

Title: The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023 IA No: DfT00458 RPC Reference No: RPC-DfT-5256(1) Lead department or agency: Department for Transport	Impact Assessment (IA)			
	Date: 02/03/2023			
	Stage: Final			
	Source of intervention: International			
	Type of measure: Secondary Legislation			
Contact for enquiries: maritimetdpconsultation@dft.gov.uk				
Summary: Intervention and Options			RPC Opinion: Green	

Cost of Preferred (or more likely) Option (in 2019 prices, 2020 present value)

Total Net Present Social Value	Business Net Present Value	Net cost to business per year ¹	Business Impact Target Status
£-0.5m	£-0.1m	£42.6m	Non-qualifying provision

What is the problem under consideration? Why is government intervention necessary?

In 2021, as part of its greenhouse gas (GHG) emissions reduction strategy, the International Maritime Organization (IMO) adopted two measures requiring ships to reduce their carbon intensity: a design measure, Energy Efficiency Ship Index (EEXI), and an annual carbon performance measure, Carbon Intensity Indicator (CII). Under the UK's international obligations, these amendments must be incorporated into UK domestic law via amendments to the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008. These new measures entered into force internationally on 1 November 2022 and take effect from 1 January 2023. The measures are currently being applied by the UK international fleet. The MCA's full powers of enforcement will not be available until the amending UK statutory instrument (SI) is made and comes into force.

What are the policy objectives and the intended effects?

The policy objectives are: (a) to accelerate progress on decarbonising the international shipping sector; and (b) to comply with the UK's international obligations to implement IMO regulations for UK-flagged vessels that perform international voyages; and (c) to enable the UK Maritime and Coastguard Agency inspectors to monitor compliance with new and existing IMO carbon reduction measures.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

The preferred option is to fully implement the latest international regulations into UK law for UK-flagged vessels that perform international voyages. Because the UK is obliged to implement the IMO regulations, doing nothing or taking non-regulatory action would fail to meet policy objectives. These measures were supported by the UK during IMO negotiations, and industry stakeholders were part of the IMO process. The amendments must be incorporated into UK domestic law and failure to make this SI will mean that the UK will be in breach of its international obligations as party to the MARPOL Convention and will impede the MCA's ability to enforce compliance. Given the need to ensure that UK law is changed to fully align with the new IMO rules, no alternatives to secondary legislation have been identified. The application of the international regulations to UK-flagged vessels that operate exclusively on domestic journeys within the UK is out of scope of this impact assessment.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** March 2028

Does implementation go beyond minimum EU requirements?	N/A			
Is this measure likely to impact on international trade and investment?	Yes			
Are any of these organisations in scope?	Micro Yes	Small Yes	Medium Yes	Large Yes
What is the CO ₂ equivalent change in greenhouse gas emissions? (Million tonnes CO ₂ equivalent)	Traded: <small>See 'Environmental Impacts' section</small>		Non-traded: <small>See 'Environmental Impacts' section</small>	

¹ This estimates the Net cost to UK business due to the new international regulations introduced by the IMO. The Net cost to UK business from 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will be significantly lower.

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister:

Vere of Norbiton

Date:

30/03/23

Summary: Analysis & Evidence

Policy Option 1

Description: Full implementation of the latest international regulations into UK law for UK-flagged vessels that perform international voyages.

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
2023	2023	8	Low: -	High: -	Best Estimate: -0.7

COSTS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	-	1	-	(see sensitivity analysis)
High	-		-	(see sensitivity analysis)
Best Estimate	0.1		0.1	0.7

Description and scale of key monetised costs by 'main affected groups'

1. Ship operators will need to make their vessels more carbon-efficient to comply with the new international regulations (EEXI and CII) introduced by the IMO (options for achieving this include engine power limitations, alternative fuels or energy efficiency measures). The cost-benefit analysis in this IA estimates the total additional compliance costs to UK-flagged vessels that perform international voyages of complying with the new international regulations at around £650m between 2023 and 2030 (present value). This represents an estimate of the overall costs of the new international regulations introduced by the IMO rather than the additional costs due to the introduction of any new domestic implementing legislation in the UK.

Even in the absence of implementing any new domestic legislation in the UK, ships operating internationally are expected to comply with the new international regulations to avoid enforcement action and fines from other IMO states. Therefore, it is expected that there would be no additional compliance costs to UK-flagged vessels that perform international voyages due to the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023'.

2. Familiarisation costs to UK-flagged vessels that perform international voyages have been estimated at around **£0.1m**. These costs are assumed to be incurred in 2023.

3. Total public sector enforcement costs (for port state control inspections) have been estimated at around **£0.6m** between 2023 and 2030 (present value).

Other key non-monetised costs by 'main affected groups'

By increasing shipping costs, the new international regulations introduced by the IMO are expected to have a small negative impact on world trade (in percentage terms), including the UK's international trade. However, as we expect that ships operating internationally (which are responsible for transporting the UK's international trade) will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK, it is not expected that the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will have a significant impact on the UK's international trade or UK GDP.

BENEFITS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	-	-	-	(see sensitivity analysis)
High	-		-	(see sensitivity analysis)
Best Estimate	0		0	0

Description and scale of key monetised benefits by 'main affected groups'

The key benefit of ships operating more efficiently due to the new international regulations introduced by the IMO is to reduce carbon dioxide (CO₂) emissions, which is of wider social benefit. The cost-benefit analysis in this IA estimates that the CO₂ emissions from UK-flagged vessels that perform international voyages will be reduced by about 7 million tonnes in total due to the new international regulations introduced by the IMO between 2023 and 2030. Monetising this using UK carbon values, the value of these emission reductions is

estimated to be around £1.7bn (present value). This represents an estimate of the overall benefits of the new international regulations introduced by the IMO rather than the additional benefits due to the introduction of any new domestic implementing legislation in the UK. As we expect that ships operating internationally will comply with the new international regulations introduced by the IMO in the absence of any new domestic implementing legislation in the UK, it is expected that there would be no additional reduction in CO₂ emissions due to the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023'.

Other key non-monetised benefits by 'main affected groups'

1. In addition to the CO₂ savings, the new international regulations introduced by the IMO are expected to improve air quality in the UK by reducing fuel consumption. The impacts on air pollutant emissions have not been quantified due to the limitations of the available evidence. However, as we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK, it is expected that there would be no additional benefits from the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023'.

2. The implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will avoid the risks of the UK failing to fulfil international obligations, and this will maintain and enhance the UK's reputation for environmental action. This will help to ensure the UK is credible in seeking to take a leading role in international maritime decarbonisation. In addition, fully implementing the MARPOL Annex VI Regulations for UK-flagged vessels that perform international voyages will ensure the UK complies with international obligations. This will maintain confidence in the UK shipping sector and in the UK flag and will avoid possible negative consequences which may have occurred in the do-nothing option. In order for 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' to result in a net benefit to society, the value of these non-monetised benefits would need to exceed the value of the monetised costs (i.e. the value of these benefits would need to be around £0.1 million per year during the 8-year appraisal period on average). Whilst the value of the non-monetised benefits is necessarily uncertain, given the high priority that the UK places on maritime decarbonisation and the risks of failing to implement the MARPOL Annex VI Regulations, the Department considers that the benefits of introducing the 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' justify the costs.

Key assumptions/sensitivities/risks

Discount rate (%)

3.5%

As the primary focus of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' is the regulation of UK-flagged vessels that perform international voyages, the quantified cost-benefit analysis in this IA assesses the costs and benefits of UK-flagged vessels that perform international voyages complying with the new international requirements (EEXI and CII) introduced by the IMO.

Two approaches are taken.

1. To provide evidence on the expected impacts due to the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023', the Full Economic Assessment above estimates the impacts that could arise due to the introduction of new domestic implementing legislation in the UK. The estimated 'Net Benefit' above therefore represents the estimated impact of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' (rather than the overall impacts of the new international regulations). This also applies to the estimated 'Total Net Present Social Value' and 'Business Net Present Value' on the 'Summary: Intervention and Options' sheet.

2. In contrast, in order to illustrate the overall impact of the new international regulations (EEXI and CII) on UK businesses in line with guidance from the Regulatory Policy Committee, the Business Assessment below estimates the overall costs of the new international regulations to UK-flagged vessels that perform international voyages and are UK-owned, as this is considered to be the best proxy for the direct impacts of the new international requirements on UK businesses. The estimates of the 'Direct impact on business' below therefore represent estimates of the overall impacts of the new international regulations (rather than the impacts of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023'). This also applies to the estimated 'Net cost to business per year' on the 'Summary: Intervention and Options' sheet above.

The costs taken into account in the analysis include capital expenditure (newbuild costs plus costs of energy efficiency, engines and fuel storage), operational expenditure (running costs, including crew costs

and maintenance costs), and fuel costs. Due to the limitations of the available evidence, not all costs are taken into account for certain ship types. In addition, not all relevant vessels are included in the cost-benefit analysis as the necessary input data is not available for some vessels. However, these issues only affect a very small percentage of the UK-flagged vessels in scope of the new international regulations on a deadweight tonnage basis (a measure of cargo carrying capacity), so the analysis is considered to be fit-for-purpose.

The cost-benefit analysis uses international evidence from International Maritime Organization (IMO) document MEPC 76/7/13 on the Comprehensive impact assessment of the short-term measures. The major risk to the validity of this approach is the UK fleet having different characteristics to the world fleet. This is partly mitigated by incorporating UK-specific data where available. In addition, extensive sensitivity analysis has been undertaken to test the impact of changing key assumptions and inputs.

Nevertheless, as the analysis in this impact assessment is very sensitive to the data sources that have been used and the assumptions that have been made, the estimates in this impact assessment are subject to considerable uncertainty. Therefore, the estimates presented in this impact assessment should be treated as indicative estimates of the order of magnitude of these costs and benefits.

BUSINESS ASSESSMENT (Option 1) (impact on UK-owned vessels in scope only, in 2019 prices, 2020 present value)

Direct impact on business (Equivalent Annual) £m:²			Score for Business Impact Target (qualifying provisions only) £m:
Costs: 42.6	Benefits: 0	Net: -42.6	Non-qualifying (international provision)

² This is an estimate of the Direct impact on UK business due to the new international regulations introduced by the IMO. The Direct impact on UK business from 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will be significantly lower than this.

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1. Policy Rationale

Policy background

- 1.1 In April 2018, the International Maritime Organization (IMO) agreed its 'Initial Strategy' on Reduction of Greenhouse Gas (GHG) Emissions from Ships³. This commits signatories to reducing GHG emissions from international shipping by at least 50% by 2050 (compared to 2008), while pursuing efforts to fully phase them out as soon as possible this century. It also includes a target of at least a 40% improvement in carbon intensity of ships by 2030, pursuing efforts towards 70% in 2050. The Initial Strategy sets out a timeline for policy measures to be considered to reduce GHG emissions from ships in the short-, mid- and long-term. Short-term measures are those which could be finalised by the International Maritime Organization's Marine Environment Protection Committee (MEPC) between 2018 and 2023⁴. In autumn 2020 and spring 2021, MEPC 75 and 76 sessions, agreed a package of short-term technical and operational energy efficiency measures for new and existing ships. The measures were supported by the UK, though the UK and other climate ambitious members had sought more aggressive reduction targets to 2030.
- 1.2 As part of these short-term measures, in June 2021, the IMO adopted two amendments to Annex VI (Air Pollution) of the International Convention for the Prevention of Pollution from Ships (MARPOL)⁵ (the "MARPOL Annex VI Regulations" herein). The measures build on existing carbon reduction measures: an Energy Efficiency Design Index (EEDI) standard for new ships, introduced in 2013, and a reporting requirement related to fuel oil consumption for ships, introduced in 2019⁶.
- 1.3 The measures will apply to UK flagged vessels that perform international voyages. The measures will not apply to UK-flagged vessels that operate exclusively on domestic journeys within the UK. In response to a targeted consultation on the forthcoming implementing statutory instrument, stakeholders, including domestic ferry operators, raised concerns about the impacts of applying these measures to the domestic fleet, since they considered that the carbon reduction measures have not been designed with short domestic routes in mind.
- 1.4 The IMO is due to review these carbon reduction measures in 2026. Ahead of this review, DfT will consult with maritime stakeholders on the domestic application of these measures and carry out further analysis on the potential impacts.
- 1.5 These new measures entered into force internationally on 1 November 2022 and take effect from 1 January 2023. These must be incorporated into UK domestic law via the proposed statutory instrument. Currently, the measures are being applied by the UK international fleet (i.e. UK flagged vessel that perform international voyages).
- 1.6 The MARPOL Annex VI Regulations focus on reducing CO₂ emissions from ships, focussing on technical design and operational efficiency respectively:
 - **Energy Efficiency Ship Index (EEXI)**: this is a technical measure and a one-time requirement concerning ship design aimed at improving energy efficiency of a ship's design. The EEXI applies to all existing ships over 400GT (gross tonnage) which fall under MARPOL Annex VI. This builds upon the Energy Efficiency Design Index (EEDI) measure, which already applies to new vessels built after 2013. The measure will operate on a pass or fail test completed at the first annual survey or special survey from 1 January 2023.
 - **Carbon Intensity Indicator (CII)**: in contrast to the EEXI, the CII measure is an operational measure concerning a ships annual CO₂ emission performance. The CII

³ See details and text at <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx/>.

⁴ The Marine Environment Protection Committee (MEPC) of the IMO meets three times every two years and is the Committee empowered to consider any matter within the scope of the IMO concerned with prevention and control of pollution from ships. The Committee has established an Intersessional Working Group to discuss matters relating to the reduction of GHG emissions from ships (ISWG-GHG).

⁵ See details of MARPOL at [https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx).

⁶ See details at <https://www.imo.org/en/OurWork/Environment/Pages/Technical-and-Operational-Measures.aspx> and <https://www.imo.org/en/OurWork/Environment/Pages/Data-Collection-System.aspx/>.

applies to all ships over 5,000GT which fall under MARPOL Annex VI Regulations. Ships will be reviewed annually and rated between A and E based on performance. The measure is aimed at improving ship's energy efficiency by gradually enforcing stricter year-on-year emission targets. Monitoring of CII will start from 1 January 2023.

- 1.7 The amending Statutory Instrument implements the MARPOL Annex VI Regulations and standards into UK domestic law via amendments to the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (the "2008 Regulations"). To ensure compliance with the new IMO measures (and to make the existing enforcement provisions more effective), enforcement mechanisms are included in the implementing legislation. The Merchant Shipping Act 1995 permits provisions to be made for carrying out inspections, creating criminal offences and detaining a ship.

Rationale for intervention

- 1.8 Science is clear that the world is warming, that this is occurring because of human activity, and that left unchecked, continued warming would be deeply harmful, not just to the natural world, but also to human security and wellbeing. Global average temperatures have already risen by around 1.1°C and 2020 concluded the earth's warmest 10-year period on record. Without action to reduce the level of greenhouse gas (GHG) emissions emitted globally down to net zero, climate change is set to continue with increasing temperatures across the world⁷.
- 1.9 The global shipping industry produces significant emissions of GHGs, including carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O)⁸. The costs resulting from these GHG emissions are 'negative externalities', meaning the costs are incurred by third parties: privately owned and operated ships produce emissions, but the negative consequences are imposed on wider society and the environment. As these 'negative externalities' are not reflected in the market prices of the fuels used by the shipping industry, it would underinvest in reducing emissions in the absence of intervention. Intervention by governments is therefore required to set appropriate limits to reduce these emissions.
- 1.10 International shipping is a global industry, meaning it is difficult for countries to regulate it individually. Therefore, shipping is regulated through international conventions. By co-operating, governments can ensure compliance with a commonly agreed framework of rules. By applying international regulations, the shipping industry can gain greater certainty of the regulatory framework for several years, reducing the risk that policies may change and enabling the owners and operators of vessels to plan a strategy to meet the requirements. This offers an incentive for investment in the technologies that have been developed to meet the emission standards. It also leads to a more consistent and co-ordinated approach to enforcement, reducing the risk of distortions in competition from non-compliant ships.
- 1.11 There is a clear rationale for the goal of decarbonising the shipping sector, and a clear rationale for the UK to do this by agreeing and implementing international agreements.

Policy objectives

- 1.12 The primary policy objectives are:
 - to accelerate progress on decarbonising the international shipping sector; and
 - to comply with the UK's international obligations to implement IMO regulations for UK-flagged vessels that perform international voyages.
- 1.13 A statutory instrument is needed to implement the latest IMO amendments to Chapter 4 of Annex VI (Air Pollution) of the MARPOL Convention. The MARPOL Annex VI Regulations require ships to adopt new measures to reduce their carbon intensity. These new

⁷ For further details, see the Climate Science Annex in https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf.

⁸ See <https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx> for further details.

measures enter into force at the international level on 1 November 2022 with the requirements applying from 1 January 2023.

- 1.14 As there are also some deficiencies in the UK's current implementation of the international regulations in MARPOL Chapter 4 Annex VI, amendments are also required to bring existing domestic legislation into line with international regulations and improve its effectiveness, and this will be achieved via the same statutory instrument.
- 1.15 Even in the absence of any new domestic implementing legislation, UK owned ships operating internationally are expected to comply with the international regulations to avoid enforcement action and fines from other IMO states when visiting their ports. As a party to MARPOL the UK is required to comply with the MARPOL Annex VI Regulations. This implementing Statutory Instrument will reduce the risk of reputational damage to the UK from not meeting these obligations and any knock-on implications for UK ships trading overseas. The implementing Statutory Instrument will also enable UK Port State Control officers to inspect foreign registered vessels arriving at UK ports more effectively to ensure compliance.
- 1.16 There has been no public consultation on the MARPOL Annex VI Regulations as implementing them is an international obligation. Amendments to IMO conventions are developed and agreed at the IMO. In addition to Member States, industry was represented at the IMO through non-governmental organisations when the short-term measures, EEXI and CII, were agreed. They were involved throughout the process of developing the policy by attending and contributing to working and drafting groups as well as plenary sessions of the MEPC. UK industry stakeholders were consulted by UK government officials throughout the UK's contribution to the development of the short-term measures at the IMO. Industry is therefore heavily involved with policy development and in helping to shape the UK's negotiating position. Working in partnership, UK officials and industry actively contribute to negotiations on new initiatives to ensure there are appropriate and proportionate measures to improve standards. The IMO requirements are widely known across the sector.
- 1.17 A targeted consultation of the draft statutory instrument was conducted during Autumn 2022. In response stakeholders raised concerns about the impacts of applying these measures to the domestic fleet, since they considered that the carbon reduction measures have not been designed with short domestic routes in mind. DfT will continue to engage with maritime stakeholders on the potential application of these measures to the domestic fleet and carry out further analysis on the potential impacts.

Options considered

Option 0 (do nothing)

- 1.18 If no action was taken, the latest IMO amendments to the MARPOL Annex VI Regulations would not be incorporated into UK law. This would mean that it would not be possible for the MCA to enforce the rules against UK-flagged vessels, nor against non-UK flagged vessels visiting UK ports.
- 1.19 Option 0 is not feasible. To fail to implement the MARPOL Annex VI Regulations would breach the UK's obligations as a member of the IMO. This would risk reputational damage to the UK at the IMO. Repeated breaches of IMO obligations may lead to poor audit performance in the IMO Audit Scheme, or ultimately to retaliatory action against the UK⁹.
- 1.20 As well as being infeasible, Option 0 is undesirable. Failure to comply with international environmental obligations would risk significant reputational damage to the UK.

Option 1 (do minimum/preferred option)

- 1.21 Option 1 implements the new MARPOL Annex VI Regulations allowing the new regulations and standards (EEXI and CII, as described above) to come into force in UK

⁹ For example, the UK is currently on the Paris MoU white list (<https://www.parismou.org/detentions-banning/white-grey-and-black-list>) of high-performing flag states. Repeated failure to comply with international obligations could increase the risk of the UK falling off this list.

law in April 2023. It also amends existing legislation implementing related to MARPOL Annex VI Regulations to deal with gaps and increase its effectiveness. This means that UK-flagged vessels that perform international voyages will have to reduce emissions in line with the standards set internationally.

- 1.22 This is the preferred option and the only viable option considered in this impact assessment. It meets the objectives of decarbonising shipping and meeting the UK's international obligations.

Other options

- 1.23 We conducted a targeted consultation on the draft statutory instrument in Autumn 2022. That targeted consultation considered applying the new MARPOL Annex VI Regulations to UK-flagged ships conducting domestic journeys within the UK. Stakeholders raised concerns about the impact of applying these measures to the domestic fleet, since they considered that the carbon reduction measures have not been designed with short domestic routes in mind. We are not pursuing this option.
- 1.24 Non-regulatory options have not been taken forward because they would be ineffective in reducing emissions and would risk failure to comply with international obligations.
- 1.25 Options going further than the IMO MARPOL Annex VI Regulations have not been considered as the primary policy aim of the statutory instrument is to implement the international IMO standards and the powers under which the statutory instrument is being made are confined to that purpose.
- 1.26 More broadly, the Government is exploring a range of other policy interventions to decarbonise the maritime sector in line with the commitments made in 'Decarbonising transport: a better, greener Britain'¹⁰. As this work is not related to the policy objective to comply with the UK's international obligations to implement IMO regulations, these further policy interventions are out of scope of this impact assessment. Where appropriate, any additional policy interventions that are taken forward by the Government will be considered in separate impact assessments.

¹⁰ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009448/decarbonising-transport-a-better-greener-britain.pdf

2. Costs and Benefits

Approach

- 2.1 As the primary focus of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' is the regulation of UK-flagged vessels that perform international voyages, the quantified cost-benefit analysis in this IA assesses the costs and benefits of UK-flagged vessels that perform international voyages complying with the new international requirements (EEXI and CII).
- 2.2 Two approaches are taken:
- To provide evidence on the expected impacts due to the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023', the analysis in this section of the IA (except for the 'Business Impact Target (BIT) analysis' section) estimates the impacts that could arise due to the introduction of new domestic implementing legislation in the UK.
 - In contrast, in order to illustrate the overall impact of the new international regulations (EEXI and CII) on UK businesses in line with guidance from the Regulatory Policy Committee, the analysis in the 'Business Impact Target (BIT) analysis' section estimates the overall costs of the new international regulations to UK-flagged vessels that perform international voyages and are UK-owned, as this is considered to be the best proxy for the direct impacts of the new international requirements on UK businesses. This follows the precedent set in the impact assessment for the 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2021'¹¹, which received a GREEN opinion from the Regulatory Policy Committee. The estimates in the 'Business Impact Target (BIT) analysis' section therefore represent estimates of the overall impacts of the new international regulations (rather than the impacts of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023').

Impacts considered

- 2.3 The analysis in this impact assessment estimates the costs to UK-flagged vessels that perform international voyages of complying with the new international regulations, and the associated benefits of reduced carbon dioxide (CO₂) emissions. Compliance costs primarily fall on businesses (ship owners and operators whose vessels must comply), while benefits are primarily benefits to society (as reduced emissions benefit society¹²).
- 2.4 Two other costs are quantified: enforcement costs (to the public sector) arising from port state control inspections of compliance with the measures, and familiarisation costs (to businesses) arising from the need to familiarise with the measures. No benefits other than the primary emissions savings are quantified, but reputational benefits and air quality benefits are discussed qualitatively.

Proportionality considerations

- 2.5 Implementing the MARPOL Annex VI Regulations is an international obligation arising from the UK's membership of the IMO. This has two key implications for the analytical approach. Firstly, the new international regulations have been agreed at the IMO, and the UK is obliged to implement the new international regulations, meaning the analysis is not contributing to decision-making at the IMO. Secondly, as an international obligation, the measure is non-qualifying for the Business Impact Target (BIT). These factors mean that the cost-benefit analysis is neither informing key decisions at the IMO, nor is it contributing to formal BIT accounting. Instead, the objective of the cost-benefit analysis is to consider and to demonstrate the likely scale of impacts on the UK shipping fleet.

¹¹ https://www.legislation.gov.uk/ukia/2021/75/pdfs/ukia_20210075_en.pdf

¹² Note that "society" is not necessarily synonymous with "UK society". Climate change is a global issue so reducing greenhouse gas emissions benefits global society. This is especially because the set of vessels in scope (UK-flagged vessels) includes some vessels which spend little or no time in UK waters or ports. This means that not all the emissions savings calculated refer to emissions physically in the UK or its waters.

- 2.6 Because of this key objective, it is not proportionate to conduct or to commission UK-specific research into the impacts of the measures (before implementation in 2023). Instead, the analysis in this impact assessment primarily uses the best available evidence on the impacts of the new international regulations on the global shipping fleet. In particular, the analysis in this impact assessment is based on outputs from IMO document MEPC 76/7/13 on the Comprehensive impact assessment of the short-term measure, specifically the ‘Assessment of the impact of the measure on the fleet as carried out by DNV (task 2)’; and related analysis of the impact of the new international regulations on the global shipping fleet as carried out by DNV (classification society and maritime industry advisors). This evidence is described in more detail below.

Impact assessment undertaken for the IMO

- 2.7 The IMO document MEPC 76/7/13 on the Comprehensive impact assessment of the short-term measure estimates the costs of actions that could be taken by the international shipping fleet to comply with EEXI and CII¹³. It simulated the future development of the global fleet (considering several factors including transport demand growth, fuel prices, and efficiency improvements) under current regulations and three scenarios for EEXI/CII. Different compliance options were considered, including energy efficiency, speed reductions and alternative fuels.
- 2.8 Compared to a “current regulations” baseline (which takes account of previously implemented regulations), all three policy scenarios assessed in IMO document MEPC 76/7/13 were estimated to have lower carbon intensity (CO₂ emissions per transport work capacity¹⁴, in grams per deadweight-tonne nautical miles travelled (dwt-mile) and higher cost intensity (total costs per tonne-mile¹⁵, in United States Dollar (USD) cents) by 2030. This means that EEXI/CII is expected to increase costs while decreasing emissions, compared to the baseline of implementing no new environmental regulations.
- 2.9 At the time IMO document MEPC 76/7/13 was completed, some features of the final policy decision were uncertain. Following the agreement at the 76th session of the Marine Environment Protection Committee (MEPC 76), DNV updated their analysis to account for the final policy as it will be implemented and produced a new “adopted regulations” scenario, including an extrapolation of CII reduction factors after 2026.
- 2.10 Outputs from the “adopted regulations” scenario are used in the central case of the cost-benefit analysis in this impact assessment. Outputs from the original “low reduction”, “high reduction” and “EEXI only” scenarios in IMO document MEPC 76/7/13 are used as part of the sensitivity analysis (see below). This is collectively referred to as the modelling undertaken by DNV below.

Vessels in scope of the new international regulations

- 2.11 The MARPOL Annex VI Regulations list which vessel types and sizes are in scope¹⁶. The EEXI applies to vessels larger than 400GT and the CII applies to vessels larger than 5,000GT. Both EEXI and CII apply to the following vessel types: bulk carrier, combination carrier, containership, cruise passenger ship, gas carrier, general cargo ship, liquefied natural gas (LNG) carrier, refrigerated cargo carrier, roll on roll off (ro-ro) cargo ship, ro-ro cargo ship (vehicle carrier), ro-ro passenger ship and tanker. However, there are some

¹³ Note that the Energy Efficiency Design Index (EEDI) regulation is not covered by this impact assessment because it has already been incorporated into UK law (see <https://www.legislation.gov.uk/ukxi/2019/940/>). As section 12 of the explanatory memorandum confirms, no impact assessment was produced to accompany the changes due to low impact. See <https://www.imo.org/en/OurWork/Environment/Pages/Technical-and-Operational-Measures.aspx> for more detail on the EEDI requirements, which apply to new ships.

¹⁴ ‘Transport work capacity’ is a measure of the activity undertaken by the international shipping sector. It is expressed in dwt-miles. Deadweight tonnage (dwt) measures the cargo carrying capacity of a vessel, excluding the weight of the ship itself. Miles refers to nautical miles. 1 dwt-mile refers to 1 dwt being transported 1 nautical mile.

¹⁵ ‘Tonne-mile’ is a measure of the activity undertaken by the international shipping sector. 1 tonne-mile refers to 1 tonne being transported for 1 nautical mile.

¹⁶ Specifically, in relation to scope, the measures will create one new ambulatory reference (AR), for references to the IMO Polar Code (specifically, vessels in scope, which are exempt from the EEXI and CII measures). Information about ambulatory reference can be found in the explanatory memorandum to section 106 of the Deregulation Act 2015 (<https://www.legislation.gov.uk/ukpga/2015/20/notes/division/5/105>). Ambulatory reference simplifies the process of incorporating future updates to international instruments in UK law, reducing administrative burden and increasing business certainty. As this ambulatory reference makes only a minor difference to the scope of the regulations, impacts are expected to be very minimal and the impact assessment does not include further material on the impacts of new ambulatory reference.

limited exemptions as outlined in the MARPOL Annex VI Regulations, including vessels in scope of the IMO Polar Code.

- 2.12 Therefore, the UK's implementation of the new requirements for ships will apply to all UK-flagged vessels that perform international voyages which satisfy these criteria.
- 2.13 In addition, the UK's implementation will enable foreign-flagged ships visiting UK ports to be checked by the UK port state control officials for compliance with the IMO rules (and for action to be taken against them in the event of non-compliance). These impacts are covered in the sections below on enforcement costs.

Estimated number of UK-flagged vessels impacted by the new international regulations

- 2.14 Using 2019 Sea/analytics voyage data¹⁷ and 2019 IHS World fleet data¹⁸, it is estimated that a total of 244 UK-flagged vessels that perform international voyages would be within the scope of the new international requirements (EEXI and CII).
 - a) It is estimated that there are 82 UK-flagged vessels that perform international voyages between 400GT and 4,999GT that would only need to comply with the EEXI requirements.
 - b) It is estimated that there are 162 UK-flagged vessels that perform international voyages over 5,000GT that would need to comply with both the EEXI and the CII requirements.
- 2.15 Within this, it is estimated that 129 UK-flagged vessels that perform international voyages in scope of the new international requirements are UK-owned.
 - a) It is estimated that 52 UK-flagged vessels that perform international voyages between 400GT and 4,999GT are UK-owned.
 - b) It is estimated that 77 UK-flagged vessels that perform international voyages over 5,000GT are UK-owned.
- 2.16 These estimates are based on data for 2019, and do not take any subsequent changes in the size of the UK flag or operating patterns into account. In addition, these estimates are sensitive to the data used for this analysis and the assumptions that have been made in this analysis¹⁹. Therefore, these estimates should be interpreted as illustrate estimates of the number of UK-flagged vessels that perform international voyages in scope of the new international regulations.

Further detail on the analytical approach and its limitations

- 2.17 Estimates of the compliance costs and CO₂ impacts for UK-flagged vessels were produced using the global outputs from the modelling undertaken by DNV, and UK-specific data where available. All calculations were on the basis of deadweight-tonne nautical miles travelled (dwt-miles²⁰), and analysis was broken down by size and type into the vessel segments used in the DNV modelling (there were UK-flagged vessels that perform international voyages in 25 of the segments).
 - i) Because the global outputs from the modelling undertaken by DNV are used in this analysis, the vessel segments included in the analysis in this IA only cover the vessel segments included in the modelling undertaken by DNV. Based on IHS World fleet data, it is estimated that these vessel segments captured vessels accounting for around 98% of the deadweight tonnage of UK-flagged vessels that

¹⁷ <https://www.sea.live/>

¹⁸ <https://ihsmarkit.com/products/ship-and-port-data.html>

¹⁹ These estimates reflect the vessel types that are recorded in the fleet data and the assumptions that have been made about which of these vessel types are in scope of the new international regulations. These estimates also reflect the classification of voyages in the voyage data and the assumptions that have been made to identify vessels that perform international voyages. In addition, on proportionality grounds, it should be noted that these estimates do not fully account for all of the nuances of the new international regulations. For example, it has not been considered proportionate to take account of the exemptions for vessels in scope of the IMO Polar Code in this analysis.

²⁰ Dwt-miles is a measure of transport work capacity. When a ship with x dwt capacity travels y nautical miles, it is said to have travelled (x * y) dwt-miles. Note this is *not* the same as actual transport-work, i.e. the rates are based on ship size rather than on cargo size.

perform international voyages in scope of the new international regulations. Therefore, the use of these vessel segments is considered to be fit-for-purpose.

- ii) The UK-flagged vessels that perform international voyages included in each of the vessel segments included in the modelling undertaken by DNV were identified using Sea/analytics voyage data and IHS World fleet data for 2019. This ensures that outputs from the modelling undertaken by DNV are scaled appropriately to adjust for the size and type composition of the fleet of UK-flagged vessels that perform international voyages. This means that the analysis does not assume that the composition of the fleet of UK-flagged vessels that perform international voyages is in line with the global average, but instead uses UK-specific data on fleet composition.
- iii) For each vessel segment, the number of dwt-miles by UK-flagged vessels that perform international voyages in scope of the new international regulations was estimated from 2019²¹ Sea/analytics voyage data. Based on IHS World fleet data, it is estimated that the Sea/analytics voyage data captured vessels accounting for around 95% of the deadweight tonnage of UK-flagged vessels that perform international voyages in scope of the new international regulations. Therefore, the use of the Sea/analytics voyage data is considered to be fit-for-purpose. Using data on dwt-miles by UK-flagged vessels means the analysis does *not* assume UK-flagged vessels are as busy as the global average but adjusts for actual journeys undertaken by UK-flagged vessels.
- iv) Where Sea/analytics voyage data provided an estimate for the number of dwt-miles for sufficient vessels in a vessel segment²², the number of dwt-miles by UK-flagged vessels that perform international voyages in scope of the new international regulations in 2019 was divided by the total number of dwt-miles in 2019 in the DNV modelling to calculate UK-flagged vessels' share of world dwt-miles for the vessel segment. Where Sea/analytics voyage data was unavailable or not sufficiently complete for a vessel segment, it was assumed that UK-flagged vessels' share of world dwt-miles is in line with their share of world deadweight tonnage. In the central case, it was assumed that UK share remains constant over the appraisal period in each of the two scenarios in the DNV modelling (current regulations and adopted regulations). Alternative assumptions were tested as part of sensitivity analysis (see below).
- v) The cost intensity (total costs per transport work capacity, in United States Dollar (USD) cents per dwt-mile) of UK-flagged vessels that perform international voyages in each vessel segment was assumed to be the same as the global average cost intensity in that segment in the DNV modelling. This assumption was made because no data source exists to estimate cost intensity for UK-flagged vessels that perform international voyages at a sufficiently granular level. Alternative assumptions were tested as part of sensitivity analysis (see below).
- vi) The carbon intensity (CO₂ emissions per transport work capacity, in grams per dwt-mile) of UK-flagged vessels that perform international voyages in each vessel segment was estimated from the outputs of the DNV modelling and Sea/analytics' voyage data. It is estimated that CO₂ estimates were included in the Sea/analytics' voyage data for vessels accounting for around 88% of the dwt-miles of UK-flagged vessels included in the cost-benefit analysis. Where Sea/analytics' voyage data provided estimated CO₂ emissions for sufficient vessels²³ in a vessel segment, the carbon intensity of the UK fleet was calculated and compared to the global average carbon intensity in that segment for 2019. In the central case, it was

²¹ The DNV modelling begins its appraisal in 2019, which was the last full year before EEXI and CII were agreed in 2020. 2019 is also the last full year prior to the coronavirus (COVID-19) pandemic, which disrupted the shipping sector. Therefore, it is a logical choice of comparison year.

²² It was decided that data was available for sufficient vessels if dwt-miles data was available for vessels accounting for at least 85% of the total deadweight tonnage of vessels included in the vessel segment in 2019.

²³ It was decided that data was available for sufficient vessels if a) dwt-miles data was available for vessels accounting for at least 85% of the total deadweight tonnage of vessels included in the vessel segment in 2019 and b) CO₂ data was available for at least 85% of the vessels that dwt-miles was available for.

assumed that the difference remained constant throughout the appraisal period, i.e. if UK carbon intensity was x% below the global average in the 2019 data, the central case assumed it was x% lower in all years. Where this was possible, the analysis does not assume UK-flagged vessels have emissions in line with the global average but accounts for systematic differences in carbon intensity between the fleet of UK-flagged vessels and the global fleet. Where Sea/analytics' voyage data did not exist or did not provide carbon estimates for sufficient vessels, the carbon intensity of UK-flagged vessels that perform international voyages in a vessel segment was assumed to be the same as the global average carbon intensity in that segment in the DNV modelling.

- vii) Estimates of UK-flagged vessels' dwt-miles, cost intensity and carbon intensity were used to calculate the costs and CO₂ emissions for each segment in each regulatory scenario. The impact of the policy was taken as the difference between the baseline (current regulations) and policy scenario (adopted regulations).
- viii) CO₂ emissions changes were monetised using standard UK carbon prices²⁴, and cost changes were monetised by converting USD values to British Pound Sterling (GBP)²⁵.

2.18 Appraisal was conducted in line with principles and guidance from the Green Book and Better Regulation Framework²⁶. A non-standard appraisal period of eight years is used, with discussion and justification below. The standard 3.5% discount rate was used. As the policy will be implemented in 2023, outputs are reported in 2023 prices and 2023 present value (unless otherwise specified).

Evaluation of analytical approach

2.19 The analysis takes international trends for cost and carbon intensity and applies them to the fleet of UK-flagged vessels that perform international voyages. This means there is an implicit assumption that UK-flagged vessels are affected by the new international regulations as much as the global average. If there were systematic reasons why UK-flagged vessels would be more or less affected by the new international regulations, this assumption would be invalid. This risk has been mitigated by evaluating and accounting in the methodology for the major systematic features of the fleet (type and size). Any other systematic biases which may exist would be harder to assess and adjust for in the analysis²⁷.

2.20 Overall, the use of international outputs introduces uncertainty to the analysis. The approach significantly reduces this uncertainty by (a) analysing the fleet on a segment-by-segment basis; and (b) introducing UK-specific data on dwt-miles and carbon intensity where available. Remaining uncertainties include uncertainty around cost intensity and time trends. To account for these, extensive sensitivity analysis was undertaken (see below).

Baseline

2.21 Except for in the 'Business Impact Target (BIT) analysis' section, the appropriate baseline for the analysis in this IA is that a) the 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' do not enter into force and b) the new international regulations are introduced by the IMO. Therefore, this baseline should still account for the expected level of compliance with the new international regulations in the absence of any new domestic implementing legislation in the UK (see Paragraph 2.24 for further details).

²⁴ As in Table A3.4 of the Transport Analysis Guidance data book (<https://www.gov.uk/government/publications/tag-data-book>).

²⁵ In the central case, the exchange rate used was the HMRC average for the year to 31 March 2022: 1.371217 USD per GBP, or 0.7293 GBP per USD (<https://www.gov.uk/government/publications/exchange-rates-for-customs-and-vat-yearly>). As exchange rates are subject to significant fluctuation, the sensitivity analysis below includes tests of higher and lower average exchange rates.

²⁶ See the Green Book and guidance at <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>, and the Better Regulation Framework at <https://www.gov.uk/government/publications/better-regulation-framework>.

²⁷ For example, it could be that, due to the UK's ambition on decarbonisation policy, it could be the case that UK companies are more likely than the global average to prioritise carbon-efficient shipping, or to have been earlier adopters of carbon-reduction technologies.

- 2.22 Note that other environmental regulations (e.g. EEDI) have previously been agreed but are not affected by this policy. The assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO accounts for this in the “current regulations” scenario, meaning that the downward pressure on emissions due to previously agreed regulations is factored into the baseline.
- 2.23 While this scenario accounts for regulations previously agreed, it does *not* explicitly account for the effect of future environmental regulations which may be agreed, and which may reduce emissions²⁸. In the hypothetical scenario that EEXI and CII do not come into force but further environmental regulations are made in future, the analysis will overestimate the impact of EEXI and CII against a baseline of “all environmental regulations except EEXI and CII”. To avoid distorting estimates of overall impacts, any future assessment of environmental regulations must account for the impacts of EEXI and CII in its baseline.
- 2.24 Because the MARPOL Annex VI Regulations are international, it is highly likely that ships travelling internationally will comply regardless of UK action, as it will be necessary to comply to operate in other countries’ waters and ports. So, this is reflected in the analysis except for in the ‘Business Impact Target (BIT) analysis’ section.
- 2.25 In the ‘Business Impact Target (BIT) analysis’ section, in line with RPC guidance on counterfactuals for international measures²⁹, the appropriate counterfactual is that the regulations do not exist internationally, and the UK does not implement them. This ensures the impacts of the regulations are fully identified and accounted for.

Appraisal period

- 2.26 This impact assessment quantifies costs and benefits over a period of eight years from 2023 to 2030. This is because the modelling undertaken by DNV covers 2023 to 2030, and therefore the required inputs are only available for this period.
- 2.27 For CII, it has been agreed internationally that reduction factors will be in place until 2030. Factors have been set until 2026 and factors for 2027 to 2030 are due to be set after a review of the policy³⁰.
- 2.28 If there is international agreement to extend CII past 2030, these changes may need to be implemented in UK law through legislative or regulatory action, depending on whether the ambulatory reference provision already in regulation 2A of the 2008 Regulations is sufficient to incorporate any future IMO changes in an effective way. The way regulation 2A works is that any references already in the 2008 Regulations (as amended) to Annex VI or the MARPOL Convention (or the Polar Code) are to be read as references to those international instruments as modified or replaced from time to time. This means that it may not be necessary to amend the 2008 Regulations if references to these international instruments can already be read as references to the updated versions of those instruments (e.g. incorporating future changes to the CII provisions) in a way that gives full effect to the changes and makes sense. Whether this will be the case will depend on reviewing each of the current cross references, in the light of the IMO’s changes, to check if they achieve the desired outcome.
- 2.29 If new implementing legislation is required, a further impact assessment will be produced alongside that legislative or regulatory action. In addition, if agreed CII reduction factors

²⁸ Note that the modelling does not account for market-based measures which the IMO has committed to develop (<https://www.imo.org/en/OurWork/Environment/Pages/Market-Based-Measures.aspx>). The IMO process for agreeing market-based measures is separate to the process for agreeing short-term and mid-term measures, so these regulations are not expected to impact them. Because the EEXI and CII measures impact the amount of greenhouse gases emitted (by limiting carbon intensity), they may affect the future operation of market-based measures such as carbon prices. These effects cannot be assessed pre-emptively here. Note that the cost-benefit analysis uses carbon prices published by the UK government for use in appraisal (<https://www.gov.uk/government/collections/carbon-valuation--2>) rather than depending on estimates of future IMO carbon prices, meaning future changes to IMO carbon prices will not affect the cost-benefit analysis.

²⁹ See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/922150/RPC_case_histories_-_counterfactuals_Sep_20.pdf, p8. This is known as a “constructed counterfactual” because it does not accurately reflect the status quo.

³⁰ See IMO guidelines on CII calculation (required reduction factors on p4): [https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/MEPC.338\(76\).pdf](https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/MEPC.338(76).pdf). Note also that the assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO appraised the policy up to 2030 on the basis that this is when CII would apply until. The analysis used an assumption that reduction factors continue to increase after 2026, at a rate of two percentage points per year, reflecting the agreed trajectory to 2026.

for 2027 to 2030 are significantly different from those anticipated by the assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO, the government will consider the extent to which this changes the impacts of the policy as assessed in this impact assessment.

- 2.30 EEXI is a measure which vessels will need to demonstrate compliance with once, but which will have an ongoing impact due to changes to vessels necessary to comply. As no evidence is currently available on the impacts of EEXI after 2030, these impacts could not be accounted for in this IA. However, as the impacts of EEXI are estimated to be significantly less than the impacts of CII, this is not expected to materially impact the conclusions in this IA.
- 2.31 Note that in both the Green Book and Better Regulation guidance, policies are appraised over a default period of ten years, and environmental policies are candidates for longer appraisal than the default³¹. The choice of a different, shorter, appraisal period for this policy is based on the best information available. Risks that long-term impacts of the measures will fail to be accounted for are mitigated by the fact that extending CII factors beyond 2030 will require UK action, at which point there will be the opportunity to conduct a further impact assessment of the measures.

Costs

Compliance costs

- 2.32 The new international regulations will create a cost to business, as vessels will need to change their operations to comply with the emissions limits. The regulations are performance-based, therefore, there are multiple methods of compliance. The assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO found that, for most existing vessels, the most cost-effective way to comply with the EEXI and CII regulations is expected to be power limitations, meaning ships will reduce speed. Reduced speed means that the same amount of transport-work (measured in tonne-miles or dwt-miles) takes longer to complete, and in the DNV modelling this increases the cost per unit of transport-work³². For new ships, energy efficiency and alternative fuels may also be used, which increase capital and operating costs. This means businesses³³ face higher costs per unit.
- 2.33 The analysis is based on DNV modelling of total costs, which generally includes capital expenditure (newbuild costs plus costs of energy efficiency, engines and fuel storage), operational expenditure (running costs, including crew costs and maintenance costs), and fuel costs. The calculation of which measures ships adopt also accounts for the lost opportunity cost of adopting measures such as speed reductions.
- 2.34 One limitation is that “newbuild and operational costs are not included for cruise and ro-pax vessels” because “they have a substantial cost element related to services offered to passengers with great variation in operational profiles”. However, it is estimated that this only affects 1% of the UK-flagged vessels in scope of the new international regulations on a deadweight tonnage basis (a measure of cargo carrying capacity), so it is not expected that this limitation will have a material impact on the analysis.
- 2.35 These costs are borne in the first instance by the vessel owners and/or operators and are therefore costs to business. Operators may absorb costs in the form of lower profits or may pass costs on to customers in the form of higher prices.

³¹ See Green Book section 2.4 (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020>) and RPC guidance note on appraisal periods (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/922143/RPC_case_histories_-_appraisal_periods_Sep_20.pdf).

³² This change may affect different costs in different ways. For example, due to the “cubic rule” between speed and fuel consumption, decreasing speed decreases fuel costs in a non-linear way. In the DNV modelling, the overall effect of the measures is to increase the unit costs of transport-work, measured in cost intensity per dwt-mile travelled.

³³ Different types of contracts can specify different arrangements for which costs are borne by vessel owners and which are borne by operators. This impact assessment does not separate out costs to owners and operators, assuming that all costs are borne by businesses.

Compliance costs for UK-flagged vessels that perform international voyages due to the new international regulations

- 2.36 Applying the methodology outlined above, the total additional compliance costs to UK-flagged vessels that perform international voyages of complying with the new international regulations are estimated at around £650m between 2023 and 2030 (2023 prices, 2023 present value). It should be noted that this represents an estimate of the overall costs of the new international regulations introduced by the IMO rather than the additional costs due to the introduction of any new domestic implementing legislation in the UK.
- 2.37 The annual estimates of the total additional compliance costs to UK-flagged vessels of complying with the new international regulations are shown in the following table. This table shows that the additional costs of the new international regulations are generally expected to increase over time as the stringency of the CII increases, although there are some annual fluctuations³⁴.

Table 1 Total annual compliance costs to UK-flagged vessels that perform international voyages due to the new international regulations (£m, 2023 prices, undiscounted)

2023	2024	2025	2026	2027	2028	2029	2030
52	51	84	102	92	115	117	135

- 2.1 Based on the costs that are taken into account in this analysis, it is estimated that the EEXI and CII will increase the total costs of UK-flagged vessels in scope of the international regulations between 2023 and 2030 by around 8%. However, this may be an over-estimate as not all costs are accounted for.

Compliance costs for UK-flagged vessels due to ‘The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023’

- 2.2 Even in the absence of any new domestic implementing legislation in the UK, ships operating internationally are expected to comply with the new international regulations to avoid enforcement action and fines from other IMO states. Therefore, it is expected that there would be no additional compliance costs to UK-flagged vessels that perform international voyages due to the implementation of ‘The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023’.

Enforcement costs

- 2.3 The measures will place obligations on UK port state control authorities to enforce the measures. UK port state control is conducted by the Maritime and Coastguard Agency (MCA)³⁵. As the UK is part of the Paris memorandum of understanding (Paris MoU)³⁶, the UK co-operates with port state control authorities in the other countries in the Paris MoU. Under the Paris MoU, the UK inspects vessels from other countries and shares data. This means that, unlike the other costs, the enforcement cost is not measured in relation to the UK fleet.
- 2.4 Although vessels are expected to comply, the MCA would normally carry out prosecutions if any breaches were found that breached criminal law. Based on past experience with similar regulations, the number of prosecutions is expected to be less than one per year. Therefore, this analysis assumes associated costs are negligible and does not quantify them.
- 2.5 EEXI/CII compliance checks will take place as part of *status quo* inspections. This means the frequency and number of inspections will be unchanged, but each individual

³⁴ The additional costs of the new international regulations are the difference between the total costs under the new international regulations and the total costs under the baseline. So, the annual fluctuations in the additional costs of the new international regulations that are estimated in this analysis arise due to the different trends in total costs that are estimated under the new international regulations and the baseline.

³⁵ See the MCA’s Merchant Shipping Notice on UK port state control, MSN 1832 (M), available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/880334/MSN_1832.pdf.

³⁶ Details about the Paris MoU are available at <https://www.parismou.org/inspections-risk/port-state-control-inspections-paris-mou>.

inspection will take longer due to the measures. The enforcement cost is therefore the cost of longer inspections:

$$\text{Cost [£]} = \text{no. of inspections} * \text{additional time per inspection [hr]} * \text{cost per inspection} \left[\frac{\text{£}}{\text{hr}} \right]$$

2.6 The enforcement cost is treated as a cost to the public sector in this impact assessment, as it is expected that the MCA will absorb the additional inspection time and will not charge higher cost recovery fees to the vessels inspected. In instances whereby the inspection results in the detention of the ship, the associated costs with this are recovered via the provisions in the Merchant Shipping (Fees) Regulations 2018. Detentions of vessels typically cover numerous contraventions over several SI topics, so no estimate is possible here as to the cases that may be caused solely by the failure to comply with this amendment.

Table 2 Inputs for enforcement costs

Input	Value	Source
Number of inspections	1,213 per year ³⁷	Paris MoU data. This is the average number of inspections conducted by the UK 2016-2021.
Additional time per inspection	30 mins	Assumption developed with input from MCA officials.
Cost per inspection	£147/hr	Standard MCA fee ³⁸ .

2.7 The annual enforcement cost is therefore estimated at around £0.1 million per year in nominal terms. In 2023 prices and 2023 present value, the total enforcement cost to the public sector is estimated at around **£0.6 million** (present value) over the eight-year appraisal period.

Familiarisation costs

2.8 It will also be necessary for vessel operators to familiarise themselves with the new regulations. On proportionality grounds, the cost is calculated according to a standard methodology:

$$\text{Cost} = \text{vessels} * \text{individuals familiarising per vessel} * \text{time per individual} * \text{labour cost}$$

Table 3 Inputs for familiarisation cost calculations

Input	Low	Medium	High	Source
Number of vessels	244 UK-flagged vessels that perform international voyages 129 UK-owned UK-flagged vessels that perform international voyages			DfT analysis of 2019 Sea/analytics voyage data and 2019 IHS World fleet data
Individuals per vessel	1	2	3	Assumption

³⁷ Not all vessels are in scope of EEXI/CII, with small vessels not having to comply. Therefore, taking data on the total number of inspections overestimates the number of inspections of compliant vessels. No data is available breaking down the number of inspections by size, so this is a conservative assumption that may overestimate total enforcement costs.

³⁸ See the latest MCA fee schedule available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/748455/Maritime_Coastguard_Agency_fees_2018.pdf. Although it is expected that the MCA will not charge cost recovery fees for these specific inspections, survey fees for MCA inspections where costs are passed on are calculated on the basis of cost recovery. Therefore, this value represents the cost of an inspection to the MCA, with the assumption the costs are equivalent across inspection types. Note that fees are fixed in nominal terms and require secondary legislation to vary.

Time per individual	4hrs	8hrs	16hrs	Assumption
Labour cost	£15.71/hr	£20.04/hr	£25.73/hr	Based on government wage data ³⁹ , adjusted for wage inflation and a non-wage uplift ⁴⁰

- 2.9 Considering all UK-flagged vessels, total familiarisation costs are estimated at around **£0.1 million** in the central case, with a range from around £0.02 to £0.3 million in the low and high cases respectively. It is assumed that these costs will be incurred in 2023.

Benefits

CO₂ emission savings

- 2.10 The key benefit of ships operating more efficiently due to the new international regulations introduced by the IMO is to reduce carbon dioxide (CO₂) emissions, which is of wider social benefit.

Reduction in the CO₂ emissions from UK-flagged vessels that perform international voyages due to the new international regulations

- 2.11 Using the methodology outlined above, it is estimated that the CO₂ emissions from UK-flagged vessels that perform international voyages will be reduced by about 7 million tonnes in total due to the new international regulations introduced by the IMO between 2023 and 2030. Monetising this using UK carbon values, the value of these emission reductions is estimated to be around £1.7bn (present value). It should be noted that this represents an estimate of the overall benefits of the new international regulations introduced by the IMO rather than the additional benefits due to the introduction of any new domestic implementing legislation in the UK.
- 2.12 An abatement cost metric can be calculated for the reduction in the CO₂ emissions from UK-flagged vessels that perform international voyages due to the new international regulations by dividing the cost increase by the emission savings. This estimates the total abatement cost for the new international regulations at about £93/tCO₂. This metric represents the compliance cost the new international regulations impose on business per unit of CO₂ emissions saved and is a measure of the social “value for money” of the new international regulations⁴¹.
- 2.13 The estimates of the CO₂ emission savings for UK-flagged vessels that perform international voyages presented above represent the CO₂ emission savings from all voyages they perform regardless of where they operate. Therefore, it should be noted that these estimates do not represent the impacts on the CO₂ emissions in scope of the UK’s domestic climate change targets.
- 2.14 The annual estimates of the reduction in CO₂ emissions from UK-flagged vessels that perform international voyages due to the new international regulations (million tonnes) in the following table. This shows that the annual emissions reductions are expected to increase over time as the stringency of the CII increases.

³⁹ Wages for managers and directors in transport and logistics Office for National Statistics (ONS) Annual Survey of Hours and Earnings (ASHE), 2021 provisional, Table 14.5a, row 26. Central case is the median, low and high are the lower and upper quartiles. Data available at <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/occupation4digitsoc2010ashtable14>.

⁴⁰ Wage inflation was assumed to be 3.8% per year, in line with Office for Budget Responsibility (OBR) long-term projections (see Table 4.2 of the latest long-term fiscal sustainability report at <https://obr.uk/download/july-2020-fiscal-sustainability-report-charts-and-tables/>). In addition, a non-wage uplift of 18.75% was applied in line with ONS data (<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/indexoflabourcostsperhourilch/julytoseptember2020>), to account for non-wage labour costs such as National Insurance and pension contributions.

⁴¹ The estimated abatement cost is discounted 2023 £ terms and calculated by dividing the compliance cost figures from above by the quantity of emissions saved. As the assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO did not calculate an abatement cost, it is not possible to compare this to a global metric. However, for comparison purposes, in its report on shipping for the sixth carbon budget (<https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Shipping.pdf>), the Committee for Climate Change (CCC) estimated abatement costs for UK shipping would be in the region of £130-£140/tCO₂ by 2035 in its “Balanced Pathway” scenario.

Table 4 Annual reduction in CO₂ emissions from UK-flagged vessels that perform international voyages due to the new international regulations (million tonnes)

2023	2024	2025	2026	2027	2028	2029	2030
0.4	0.4	0.7	0.8	1.0	1.1	1.2	1.4

2.15 It is estimated that the EEXI and CII will reduce the total CO₂ emissions of UK-flagged vessels that perform international voyages in scope of the international regulations between 2023 and 2030 by around 13%.

Reduction in the CO₂ emissions from UK-flagged vessels that perform international voyages due to ‘The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023’

2.16 As we expect that ships operating internationally will comply with the new international regulations introduced by the IMO in the absence of any new domestic implementing legislation in the UK, it is expected that there would no additional reduction in CO₂ emissions due to the implementation of ‘The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023’.

Other impacts on greenhouse gas emissions

2.17 Furthermore, it is expected that the action taken to reduce CO₂ emissions would also impact on other greenhouse gas emissions, including methane (CH₄) and nitrous oxide (N₂O). Depending on the specific actions taken, the impacts on other greenhouse gases may be positive or negative. For example, actions taken to improve fuel efficiency and reduce fuel consumption will also reduce the emissions of other greenhouse gases. On the other hand, the “use of transitional fuels” section below discusses risks that the measures could create an incentive to switch to fuels with higher non-CO₂ greenhouse gas emissions, which might increase emissions of these gases. As the IMO document MEPC 76/7/13 on the Comprehensive impact assessment of the short-term measure only modelled the impacts on CO₂ emissions, the impacts on other greenhouse gas emissions are not taken into account in the monetised benefits presented above.

Air quality

2.18 In addition to reducing carbon dioxide emissions, the new international regulations are also expected to have a positive impact on air quality in the UK by reducing emissions of air pollutants such as nitrogen oxides, sulphur dioxide, and particulate matter. This occurs because speed reduction is one of the primary compliance measures, and reducing speed reduces fuel consumption. Therefore, the new international regulations will lead to less fuel consumption, which will reduce emissions of air pollutants.

2.19 Previous UK government research⁴² has found that air pollutants emitted from shipping have a significant impact on UK air quality, and that reducing pollutants from shipping may make a meaningful improvement in air quality, especially in coastal areas of southern England. The emissions of air pollutants from shipping can have both localised and long-range impacts on air quality⁴³, so reducing these emissions could improve air quality both near to the coast and inland.

2.20 The new international regulations specifically target carbon dioxide emissions and air pollutants are targeted by separate MARPOL measures. The assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for IMO did not model impacts on air quality, and impacts cannot be inferred due to uncertainties in translating outputs into fuel consumption and from fuel consumption into air pollutant impacts. In addition, UK-flagged vessels that perform international voyages may include some vessels which

⁴² See the 2021 report commissioned by the Department for Environment, Food and Rural Affairs (Defra) on 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), which estimates air pollutant emissions by UK domestic and international shipping, and the Air Quality Expert Group’s 2017 report on the impacts of shipping on UK air quality (https://uk-air.defra.gov.uk/assets/documents/reports/cat11/1708081025_170807_Shipping_Report.pdf). For example, the report finds that a 30% reduction in shipping emissions would lead to a reduction of 9-15% in SO₂ in many coastal areas of southern England.

⁴³ https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2108051339_210215ShippingReportRevisedFeb21Publicationv2.pdf

spend little or no time in UK waters or ports (while there are many vessels spending a lot of time in UK waters or ports which are foreign-flagged), making it difficult to estimate the impact of the new international regulations on air quality in the UK. For these reasons, estimating air quality impacts on the UK is not feasible and not proportionate.

- 2.21 However, as we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK, it is expected that there would be no additional benefits from the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023'.

UK reputation

- 2.22 The implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will avoid the risks of the UK failing to fulfil international obligations, and this will maintain and enhance the UK's reputation for environmental action.
- 2.23 This will help to ensure the UK is credible in seeking to take a leading role in maritime decarbonisation⁴⁴. At the 2021 United Nations Climate Change Conference (COP26) in Glasgow, the UK signed the *Declaration on Zero Emission Shipping by 2050*⁴⁵, in line with its IMO position. Any impacts are not quantified as the extent and specific implications of any benefits are uncertain.
- 2.24 In addition, fully implementing the MARPOL Annex VI Regulations for UK-flagged vessels that perform international voyages will ensure the UK complies with international obligations. This will maintain confidence in the UK shipping sector and in the UK flag, and will avoid possible negative consequences which may have occurred in the do-nothing option. As above, impacts are not quantified due to uncertainty.

Industry reputation

- 2.25 There may also be benefits from the new international regulations to shipping companies, especially those who are publicly listed, from increasing their green profile and reputation for acting to comply with environmental regulations. This may be an intangible benefit or may be accompanied by benefits such as improved access to capital markets⁴⁶ or charging a premium rate for "environmentally-friendly" service. Whether and to what extent this may be the case for UK-flagged vessels is uncertain, so the effects are not quantified.
- 2.26 However, as we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK, it is expected that there would be no additional benefits from the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023'.

Summary

Total impacts

- 2.27 Table 5 summarises the estimates of the total quantified impacts of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' in the

⁴⁴ This feeds into the ambition laid out in the UK government's Maritime 2050 strategy, which is that "the UK will be seen as a global exemplar in green maritime issues" (See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872194/Maritime_2050_Report.pdf p151.)

⁴⁵ See <https://em.dk/media/14312/declaration-on-zero-emission-shipping-by-2050-cop26-glasgow-1-november-2021.pdf>.

⁴⁶ Some investors show preference for companies which demonstrate forms of environmental, social or governance (ESG) responsibility. In some countries there is a statutory basis for this: for example, in Norway, the Transparency Act (<https://lovdata.no/dokument/NL/lov/2021-06-18-99>) requires companies to report on ESG aspects of their business to raise money from capital markets.

central case. These are the total cumulative impacts over the appraisal period in present value terms. All values are in 2023 prices, discounted from 2023.

Table 5 Summary of costs and benefits of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' (Central estimates) (2023 prices, 2023 present value)

Impact	Affected group	Estimated value
Compliance costs	Businesses	£0
Enforcement costs	Public sector	£0.6m
Familiarisation costs	Businesses	£0.1m
TOTAL COSTS	(all)	£0.7m
CO ₂ emission savings	Society	£0
TOTAL BENEFITS	(all)	£0
Net social impact	(all)	-£0.7m
Net impact on business	Businesses	-£0.1m

- 2.28 A key conclusion of this IA is that the impacts of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' on UK shipping will be significantly less than the overall impacts of the new international regulations. This is because we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK.
- 2.29 Based on the impacts that it has been possible to quantify, the best estimate of the net social impact of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' is a net cost of about **£0.7m** (present value). However, this does not account for the non-monetised benefits. In particular, the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will avoid the risks of the UK failing to fulfil international obligations, and this will maintain and enhance the UK's reputation for environmental action. This will help to ensure the UK is credible in seeking to take a leading role in international maritime decarbonisation. In addition, fully implementing the MARPOL Annex VI Regulations for UK-flagged vessels that perform international voyages will ensure the UK complies with international obligations. This will maintain confidence in the UK shipping sector and in the UK flag, and will avoid possible negative consequences which may have occurred in the do-nothing option. To fail to implement the MARPOL Annex VI Regulations would breach the UK's obligations as a member of the IMO. This would risk reputational damage to the UK at the IMO. Repeated breaches of IMO obligations may lead to poor audit performance in the IMO Audit Scheme, or ultimately to retaliatory action against the UK. For example, the UK is currently on the Paris MoU white list of high-performing flag states, and repeated failure to comply with international obligations could increase the risk of the UK falling off this list, which could result in UK flagged ships being challenged more frequently during port state control checks in foreign ports, leading to expensive delays and inconvenience for UK flagged ships trading internationally. In order for 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' to result in a net benefit to society, the value of these non-monetised benefits would need to exceed the value of the monetised costs (i.e. the value of these benefits would need to be around £0.1 million per year during the 8-year appraisal period on average). Whilst the value of the non-monetised benefits is necessarily uncertain, given the high priority that the UK places on maritime decarbonisation and the risks of failing to implement the MARPOL Annex VI Regulations, the Department considers that the benefits of introducing the 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' justify the costs.

- 2.30 In addition, as the analysis in this IA is very sensitive to the data sources that have been used and the assumptions that have been made, the estimates in this IA are subject to considerable uncertainty. Therefore, these estimates should be treated as indicative estimates of the order of magnitude of these costs and benefits.
- 2.31 The benefits are social benefits and the costs are (almost all) costs to business. This demonstrates that the new international regulation represent a transfer of value from businesses to wider society in direct terms. Many businesses may pass costs on to consumers to offset increased costs, meaning the distribution of costs between businesses and wider society may be more ambiguous in indirect terms once pass-through is taken into account.
- 2.32 As described above, the analysis uses UK-specific data where available to mitigate the risks of assuming the fleet of UK-flagged vessels has similar features to the global fleet. Because UK-specific data is available for carbon intensity but not cost intensity, the estimate of benefits in this IA is more sensitive to features of the fleet of UK-flagged vessels than the estimate of costs in this IA. Given lack of data, the extent to which this affects results cannot be quantified. Assumptions are tested as part of the sensitivity analysis (see below).

Business Impact Target (BIT) analysis

Status

- 2.33 The measure is **non-qualifying** for the Business Impact Target (BIT) as it is an international requirement to implement the IMO measures in UK law⁴⁷. Nevertheless, BIT outputs have been calculated and reported. This is to demonstrate the high impacts (far above the *de minimis* threshold) of the new international regulations, and to allow comparison with the impact of other regulations.

Approach

- 2.34 To illustrate the overall impact of the new international regulations (EEXI and CII) on UK businesses in line with guidance from the Regulatory Policy Committee, the Business Impact Target (BIT) analysis estimates the overall costs of the new international regulations to UK-flagged vessels that are UK-owned, as this is considered to be the best proxy for the direct impacts of the new international requirements on UK businesses.
- 2.35 The estimates of the Equivalent annual net direct cost to business (EANDCB) below therefore represent estimates of the overall impacts of the new international regulations (rather than the impacts of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023').
- 2.36 The EANDCB should be the best estimate of the net direct total cost to the private sector of the UK economy. To estimate the EANDCB of the new international regulations, only direct costs to business should be taken into account. All costs to business estimated in this IA are direct as they result from the action necessary to comply with the new international regulations.
- 2.37 The international nature of the maritime sector means it is more difficult to distinguish clearly between UK and non-UK impacts than in typical regulatory contexts. The EANDCB should represent the Department's best estimate of the impact of the policy on businesses whose activity forms part of UK GDP⁴⁸. Based on relevant precedents⁴⁹, the

⁴⁷ See Annex 1 of the Better Regulation Framework:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/916918/better-regulation-guidance.pdf. Note the exclusion for implementing European Union directives also applies to "other international commitments and obligations". This policy does not entail gold-plating as UK implementation will not go beyond IMO requirements.

⁴⁸ See RPC guidance on defining a business at

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/858862/Issues_around_defining_a_business.pdf.

⁴⁹ Two key precedents supporting the choice of UK-flagged vessels which are owned by companies based in the UK are as follows.

The first is the IA for the Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2021

(https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/989793/draft-impact-assessment-merchant-

impacts of the new international regulations on UK-flagged vessels that perform international voyages, and which are owned by companies based in the UK, was considered to be the best proxy for economic activity conducted by companies located in the UK. UK ownership means the company registered as owning the vessel is located in the UK, so using this definition was considered to provide the best consideration of companies located in the UK.

- 2.38 In line with guidance and for comparison purposes⁵⁰, the Equivalent annual net direct cost to business (EANDCB) was estimated in 2019 prices and 2020 present value. This differs from the other estimates presented in the IA, which are in 2023 prices and 2023 present value.

Results

- 2.39 The following direct costs to business have been taken into account when estimating the EANDCB.
- The annual costs of complying with the new international regulations for UK-flagged vessels - that perform international voyages and are owned by companies based in the UK - is estimated to total around £379 million between 2023 and 2030 (2023 prices, 2023 present value)
 - The one-off familiarisation costs for UK-flagged vessels that perform international voyages which are owned by companies based in the UK which are estimated at around £0.1 million in 2023 (2023 prices, 2023 present value)
- 2.40 Based on these estimates, the EANDCB of the new international regulations to UK businesses is estimated at £42.6m per year in 2019 prices and 2020 present value. In line with RPC guidance, this is estimate quoted on the summary sheets in this impact assessment.
- 2.41 For comparison purposes, the EANDCB of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' would be very significantly lower. This is because we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK. So, this would only capture the estimated familiarisation costs associated with these regulations.

Sensitivity Analysis

Approach

- 2.42 As we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK, the conclusion that 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' is estimated to result in a low net cost is not sensitive to the other assumptions made in the IA.
- 2.43 Therefore, the focus of the sensitivity analysis is the Equivalent annual net direct cost to business (EANDCB) estimated in this IA. This is because the EANDCB represents an estimate of the overall impacts of the new international regulations (rather than the impacts of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023'). It is consequentially very sensitive to the inputs used to estimate the costs of complying with the new international regulations.

[shipping-regulations-2021.pdf](#)), which are the most recent MARPOL regulations for which a UK IA has been published. This IA considered impacts on UK-flagged (i.e. UK-registered) ships with some element of UK ownership and was green-rated by the RPC.

The second is the impact assessment for the Seafarers' Wages Bill

(https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1095066/seafarers-wages-impact-assessment.pdf), which gave detailed consideration to multiple possible interpretations of "UK business" and concluded that UK-owned vessels in scope was the best basis for calculating EANDCB. The RPC green-rated the IA.

⁵⁰ See the IA calculator and accompanying guidance: <https://www.gov.uk/government/publications/impact-assessment-calculator--3>.

- 2.44 As discussed above, the inputs used in this analysis are subject to uncertainty. For example, because the analysis applied international evidence to the fleet of UK-flagged vessels, the approach is valid only to the extent that the fleet of UK-flagged vessels that perform international voyages in scope of the new international regulations is representative of the global fleet, in relation to these issues. This is in line with proportionality guidance to explore the impact of uncertain assumptions and inputs using sensitivity analysis⁵¹.
- 2.45 After a brief discussion of sensitivity analysis in the DNV modelling, the section discusses the sensitivity analysis that has been undertaken for the EANDCB estimated in this IA. Each scenario uses the same methodology described above and varies one key input or assumption from the main scenario. This means that each scenario demonstrates the impact of varying each input, and the table demonstrates which inputs make most difference to the final outputs.

Sensitivity testing in DNV modelling

- 2.46 Section 4.4 of the assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO contains details of sensitivity tests on several inputs and assumptions in that modelling, such as if fuel costs are higher than has been assumed. For the sensitivity tests considered, the key results⁵² with respect to cost intensity estimate a range of a -4.8 percentage point to a +3.6 percentage point change to the central 16% increase in cost intensity in the high policy impact scenario. However, more than half the fifteen sensitivity tests change this output by less than 1 percentage point.
- 2.47 Further discussion and analysis of uncertainty in the modelling is provided in Section 4.5. Key results⁵³ for plausible combinations of sensitivity tests estimates that, in the high policy impact scenario, the change in % increase in cost intensity ranges from -3.7 percentage point to +5.3 percentage point around a central output of 16%.
- 2.48 To put this in context, if the increase in cost intensity is +5.3 percentage points higher in practice than the central estimate of 16%, this would mean the absolute increase in cost intensity is around one third higher. This illustrates the significant uncertainty around any estimates of the absolute costs of the new international regulations.
- 2.49 The assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO does not include similar sensitivity analysis around the carbon intensity outputs, meaning similar conclusions for CO₂ emissions are not available.

Range around the estimated EANDCB

- 2.50 Compliance costs (in USD) were calculated from intensities, as described above. To monetise the impacts, these were converted to GBP using the exchange rate. In the case of the GBP-to-USD exchange rate, exchange rates are subject to significant fluctuation.
- a. Strong sterling: this scenario converts cost impacts to GBP with a GBP-to-USD exchange rate of £1 = \$1.714 (so £1 buys 25% more in \$ terms than in the main scenario). The same value in USD is worth less in GBP terms, so the compliance costs convert to a 20% lower GBP value⁵⁴. This means the EANDCB is lower.
 - b. Weak sterling: this scenario converts cost impacts to GBP with a GBP-to-USD exchange rate of £1 = \$1.028 (so £1 buys 25% less in \$ terms than in the main scenario). In this scenario, the same value in USD is worth more in GBP terms, so the compliance costs convert to a 33% higher GBP value⁵⁵. This means the EANDCB is larger.

⁵¹ See RPC guidance on proportionality at

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/800603/Final_proportionality_.pdf.

⁵² See Table 4-2 on p42 of the assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO.

⁵³ See Table 4-6 on p52 of the assessment of the impact of the measure on the fleet as carried out by DNV (task 2) for the IMO.

⁵⁴ Costs are calculated in USD and converted to GBP. GBP being 25% (1/4) stronger is equivalent to USD being 20% (1/5) weaker.

⁵⁵ Costs are calculated in USD and converted to GBP. GBP being 25% (1/4) weaker is equivalent to USD being 33% (1/3) stronger.

Impact of the UK fleet not being representative of the global fleet

- 2.51 As discussed above, the analysis applied global evidence to the fleet of UK-flagged vessels on a segment-by-segment basis. For cost intensity, no data is available, so global outputs are applied direct to the UK fleet for all segments. The analysis also assumed the UK share of dwt-miles would remain constant over time. Due to the incompleteness of the UK-specific data, the analysis partly assumes the fleet of UK-flagged vessels is representative of the global fleet and that time trends will be similar, but the extent to which these assumptions are true is uncertain. Therefore, these sensitivity scenarios test the impact of explicitly assuming the UK fleet is *not* representative of the global fleet. This quantifies the impact of the assumptions made in applying global cost outputs to the UK fleet.
- c. UK flag growth: the main scenario assumed that the UK share of the global fleet (specifically, the proportion of dwt-miles by UK-flagged vessels per segment) is constant over the appraisal period. This scenario tests the impact of assuming the UK share of the global fleet increases gradually over the appraisal period⁵⁶. This means more dwt-miles are performed by UK-flagged vessels, so the same changes in per-mile terms have greater overall effect on UK-flagged vessels. In this case, total dwt-miles by UK-flagged vessels are about 15% higher over the appraisal period and compliance costs increase by approximately 16%, indicating that impacts are close to (but not exactly) rising in proportion to dwt-miles⁵⁷. This means the EANDCB is higher.
 - d. UK flag decline: conversely, this scenario tests the opposite assumption, that the UK share of global fleet decreases gradually over the appraisal period. Impacts are the opposite of the previous scenario: about 15% fewer dwt-miles are travelled by UK-flagged vessels and compliance costs are about 16% lower. This means the EANDCB is lower.
 - e. UK more cost-efficient: the central scenario assumed UK cost intensity was in line with the global average, due to lack of UK-specific cost data. This scenario tests the impact of assuming that UK-flagged vessels have cost intensity 25% lower than the global average, i.e. it assumes that all UK-flagged vessels have compliance costs 25% lower per dwt-mile than the global average from the DNV modelling. This means compliance costs are 25% lower than the central scenario. This means the EANDCB is lower.
 - f. UK less cost-efficient: conversely, this scenario tests the impact of assuming UK-flagged vessels have cost intensity 25% higher than the global average. In this scenario, compliance costs are 25% higher. This means the EANDCB is higher.

Different scenarios from the DNV modelling

- 2.52 The main analysis in this IA is based on DNV modelling for the “adopted regulations” scenario, i.e. the modelling reflects the regulations as agreed at the IMO. The original DNV modelling included a range of scenarios where the policy was more or less stringent. The following scenarios use outputs from the different scenarios. Methodologically, because the segment breakdown was not available at the same granularity as for the “adopted regulations” scenario, these other scenarios were analysed on the basis of overall average cost intensities. For comparison, a scenario which analysed the main “adopted regulations” scenario on the basis of overall average intensities (rather than with a vessel segment breakdown) was also used:
- g. Adopted regulations (average): this scenario uses the main “adopted regulations” scenario output but does not break analysis down by segment. Instead, UK share of dwt-miles is based on the total share of dwt-miles by all relevant ships. This scenario has compliance costs about 17% lower than the central scenario. The main reason for this is that the fleet of UK-flagged ships has a different composition to the global fleet. Therefore, failing to

⁵⁶ Specifically, the sensitivity test assumes the share of global dwt-miles by UK-flagged vessels in each segment increases by 2% of its 2019 level in each subsequent year, so in 2030, the increase corresponds to 22% of its 2019 level (11 years after 2019). The “UK flag decline” sensitivity test uses the opposite assumption, i.e. that the UK share of global dwt-miles in each segment falls by 2% of its 2019 level in each subsequent year.

⁵⁷ The reason the increase is not in direct proportion to dwt-miles is because of the time trends. The difference in cost intensity tends to rise over the appraisal period. The total number of global dwt-miles in the DNV modelling does not follow a consistent trend, but rises in the final years of the appraisal, meaning that these years have the greatest impact on overall results (and due to larger differences in cost intensity make a disproportionately large contribution to the overall change).

adjust for fleet composition means costs are lower than in the central scenario. This means the EANDCB is lower.

- h. High policy impact: this scenario takes the cost intensity outputs from the “high policy impact” scenario in the DNV modelling in which there is a larger reduction in CO₂ emissions than required under the new international requirements agreed by the IMO. This leads to a larger increase in cost intensity. This means compliance costs are higher than in scenario (g). However, compared to the central scenario, compliance costs are still about 10% lower due to the differences in fleet composition. As above, the EANDCB is lower.
- i. Low policy impact: this scenario takes the cost intensity outputs from the “low policy impact” scenario in the DNV modelling in which there is a smaller reduction in CO₂ emissions than required under the new international requirements agreed by the IMO. Effects are the opposite of the “high policy impact” scenario, with a smaller increase in cost intensity than in scenario (g). Compliance costs are lower than scenario (g) and compliance costs are about 45% lower than the central scenario. As above, the EANDCB is lower.
- j. EEXI only: this scenario takes the cost intensity outputs from the DNV “EEXI only” scenario in the DNV modelling in which only the EEXI is introduced (and the CII is not introduced). As only part of the new international regulations apply under this scenario, compliance costs are about 76% lower than the central scenario. This means the EANDCB lower in this scenario.

Results

Table 6 Estimates of the Equivalent annual net direct cost to business (EANDCB) for the sensitivity analysis scenarios

	<u>Scenario</u>	<u>EANDCB</u>
		<i>EANDCB in 2019 prices, 2020 PV (£m)</i>
	CENTRAL SCENARIO	42.6
(a)	Strong sterling	34.0
(b)	Weak sterling	56.7
(c)	UK share of dwt-miles increases	49.0
(d)	UK share of dwt-miles decreases	36.1
(e)	UK cost intensity 25% below world	31.9
(f)	UK cost intensity 25% above world	53.2
(g)	DNV adopted regulations (average method)	22.6
(h)	DNV high policy impact	24.6
(i)	DNV low policy impact	14.9
(j)	DNV EEXI only policy impact	6.5

Discussion

- 2.53 In the above table, the estimates of the EANDCB are estimates of the impacts of the international regulations.
- 2.54 The sensitivity analysis suggests that the analysis in this IA is very sensitive to the data sources that have been used and the assumptions that have been made, and that the estimates in this IA are subject to considerable uncertainty. Therefore, the estimates presented in this IA should be treated as indicative estimates of the order of magnitude of these costs and benefits.
- 2.55 Whilst these estimates are subject to significant uncertainty, the sensitivity analysis suggests that the analysis in this IA is fit-for-purpose and provides a reasonable assessment of the likely scale of the costs and benefits of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' and the new international regulations.
- 2.56 In particular, the EANDCB is in the tens of millions of pounds per year for all of the sensitivity tests which assess the new international regulations actually introduced by the IMO (scenarios a to f). This indicates that the central estimate of the EANDCB is fit-for-purpose as an illustration of the likely order of magnitude of the direct costs of the new international regulations to UK-flagged vessels that are owned by UK businesses. In addition, this suggests that it is reasonable to conclude that the impacts of the 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' on the UK will be much less than the overall impacts of the new international regulations.
- 2.57 Finally, whilst the Net Present Social Value of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' is estimated to be a small net cost, it should be noted that there are a number of non-monetised benefits, including the reputational benefits for the UK of introducing these Regulations, which need to be taken into account when comparing the benefits and costs of these Regulations.

3. Risks and unintended consequences

Use of transitional fuels

- 3.1 As described above, the cost-benefit analysis was based on modelling undertaken by DNV for the IMO. The DNV modelling factored in the possible use of biofuels for existing ships, and possible use of transitional fuels including liquified natural gas (LNG) and liquified petroleum gas (LPG) for new ships⁵⁸.
- 3.2 As the new international regulations target CO₂ only and no other greenhouse gases, the DNV modelling only assessed the impacts on CO₂ emissions rather than all greenhouse gases. This means that it does not account for changes in emissions of non-CO₂ greenhouse gases such as methane (CH₄) and nitrous oxides (N₂O).
- 3.3 However, changes in the fuel mix can result in differing impacts on different gases. In particular, LNG has lower CO₂ intensity but higher CH₄ intensity than traditional maritime fuels⁵⁹. This means that for LNG uptake, the DNV modelling captures the reduction in CO₂ emissions but will fail to capture the increase in CH₄ emissions.
- 3.4 Impacts on air quality also depend on fuels adopted. For example, increased uptake of LNG is likely to improve air quality by reducing air pollutant emissions⁶⁰. Because air quality impacts are not quantified, the extent to which they will be affected by the fuel mix also cannot be quantified.

⁵⁸ LNG and LPG are described as "alternative fuels" in the IMO document MEPC 76/7/13 on the Comprehensive impact assessment of the short-term measure. "Transitional" nomenclature is preferred here to emphasise that these are also fossil fuels.

⁵⁹ See, for example, research at https://theicct.org/wp-content/uploads/2021/06/LNG-as-marine-fuel-working-paper-02_FINAL_20200416.pdf.

⁶⁰ By contrast, use of biofuels may have an ambiguous effect on air quality. For example, Jeswani, Chilvers and Azapagic (2020) find that "human health impacts from biofuels remains open to debate" (<https://doi.org/10.1098/rspa.2020.0351>).

- 3.5 Consequentially, the key benefits of the new international regulations may rely at least to some extent on generating a particular response (speed reduction or other measures, rather than use of transitional fuels which may increase other GHG emissions).
- 3.6 As these are international measures, the primary responsibility for monitoring impacts and amending measures if necessary, falls at international level. However, the UK government will also monitor ship emissions and will engage pro-actively in the international process if there is evidence that the new international regulations are not contributing to reductions in ship emissions.

Compliance risks

- 3.7 It is not expected that compliance with the measures will be difficult to enforce. Operators will need to provide a declaration of compliance which will be checked by port state control inspectors. This includes UK port state control inspectors checking some ships entering UK ports. Although each inspection may not necessarily check whether a vessel is indeed complying, it is expected that there will be robust, internationally agreed processes for ensuring the validity of compliance certificates. Furthermore, as discussed above, there are likely to be reputational advantages to ships and operators who clearly demonstrate compliance with the measures. This means operators are unlikely to have significant incentives not to comply.
- 3.8 Furthermore, in theory, for vessel sizes close to the thresholds determining whether a vessel is in scope of the new international regulations (i.e. 400GT or 5,000GT), there could be an increased incentive for ships to be designed to be slightly smaller than the participation threshold⁶¹. However, the majority of the UK-flagged vessels in scope of the new international regulations are currently significantly larger than these thresholds. In addition, the available evidence suggests that there can be significant economies of scale in shipping⁶², which would disincentivise significant reductions in ship size.

⁶¹ For example, <https://www.imarest.org/themarineprofessional/on-the-radar/5793-the-tonnage-game-making-the-most-of-the-rules> suggests that this already happens in respect to other international regulations.

⁶² For example, <https://www.itf-oecd.org/sites/default/files/docs/decarbonising-maritime-transport.pdf> provides evidence on the economies of scale associated with larger ships.

4. Wider impacts

Small and Micro Business Assessment (SaMBA)

- 4.1 Small businesses are defined in the Better Regulation Framework guidance as businesses with between 10 and 49 (small) and with fewer than 10 (micro) employees⁶³. In line with guidance and statutory duties, this section considers the impact on small businesses.

Number of small businesses affected

- 4.2 It is difficult to determine how many small businesses would be affected by the regulations because there is limited data available about the companies affected (the international shipping sector is not covered well by typical data sources such as BEIS business population estimates⁶⁴). There are also ambiguities about exactly which companies act as employers⁶⁵.
- 4.3 The new international regulations apply to large vessels only (EEXI applies to vessels larger than 400GT, CII to vessels larger than 5,000GT). This means that companies owning only small vessels are not affected (and companies owning only vessels between 400GT and 5,000GT are affected only by part of the measures), and only companies owning vessels large enough to be in scope are affected. This means larger companies are more likely to be affected by the new international regulations. Vessel size roughly correlates with business size because a large vessel is a significant capital asset, meaning the owner of a vessel large enough to be in scope is more likely to be a company with large enough size and funds to secure a substantial capital investment or loan.
- 4.4 However, it is still possible that some companies affected by the regulations may meet the definition of a small business based on the number of employees. For some vessel types, the number of individuals needed to crew a single vessel is unlikely to exceed 50, meaning that a company owning a single ship and employing its crew could theoretically fall below the 50-employee threshold. Crew sizes vary between operators, routes, and vessel types. Data is limited but suggests many international cargo vessels, including very large vessels, run with average crew sizes around 25, only half the threshold⁶⁶. This means a business owning a single vessel and employing the crew could theoretically be a small business (in some cases, a company owning two vessels could also theoretically fall below the 50-employee threshold but would be more likely to employ sufficient off-duty crew or shore-based staff to exceed 50).
- 4.5 Based on 2019 Sea/analytics voyage data and 2019 IHS World fleet data, it is estimated that there are 57 UK registered owners that own a single UK-flagged ship, that performs international voyages, expected to be in scope of the new international regulations. This number is an estimate for the upper bound of the number of small businesses which might be affected. In practice, the true number of small businesses is likely to be far lower because many of these UK registered owners will not meet the definition of a small business. Reasons this might be the case include:
- Some companies may own additional vessels which are not UK flagged.

⁶³ See part 2.3 of the Better Regulation Framework (<https://www.gov.uk/government/publications/better-regulation-framework>).

⁶⁴ <https://www.gov.uk/government/statistics/business-population-estimates-2021>

⁶⁵ For example, depending on vessel type, contract type and specific business arrangements, either the vessel owner or the vessel manager may employ crew. In some cases, employment may be done by third-party agencies, which may in theory have a very small number of employees (and provide only part of the crew for a given vessel). The extent to which this is the case cannot be estimated precisely. It is generally assumed that the ultimate cost of employment falls on the vessel owner, so available data on companies registered as vessel owners is considered the best proxy for the business employing the crew. If agency arrangements are common and are considered small businesses, then exemptions for small businesses may create an incentive for operators to engage in non-standard employment practices.

⁶⁶ For example, Winchester, Sampson and Shelly (2006) found that crew sizes on tanker and bulker vessels did not exceed about 25 on average, even on very large tanker and dry cargo vessels. (<https://orca.cardiff.ac.uk/id/eprint/64731/>)

- Some companies may have larger crew sizes and/or employ enough off-duty crew to exceed the threshold (even if the active crew size at any given point is less than 50).
 - Some companies may employ enough shore-based staff to exceed the threshold.
 - Some companies listed as vessel owners may be a subsidiary or sister company of a larger company which owns more vessels.
- 4.6 Data limitations mean the number of companies falling into each category cannot be estimated precisely, so the number of small businesses that will be impacted by the new international regulations is subject to uncertainty.
- 4.7 However, as we expect that ships operating internationally will comply with the new international regulations introduced by the IMO in the absence of any new domestic implementing legislation in the UK, no businesses are expected to experience material impacts from the ‘The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023’.

Impacts on small businesses

- 4.8 The analysis above appraised the impact of the measures on costs and emissions in terms of intensities (cost and carbon per dwt-mile). This means that, for vessels with similar cost and carbon intensity impacts, the impact scales linearly in line with vessel activity (expressed in terms of dwt-miles): a company whose vessels travel x% more dwt-miles would incur x% more costs than a company with a similar fleet profile. The nature of impacts of the policy is therefore that they are proportionate to the amount of business activity. As above, vessel activity does not determine business size, but likely correlates because companies with more vessels and/or more active vessels are likely to be employing more people⁶⁷. Therefore, the way impacts scale with business activity suggests that the impacts of the new international regulations are likely to increase in absolute terms as business size increases expressed in terms of number of employees.
- 4.9 Although impacts scale with dwt-miles, the precise % impact on a specific vessel depends on features of the vessel (the analysis applied cost and carbon intensity changes by segments based on type and size). Vessels below 400GT are not affected as they are not in scope of the international regulations at all, so there would be no disproportionate impacts on the owners of these vessels. In addition, vessels between 400GT and 5,000GT are only affected by one of the two measures (EEXI). As the CII is estimated to result in a much more significant increase in costs than the EEXI, this should mean that the owners of vessels between 400GT and 5,000GT do not experience disproportionate impacts, in comparison to the owners of vessels above 5,000GT.
- 4.10 Among vessels large enough to be fully in scope of both the CII and EEXI (above 5,000GT), it is estimated that exact trends vary by vessel type, but for most vessel types, it is estimated that smaller vessels are generally relatively somewhat more affected (with a larger % change in cost intensity) than larger vessels of the same type. This provides some basis to conclude that, among vessels large enough to be fully in scope of both the CII and EEXI (above 5,000GT), smaller vessels may experience relatively larger cost increases than larger vessels. If, as above, it is assumed that vessel size correlates with business size, this may mean that relatively smaller businesses (while still large enough to be in scope) may be slightly more affected than larger businesses.
- 4.11 However, as we expect that ships operating internationally will comply with the new international regulations introduced by the IMO in the absence of any new domestic implementing legislation in the UK, it is not expected that the ‘The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023’ would result in any disproportionate impacts on small businesses.

⁶⁷ The more vessels a company owns, the more people it will be employing to crew them. A further effect is that vessels which are more active may require more individuals to be employed, as more active hours is likely to necessitate more changes of crew.

- 4.12 The only impact on business which is arguably not dependent on any factors correlated with business size is familiarisation costs. These are administrative costs which are “fixed” and create the same burden per business or per vessel regardless of size. As small businesses operate on a smaller scale and have less administrative capacity, these costs represent a larger share of overall costs for smaller businesses. However, in this case, familiarisation costs are very small (only around £0.1 million in the central case).
- 4.13 Overall, the risk of significant disproportionate impacts on small business is low. Although, among the vessels in scope, smaller vessels are relatively somewhat more affected than larger vessels, this effect is mitigated by the fact that the size limits on scope mean the smallest vessels are not affected at all. In addition, impacts generally scale with the level of business activity, and administrative costs are expected to be extremely small. Translating these factors to business size in terms of number of employees is difficult and uncertain, but there is no conclusive evidence that small businesses (<50 employees) will be affected in a significantly disproportionate way compared to larger businesses (>50 employees).

Exemptions

- 4.14 As ‘The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023’ are the UK’s implementation of the new international regulations, for the UK to exempt small businesses would risk non-compliance with IMO obligations, thus failing a policy objective. This means that the threshold for maintaining a “sufficiently large part of the intended benefits” must be interpreted very strictly for these measures. In this context, and because there is no conclusive evidence that small businesses (<50 employees) will be affected in a significantly disproportionate way compared to larger businesses (>50 employees), the Department believes there is no case for an exemption for small and micro businesses.

Equalities Impact Assessment (EIA)

- 4.15 In line with legal requirements the Department has considered the Public Sector Equality Duty and considers that the statutory instrument does not raise any issues relevant to that duty as no disproportionate impacts on individuals with protected characteristics are anticipated.

Justice Impact Test (JIT)

- 4.16 ‘The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023’ create a new criminal offence and update existing criminal offences around compliance. This is not expected to lead to any significant impact on the justice system.

Environmental Impact

- 4.17 As described above, the key policy objective of the new international regulations is to reduce CO₂ emissions, and the primary benefit of the new international regulations is significant CO₂ emission savings. The analysis in this IA estimates that UK-flagged vessels that perform international voyages will emit about 7MtCO₂ less in total due to the new international regulations over eight years (with an average annual saving of around 0.9MtCO₂).
- 4.18 However, in the context of the UK’s greenhouse gas emissions statistics, the UK’s share of international shipping emissions is not determined by the actual emissions by UK-flagged ships, but by fuel sales in the UK⁶⁸. The analysis in this IA does not therefore directly estimate the impact of this measure on the UK’s share of international shipping emissions.

⁶⁸ See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1051408/2020-final-greenhouse-gas-emissions-statistical-release.pdf.

- 4.19 In June 2021, the UK government set the Sixth Carbon Budget (covering 2033-37) to include the UK's share of international aviation and shipping emissions, as recommended by the Climate Change Committee. This is the first time that emissions from international shipping will be included in the UK's domestic carbon budget targets⁶⁹. However, because the appraisal period ends in 2030 and international shipping will not be included in carbon budgets until 2033, only the impacts of the new international regulations on the UK's domestic shipping emissions (i.e. the emissions from UK domestic voyages and vessels at berth at UK ports) will affect UK carbon accounting during the appraisal period.
- 4.20 In addition, as we expect that ships operating internationally will comply with the new international regulations introduced by the IMO in the absence of any new domestic implementing legislation in the UK, it is expected that the 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' would have no impact on carbon budgets.

Trade and Investment Impact

- 4.21 By increasing shipping costs, the new international regulations are expected to have a small negative impact on world trade, including the UK's international trade. However, as we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK, it is not expected that the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will have a significant impact on the UK's international trade or UK GDP. The remainder of this section discusses the impacts of the new international regulations on trade and investment.

Impact on the market

- 4.22 As discussed above, the DNV modelling finds that speed reduction will be a key compliance mechanism. Reducing the speed of vessels means that the same amount of transport work will take longer to perform (if the speed is lower, one dwt-mile or tonne-mile takes more time to complete).
- 4.23 The DNV modelling assumes that transport demand and transport work capacity is the same or almost the same in all regulatory scenarios, i.e. it is independent of the policies. In addition, the DNV modelling assumes that speed reduction lowers the distance sailed by individual vessels each year and that more vessels will be required to perform the same amount of transport work.
- 4.24 Because of these assumptions, the policy scenarios model an increase in the total number of vessels in the fleet (for example, compared with the baseline current regulations scenario, the adopted regulations scenario has less than 0.01% more global dwt-miles in 2030, but the total number of ships in the global fleet in 2030 is about 15% higher).
- 4.25 However, there may be factors that mean that fewer new vessels are required than estimated in this modelling, such as if ship operations change to enable ships to spend more time at sea and less time in ports, or if the new international requirements lead to a reduction in transport demand.
- 4.26 Other actions that may be taken to comply with the new international regulations are the use of alternative fuels or other energy efficiency measures. As shown above, the combined impact of these actions is estimated to be an increase in shipping costs.

Impact on international trade

- 4.27 The IMO document MEPC 76/7/13 on the Comprehensive impact assessment of the short-term measure included an assessment of the impact of the measures on States

⁶⁹ As per p28 of 2020 UK emissions statistics

(https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1051408/2020-final-greenhouse-gas-emissions-statistical-release.pdf).

as carried out by the United Nations Conference on Trade and Development (UNCTAD) (task 3) which analysed the impact of the new international regulations on international trade, including a breakdown by economy.

- 4.28 The UNCTAD analysis provides estimates of the changes in maritime logistics costs, trade flows and GDP levels due to the new international regulations. Due to the uncertainty and assumptions made in the analysis, UNCTAD reports that this “cannot be determined with a high degree of precision”. So, this should be borne in mind when considering the results of this analysis.
- 4.29 The UNCTAD study estimated the average increase in total maritime logistics costs in 2030 due to the new international regulations to be between 3% and 7%⁷⁰, and concluded that this “can be considered small when compared to typical market variability of freight rates.” The impact on total maritime logistics costs for the UK economy was broadly in line with the global average⁷¹.
- 4.30 The overall volume of trade is expected to fall due to higher costs. However, the overall impact of the cost increases described is unlikely to make a significant difference. This is because maritime freight costs are subject to significant fluctuation, meaning the additional impact of a small percentage increase is relatively modest⁷². In addition, because transport is a derived demand, it is price-inelastic, so any increase in costs would be expected to cause a less-than-proportionate decrease in trade volumes⁷³. Therefore, a large fall in trade due to increase costs is not expected.
- 4.31 UNCTAD report that the reductions in trade estimated in its analysis “tend to be relatively lower in comparison with the trade contractions seen during the financial crisis and the COVID-19 disruption, or those projected to result from unmitigated GHG emissions and climate change”.

Impact on the UK economy

- 4.32 The expectation of a small fall in trade volumes is shown by the UNCTAD analysis of the impact of the new international regulations on trade. For the UK, the impact of the new international regulations on trade volumes in 2030 was estimated at between -0.2% and -0.4%, with very similar results for exports and imports. The impact of this on real national income is estimated at between -0.02% and -0.04% in 2030. This is broadly in line with the estimated global average impacts, which UNCTAD reports “can be considered small when compared to the long-term impact of other disruptions such as a pandemic or climate change factors”. In addition, as these estimates are for 2030, these estimates suggest that any reductions in UK GDP due to the international regulations would be dwarfed by the expected growth in UK GDP between now and 2030⁷⁴.
- 4.33 Given that analysis of this nature is subject to considerable uncertainty, it is not considered that precise estimates can be produced of the impacts of the international regulations on UK GDP. However, given that the UK’s gross national income is currently over £2tn⁷⁵, it is recognised that even a very small 0.01% percentage

⁷⁰ See Table 7 (p45) of the UNCTAD report for the IMO (https://unctad.org/system/files/official-document/dtltlb2021d2_en.pdf). Only the original DNV scenarios “high reduction” and “low reduction” were assessed, meaning the final “adopted regulations” scenario used in the central case of the cost-benefit analysis above was not assessed. The average increase in total maritime logistics cost is 2.7% in the low scenario and 7.2% in the high scenario.

⁷¹ See Table 8 (p45-49) and Table 9 (p49-54) of the UNCTAD report for the IMO (https://unctad.org/system/files/official-document/dtltlb2021d2_en.pdf). Total maritime logistics costs are estimated to increase by between 3.1% (low) and 7.2% (high) where the UK is the importing economy and by between 3.3% (low) and 7.5% (high) where the UK is the exporting economy. This means the cost increase to UK trade is expected to be broadly in line with (or very slightly higher than) the global average.

⁷² For example, the Baltic Exchange Dry Index on 31 August 2022 (965 points) was 76% lower than its value a year previously (4,013 points on 1 September 2021), a fluctuation more than ten times greater than the total cost increase in the high scenario of the UNCTAD analysis. This and other freight rate indices are frequently subject to significant fluctuations. (<https://uk.investing.com/indices/baltic-dry-historical-data>)

⁷³ See, for example, the World Bank paper at <https://documents1.worldbank.org/curated/en/573201468766481035/pdf/multi-page.pdf>, which shows demand for freight transport is price-inelastic (the price elasticity for ocean shipping of general cargo is estimated at around 0.5, and estimates for specific commodities are much lower). The paper is from 1990 but the economic theory has not changed.

⁷⁴ For example, see https://obr.uk/docs/dlm_uploads/CCS0222366764-001_OBR-EFO-March-2022_Web-Accessible-2.pdf.

⁷⁵ See Office for National Statistics dataset ABMZ at <https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/abmz/ukea>.

reduction in UK GDP could still equate to a reduction of several hundred million pounds⁷⁶.

- 4.34 The estimates in UNCTAD's analysis are estimates of the overall impact of the new international regulations on the UK. However, as noted above, we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK. Therefore, it is not expected that the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will have a significant impact on the UK's international trade or UK GDP.
- 4.35 Exactly who will bear the costs of the new international regulations is not clear because it depends on the extent to which maritime operators pass costs through to consumers and businesses (the extent to which this is possible depends on elasticities and may vary by market segment). Therefore, the national income effect appraised in the UNCTAD modelling may partly constitute double-counting the costs to business appraised above.

Impact on investment

- 4.36 The international regulations are expected to lead to additional investment in the shipping industry in order to reduce emissions.
- 4.37 However, because the impact of the measures is expected to be a net cost to UK companies, the measures may lead to a reduction in investment elsewhere in the economy. The extent of this reduction is not certain and is likely to vary by company, so it is not quantified.
- 4.38 As above, because foreign vessels and companies are expected to be affected in similar ways on average, there is not expected to be any significant reduction in investment by UK companies, or in investment to the UK, compared to investment by other companies, or investment in other countries, on average.

Competition Assessment

Maritime sector

- 4.39 In the short term, the new international regulations place a higher burden on vessels which currently do not comply with the new standards, which must implement greater reductions in their carbon intensity to meet the requirements. Some of the most efficient ships will not need to take any action because they will already be meeting the requirements and will therefore incur smaller costs than less efficient ships. This means the implementation of the new international regulations may affect operators unevenly, and there may be greater short-term pressure on some operators (i.e. operators of less efficient vessels) to raise prices in response. However, the gradual process by which measures are agreed, implemented, and tightened means affected operators will have had a long time to prepare, meaning there will be no sudden differential impact.
- 4.40 In the long term, the measures place the same burden on all vessels of equivalent types. This is because the new international regulations will apply equally and will require the same or equivalent changes to carbon intensity. No vessel will be obliged to meet higher standards than its competitors⁷⁷. This means the new international regulations will not distort market competition. As the new international regulations are performance-based, if different operators choose different mechanisms for meeting the obligations (for example, speed reduction or bio-fuels), and it becomes clear that some

⁷⁶ This does not account for economic growth. If the economy grows, as expected, up to 2030, then a given % change would lead to a larger absolute change. Conversely, the % change to national income the UNCTAD analysis estimates is for 2030, and the impact in intervening years would be expected to be smaller.

⁷⁷ The carbon intensity reduction factors are determined by vessel type and size. Because vessels can compete across type and size (for example, roll-on, roll-off (ro-ro) ferries serving the UK compete with container services on some routes) it is theoretically possible that factors could be set such that the practical effect is more demanding for one type. This analysis assumes the ongoing IMO process for agreeing factors meets its goal of setting fair and equivalent reduction factors, taking account of the different features of each vessel type and size.

mechanisms are more efficient or create a competitive advantage, there will be no constraint on operators changing their mechanism to compete.

- 4.41 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will apply to UK-flagged vessels that perform international voyages. This means that if only the UK implemented the regulations, UK-flagged vessels may be at a competitive disadvantage (given the regulations are expected to increase cost intensity, as above). However, in the same way the UK is obliged to implement the regulations, other IMO member states are also obliged to implement the regulations. Therefore, assuming other countries meet their obligations, the UK fleet will *not* be disadvantaged in relation to other countries' fleets⁷⁸. This includes in relation to non-UK-flagged vessels trading in UK waters: as above, the Regulations will apply to relevant non-UK-flagged vessels operating in UK waters, meaning foreign vessels will not be able to gain a competitive advantage over UK vessels serving UK routes or ports. The powers given to UK port state control to enforce the regulations for non-UK-flagged vessels ensure the UK will be able to enforce a "level playing field".

Inter-modal competition

- 4.42 Because the new international regulations are expected to increase the costs of transporting goods by sea, they may theoretically cause a switch from maritime to transporting goods by other modes. However, any effects are expected to be very limited. This is because of the low substitutability between modes, and because substitution is not highly price sensitive.
- 4.43 Air freight transport is significantly more expensive than sea freight⁷⁹, and accounts for only a very small share of total UK trade by volume⁸⁰. Air freight tends to be used for specialised purposes: time-sensitive or high-value goods. Given the very large cost differential (which will not be significantly impacted by the policy), the choice to use air freight rather than sea freight does not appear to be primarily driven by price. Therefore, any modal shift from sea freight to air freight resulting from the new international regulations would likely be very limited.
- 4.44 Maritime transport also competes with international rail freight in specific markets, especially cross-Channel (Dover-Calais). Due to strong interchangeability between the two modes on this specific route, price sensitivity is relatively high. This means the new international regulations could in theory induce some shift from ferries to rail on cross-Channel markets. The exact extent of this is unknown. However, as we expect that ships operating internationally will comply with the new international regulations in the absence of any new domestic implementing legislation in the UK, it is not expected that the implementation of 'The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023' will have a significant impact on these routes. More broadly, competition from international rail is limited to specific short-sea routes, so the large majority of UK trade will not be impacted by competition with international rail.
- 4.45 Maritime may also compete with other modes of transport for passenger transport in some cases, but due to the wider policy action being taken to decarbonise transport⁸¹, any impacts of individual policies on competition should be moderated.

⁷⁸ The IMO has 175 member states and 3 associate members (<https://www.imo.org/en/OurWork/ERO/Pages/MemberStates.aspx>), including all major shipping nations. The IMO briefing on the short-term measures says that around 97% of world merchant shipping by tonnage is represented by states which are parties to MARPOL Annex VI (<https://www.imo.org/en/MediaCentre/PressBriefings/pages/MEPC76.aspx>). Therefore, the vast majority of the global fleet will be covered by the regulations once implemented by all IMO states.

⁷⁹ In 2009, the World Bank found that air freight is typically 12-16 times more expensive than sea freight (see <https://www.worldbank.org/en/topic/transport/publication/air-freight-study>). Though the study is more than a decade old, the key economic drivers of the difference have not significantly changed, so the principle of a large cost differential remains the same.

⁸⁰ Air freight accounts for just 1.0% of UK exports and 0.5% of UK imports by volume (see chart 10 at <https://www.gov.uk/government/statistics/transport-statistics-great-britain-2021/transport-statistics-great-britain-2021>).

⁸¹ For example, see <https://www.gov.uk/government/publications/transport-decarbonisation-plan>.

5. Monitoring and evaluation

Post implementation review (PIR)

Review status:									
<input type="checkbox"/>	Sunset clause	<input type="checkbox"/>	Other review clause	<input type="checkbox"/>	Political commitment	<input checked="" type="checkbox"/>	Other reason	<input type="checkbox"/>	No plan to review
Regulations to be reviewed every five years to ensure continued suitability.									
Expected review date:									
<input type="text" value="0"/>	<input type="text" value="3"/>	/	<input type="text" value="2"/>	<input type="text" value="8"/>	(Five years from when the Regulations come into force)				
Rationale for PIR approach:									
<p>Monitoring and evaluation to inform a PIR is subject to Regulation 38 of the 2008 Statutory Instrument (inserted by SI 2014/3076).⁸² This requires the Secretary of State to carry out a review of the Regulations, set out conclusions and publish the report. Because these are international measures, the primary responsibility for monitoring impacts will be at the IMO level. As an IMO member, the UK will be party to continued IMO negotiations and the IMO process for monitoring the impact of the measures.</p> <p>The UK will monitor the progress of international regulations and will consider whether updates to UK legislation are needed to stay in line with any changes or updates to IMO regulations⁸³. The UK will also monitor whether any other IMO countries implement the standards in different ways, and if so, evaluate the consequences, advantages, and disadvantages of different approaches⁸⁴.</p>									

International review

- 5.1 EEXI and CII are part of the IMO's short-term measures and will be kept under review by the IMO. According to the IMO agreement, the IMO is required to review the effectiveness of EEXI and CII before 1 January 2026, and to develop further amendments and changes if necessary⁸⁵. In particular, CII reduction factors for the years 2027-2030 are to be set taking account of lessons learned from the early implementation of CII. This provides a review point and an ability for the UK to contribute to further IMO decision-making on the future of the policy.
- 5.2 The IMO review will take place in the context of a developing decarbonisation strategy. The review will take place alongside development of further ambition in decarbonisation, and progress on mid-term measures and market-based measures⁸⁶. The UK supports decarbonisation of the international shipping sector and will play a full role in these reviews and in setting further emissions reductions measures at IMO level.

⁸² See SI 2014/3076 Regulation 2(5) inserting review provision (Regulation 38) [The Merchant Shipping \(Prevention of Air Pollution from Ships\) and Motor Fuel \(Composition and Content\) \(Amendment\) Regulations 2014](https://www.legislation.gov.uk/si/2014/3076/regulation-38) (legislation.gov.uk)

⁸³ This is in line with RPC guidance on international regulations: see Section 3 at [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/790031/RPC case histories post-implementation reviews March 2019.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/790031/RPC_case_histories_post-implementation_reviews_March_2019.pdf).

⁸⁴ This is a requirement in line with RPC guidance on post implementation reviews (see discussion in the "Assessing impacts" section at <https://www.gov.uk/government/publications/business-regulation-producing-post-implementation-reviews/producing-post-implementation-reviews-principles-of-best-practice>).

⁸⁵ See discussion in the IMO briefing on short-term measures at <https://www.imo.org/en/MediaCentre/PressBriefings/pages/MEPC76.aspx>.

⁸⁶ See details of the IMO greenhouse gas emissions reduction strategy at <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx>, including discussion of candidate mid-term measures.

Monitoring policy impacts

- 5.3 Because these are international measures, the primary responsibility for monitoring and evaluation will be at the IMO level. However, the UK will review the impacts on the UK fleet to track impacts of the UK regulations and to inform UK contributions to future IMO negotiations.
- 5.4 The UK will monitor the performance of UK-flagged vessels and will be able to review compliance levels and the ratings achieved. This will indicate whether UK vessels are finding it difficult to meet the standards and whether any UK vessels are failing to comply. The Department will also continue to engage with industry stakeholders and will become aware of industry views on the measures and the compliance process. In addition, the Department will continue to build our broader evidence base on maritime decarbonisation, including on the costs and benefits of reducing emissions in the maritime sector; and will carefully consider how the ongoing development of our evidence base on maritime decarbonisation could assist with the completion of this PIR.
- 5.5 The PIR will consider any relevant available data on number of ships, number of dwt-miles, and average transport work per ship to determine the extent to which these variables have changed as expected, and whether trade patterns have changed significantly. It may be difficult to attribute any changes solely to these regulations, but engagement with industry should help understand the extent to which these changes have impacted the sector.
- 5.6 Taking any improved evidence and data that becomes available into account, the PIR will also review the extent that the other assumptions made in this IA can be validated, such as the assumptions around cost intensity, where UK-specific data was lacking.

Evaluation of risks

- 5.7 As above, the key risk to policy effectiveness is that the measures could create an incentive to switch to fuels which increase emissions of non-CO₂ greenhouse gases. The PIR will consider available data on the take-up of alternative and transitional fuels, to determine the extent to which the risks associated with transitional fuels are occurring in practice and will aim to evaluate the extent to which this is undermining policy objectives.
- 5.8 The PIR will also consider the extent to which compliance has been possible and any problems faced by UK port state control in ensuring compliance with the regulations.