This may be a pre-requisite for some operational uses and will continue to deliver operational cost savings by reducing fuel use.

Commitment

We will support IMO short-term measures to further incentivise energy efficiency, to be implemented from January 2026, and explore domestic measures.

BOX 8 UK support for Artificial Intelligence and Autonomy

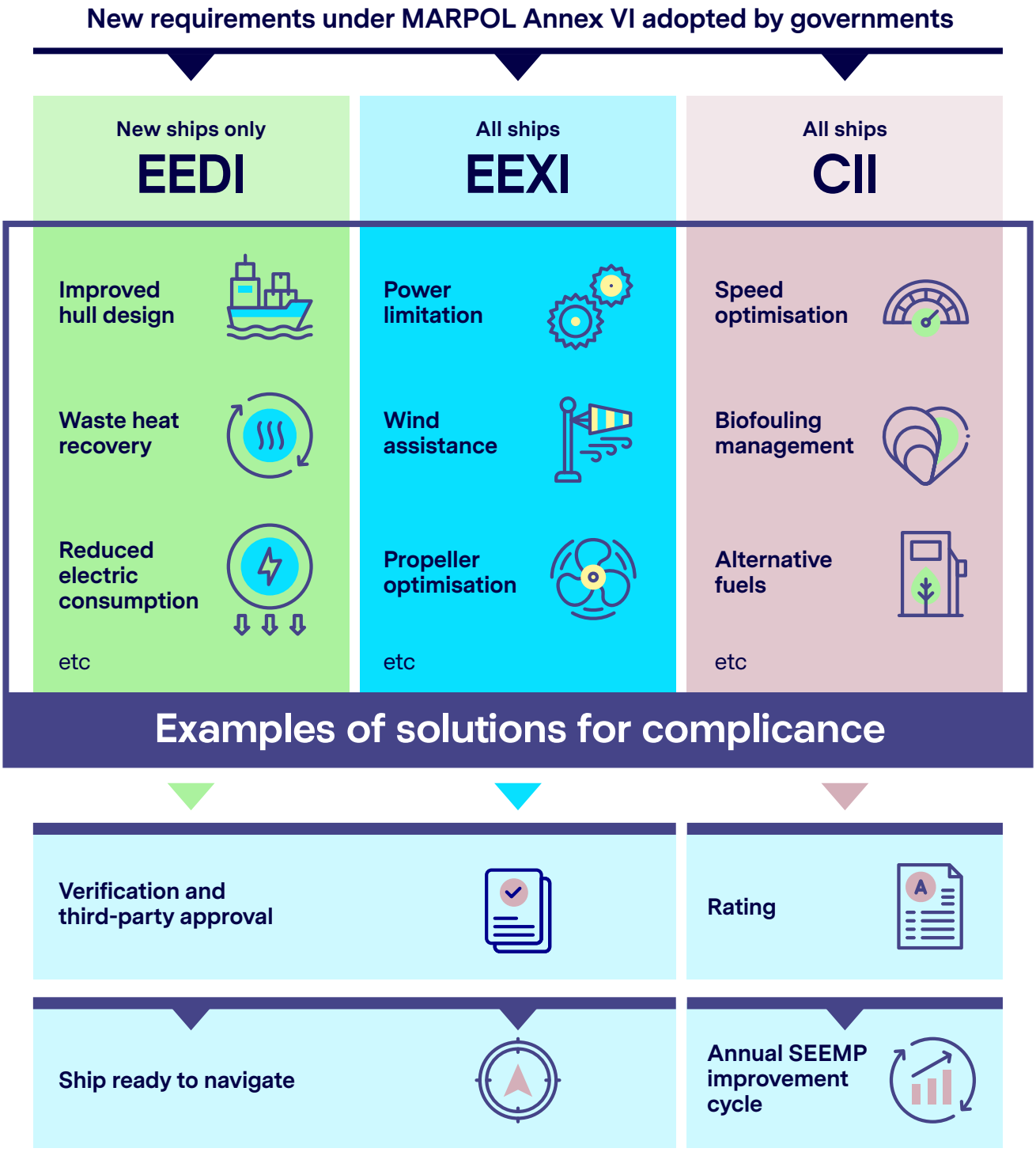
'Smart shipping' is an energy efficiency solution that can drive route optimisation and enable just-in-time arrivals. The UK maritime sector is well placed to take advantage of this emerging opportunity.

In 2024, the UK launched the Smart Shipping Acceleration Fund (SSAF), an £8 million competitive fund for R&D under UK SHORE. Winning projects will deliver feasibility studies for innovative technology demonstrations for scalable smart shipping solutions that deliver reductions in GHG and air pollutant emissions. SSAF is funding projects across all corners of the UK that encompass a range of topics from vessel efficiency, route optimisation, cyber security and robotics.

The IMO's energy efficiency and carbon intensity requirements

The IMO has a range of measures aimed at improving energy efficiency, the Emergency Efficiency Design Index (EEDI), the Energy Efficiency Existing Ships Index (EEXI) and the Carbon Intensity Index (CII).

Figure 14: From the IMO[48], an overview of the different energy efficiency measures currently in place through the IMO.



Note: Figure 14 shows the three energy efficiency measures required under Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL), the EEDI, the EEXI, and the CII. For each of the three, examples of mechanisms by which operators can comply with each are given, along with the compliance cycle for the different measures.

The IMO has committed to reviewing the effectiveness of the short-term measures by 1 January 2026 at the latest. The UK will push for this review to further incentivise energy efficiency, as well as exploring the case for additional domestic energy efficiency measures.

Evidence

Our modelling suggests that near-term reductions in GHG emissions will be driven, primarily, by increased energy efficiency through a combination of existing international requirements, the IMO's 'short-term measures' and the cost-effectiveness of these technologies. However, it is possible that we are overestimating the rate of uptake of these technologies, either due to missing costs, wider barriers to their uptake not included in our modelling or operator behaviours that are not cost-optimising. We will keep this under review as these measures continue to take effect.

CHAPTER 5

The Impact of our Policies

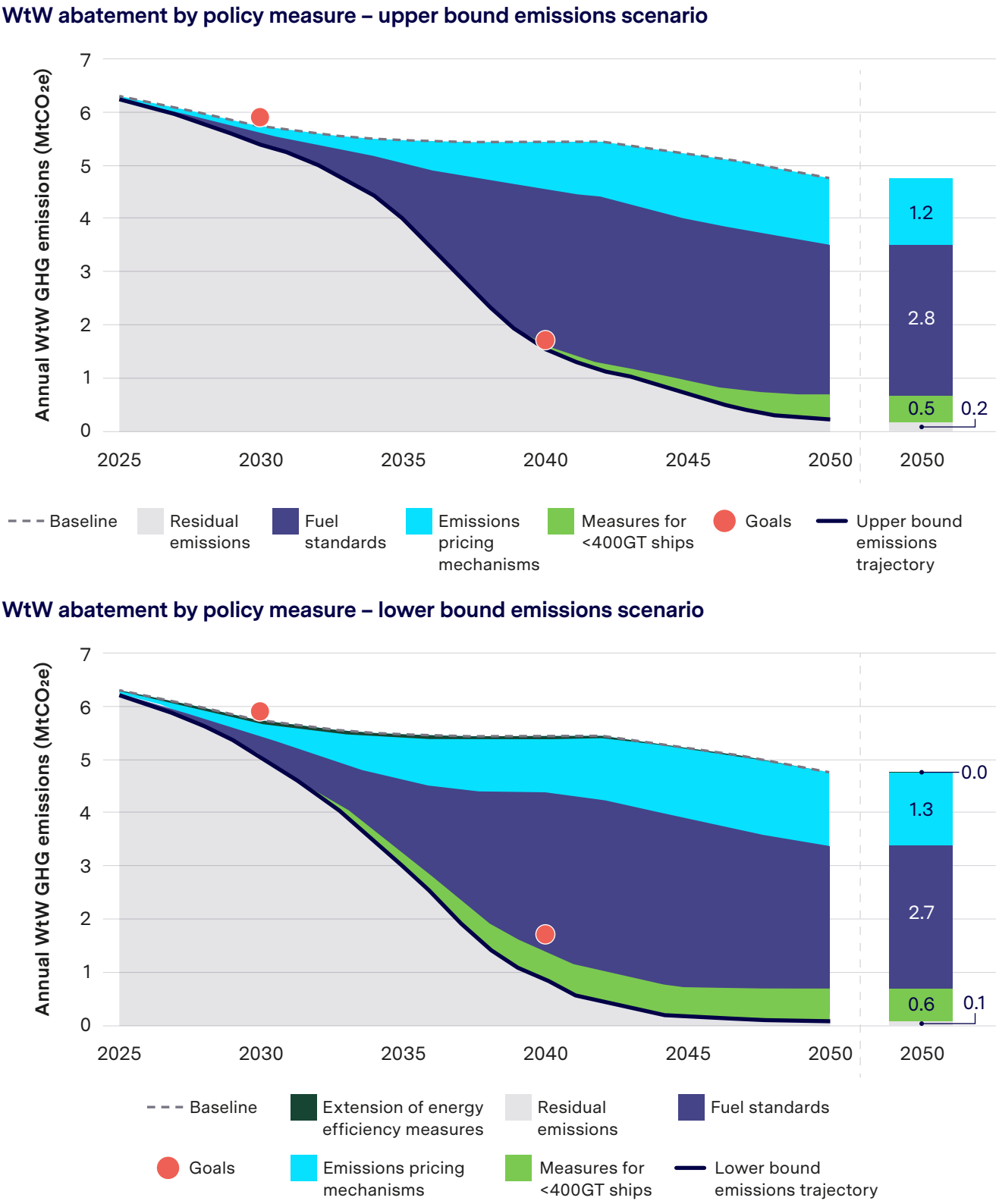
This chapter sets out how the impacts of our policies have been modelled and the extent to which they are expected to drive both GHG and non-GHG emission reductions in order to meet our goals.

5.1 The GHG impact of our policies

We estimate that the combined impact of the key policy measures set out in this *Strategy*[49] can reduce the total WtW (fuel lifecycle) emissions from UK domestic maritime vessels (excluding inland waterways) by 94–98% in 2050 relative to our baseline forecast. Figure 15 presents our estimates of the combined impact of policy measures across our decarbonisation scenarios on GHG emissions over time and their cumulative impact in 2050. These figures show that regulations to reduce the GHG emission intensity of maritime fuels (modelled as fuel standards) and emissions pricing mechanisms, together, drive up to 90% of estimated GHG emissions savings in 2050.

However, as there is overlap in the remit of each of our policies, the order in which they are modelled has an impact on the GHG emission savings attributed to each policy. For more detail on the scenarios, assumptions and estimates included in Figure 15, please refer to the Analytical Annex.

Figure 15: Estimated contribution of different measures to reducing the annual fuel lifecycle, i.e. WtW, GHG emissions from UK domestic maritime vessels under our illustrative upper and lower bound decarbonisation scenarios (excludes inland waterways)



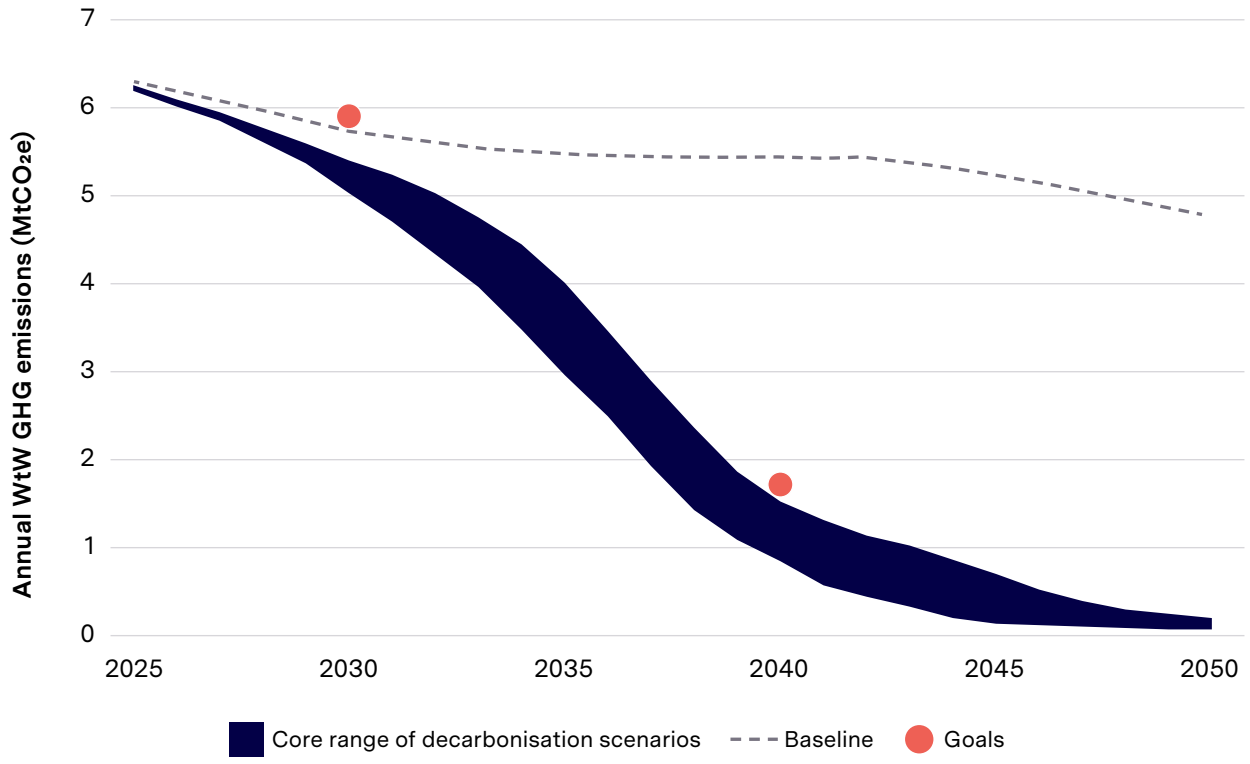
Note: Figure 15 shows the estimated contribution of different policy measures to reducing the annual fuel lifecycle (WtW) GHG emissions from UK domestic maritime vessels, associated with our core range of illustrative decarbonisation scenarios. The chart above provides the estimated emission reductions provided by each package of policy measures in 2050 compared to our baseline scenario. These graphs do not include emissions produced by inland waterways. The allocation of emissions reductions to policies is dependent on the order in which policies are implemented in the model, due to the overlapping impacts of policies. This analysis allocates emissions reductions to policies in the following order: extension of energy efficiency measures, emissions pricing mechanisms, fuel standards, measures for <400 GT ships. Measures for emissions at berth are not explicitly modelled, though emissions at berth are within scope of the modelled fuel standards and emissions pricing mechanisms.

5.2 Meeting our goals

We have modelled a range of illustrative scenarios that show the UK domestic maritime sector can meet our interim goals and get as close to zero GHG emissions as possible in 2050.

The results of this modelling, shown in Figure 16 by the declining emissions over time, indicate that there is considerable scope to reduce the UK domestic maritime sector's fuel lifecycle GHG emissions. With sufficient policy action, it is feasible to achieve our interim goals (represented by the orange dots on the charts), and for the sector to reach close to zero GHG emissions by 2050. Under this range of scenarios, the annual fuel lifecycle GHG emissions from UK domestic maritime (excluding inland waterways) are estimated to be reduced by 36–40% by 2030, 82–90% by 2040, and 98–99% by 2050 (compared to 2008 levels). As the modelling does not include inland waterways (see 3.1), we must leave sufficient room between our goals and forecast emissions to accommodate these emissions, and these must still decrease to meet the goals (refer to Box 4 of the Analytical Annex for more detail on this).

Figure 16: Estimates of the annual fuel lifecycle (WtW) GHG emissions from UK domestic maritime vessels under our range of illustrative decarbonisation scenarios (excludes inland waterways).



Note: Figure 16 shows the core range of estimated annual fuel lifecycle (WtW) GHG emissions from UK domestic maritime vessels under our illustrative decarbonisation scenarios, compared to our domestic maritime decarbonisation goals in 2030 and 2040. The range varies key policy assumptions such as start dates and stringency. Emissions are measured in MtCO2e, and trajectories and goals do not include emissions from inland waterways. Further information on the scenarios and assumptions can be found in the Analytical Annex.

As there is significant uncertainty surrounding the final basket of measures that will be introduced, we have modelled a range of scenarios reflecting assumptions relating to the date and stringency of policy measures[50].

Our illustrative decarbonisation scenarios highlight the scale of the challenge in meeting our goals. Our scenarios estimate that the fuel lifecycle GHG emissions from UK domestic maritime can fall to very near zero by 2050. Although based on the technologies and fuels currently incorporated in our maritime emissions model, there continue to be some residual GHG emissions in 2050 (between 0.07 and 0.2 $MtCO_2e$). However, while the assumptions used reflect the best possible evidence at the time of developing our modelling, there are other potential emission reduction technologies, fuels and energy sources that are not currently included in our modelling that have the potential to reduce emissions further. These include potential improvements to engine designs, Onboard Carbon Capture and Storage (OCCS), nuclear power, and fuels with negative WtW GHG emissions[51].

We have also carried out sensitivity testing which has considered the impact of wider uncertainties reflecting changes not directly under policy control, such as freight demand and fuel costs. These are presented in Section 5 of the Analytical Annex. We will continue to refine our modelling of decarbonisation scenarios for the sector, including to reflect our progress in implementing the commitments in this *Strategy*, as well as seeking to improve our evidence base on maritime decarbonisation. However, these illustrative decarbonisation scenarios provide a clear indication of the scale of policy action that will be required to meet the new decarbonisation goals.

5.3 The role of fuels

As a sector, there a range of decarbonisation options and propulsion technologies that will be available to maritime operators. This provides a great deal of flexibility to the operators in choosing how to decarbonise their businesses, but also creates considerable uncertainty surrounding the future fuel and energy mix.

Given this uncertainty, we have modelled five illustrative fuel mix scenarios, alongside our core range of GHG emissions scenarios, which aim to capture a range of potential outcomes. These scenarios are explained in more detail in Section 4 of the Analytical Annex. There are additional uncertainties where we have a limited evidence base, such as the role of nuclear power, OCCS, hybrid-electric vessels, and shore power provision. As we develop the emissions model further, we will work with stakeholders to fill these evidence gaps, and we will continue to review and update the decarbonisation scenarios and the evidence that underpins them.

The five illustrative scenarios, displayed in the two charts in Figure 17 on page 69 and summarised in Table 3 of the Analytical Annex, are 'More ammonia', 'No ammonia', 'More battery electric propulsion (BEP)', 'More biofuel', and 'Balanced mix'. Each scenario varies the extent to which certain fuels emerge as potential solutions for the domestic market and represent different possible 'states of the world' regarding the future fuel mix, while the 'Balanced mix' scenario reflects a middle ground set of assumptions within this range (though we do not claim that this represents a central or most likely fuel mix outcome in reality). Though these scenarios do not explicitly model the supply of different fuels, in all but the 'More biofuel' scenario, biofuel use is assumed to be severely constrained due to a lack of supply, with blends capped at a 30% limit, other than for use in pilot fuels.

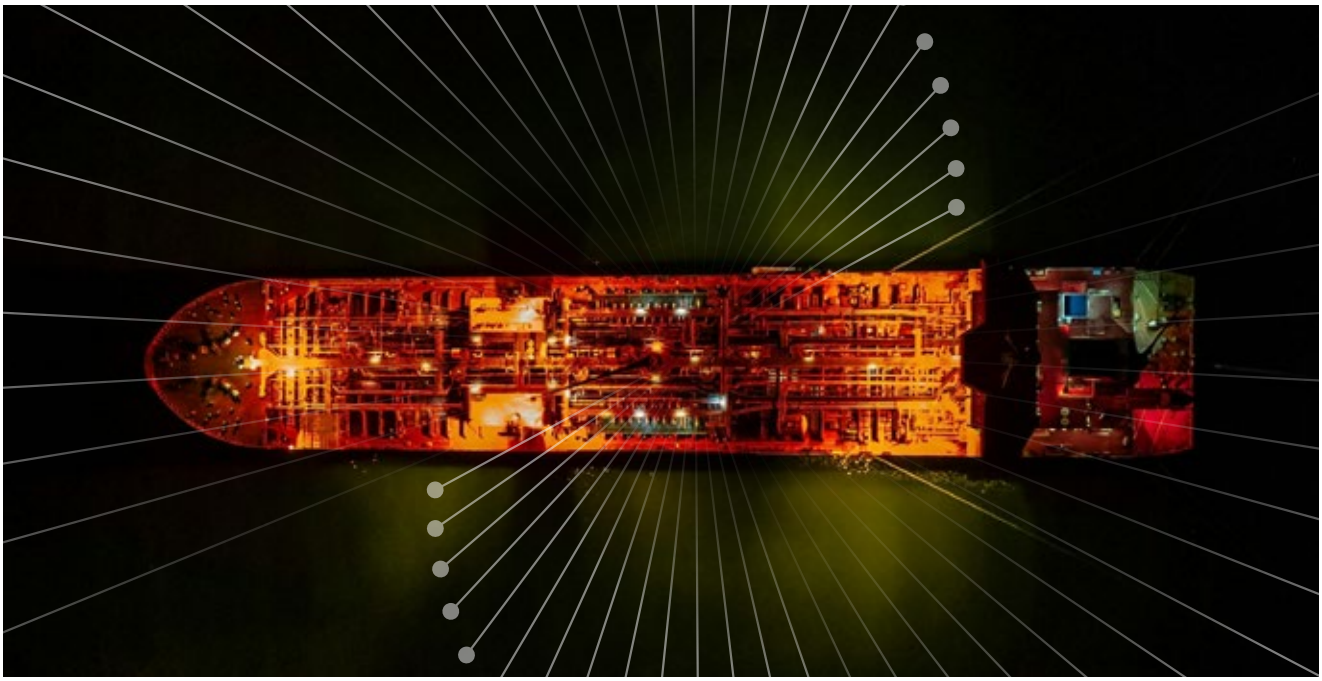
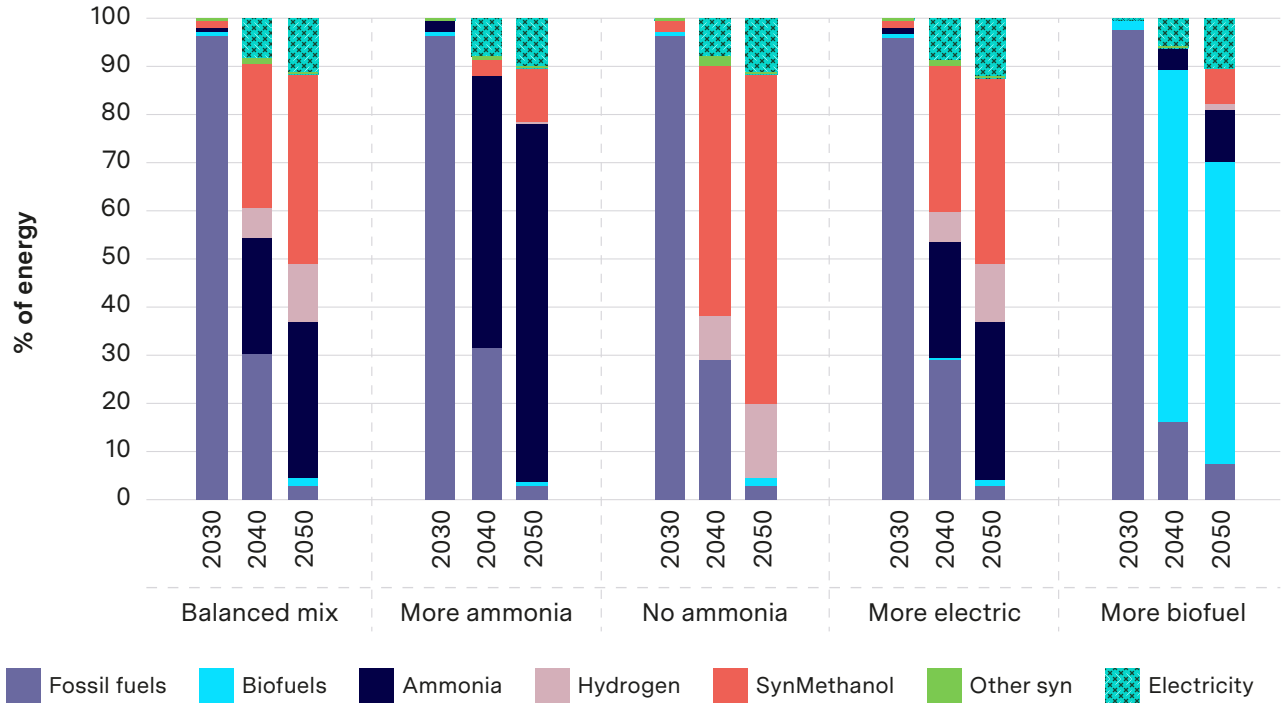
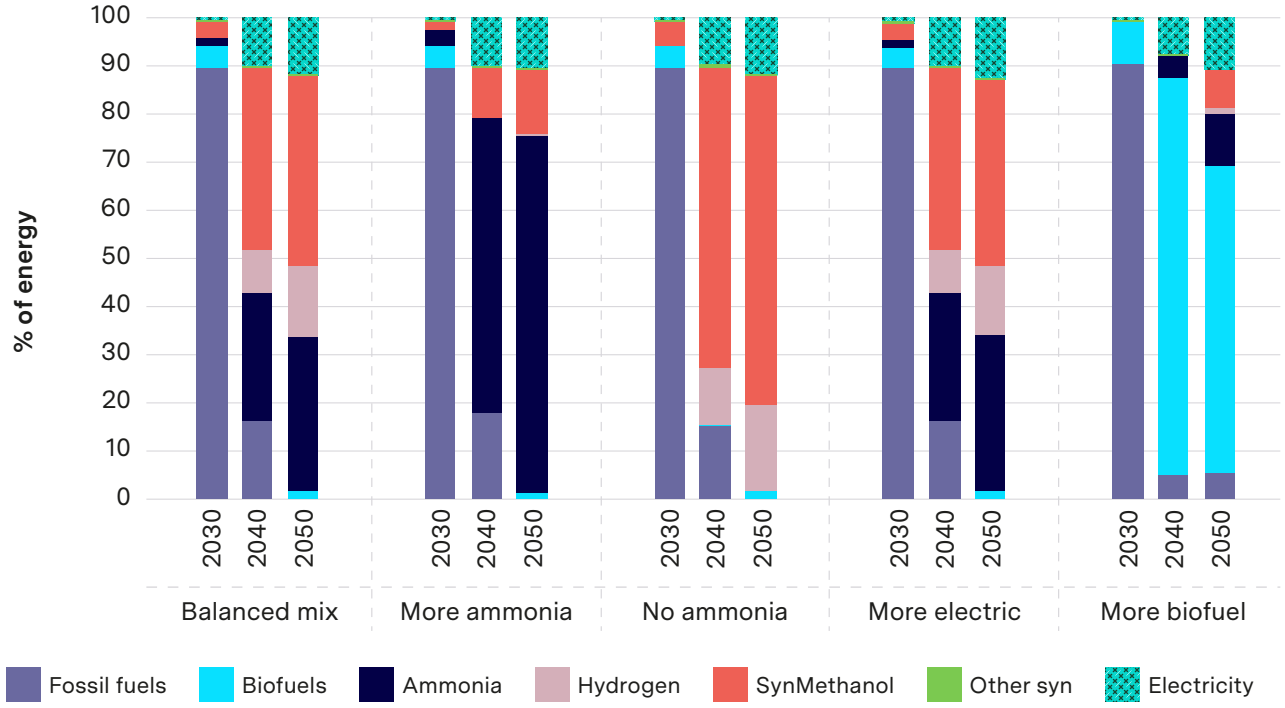


Figure 17: Examples of potential fuel mixes for UK domestic maritime vessels under our illustrative lower and upper bound decarbonisation scenarios (excludes inland waterways)

UK domestic shipping fuel mix under upper bound emissions scenario



UK domestic shipping fuel mix under lower bound emissions scenario



Note: Figure 17 shows the range of fuel mix scenarios that have been modelled for UK domestic maritime vessels alongside our illustrative decarbonisation scenarios. The first figure shows these fuel mixes under our 'lower bound emissions' decarbonisation scenario, while the second figure shows the fuel mixes under our 'upper bound emissions decarbonisation scenario. For further information on the assumptions that have informed the development of these fuel mix scenarios, please refer to the Analytical Annex.

The results from this modelling demonstrate that there are many viable fuel pathways to achieve deep reductions in GHG emissions from the UK domestic maritime sector. It is likely that hydrogen and hydrogen-derived fuels, along with battery electrification and potentially drop-in fuels such as biofuels (dependent on availability) will all have a role to play in decarbonising the UK domestic maritime sector. However, we recognise that our modelled fuel mixes do not capture all possible evolutions of the fuel mix and that the relative contributions from different fuels and energy sources, in reality, may differ from our modelled fuel mixes. For example, we acknowledge that there are potential scenarios where electrification, including shore power provision, has a larger role to play in decarbonising the UK domestic maritime than in our modelling.

While research undertaken for the IMO[52] indicates that it should be feasible to scale up the global supply of these fuels and energy sources sufficiently to deliver the goals set out in this *Strategy*, we need to consider supply of fuels and energy on a domestic basis. It is crucial to note that maritime is not the only UK sector that uses these fuels, and we must consider the implications for maritime of their demand and supply across all transport modes and other sectors of the UK economy. That said, relatively few voyages are performed entirely within the UK, and refuelling takes place wherever is most suitable or most affordable for the vessel. As we develop our policy approach, we will include considerations on both constraints on the supply of these fuels and maritime refuelling behaviour, as set out in more detail in section 4.1.

The rate at which the UK domestic maritime sector transitions to widespread use of low carbon and, ultimately, zero and near-zero GHG emission fuels and energy sources will need to increase. The future fuel and energy mix is highly dependent on the cost of different fuels and of domestic electricity. Irrespective of which specific fuels and energy sources come to dominate the market, there are multiple viable pathways to deliver deep reductions in GHG emissions.

5.4 The non-GHG impact of our policies

The transition to zero and near-zero GHG emission operations in the maritime sector represents a generational opportunity to address the wider impacts of the sector on the environment, as the GHG intensity of fuel represents just one of the sustainability criteria that needs to be considered when investment decisions are made.

Beyond climate impact, the maritime sector has significant impacts on biodiversity, air quality and water quality and, subsequently, on human and environmental health. The available evidence demonstrates that shipping, both domestic and international, is a significant source of air pollutant emissions[53]. The contribution of shipping to exposure to PM2.5 is estimated to result in health costs for the UK population of around £1.5 billion a year (in 2017 prices)[54]. In addition to climate change and air pollution sharing many of the same sources, air pollution also negatively impacts on ecosystem services provided by carbon sinks such as forests and peatland. Globally, poor air quality is estimated to cause 7 million premature deaths every year and the loss of millions of years of healthy life[55].

There are many opportunities to improve other environmental outcomes while also decarbonising the shipping industry. For example, improved energy efficiency will reduce fuel consumption and have a direct impact on air pollution, and the transition to new fuels and energy sources may allow substantial reductions to be made in certain air pollutant emissions alongside GHG savings. The results of our modelling, as set out in Figure 18, show that the impact of our policies on the direct (or primary) emissions of air pollutants is heavily dependent on the fuel mix which is taken up by the sector.

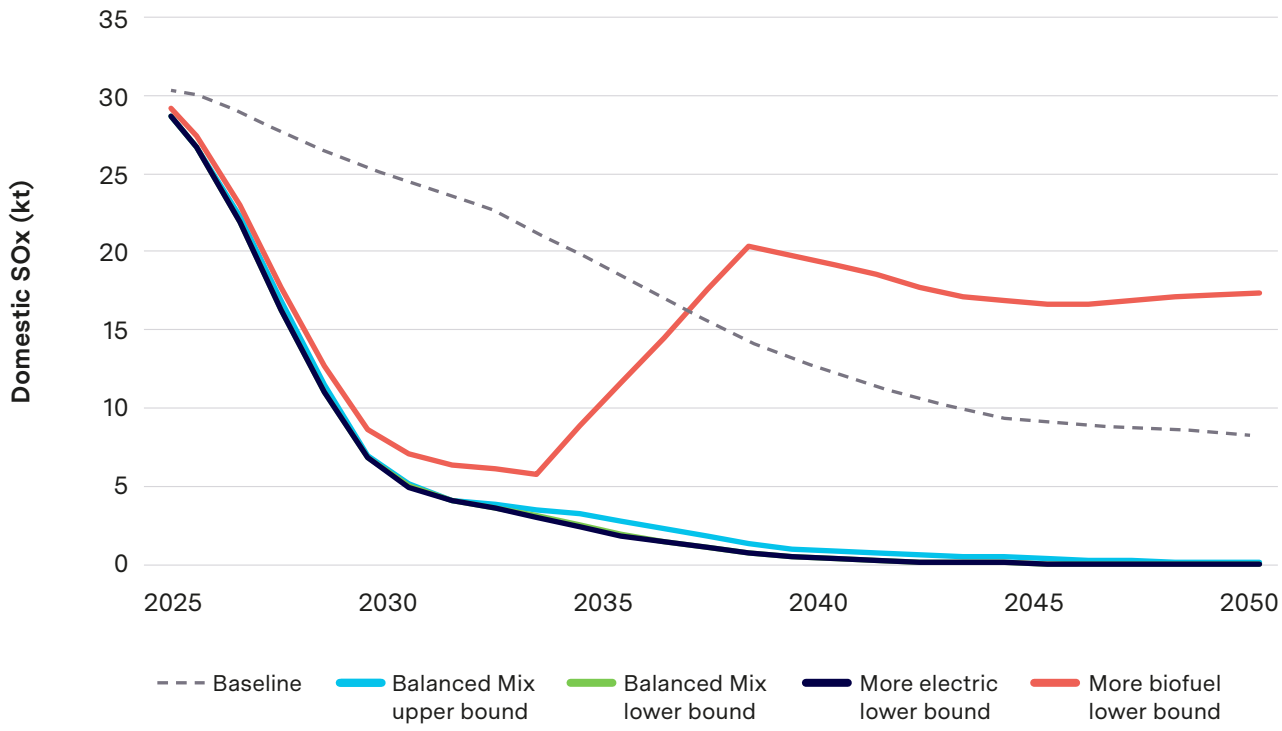
In many cases, use of these new fuels is expected to drive reductions in the direct emissions of the modelled air pollutants, but further work will be needed to better understand their impact and new policies may be needed to reduce air pollutant emissions. For example, the increased use of ammonia as a fuel will likely cause direct emissions of nitrogen oxides (NOx) and ammonia from marine engines to increase, though this will be mitigated by the application of the NOx limits found in MARPOL Annex VI, and in particular our efforts to establish a North Atlantic ECA, controls which are not currently modelled. NOx and ammonia are particularly harmful for human and animal health and we may require policies that ensure solutions are implemented to prevent increased NOx and PM2.5 concentrations.

At present, there are some gaps in our modelling in relation to air quality. These include secondary generation of air pollutants, concentrations of air pollutants derived from maritime operations, and the risk of ammonia or other fuels emissions from either the production, transportation or storage of fuel.

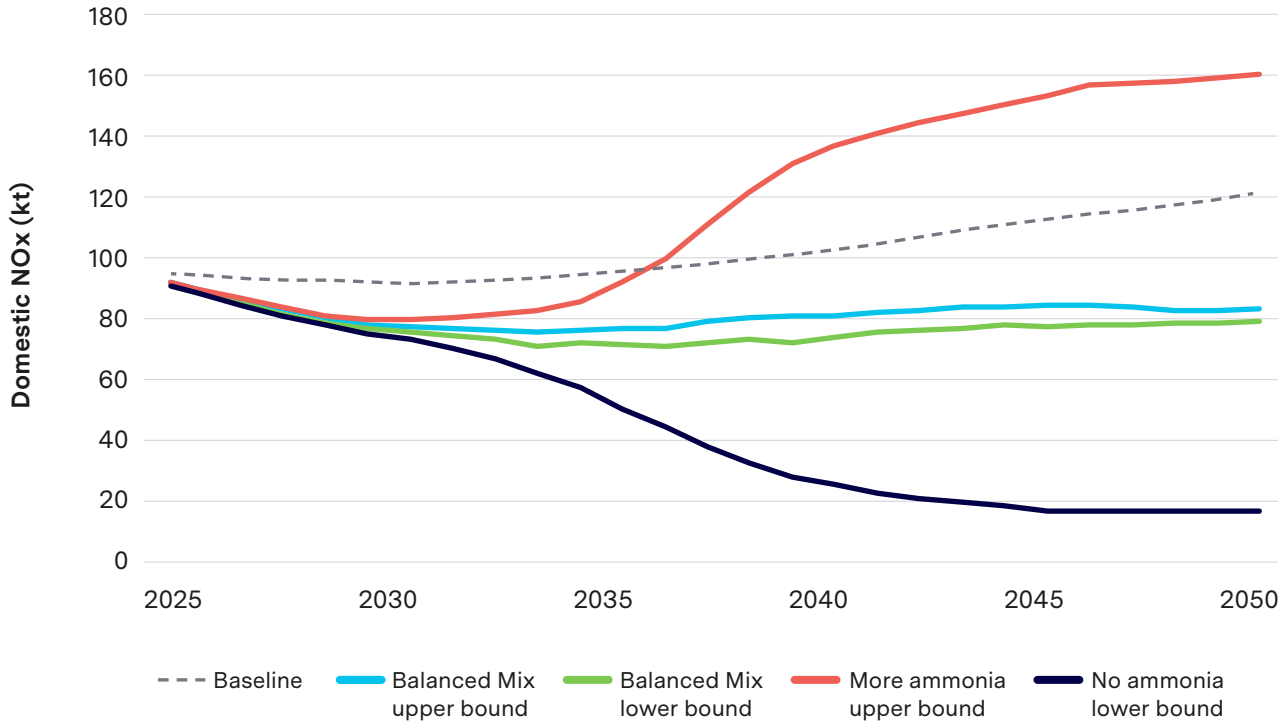
These processes could have further harmful effects on health and the environment, for example, ammonia can cause eutrophication, acidification and stratospheric ozone depletion. It will be necessary to provide a comprehensive assessment of the impacts of our policies, and the use of low carbon, and ultimately zero, and near-zero GHG emissions fuels on the environment, to ensure the transition of the sector is aligned to the targets set in the Environment Act (2021). As such, better evidence is needed to more fully assess the impact of maritime decarbonisation policies on the environment and inform the innovation, support and regulation needed for the supply of new fuels. We will aim to improve our air pollutant emission modelling capabilities in future, and work across Government to fully understand and address the environmental risks arising from zero and near-zero GHG emission fuel manufacturing, distribution and use emissions.

Figure 18: Estimates of the direct air pollutant emissions from UK domestic maritime vessels under our range of illustrative decarbonisation scenarios (excludes inland waterways): a) sulphur oxides (SOx), b) NOx, and c) primary PM2.5

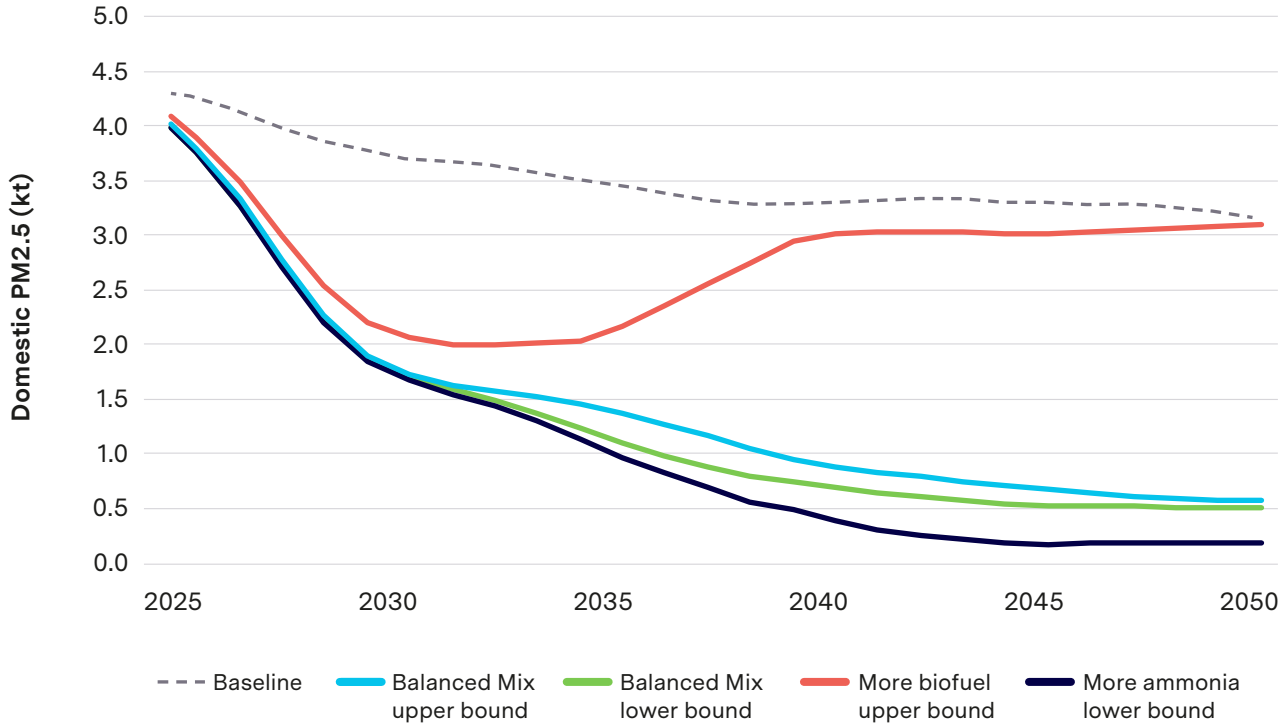
a. SOx:



b. NOx:



c. Primary PM2.5:



Notes: Figure 18 shows the modelled emissions of primary SOx, NOx and PM2.5 from UK domestic maritime vessels under the range of decarbonisation scenarios and fuel mixes. The fuel mixes with the highest and lowest air pollutant emissions are included, to illustrate the full range of potential outcomes, alongside the Balanced Mix fuel mix. For more information on our fuel mix scenarios, refer to section 4 in the Analytical Annex. The upper estimate for NOx should be seen as a worst-case outcome, as the model currently includes a pessimistic assumption about NOx emission rates for ammonia, for which there is currently some uncertainty. The figures include primary emissions of PM2.5 only. The inclusion of secondary PM2.5 may change which scenario has the lowest contribution to PM2.5 concentrations in the UK (e.g. a higher uptake of ammonia could see higher levels of secondary PM2.5). Air pollution abatement technologies (such as exhaust treatment systems) are not included in our modelling at this stage, though these could also be applied in practise to further reduce emissions of air pollutants.

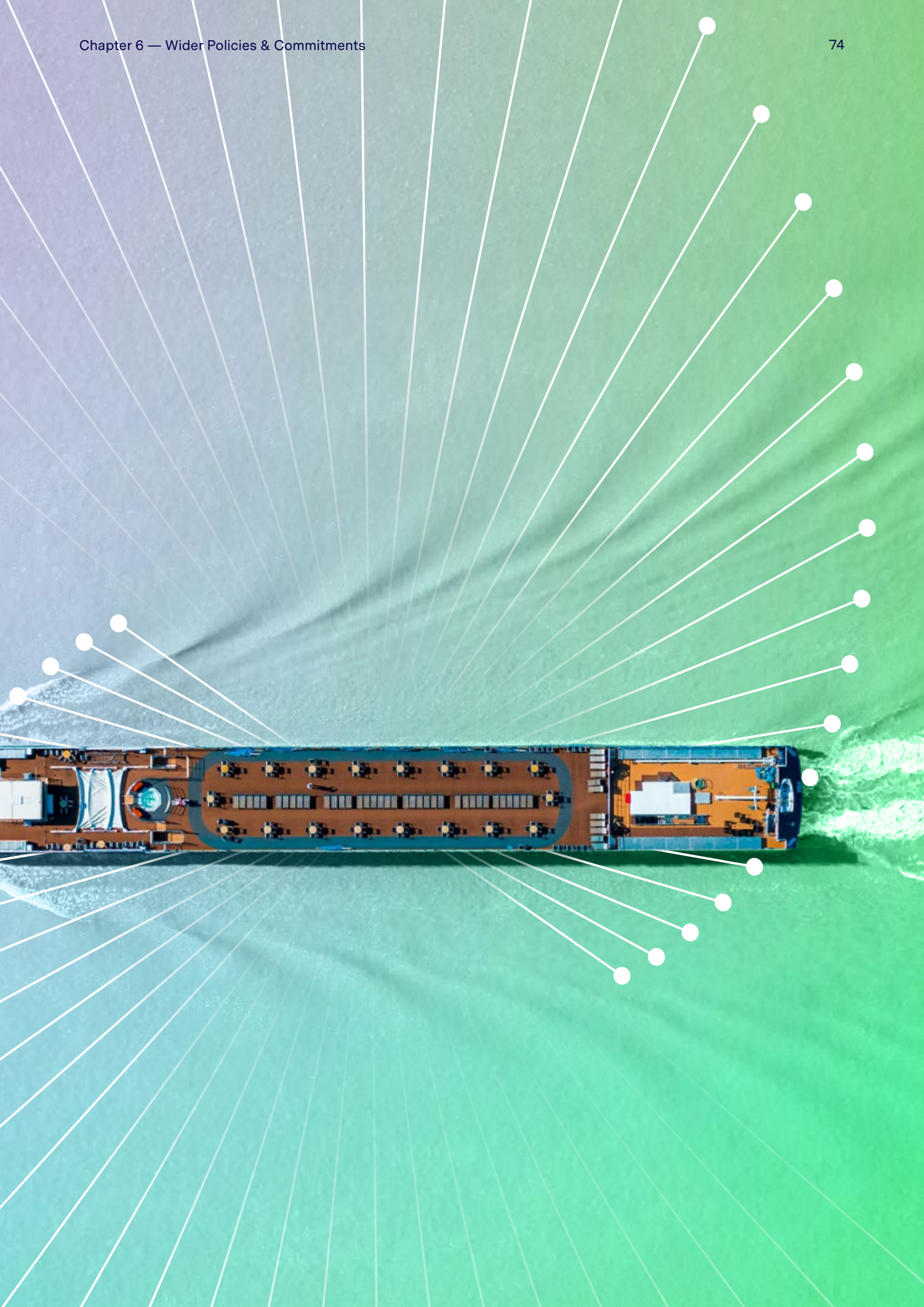
CHAPTER 6

Wider Policies & Commitments

This chapter sets out the wider set of commitments and areas of action that support our key policies:

- Innovative regulatory environment
- Green skills
- Continuing R&D support through UK SHORE
- Green Corridors
- Emission Control Areas
- Government shipbuilding procurement

These actions will act as critical enablers for the sector to reach our decarbonisation goals and help to address the wider environmental impacts of shipping.



6.1 Innovative regulatory environment

We want the UK to be an attractive place for the global maritime sector to operate safely, grow and thrive. Good progress has been made, but there is more we can do to realise this ambition. This includes investing in R&D capitalising on green job opportunities for the maritime sector and associated sectors such as the UK's shipbuilding industry.

Alongside a policy landscape that encourages innovation, the future regulatory framework must also support maritime businesses that want to be innovative, particularly those developing the technologies and fuels necessary for decarbonisation.

As the regulator for maritime, the MCA will play a key role in this agenda and plans to create a new UK Maritime Innovation Hub to lead the way. The Hub will build on the MCA's existing strengths in working with industry, UK and international regulators and the IMO.

The MCA is focused on providing essential regulatory oversight for the safe use of alternative fuels. This includes working at the IMO to develop technical standards for vessels, training of crew in the use of these fuels and processes for domestic deployment of vessels using these fuels in the UK. The MCA has also supported the UK SHORE programme to accelerate the technologies and fuels necessary to decarbonise the sector, both by shaping the UK SHORE programme and by engaging directly as a regulator with the projects supported by it. This is alongside the activities the MCA has undertaken as part of the Regulator's Pioneer Fund, helping to create a UK regulatory environment that encourages business innovation and growth. The new Unit will build on this work to date, helping innovators navigate the regulation system, supporting the development and ultimately the safe use of new technologies in the sector

The MCA will engage with industry and other environmental regulators, such as the Environment Agency and the HSE, to ensure the right framework for future fuels is in place that includes standards for their environmental impact and enables their uptake and use. Similarly, the MCA will continue to work with other regulators to ensure that the regulatory framework for the safe bunkering and use of future fuels at ports does not pose a barrier to the uptake of clean maritime fuels.

The MCA's continued activities will facilitate the timely deployment of low carbon and zero and near-zero GHG emission fuels and drive confidence in their safety. This will provide assurance for safe innovations in development today and the eventual standardisation as

Commitment

The MCA will create a new globally leading UK Maritime Innovation Hub to encourage innovation, research and development, and support economic growth.

these ‘alternative fuels’ simply become ‘fuels’. The MCA has already provided regulatory guidance on the use of new fuels and innovative technologies[56]. Given the pace of change within the industry, this guidance is adaptable as new technologies emerge and will continue to be developed as the need arises, supporting the sector to both innovate and transition towards zero GHG emissions.

Internationally, the MCA actively engages in discussions, together with likeminded Administrations, at the IMO. This allows the MCA to not only directly influence and contribute to the development of new global regulations, it also allows for cross-regulator learning and development. There is a great deal of activity in the IMO, such as the development of interim guidelines that ensure the safety of ships using compressed and liquid hydrogen and ammonia as fuels. These guidelines will be continuously updated based on gained experience and will ultimately evolve into final guidelines or mandatory provisions. Once the IMO agrees on applicable standards, the UK will implement them into the UK regulatory framework.

To date, efforts at the IMO have been focused on guidelines for the use of methanol, ammonia and hydrogen as fuels, with these guidelines expected to be variously completed by 2026. Work is also ongoing on fuel cell standards following on from the 2022 interim guidance, and mandatory requirements for methanol, ammonia and hydrogen will follow interim guidelines on these fuels.

It is not just fuels that require a sound regulatory framework. It is also important that those parts of sector investigating other alternatives now that may play a significant role in the future are supported. For example, the Merchant Shipping (Nuclear Ships) Regulations 2022[57], allows for the use of nuclear power in UK commercial shipping and the reception of merchant nuclear ships in UK waters. This positions the UK as an attractive destination for further development and investment in this area, creating opportunities for technological advancements.

6.2 Green skills

Green skills will help the maritime sector capitalise on future growth areas, driving the UK economy and supporting a maritime sector fit for the opportunities ahead.

DfT welcomes all industry efforts to attract more people into the sector as it decarbonises. Success in this area will be driven by strong partnerships across government and with industry.

Last year, the Government established a new arms-length body, Skills England, to coordinate and plan skills provision in all sectors. As Skills England develops, DfT will work with the Department of Education to reflect the needs and opportunities within maritime and will encourage industry engagement in its work. Additionally, the June 2024 report, 'Skills for Green Jobs', produced by the Maritime Skills Commission (MSC), identified current and future green skills shortages and recommended next steps and solutions to improve the green skills training offer.

The UK is well placed to meet the green skills needs, with a strong foundation in maritime education. London, for example, has more maritime education institutions than any other city in the world[58] and universities across the UK offer an extensive range of courses, including marine and mechanical engineering, naval architecture subsector specific courses on offshore engineering and technology for small craft. The UK maritime education offer extends beyond maritime technology and engineering to wider skills in maritime law, trade and finance, all of which will enable the decarbonisation of the sector. The Clean Maritime Research Hub, made up of 13 UK universities, is facilitating capacity building and skills development in the clean maritime research community across all career stages, for example through waves of flexible funding calls targeting emerging gaps in maritime research, which supports the career development of early career researchers.

Commitment

We will work with industry and across government to meet the maritime sector's future green skills needs.

The MCA is supporting green skills through training and certification. By investing in our cadets and seafarers, we can shape a greener and more efficient maritime sector. For example, from September 2025, all those holding Unlimited Certificates of Competency (Deck, Engineering and Electro Technical Officers) will receive training in sustainable practices and control of GHG emissions. The MCA recently certified the UK's first hydrogen course and consulted on the first Approved Electric Propulsion course for small vessels, with final criteria to be released shortly.

As well as delivering the right skills provision, it is essential that employers and prospective students are aware of the training opportunities available across the sector, which is why DfT supports Maritime UK's plans to explore the development of a digital skills and careers platform. The platform would enable industry and prospective students to search for and identify available courses and training across the maritime sector.

Skills are also a key enabler for shipbuilders to access green shipbuilding market opportunities, and there is a clear need for a sustained pipeline of skilled and highly motivated employees to support the industry to become more competitive. To support this, the NSO established the industry-led UK Shipbuilding Skills Taskforce[59] which made recommendations on resolving shortages in the skills needs of the sector. The Taskforce published its report in September 2023[60] outlining four priorities, including the need to collaborate on shipbuilding skills; to promote shipbuilding as a vibrant and inclusive sector; to leverage and enhance the existing skills system; and to ensure shipbuilding skills are fit for the future. In response to these recommendations, the NSO set up the Shipbuilding Skills Delivery Group to oversee and drive delivery of the recommendations. One of their identified priorities is to ensure that shipbuilding skills are fit for the future, including preparing for the skills needs arising from the transition to net zero.

6.3 Continuing R&D support through UK SHORE

The £236 million UK SHORE programme represents the biggest government investment ever in the UK's commercial maritime sector.

This has helped clarify the tools and barriers for achieving net zero, unlocked private sector investment and helped inform government regulation. R&D funding plays a dual role, addressing barriers to investment and accelerating development towards commercial readiness, but it also provides a boost to green growth, unlocking capital and supporting regional development and green jobs.

To date, UK SHORE has leveraged £108 million of private investment in green shipping technologies across a range of solutions, has provided funding across all 12 regions of the UK, and has funded over 150 small and medium enterprises (SMEs). Reflecting the scale of these benefits, and the success of UK SHORE, we will continue to support the sector with the recent announcement of a further £30 million of investment, through a sixth round of the CMDC[61]. CMDC6 will focus on the development of zero and near-zero GHG emission solutions on vessels, the shoreside infrastructure to support them and the scale-up of the supply chain.

There are already exciting outcomes from the UK SHORE programme. It has so far supported the completion of over 80 projects (which make up 10% of the total spend due to the larger projects still being in build phase) ranging from a new system to charge electric off-shore wind vessels to the demonstration of a new ammonia vessel[62]. We know from previous rounds of CMDC, including CMDC2 ports and shoreside projects[63], that there is space for a range of fuels and technologies in the maritime sector and that electricity is closer to commercial readiness than fuels such as ammonia and methanol (though some UK SHORE projects are exploring engine design and fuel viability for methanol and ammonia). Furthermore, UK SHORE projects have also supported the creation and retention of approximately 750 green and highly skilled jobs across the UK, with over 66% of projects having advanced towards commercialisation[64].

An interim evaluation report, covering the initial findings from UK SHORE, has been published alongside this *Strategy*.

Commitment

We will continue to support R&D through the sixth round of the Clean Maritime Demonstration Competition in 2025, which will support zero and near-zero GHG emission fuels and technology, and start projects on the path toward shoreside infrastructure while supporting the wider supply chain.

BOX 10 UK SHORE

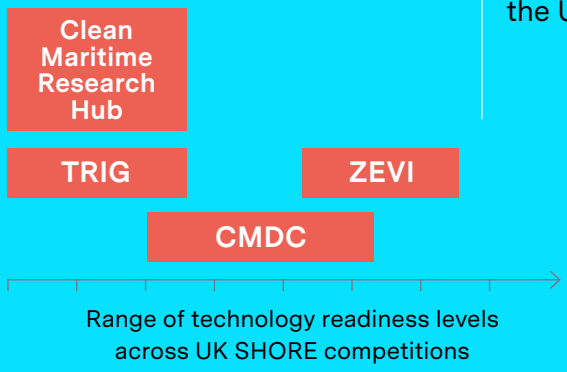
Provided
£236m
in government funding
to the development of clean maritime technology

Supporting over
150 projects
across a range of technologies
from future maritime fuels and infrastructure to energy efficiency measures

Leveraged over
£100m
in private investment
to support these projects

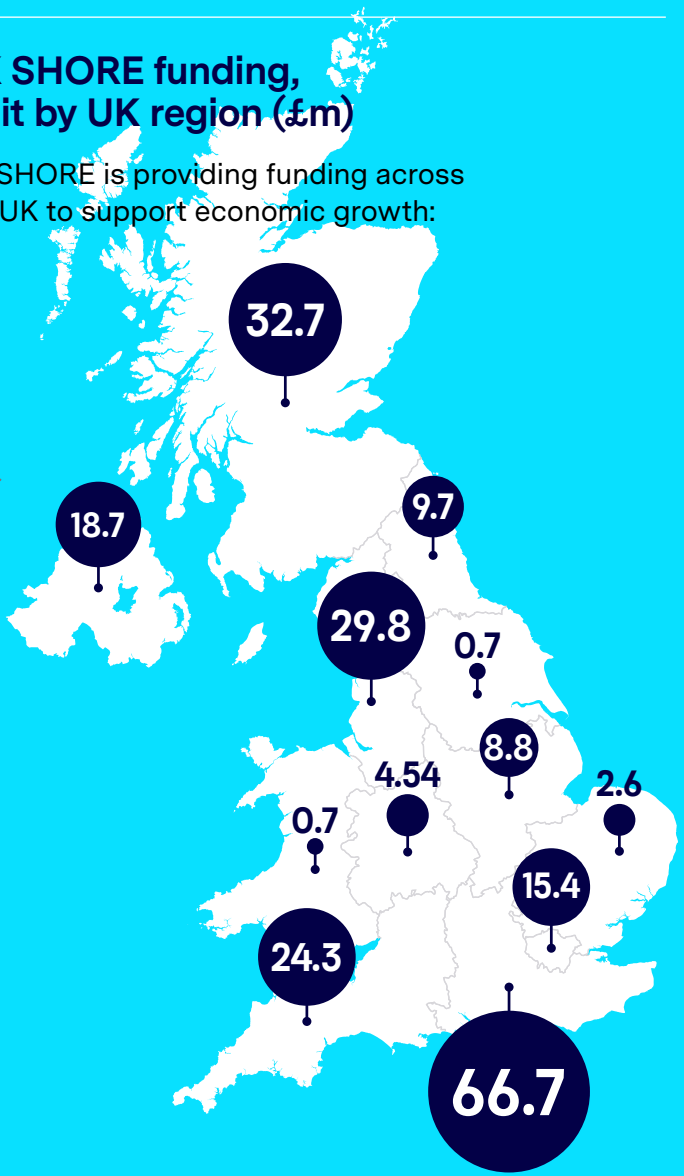
Approximately
30% of UK SHORE recipients received funding
from multiple competitions, helping to create a pipeline of R&D towards commercialisation

R&D targets across UK SHORE competitions



UK SHORE funding, split by UK region (£m)

UK SHORE is providing funding across the UK to support economic growth:



Completed UK SHORE projects have

supported the creation and retention of approximately
750 jobs

6.4 Green Corridors

The UK launched the Clydebank Declaration at COP26, in Glasgow, in November 2021 with the collective aim of supporting the implementation of at least six Green Corridors by the mid-2020s. Green Corridors are defined as 'zero-emission maritime routes between two or more ports'.

They represent the largest scale demonstrations of zero-emission shipping, tackling economic and regulatory barriers, often across states, and showcasing routes to commercial viability, enabling robust policies to be introduced that either require the uptake of clean maritime solutions or the phasing out of conventional, carbon-intensive technologies.

Green Corridors are an essential part of maritime decarbonisation, bringing together stakeholders across the sector including regulators, investors, shipyards and operators, introducing disruptive technologies and unlocking investment through a clear pathway to deployment. Green Corridors create demonstrable business cases for those keen to adopt clean technologies, and can be used to encourage even the slowest movers in the sector.

Since launching the Clydebank Declaration, the UK has formed bilateral partnerships to support the establishment of Green Shipping Corridors with the US, Norway, the Netherlands, France and Singapore. Further agreements are in place with Belgium, Spain and the Republic of Korea with the objective of creating further Green Corridors. These partnerships aim to convene government and private sector stakeholders to drive collaborative innovation and knowledge-sharing the establishment of Green Corridors between partner nations.

UK SHORE CMDC has supported our work on Green Corridors, providing over £1.1 million by completion in 2023 to support three feasibility studies between Dover & Calais/Dunkirk, Aberdeen & Bergen and a Clean Tyne Shipping Corridor aiming to link into the European Green Corridors Network[65].

Building on this success the £1.5 million International Green Corridor Fund was announced on 17 October 2024[66]. This will fund feasibility studies for Green Corridor routes including UK-Ireland, UK-Netherlands, UK-Norway and UK-Denmark. Partner countries are providing match-funding or in-kind contributions through access to information and facilitation of collaboration. Working with them, this fund will drive progress towards the delivery and implementation of Green Corridors by de-risking business development and future investment.

Moving forward, we will continue to work internationally to deliver Green Corridors and these learnings will be used to support the development of regulation and policy interventions with an eventual view to phase out R&D support.

Commitment

We will aim to develop at least one international green corridor from the UK by the end of 2027/28 and three domestic green corridors in the same timeframe.

BOX 11 Case Study: CMDC2 Port of Dover Green Corridor

Each year, the Port of Dover handles trade worth £144 billion and a third of all UK trade with the EU. A busy day sees up to 110 miles of freight via 130 ferry movements travel through the port.[67]

A £530,000 funding grant has supported the port's ambitions to become the UK's first high-volume green shipping corridor. The eight-month Green Corridor at Short Straits research project looked at how the Dover to Calais/Dunkirk routes can be decarbonised. This included an analysis of regulations and policies, together with an assessment of viable energy options for both marine and land-side vessels and vehicles. It has also allowed Dover to understand future electricity demand, including peak demand from charging battery electric ferries.

The Green Corridor at Short Straits project received funding from UK SHORE Clean Maritime Demonstration Competition Round 2 (CMDC2), and the project ended in August 2023.[68]

(Information provided by the project as part of their UK SHORE bid.)

6.5 Emission Control Areas and air quality

ECAs provide additional limits on air pollutant emissions on top of the IMO's global standards to prevent, reduce and control NOx or sulphur oxides (SOx) (and indirectly limiting Particular Matter (PM)) emissions from ships[69].

Vessels operating in an ECA are required to take actions to ensure that they are compliant with the more stringent limits that operate in the area. For SOx emissions, this could mean using low sulphur fuels or using an exhaust gas cleaning system. For NOx emissions, this could mean the fitting of a Tier III engine or using other abatement technologies.

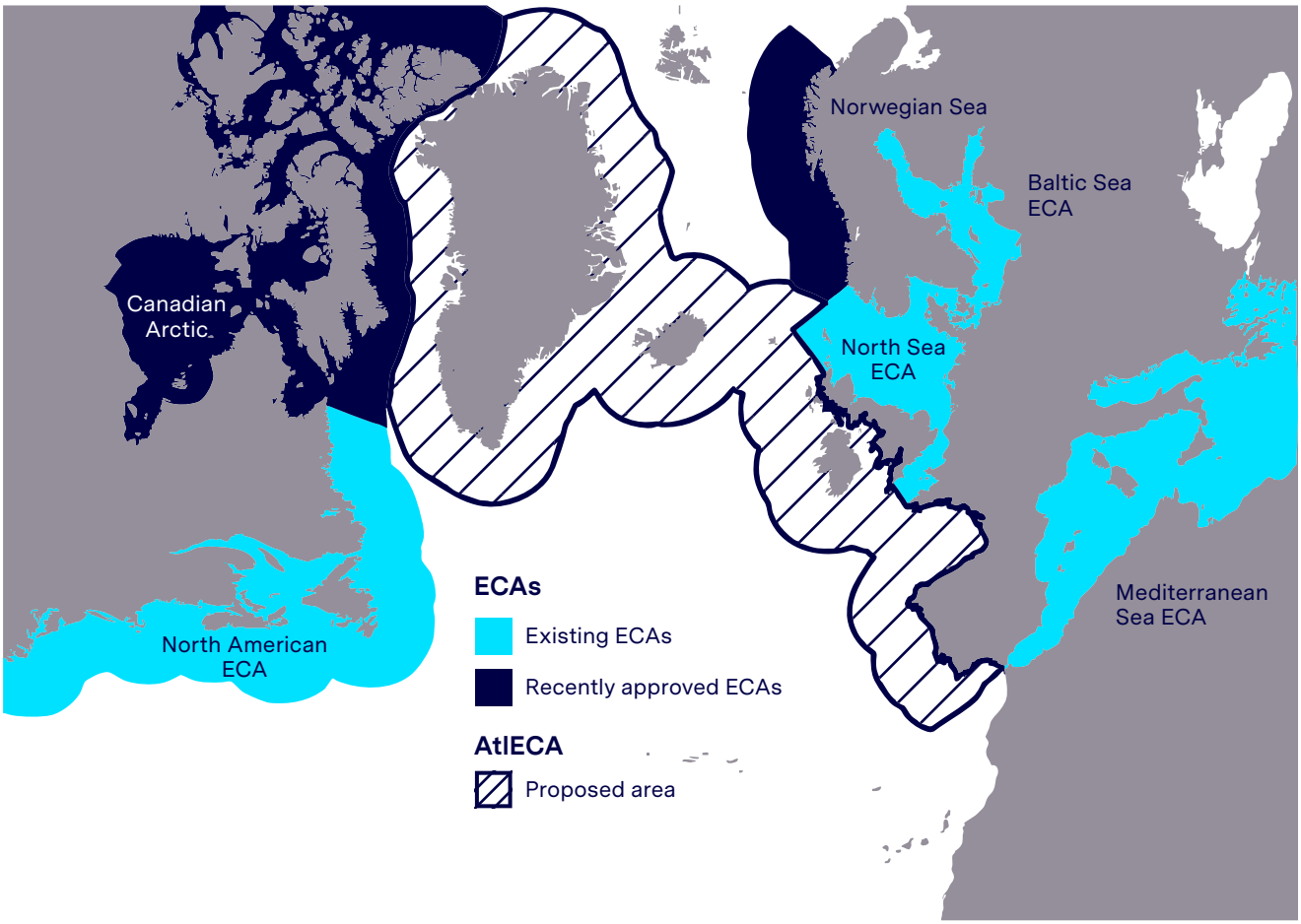
Last year, we launched a call for evidence to inform decisions to reduce air pollutants through the extension of ECAs. The UK is working with partner states along the North Atlantic to develop a proposal to designate a larger ECA along this sea area which would include all UK waters outside the existing North Sea ECA. This would link the existing ECAs in the Baltic Sea, North Sea and English Channel with the recently adopted ECAs in the Mediterranean Sea, Norwegian Sea and Canada Arctic. Figure 19 shows the proposed scope of the North Atlantic ECA. Evidence developed by the International Council on Clean Transportation estimates that this could lead to reductions in UK maritime emissions of SOx, PM2.5, and black carbon of up to 82%, 64%, and 31% respectively relative to a baseline scenario by 2030[70]. The proposed area also includes over 1,500 marine protected areas and 148 UNESCO World Heritage sites, which would benefit from reduced SOx and NOx emissions as these contribute to pollutants deposition and ocean acidification that harms marine biodiversity and cultural heritage sites.

As we develop our evidence base on air pollutant emissions of different zero, and near zero, GHG emission fuels and energy sources, as described in section 5.4, we will be able to better understand the full impact of the switch to these fuels from conventional marine fuels, and the potential impact on air quality and human health. It may be that our action through the IMO on the North Atlantic ECA will not be sufficient to reduce these emissions, and we will consider what further air pollution specific policies may be needed to protect both the environment and health outcomes.

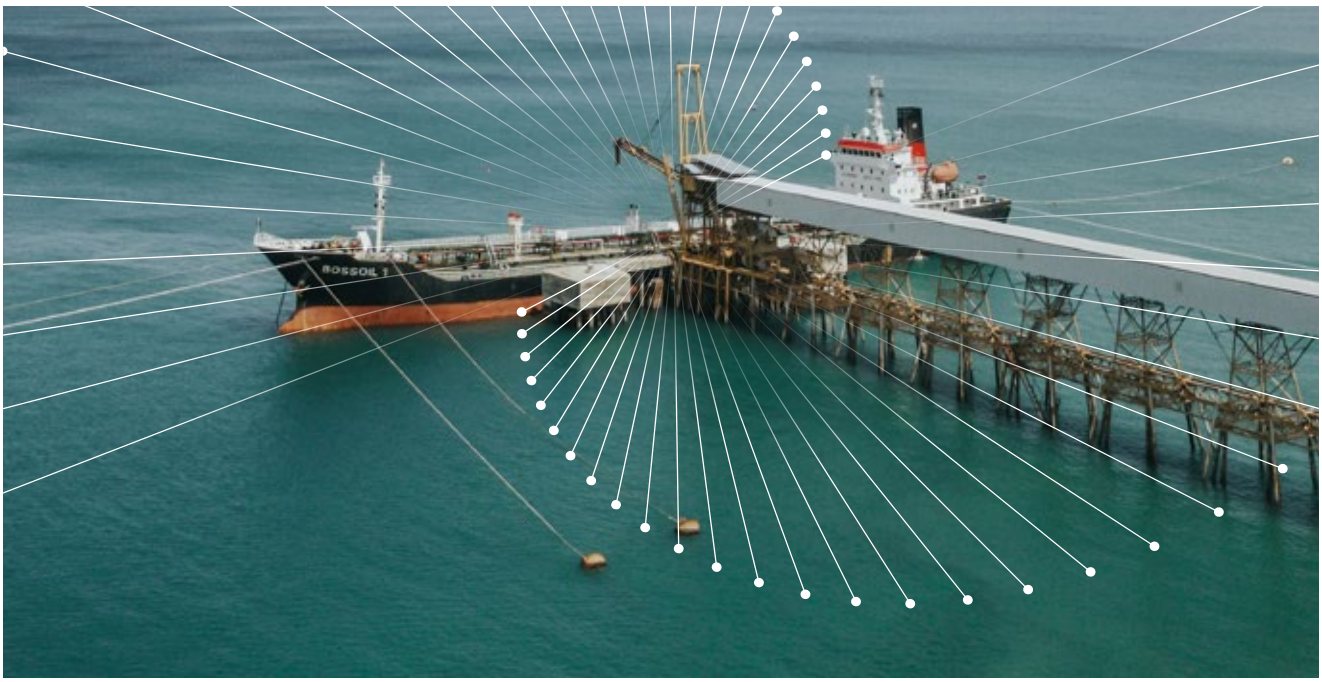
Commitment

We will work with neighbouring Atlantic coastal states to designate a North Atlantic ECA through the IMO, and consider the needs for further air pollution specific policies alongside maritime decarbonisation.

Figure 19: Proposed scope of the North Atlantic ECA



Note: Figure 19 shows the scope of the proposed North Atlantic ECA. If approved by IMO member states, this could see an additional 5.05 million km2 of ocean designated as an ECA, linking up the current and approved ECAs in Europe to those in North America. This map has been created by the International Council on Clean Transportation.



6.7 Government shipbuilding procurement

The UK is committed to ambitious action in green shipbuilding. However, we cannot expect industry to deliver this alone, and it is imperative that government also leads the way through its procurements. The Government has set out a series of policy objectives that underpin government procurement programmes.

This includes the objective to exceed our legal requirements on vessels using zero and near-zero GHG emission fuels and energy sources to reduce UK fleet emissions and encourage green growth, and to invest in emerging technologies. Alongside these objectives, to provide a clearer demand signal, the NSO have set out a 30-year cross-government shipbuilding pipeline of over 150 new vessels.

Through the delivery of this pipeline, the NSO is working across government to identify opportunities to deliver our ambitions for green growth and low carbon vessels across the commissioning cycle.

There is a clear case for government to be as ambitious as possible, and the NSO is clear that government procurements must be bold in their adoption of green technology. As a minimum, we will consider the introduction of legal requirements for government on green shipbuilding procurements, and actively encourage overachieving on these requirements across the full range of government shipbuilding procurements.

Commitments

The NSO will support the goals of this *Strategy* through future government procurement.


T.S. LINES
T.S. LINES
HANJIN
165
166

CHAPTER 7

Future Review

This chapter sets out our plans to review progress and impact in the next five years and to strengthen our evidence base, drawing on industry and academic expertise.


IMO5383158

7.1 Next steps

This *Strategy* presents the current best evidence and pathways towards reaching our UK domestic maritime emission reduction goal of zero fuel lifecycle GHG emissions by 2050, with at least a 30% reduction by 2030 and an 80% reduction by 2040, relative to 2008 levels.

However, we recognise that there are areas in which our evidence is less well developed, either due to a lack of data or the need for further research.

Additionally, we recognise that both the rapid pace of change of decarbonisation technologies and the impact of decisions taken internationally at the IMO will have a significant impact on UK domestic maritime emissions.

As such, we will need to review our progress regularly following key developments ahead of a likely refresh of this *Strategy*, which we expect to publish within five years, updating our goals and policy interventions as our evidence base increases in both size and robustness.

Commitments

We will continue to strengthen our maritime emissions modelling, analytical and data capabilities, and to publish reviews of this *Strategy* following the adoption of mid-term measures at the IMO and five years post publication.

Abbreviations list

CBDP – Carbon Budget Delivery Plan

CCUS – Carbon Capture, Usage and Storage

CII – Carbon Intensity Indicator

CMDC – Clean Maritime Demonstration Competition,

CO2 – Carbon dioxide

CO2e – Carbon dioxide equivalent

COP26 – 26th UN Climate Change Conference of the Parties

CTV – Crew Transfer Vessels

Defra – Department for Environment, Food & Rural Affairs

DfT – Department for Transport

DNO – Distribution Network Operator

ECA – Emission Control Area

EEDI – Energy Efficiency Design Index

EEXI – Energy Efficiency Existing Ship Index

EEZ – Exclusive Economic Zone

EPSRC – Engineering and Physical Sciences Research Council

EU – European Union

EU ETS – European Union Emissions Trading System

GBE – Great British Energy

GHG – Greenhouse gas

GT – Gross tonnes

GVA – Gross Value Added

HSE – Health and Safety Executive

IMO – International Maritime Organization

LCA – Lifecycle Assessment

LCF – Low Carbon Fuel

MCA – Maritime and Coastguard Agency

MEPC – Marine Environment Protection Committee

MRV – Monitoring, Reporting and Verification

MSC – Maritime Skills Commission

Mt – Megatonne

NESO – National Energy System Operator

NOx – Nitrogen oxides

NSO – National Shipbuilding Office

NWF – National Wealth Fund

OCCS – Onboard Carbon Capture and Storage

Ofgem – Office for Gas and Electricity Markets

PM – Particulate matter

R&D – Research and development

ROUV – remotely operated unmanned vessel

RTFO – Renewable Transport Fuel Obligation

RV – Research Vessel

SAF – Sustainable Aviation Fuel

SEEMP – Ship Energy Efficiency Management Plan

SME – small and medium enterprise

SOx – Sulphur oxides

SOV – Service Operation Vessels

SSAF – Smart Shipping Acceleration Fund

TRIG – Transport Research and Innovation Grant

TtW – Tank-to-Wake

UK ETS – United Kingdom Emissions Trading Scheme

UKRI – United Kingdom Research and Innovation

UK SHORE – United Kingdom Shipping Office for Reducing Emissions

WtT – Well-to-Tank

WtW – Well-to-Wake

ZEVI – Zero Emission Vessels and Infrastructure

Endnotes

1 DfT analysis of HMRC bulk customs data. DfT use the port of entry for the good to define the mode, as the HMRC mode of transport field is incomplete and not validated. This method results in 17% of total trade in weight and 14% of total trade by value having an unknown mode of transport which are not included in this analysis. For more information regarding the data, please see HMRC Trade Info: https://www.uktradeinfo.com/trade-data/latest-bulk-datasets/

2 https://www.gov.uk/government/statistics/transport-and-environment-statistics-2024/greenhouse-gas-emissions-from-transport-in-2022

3 https://www.gov.uk/government/statistics/transport-and-environment-statistics-2024/greenhouse-gas-emissions-from-transport-in-2022

4 https://edgar.jrc.ec.europa.eu/report_2024

5 2023 IMO Strategy on Reduction of GHG Emissions from Ships; https://www.imo.org/en/OurWork/Environment/Pages/2023-IMO-Strategy-on-Reduction-of-GHG-Emissions-from-Ships.aspx

6 UK becomes first major economy to pass net zero emissions law – GOV.UK (www.gov.uk); https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

7 Maritime UK (2022), State of the Maritime Nation 2022; https://www.maritimelondon.com/wp-content/uploads/2022/06/CEBR-report-2022pdf.pdf

8 UK becomes first major economy to pass net zero emissions law – GOV.UK (www.gov.uk); https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

9 2023 IMO Strategy on Reduction of GHG Emissions from Ships; https://www.imo.org/en/OurWork/Environment/Pages/2023-IMO-Strategy-on-Reduction-of-GHG-Emissions-from-Ships.aspx

10 The Paris Agreement | UNFCCC; https://unfccc.int/process-and-meetings/the-paris-agreement

11 2023 IMO Strategy on Reduction of GHG Emissions from Ships; https://www.imo.org/en/OurWork/Environment/Pages/2023-IMO-Strategy-on-Reduction-of-GHG-Emissions-from-Ships.aspx

12 https://www.imo.org/en/OurWork/Environment/Pages/2023-IMO-Strategy-on-Reduction-of-GHG-Emissions-from-Ships.aspx

13 https://www.gov.uk/government/news/chris-stark-to-lead-mission-control-to-deliver-clean-power-by-2030

14 https://www.theccc.org.uk/publication/progress-in-reducing-emissions-2024-report-to-parliament/

15 Digest of UK Energy Statistics (DUKES): petroleum –GOV.UK Table 3.2au Petroleum products: commodity balances – alternative units, barrels and litres; https://www.gov.uk/government/statistics/petroleum-chapter-3-digest-of-united-kingdom-energy-statistics-dukes

16 DfT analysis of HMRC bulk customs data. DfT use the port of entry for the good to define the mode, as the HMRC mode of transport field is incomplete and not validated. This method results in 17% of total trade in weight and 14% of total trade by value having an unknown mode of transport which are not included in this analysis. For more information regarding the data, please see HMRC Trade Info; https://www.uktradeinfo.com/trade-data/latest-bulk-datasets/

17 Maritime UK (2022), State of the Maritime Nation 2022, https://www.maritimelondon.com/wp-content/uploads/2022/06/CEBR-report-2022pdf.pdf

18 Maritime UK (2022), The economic contribution of the UK Maritime Engineering and Science Industry; https://www.maritimeuk.org/media-centre/publications/2022-cebr-reports/

19 Figures taken from research carried out by Ricardo for DfT in 2024 as part of the Net Zero Transport Growth Opportunities and Impacts Programme. Estimates cover GVA and jobs related to on-board technologies, fuel storage and engines. This research will be published on GOV.UK in due course.

20 Global Maritime Forum (2024), Green Jobs and Maritime Decarbonisation; Green-jobs-and-maritime-decarbonisation.pdf (globalmaritimeforum.org); https://cms.globalmaritimeforum.org/wp-content/uploads/2024/05/Green-jobs-and-maritime-decarbonisation.pdf

21 Targets have been set as secondary legislation under the Environment Act (2021) https://www.legislation.gov.uk/uksi/2023/96/contents/made

22 NSO (2022), National Shipbuilding Strategy Refresh; https://www.gov.uk/government/publications/refresh-to-the-national-shipbuilding-strategy

23 DfT (2021), Clean Maritime Demonstration Competition; https://www.gov.uk/government/publications/clean-maritime-demonstration-competition-cmdc

24 DfT (2023), Zero Emission Vessels and Infrastructure (ZEVI) competition; https://www.gov.uk/government/publications/zero-emission-vessels-and-infrastructure-zevi-competition

25 DfT (2023), Clean Maritime Research Hub competition; https://www.gov.uk/government/publications/clean-maritime-research-hub-competition/clean-maritime-research-hub-competition

26 MariNH3 project webpage; https://marinh3.ac.uk/

27 Renewable Transport Fuel Obligation – GOV.UK; https://www.gov.uk/guidance/renewable-transport-fuels-obligation

28 GOV.UK; https://www.gov.uk/government/statistical-data-sets/energy-and-environment-data-tables-env

29 Ship type categories are consistent with those used in the IMO 4th GHG Study. Please refer to the Ship Types sheet within the Maritime Emissions Model inputs spreadsheet for further detail on which vessels are included within each category.

30 2022 Progress Report to Parliament – Climate Change Committee; https://www.theccc.org.uk/publication/2022-progress-report-to-parliament/

31 This is different to the approach taken when calculating transport's contribution to meeting carbon budgets, which does not generally consider the upstream emissions emitted during the production of fuels (as this is accounted for in other sectors' totals).

32 UK Low Carbon Hydrogen Standard – GOV.UK; https://www.gov.uk/government/publications/uk-low-carbon-hydrogen-standard-emissions-reporting-and-sustainability-criteria

33 Multi-year clean maritime demonstration competition – GOV.UK; https://www.gov.uk/government/publications/clean-maritime-demonstration-competition-cmdc

34 https://www.imo.org/en/OurWork/Environment/Pages/Lifecycle-GHG---carbon-intensity-guidelines.aspx

35 WG 46: Working Group on Life Cycle GHG Intensity of Marine Fuels | GESAMP; http://www.gesamp.org/work/groups/gesamp-working-groupo-n-life-cycle-ghg-intensity-of-marine-fuels

36 GOV.UK 2023; https://www.gov.uk/government/publications/biomass-strategy

37 Sustainable aviation fuel initiatives – GOV.UK; https://www.gov.uk/government/speeches/sustainable-aviation-fuel-initiatives

38 European Council (2023), FuelEU maritime initiative; https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/fueleu-maritime-initiative-council-adopts-new-law-to-decarbonise-the-maritime-sector/

39 UK ETS Authority (2023), Developing the UK Emissions Trading Scheme: Main Response; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1166812/uk-emissions-trading-scheme-consultation-government-response.pdf

40 Zero Emission Vessels and Infrastructure (ZEVI) competition winners – GOV.UK; https://www.gov.uk/government/publications/zero-emission-vessels-and-infrastructure-zevi-competition-winners

41 Zero Emission Vessels and Infrastructure (ZEVI) competition winners – GOV.UK; https://www.gov.uk/government/publications/zero-emission-vessels-and-infrastructure-zevi-competition-winners

42 Multi-year clean maritime demonstration competition – GOV.UK; https://www.gov.uk/government/publications/clean-maritime-demonstration-competition-cmdc

43 British Ports Association and the UK Major Ports Group commissioned ports within their membership to provide information on their future electricity demand

44 https://assets.publishing.service.gov.uk/media/677bc80399c93b7286a396d6/clean-power-2030-action-plan-main-report.pdf

45 https://www.gov.uk/government/publications/national-wealth-fund-mobilising-private-investment/national-wealth-fund-mobilising-private-investment-accessible

46 https://www.gov.uk/government/publications/introducing-great-british-energy/great-british-energy-founding-statement

47 https://assets.publishing.service.gov.uk/media/677bc80399c93b7286a396d6/clean-power-2030-action-plan-main-report.pdf

48 Figure from the International Maritime Organization's information page on 'Short-term GHG reduction measures' https://www.imo.org/en/OurWork/Environment/Pages/Short-term-GHG-reduction-measure.aspx

49 1) fuel regulation, 2) emissions pricing, 3) measures for emissions from vessels at berth, 4) measures for emissions from smaller vessels and targeted subsectors, and 5) energy efficiency measures.

50 Refer to Table 2 in the Analytical Annex for details of the assumptions that have been made to produce these scenarios. These assumptions are indicative and may not reflect the final policy measures or their timing, as they will be subject to public consultation, or in the case of the IMO, the final outcome of ongoing negotiations

51 Potential examples of non-modelled fuels that could have negative WtW GHG emissions include the use of hydrogen produced using bioenergy with carbon capture and storage (BECCS); and methanol produced using renewable electricity and carbon dioxide (CO2) extracted from the atmosphere using Direct Air Carbon Capture and Storage (DACCS) and used by vessels fitted with OCCS. However, further work is required to develop our evidence on fuels with negative WtW GHG emissions before these can be included in our maritime emissions model.

52 https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/FFT%20Project/MEPC80-INF.10%20-%20Summary%20report%20on%20the%20study%20.PDF

53 https://assets.publishing.service.gov.uk/media/6763f8f33229e84d9bbde88a/env0301.ods; H ApSimon, T Oxley and H Woodward (2021), The contribution of shipping emissions to pollutant concentrations and nitrogen deposition across the UK; https://uk-air.defra.gov.uk/library/reports?report_id=1028

54 H ApSimon, T Oxley and H Woodward (2021), The contribution of shipping emissions to pollutant concentrations and nitrogen deposition across the UK; https://uk-air.defra.gov.uk/library/reports?report_id=1028

55 WHO (2021), New WHO Global Air Quality Guidelines aim to save millions of lives from air pollution; https://www.who.int/news/item/22-09-2021-new-who-global-air-quality-guidelines-aim-to-save-millions-of-lives-from-air-pollution

56 MCA (2022), MGN 664, MCA (2023), The Workboat Code Edition 3, and MCA (2024) MGN 550; https://www.gov.uk/government/publications/mgn-664-mf-amendment-1-certification-process-for-vessels-using-innovative-technology, https://www.gov.uk/government/publications/the-workboat-code-edition-3, MGN 550 (M+F) Amendment 1: Electrical installations – guidance for safe design, installation and operation of lithium-ion batteries – GOV.UK (www.gov.uk); https://www.gov.uk/government/publications/mgn-550-mf-amendment-1-electrical-installations-guidance-for-safe-design-installation-and-operation-of-lithium-ion-batteries

57 MCA (2022), Nuclear Ships guidance note; https://www.gov.uk/government/publications/mgn-679-nuclear-ships

58 DNV (2024), The Leading Maritime Cities of the World in 2024; https://www.dnv.com/maritime/publications/the-leading-maritime-cities-in-the-world-in-2024/

59 GOV.UK, 2023, UK Shipbuilding Task Force: UK shipbuilding skills taskforce (UKSST) – GOV.UK (www.gov.uk); https://www.gov.uk/government/groups/uk-shipbuilding-skills-taskforce-uksst

60 A Step Change in UK Shipbuilding https://www.cityofglasgowcollege.ac.uk/sites/default/files/A%20Step%20Change%20UK%20ShipSkills_Digital.pdf

61 https://www.gov.uk/government/news/30-million-to-clean-up-sea-travel-and-turbocharge-coastal-economies

62 https://www.ukri.org/wp-content/uploads/2022/09/IUK-28092022-7052_CMDC-Project-Brochure_sh_final1.pdf

63 CMDC2 Brochure: Innovate-UK-Clean-Maritime-Rd-2-Booklet-final.pdf; https://iuk-business-connect.org.uk/wp-content/uploads/2024/10/Innovate-UK-Clean-Maritime-Rd-2-Booklet-final.pdf#page=7&zoom=100,0,0

64 Based on projects reporting of Commercial Readiness Level (CRL) progress. Commercial readiness levels are a type of measurement system used to assess the commercial maturity level of a particular technology.

65 Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping (2022), Green Corridor in Northern Europe and the Baltic Sea; https://www.zerocarbonshipping.com/projects/green-corridor-in-northern-europe-and-the-baltic-sea/

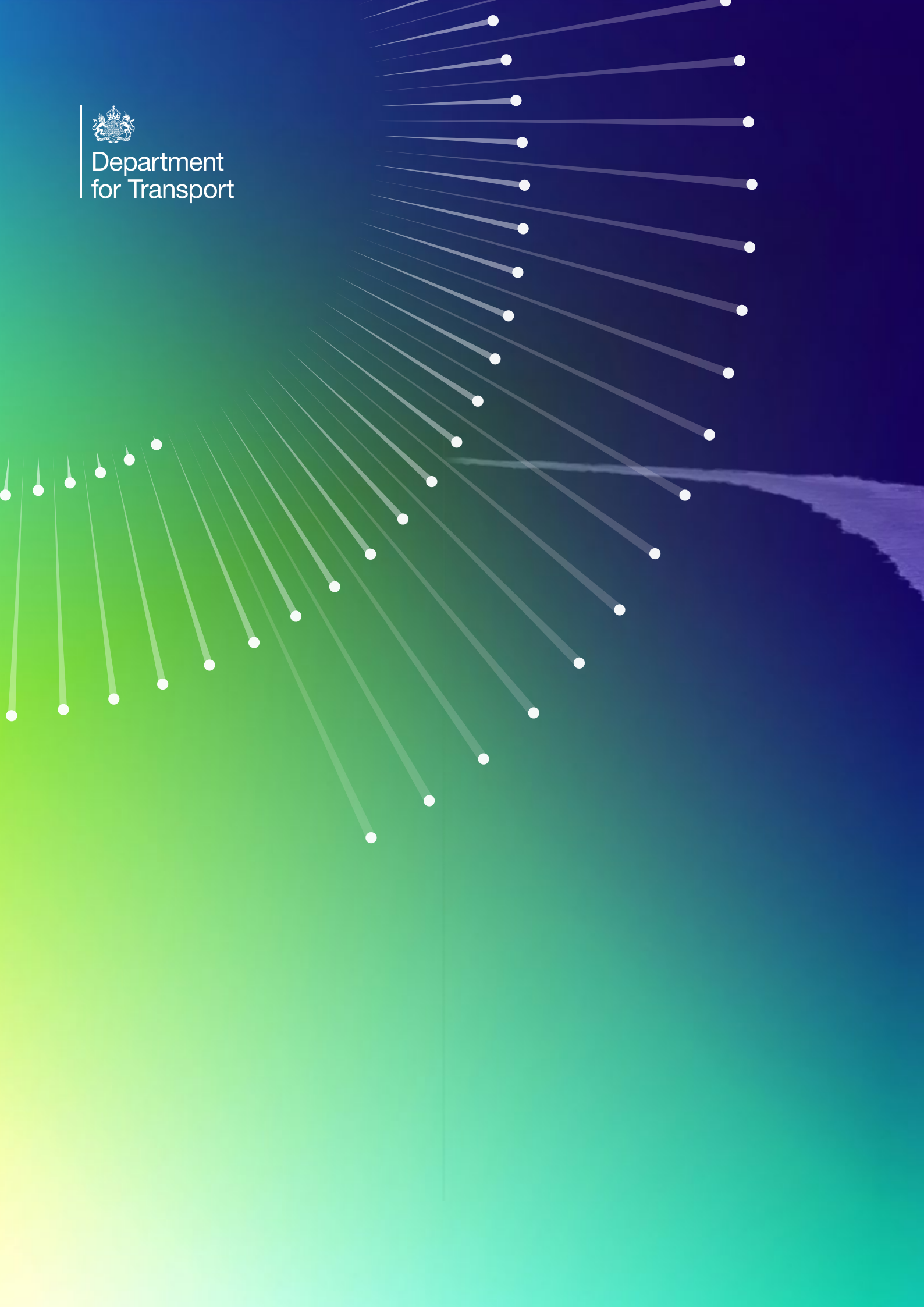
66 Passengers to enjoy cleaner travel between UK and Europe – GOV.UK; https://www.gov.uk/government/news/passengers-to-enjoy-cleaner-travel-between-uk-and-europe

67 Oxera 2021: the role of the Port of Dover in the UK economy.

68 Multi-year clean maritime demonstration competition – GOV.UK; https://www.gov.uk/government/publications/clean-maritime-demonstration-competition-cmdc

69 IMO, Emission Control Areas (ECAs) designated under MARPOL Annex VI https://www.imo.org/en/OurWork/Environment/Pages/Emission-Control-Areas-(ECAs)-designated-under-regulation-13-of-MARPOL-Annex-VI-(NOx-emission-control).aspx

70 https://theicct.org/wp-content/uploads/2024/06/ID-146-%E2%80%93-Atlantic-ECA_final-1.pdf


Department
for Transport