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# GHG EMISSIONS FROM SHIPPING: HOW TO OVERCOME PERSISTENT CHALLENGES

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# GHG emissions from shipping: How to overcome persistent challenges

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ABSTRACT

Decarbonisation represents a top priority in the agenda of the shipping industry. Governments, regional and international organisations are currently engaged in adopting effective measures to reduce the impact of shipping while ensuring their suitability for maritime trade operators.

Since the nineteenth century, shipping has been characterised by attempts of harmonisation drafted by international commercial bodies, such as the Comité Maritime International (CMI), focused on the unification of maritime and commercial laws. In modern times, the role of governments became more prominent, as the development of scientific knowledge and the increasing involvement of civil society called for greater regulation at the public level. Oil pollution incidents, such as the *Torrey Canyon* (1967), the *Exxon Valdez* (1989), the *Erika* (1999), and the *Prestige* (2002) demonstrated the importance of public control over commercial activities carried out by sea.

In contrast to other sources of marine pollution, such as oil spills and land-based contamination, atmospheric pollution and greenhouse gas (GHG) emissions are relatively young sources. The 1982 United Nations Convention on the Law of the Sea (UNCLOS) was one of the first treaties to recognise their impact on the marine environment, and now they represent a major challenge faced by the shipping industry. The International Maritime Organization (IMO) is tasked with implementing the GHG agenda but is considered largely ineffective and other regional entities, particularly the EU, have taken the lead.

Keywords: International Maritime Organization (IMO), GHG emissions, MARPOL Annex VI, technical and operational measures, market-based measures, alternative fuels

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# 1 Introduction

Anthropogenic GHG emissions represent a persistent threat to human health, animal welfare, and the environment. The Secretary-General of the United Nations (UN), Antonio Guterres, has stated that we are living through several crises today, including 'the crisis of climate emergency'. Ocean warming and acidification, loss of biodiversity, arctic smelting, and sea-level rise are well-known negative consequences. As shipping significantly contributes to atmospheric pollution and global GHG emissions, the matter requires special attention from the International Maritime Organization (IMO).

The principal reason for exploring air pollution and GHG emissions from shipping is to be found in current demographic and international trade dynamics. The total human population is increasing, and the signs are that the volume of cargo carried by sea will increase. In this context, the impact of shipping on the marine environment and air quality is a source of concern, imposing the need for sustainable maritime transport.

This paper analyses the regulatory framework of GHG emissions from shipping, the technical and operational measures adopted by the IMO, the debates on market-based measures (MBMs) among States and industry members, and the development of alternative fuels. It aims to suggest opportunities for the shipping industry, such as the use of climate clauses in charterparties, and States, such as the development of incentives and infrastructures for alternative fuels, to reduce the carbon footprint of shipping.

# 2 The impact of shipping and the current regulatory framework

This section of the paper gives an overview of the impact of shipping on global GHG emissions and the international legal framework concerning GHG emissions from shipping. It analyses the mandate of the IMO concerning 'climate action',[1] particularly the measures adopted by the Marine Environment Protection Committee (MEPC).[2] The section will also discuss Annex VI of the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) and the 2018 IMO Initial Strategy to

[1] Sustainable Development Goal 13 of the UN Agenda for Sustainable Development.

[2] See <https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-default.aspx> accessed 6 July 2023.

reduce GHG emissions from ships. It will conclude by introducing the juxtaposition between countries supporting the principles of 'Common but Differentiated Responsibilities' and 'No More Favourable Treatment' within the MEPC.

## 2.1 Definition of air pollution and GHG emissions from shipping

The starting point is the negative consequences of bunker fuel, primarily used by the shipping industry because of its low cost. However, when bunker fuel burns, it produces nitrogen oxides ($NO_x$) and sulphur oxides ($SO_x$). Emissions from shipping also include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_20$), halogenated hydrocarbons, and particulate matter (PM), many of which are correlated with each other.[3] All contribute to energy retention at the lower atmospheric level, generating the GHG effect.[4] Not all emissions originate from fuels. Handling crude oil as cargo and compounds used in refrigeration systems on board ships also cause emissions, namely volatile organic compounds (VOCs) and ozone-depleting substances.[5]

Cargo and passenger ships account for the vast majority of atmospheric emissions, while fishing and service ships account for less than 4 per cent. Regarding spatial distribution, around 70 per cent of all shipping emissions occur within 400 km from the coast and primarily in the Northern Hemisphere.[6]

### *2.1.1 The four IMO GHG studies*

Discussions at international fora, such as the UN General Assembly for the annual resolutions on 'Oceans, law of the sea and sustainable fisheries' and the Food and Agriculture Organization (FAO),[7] emphasise how GHG emissions from ships represent a threat to the marine environment, including marine ecosystems and biodiversity, and human health.

Between 2000 and 2020, the IMO produced four GHG studies on GHG emissions from shipping. The data gathered constituted, among other things, the basis for the organisation's activities in this field. In

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3 K Salo et al, 'Emissions to the Air' in K Andersson et al, *Shipping and the Environment: Improving Environmental Performance in Marine Transportation* (Springer 2016) 170.

4 M Tsimplis, *Environmental Norms in Maritime Law* (Edward Elgar Publishing 2021) 21-22.

5 Salo (n 3) 170.

6 Tsimplis (n 4) 20. See also Salo (n 3) 170.

7 In particular, the Committee on Fisheries (COFI), which is a subsidiary body of the FAO Council.

the First IMO GHG Study 2000, in 1996, the IMO estimated that international shipping contributed around 1.8 per cent of global $CO_2$ emissions.[8] The Second IMO GHG Study 2009 highlighted that, in 2007, international shipping was responsible for 885 million tonnes of $CO_2$ emissions, 2.8 per cent of that year's total global $CO_2$ emissions. The Study considered 'technical and operational measures' and 'market-based measures' to reduce GHG emissions from ships and emphasised that by 2050, $CO_2$ emissions from shipping could grow between 50 per cent and 250 per cent, depending on the intensification of world trade and the adoption of energy policies.[9] By the time of the Third IMO GHG Study in 2014, international shipping emitted 796 million tonnes of $CO_2$ in 2012, about 2.2 per cent of that year's total global $CO_2$ emissions.[10] In 2018, GHG emissions from shipping were a source of 1,076 million tonnes of $CO_2$, about 3 per cent of global GHG emissions.[11] It was found that today the shipping sector improved in terms of energy efficiency, being responsible for around 680 million tonnes of carbon emissions per year. However, emissions will likely stay at about 600 million tonnes as seaborne trade is expected to grow by 15 per cent by 2030.[12]

The IMO has adopted several standards to reduce air pollution from vessels to meet the Paris Agreement target of restraining the earth's temperature increase to 1.5°C. However, these measures give rise to issues of application by the shipping industry.

### *2.1.2 Current trends and answers*

The global shipping industry moves and burns fossil fuels, moving between 80 and 90 per cent of all world trade.[13] However, at the same time, between 36 and 40 per cent of all cargo is coal, oil, and gas, representing the fossil fuels that cause climate damage.[14] Crude oil and oil products form the bulk of

8 First IMO GHG Study (IMO 2000).
9 Second IMO GHG Study (IMO 2009).
10 Third IMO GHG Study (IMO 2014).
11 Fourth IMO GHG Study (IMO 2020).
12 James Baker, 'Green Fuels Face Costly Development Challenges' *Lloyd's List* (London, 16 May 2023).
13 E McGaughey, 'Liability for Climate Damage and Shipping' in B Soyer and A Tettenborn *Disruptive Technologies, Climate Change and Shipping* (Informa Law from Routledge 2022) 198-199.
14 *Shipping's Role in the Global Energy Transition. A Report for the International Chamber of Shipping* (ICS, 2022) 3 <https://tyndall.ac.uk/news/new-shipping-emissions-report/> accessed 28 June 2023. See also McGaughey, ibid.

seaborne energy transported, accounting for around 66 per cent. About 64 per cent of oil and 15 per cent of both natural gas and coal are carried by sea.[15]

The top ten shipping companies hold over 80 per cent of the world market share, and the top four European companies (Mediterranean Shipping Co, APM-Maersk, CMA CGM Group, and Hapag-Lloyd) hold 52.4 per cent of the global market share. These big four European corporations are likely responsible for around one or two per cent of global GHG emissions.[16]

One response of the shipping industry was slow steaming, which started after the financial crisis in 2008. Vessel speeds have been reduced by 17 to 25 per cent across shipping segments, and baseline $CO_2$ emissions declined by around 24 per cent when ships reduced their speeds by 20 per cent.[17] The attention is now focused on drafting charterparty clauses and sharing duties between shipowners and charterers.

### 2.2 UNCLOS and GHG emissions from shipping

The overarching instrument governing oceans and seas is the United Nations Convention on the Law of the Sea (UNCLOS). The 'constitution for the oceans' was adopted in 1982 and entered into force on 16 November 1994.[18] Part XII contains various provisions dedicated to protecting and preserving the marine environment. Article 194(1) establishes that States shall take 'all measures … necessary to prevent, reduce and control pollution of the marine environment from any source', using the 'best practicable means at their disposal and in accordance with their capabilities'. Article 194(2) also states that States shall take 'all measures necessary to ensure that activities under their jurisdiction or control are carried out by not causing damage by pollution to other States and their environment …'.[19] Such measures include art 194(3)(b), aimed at minimising pollution from vessels, including 'preventing

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15 Ibid, 43.

16 McGaughey (n 13) 198-199.

17 HN Psaraftis, *Sustainable Shipping – A Cross-Disciplinary View* (Springer 2019) 67. See also Richard Meade, 'Shipping Skips over Short-term Struggles in Favour of Long-term Aspirations' *Lloyd's List* (London, 8 June 2023).

18 For the list of signatories, see the UN Treaty Collection <https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en> accessed 6 July 2023.

19 The text of UNCLOS is available at the Division for Ocean Affairs and the Law of the Sea (DOALOS), Office of Legal Affairs (OLA) of the United Nations: <https://www.un.org/depts/los/convention_agreements/texts/unclos/UNCLOS-TOC.htm> accessed 5 July 2023.

accidents and dealing with emergencies, ensuring the safety of operations at sea, preventing intentional and unintentional discharges, and regulating the design, construction, equipment, operation and manning of vessels'.[20] Finally, UNCLOS art 211, relating to vessel-source pollution, legitimises the IMO to adopt standards and requirements for protecting marine flora and fauna, delegating the power to enforce these rules to flag and port States.

*2.2.1 Pollution from or through the atmosphere*

UNCLOS regulates pollution from or through the atmosphere through arts 212 and 222, respectively dedicated to the legislative and enforcement powers of States. It further develops the obligation of States under art 194(3)(a), to take measures designed to minimise to the fullest possible extent 'the release of toxic, harmful or noxious substances, especially those which are persistent ... from or through the atmosphere'. UNCLOS, art 212 calls on States to adopt laws and regulations and to take other necessary measures applicable to the airspace under their sovereignty or to vessels or aircraft of their registry, to control pollution of the marine environment from or through the atmosphere.[21]

**2.3 The mandate of the IMO**

In 1997, States parties to the United Nations Framework Convention on Climate Change (UNFCCC) legitimised the mandate of the IMO in the Kyoto Protocol (KP) to regulate emissions from shipping, as *lex specialis* compared to the international climate change regime. However, progress at the IMO to address the issue has been slow and limited.[22] Indeed, the history of the IMO can be read as a series of responses to casualties. However, concerning environmental regulation, particularly GHG reduction, the industry, governments and the IMO are in new territory.[23]

As noted by Broder and Van Dyke, 'strong forces are at work within the IMO to protect the economic and financial concerns and profits of the shipping industry, leading to delays in improving the quality of

[20] M Nordquist et al, *United Nations Convention on the Law of the Sea 1982: A Commentary* vol IV (Martinus Ninjhoff Publishers 1993) 56.
[21] Ibid, 208.
[22] See, eg, Megawati Wijaya, 'IMO "Not Fit for Purpose", Says Former ICS Chief' *Lloyd's List* (London, 24 April 2023).
[23] Richard Meade, 'The Case for a More Holistic Approach to Regulation' *Lloyd's List* (London, 26 May 2023).

bunker fuel or reducing its use'.[24] The IMO has been criticised for looking like the 'bedfellow to the industry, not its regulator'.[25]

*2.3.1 MARPOL Annex VI and 'scrubbers'*

IMO's first activities on shipping-based air pollution started during the second half of the 1980s.[26] MARPOL sets out the international requirements for preventing pollution from ships sailing internationally or between two Member States. In 2003, the IMO Assembly adopted a resolution urging MEPC to identify and evaluate mechanisms to limit GHG emissions from ships.[27] The MEPC was established in 1973 following the *Torrey Canyon* casualty in 1967. It is the body in charge of the amendments of MARPOL.[28] MARPOL is characterised by six annexes, dealing with the particular sources of pollution from shipping. These include oil in Annex I, noxious liquid substances in bulk in Annex II, and garbage in Annex V. It is worth noting that States that become parties to MARPOL must automatically comply with the provisions of Annex I and Annex II, but not with the remaining annexes.[29] The discussion at the IMO on Annex VI (concerning air pollution) represents one of the best examples of the close interrelation between States and the shipping industry.[30]

MARPOL Annex VI provides the legal basis for reducing GHG emissions from shipping.[31] Annex VI was adopted in 1997 by a majority of Member States at the IMO and entered into force in 2005. At the time of writing, there were 100 States parties, Argentina being the most recent ratifying country in 2021.[32]

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[24] SP Broder and JM Van Dyke, 'The Urgency of Reducing Air Pollution from Global Shipping' in A Chircop et al, *The Regulation of International Shipping: International and Comparative Perspectives – Essays in Honor of Edgar Gold* (Martinus Nijhoff Publishers 2012) 261.

[25] Ibid, 251-252; C Moore, *Out of sight, on the high seas: The biggest piece of low-hanging fruit in air pollution history* (2008) available at http://curtismoore.files.wordpress.com/2008/10/9-out_of_sigh.pdf accessed on 25th June 2023.

[26] See *IMO Begins Work on Air Pollution – Historic Background* of the Marine Environment Protection Committee on the IMO website: <https://www.imo.org/en/OurWork/Environment/Pages/Historic-Background-.aspx> accessed 27th June 2023.

[27] IMO Policies and Practices Related to the Reduction of Greenhouse Gas Emissions From Ships, Resolution A.963(23) (5th December 2003).

[28] See C de La Rue et al, *Shipping and the Environment* (3rd edn, Informa Law from Routledge 2023) 957.

[29] R Churchill et al, *The Law of the Sea* (4th edn, Manchester University Press 2022) 630.

[30] For the importance of the shipping industry's role within the IMO, A Chircop, 'The International Maritime Organization' in D Rothwell D et al (eds), *The Oxford Handbook of the Law of the Sea* (Oxford University Press 2015) 426.

[31] Churchill (n 29) 635.

[32] See <https://www.imo.org/en/MediaCentre/PressBriefings/pages/MARPOL100State.aspx> accessed 25 June 2023.

Under Annex VI, maximum permissible levels of sulphur in bunker fuel are set by the IMO and implemented by States parties. The maximum allowable levels have decreased with time. These levels are expressed in percentage by mass of solution, using the abbreviation 'm/m' (e.g., 2 per cent m/m of the mass of the total solution).[33] In 2008, the cap of the allowable emission of $SO_x$ in fuels was 4.5 per cent, but in 2020, this was reduced to 0.5 per cent and enacted even stricter measures in specific 'emission control areas' (ECA).[34] Four emissions control areas exist: the Baltic Sea, the North Sea, the North America Sea and the United States Caribbean Sea (where the maximum limit has been fixed to 0.1 per cent since 2015).[35]

However, it is difficult for shipowners and operators to comply with the costly innovations required by these standards. This may explain the preference for installing so-called 'scrubbers' rather than investing in research and development to study and possibly employ sustainable fuels. Using scrubbers implies washing the exhaust gases of the ship's engines, reducing atmospheric emissions from ships.[36] However, through scrubbers, ships release all or part of the water containing the pollutant substances into the sea, raising concerns for marine flora and fauna in light of the daily discharge of copper and zinc in much larger quantities than the antifouling paint of ships.[37]

Scrubbers have been installed on about 5,000 of the world's biggest ships as a sulphur abatement measure, allowing them to continue burning cheaper, higher-sulphur fuel. About 80 per cent are 'open-loop' scrubbers that discharge washwater directly into the sea, often untreated,[38] and this is critical in relation to the Arctic, affected by 'black carbon', a climate pollutant that accelerates snow and ice loss.[39]

What is worse is that scrubbers have a legal basis in Annex VI itself. Regulation 4 states that ships may continue to use dirty fuel if the ship has an exhaust gas cleaning system.[40] While wet and dry scrubbers

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33 M Davies and A Dickey, *Shipping Law* (4th edn, Thomson Reuters Professional (Australia) Ltd 2016) 815.
34 Churchill (n 26) 635.
35 Psaraftis (n 17) 15-16. See also Davies and Dickey (n 33) 815.
36 De La Rue (n 28) 988.
37 Tsimplis (n 4) 26.
38 Michelle Wiese Bockmann, 'Influential IMO Members in Pollution Pushback on Scrubbers and Black Carbon Arctic Emissions' *Lloyd's List* (London, 15 December 2022).
39 Ibid. See also Enes Tunagur, 'IMO Fails to Make Progress on Arctic Black Carbon Emissions' *Lloyd's List* (London, 2 May 2023).
40 Churchill (n 29) 635.

exist, the industry prefers wet scrubbers.[41] The European Union (EU) provides more stringent caps. In July 2005, the European Council and the Parliament enacted a Directive introducing a cap of 1 per cent sulphur content in heavy fuel oils.[42] This Directive aims to reinforce the EU and Member States' position in IMO negotiations in the revision phase of Annex VI, promoting stricter measures on sulphur limits regarding heavy fuels used by ships.[43]

*2.3.2 Overview of MEPC action*

Following the 2008 amendments, MEPC has adopted several measures to reduce GHG emissions from shipping.[44] At the 62nd session in 2011, it approved Chapter 4 to Annex VI, requiring ships of 400 grt and above built from 2014 onwards to comply with the Energy Efficiency Design Index (EEDI).[45] As will be explained,[46] this sets minimum levels of energy efficiency, which increases at five-year intervals up to 2025. Shipbuilders can then decide how to fulfil these requirements, for instance, through hull design.[47] Further, vessels built before 2014 must have a Ship Energy Efficiency Management Plan (SEEMP) in place to monitor their energy efficiency. The SEEMP applies to all ships.[48] However, there is no obligation to improve the efficiency of the vessel, leaving shipowners and operators with the decision to take appropriate measures after monitoring.

In 2016, MEPC adopted the IMO Data Collection System (DCS), requiring all ships over 5,000 grt to record their fuel consumption and to report it to their flag State and the IMO.[49] The gathered data would be analysed for further actions to improve energy efficiency.[50]

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41 Tsimplis (n 4) 26.

42 For the comment on the Directive, see H Jessen, 'Commentary, Directive 2005/35/EC on ship-source pollution and on the introduction of penalties, including criminal penalties, for pollution offences (as amended by Directive 2009/123/EC)' in H Jessen and MJ Werner (eds), *EU Maritime Transport Law* (CH Beck Hart Nomos 2016) 667-712.

43 S Karim, 'Implementation of the MARPOL Convention in Developing Countries' (2010) 79 Nordic J of Int'l Law 318. See also para 15 of the preamble of Directive 2005/33/EC.

44 Churchill (n 29) 637.

45 The vast majority of MARPOL Annex VI State parties voted in favour of the new measures, with Brazil, Chile, China, Kuwait and Saudi Arabia voting against. See also A Chircop, *Shipping and Climate Change* (Centre for International Governance Innovation 2018) 41.

46 See above para 3.1.1.

47 Churchill (n 29) 637.

48 Broder and Van Dyke (n 24) 275.

49 This measure was shaped on previous regulations by the EU. See below para 4.3.2.

50 Churchill (n 29) 637.

In June 2021, MEPC 76 adopted the Energy Efficiency Existing Ship Index (EEXI) and the Carbon Intensity Indicator (CII), and these measures entered into force on 1 January 2023.[51] However, it was found that the shipping industry, particularly tanker owners, did not make any improvement to adapting to such standards in 2022, being more concerned about market volatility.[52] This was also caused by the regulatory gaps and uncertainties that shipowners and ship operators found for compliance.[53]

*2.3.3 The IMO Strategy on GHG emissions from shipping*

The adoption of the IMO Initial Strategy on GHG emissions from shipping (the Strategy) is due to the prior conclusion in 2015 of the Paris Agreement,[54] which changed the States' attitude toward GHG emissions. As emphasised by Tsimplis, the Kyoto Protocol required specific undertakings for target reductions. However, the Paris Agreement constitutes an evolutionary normative approach, providing voluntary National Determined Contributions (NDCs) to keep the global temperature increase below 2°C and closer to 1.5°C.[55] The Intergovernmental Panel on Climate Change (IPCC) warned that global emissions in 2030, implied by NDCs announced before UNFCCC COP26[56] made it likely that warming will exceed 1.5˚C during this century, also making it harder to limit warming below 2°C.[57] Moreover, the phase-out of fossil fuels represents a major component of the 1.5˚C scenario. However, States at the COP26 only went as far as a promised 'phase down' of coal rather than a phase-out of oil, natural gas, and coal. It was also found that financial support from governments for fossil fuel production and consumption is increasing, despite the pledges at international fora.[58]

Under pressure from Paris Agreement, the IMO adopted its most recent measure in 2018.[59] As noted by Doelle and Chircop, this is a political declaration rather than a legally binding treaty.[60] The Strategy

[51] 'Decarbonisation – A Special Report' *Lloyd's List* (London, 31 May 2022) 15.
[52] 'Half-year outlook 2023' *Lloyd's List* (London, 30 June 2023) 6.
[53] Special Report (n 51) 12.
[54] This entered into force in 2016.
[55] M Tsimplis, 'Marine Pollution from Shipping Activities' in Y Baatz (ed), *Maritime Law* (5th edn, Informa 2021) 462-463.
[56] Held in Glasgow, Scotland in October 2021.
[57] Enes Tunagur, 'Sustainable Biofuels and Hydrogen Can Help Shipping Cut Emissions, Says IPCC' *Lloyd's List* (London, 20 March 2023).
[58] ICS (n 14) 40.
[59] MEPC Resolution 304(72) adopted on 13 April 2018. See de La Rue (n 28) 983.
[60] M Doelle M and A Chircop, 'Decarbonizing International Shipping: An Appraisal of the IMO's Initial Strategy' (2019) 28 RECIEL 268, 271.

follows the 'Guiding Principles'[61] of non-discrimination, no more favourable treatment, and common but differentiated responsibilities. The document includes full implementation of measures by all ships, regardless of the flag; the impacts of IMO measures on States, particularly developing States and SIDS; and evidence-based decision-making 'balanced with the precautionary approach as set out in resolution MEPC.67(37)'.[62]

IMO commits itself to phasing out GHG emissions from shipping 'as soon as possible in this century' through this intervention. There are also three 'levels of ambition':

1. Reduction of the 'carbon intensity of each ship' through the implementation of further phases of the Energy Efficiency Design Index for new ships;
2. Decline in the carbon intensity of international shipping, by reducing $CO_2$ emissions per transport work by at least 40 per cent by 2030, with efforts to achieve 70 per cent by 2050, compared to 2008; and
3. Reduction of total annual GHG emissions by ships of at least 50 per cent by 2050, compared with 2008.[63]

The IMO has discussed various strategies, including short, mid and long-term measures. Short-term measures approved in 2018-2023 imply more technical and operational aspects related to ships, such as improved energy efficiency, the establishment of speed restrictions, and technical cooperation among States. Mid-term measures, in force during 2023-2030, include market-based measures (MBMs), such as carbon levies and emissions trading schemes. Long-term measures to be enacted after 2030 include developing zero-carbon fuels and renewable energy, such as hydrogen, wind assistance, and solar power. However, the lack of necessary knowledge, the industry's continued use of fossil fuels and the available technology does not yet permit fruitful discussion.[64] As stressed by Tsimplis, the regulatory system established by the IMO is based on uniform minimum standards, and the lack of general consent within the IMO deprives pioneers in the sector of the financial benefits of innovation

[61] Art 3.2 of the Strategy.
[62] Para 3.2.4 of the Guiding Principles of the Strategy.
[63] Para 3.1 of the Strategy. See *What does the initial IMO GHG strategy say? – Initial IMO GHG Strategy* available at <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx> accessed 13 June 2023.
[64] Churchill (n 29) 638.

and the development of sustainable and efficient energy solutions.[65] The Strategy will be revised in July 2023 at MEPC 80 this year.

### 2.4 'Common but Differentiated Responsibility' or 'No More Favourable Treatment'?

There are several reasons behind the difficulties faced by the IMO. An example is the disagreement among States on MBMs. Progress is also exacerbated because there is no immediate replacement for oil as fuel for ships. However, MEPC is also experiencing the juxtaposition between the principles of 'Common but Differentiated Responsibility' (CBDR) and 'No More Favourable Treatment' (NMFT).

Principle 7 of the Rio Declaration on Environment and Development (the Rio Declaration), adopted at the 1992 UN Conference on Environment and Development, makes the following provision for CBDR: [66]

> States shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Under this Declaration, developed and developing countries are responsible for taking necessary legislative, control and enforcement measures regarding potential environmental damage. However, the burden should be more on developed countries, in light of their economic development through the previous centuries, allowing developing countries more time (if not discretion) to achieve sustainable economic development.[67]

Within the MEPC, larger developing countries supporting the CBDR[68] claim their sovereign prerogatives for national economic development. However, developed countries and Small Island Developing States

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65 Tsimplis (n 55) 463.

66 The Rio Declaration is available at: <https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_CONF.151_26_Vol.I_Declaration.pdf> accessed 10 June 2023.

67 Y Shi, *Climate Change and International Shipping – The Regulatory Framework for the Reduction of Greenhouse Gas Emission* (Brill Nijhoff 2017) 82-91.

68 Brazil, China, India and Saudi Arabia.

(SIDS), whose existence is threatened by climate change, support the traditional approach of IMO conventions following the NMFT.[69]

The former group of States believe the CBDR application is necessary as the international climate change regime, including the Kyoto Protocol, espouses this principle. Their position is based on the assumption that IMO's mandate to regulate GHG emissions from shipping originates from the Kyoto Protocol. Therefore the CBDR should always inspire regulations and standards adopted within the IMO, creating a sort of hierarchy of international conventions.[70]

Developed countries and SIDS have argued that IMO measures on GHG emissions should follow the IMO's traditional principles of non-discrimination and no more favourable treatment. The legal basis for this principle is to be found in the IMO Convention. Article 1(b) states that removing any discriminatory action represents one of the organisation's purposes, while art 3 considers the 'normal processes of international shipping business' as a recommended way to deal with shipping-related matters.[71]

The NMFT principle allows port States members of the IMO conventions to exercise their powers and jurisdiction over foreign vessels, regardless of the flag State in question. In other words, actions by port States lead to de facto compliance with IMO conventions, even by non-parties.[72]

In conclusion, in the view of these countries, as the overwhelming majority of ships fly the flag of developing States,[73] applying the CBDR principle reduces the effectiveness (or, at least, considerably limits the scope) of any GHG reduction measures that the IMO might adopt.[74]

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[69] The NMFT principle is embodied in the leading IMO conventions, such as MARPOL, the 1978 Protocol to the 1974 International Convention for the Safety of Life at Sea (SOLAS), and the 1978 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).

[70] Churchill (n 29) 636.

[71] Shi (n 67) 91.

[72] Churchill (n 29) 461.

[73] The three leading registries in the world by tonnage are Panama, Liberia and the Marshall Islands. See *Review of Maritime Transport 2022* (UNCTAD 2022) 42.

[74] The measures adopted by the IMO would address only the 25 per cent of the world merchant fleet in tonnage, i.e. the remaining percentage taking into account the 75 per cent of vessels sailing under open-registry flags.

# 3 Technical and operational measures by the IMO to reduce GHG emissions from ships

This section deals with the action of MEPC to reduce GHG emissions from shipping through the Energy Efficiency Design Index (EEDI), the Ship Energy Efficiency Management Plan (SEEMP), the Energy Efficiency Indicator for Existing Ships (EEXI), and the Carbon Intensity Indicator (CII). The IMO addressed the EEDI and the SEEMP to shipbuilders and shipowners, while the EEXI and the CII to ship operators who, in the case of a time charterparty, are the charterers. Therefore, general IMO requirements and commercial implications are considered, particularly the contribution of shipbuilders and issues rising between shipowners and charterers.

The main issue is whether the current technical and operational measures (or short-term measures) are effective in achieving the levels of ambition of the 2018 IMO Strategy.

### 3.1 Scope of short-term measures

In April 2008, MEPC 57 adopted the following fundamental principles as a basis for IMO regulations on the reduction of GHG emissions:

1. Effective in contributing to the reduction in total global greenhouse gas emissions;

2. Binding and equally applicable to all flag States in order to avoid evasion;

3. Cost-effective;

4. Able to limit, or at least effectively minimise competitive distortion;

5. Based on sustainable environmental development without penalising global trade and growth;

6. Based on a goal-based approach and not prescribe specific methods;

7. Supportive of promoting and facilitating technical innovation and research and development (R&D) in the entire shipping sector;

8. Accommodating to leading technologies in the field of energy efficiency; and

9. Practical, transparent, fraud-free and easy to administer.[75]

The short-term measures implemented by the IMO refer to those standards applied to ships according to their physical structure and employment. The EEDI and the SEEMP were conceived as crucial devices for reducing GHG emissions. To show progress at the UNFCCC COP 15 held in July 2009 in Copenhagen,[76] the MEPC, at its 59th session, adopted voluntary energy efficiency measures to tackle air pollution from vessels, developing the EEDI and the SEEMP, and discussed parameters to assess and reduce GHG emissions from shipping.

These short-term measures create a framework for incentivising the uptake of renewable fuels and require mandatory retrofitting of cost-effective technologies. One measure, speed reduction, clearly shows the difficulty of achieving consensus within MEPC about such measures among delegations[77] and the shipping industry. In April 2019, the French delegation proposed mandatory slow steaming for international shipping except for container ships. However, the ship-owning community highlighted that slow steaming implied longer voyage times, leading to higher operating costs, insurance, and employment costs. Moreover, shipowners would be encouraged to buy in extra tonnage, which would delay the introduction of new energy-efficient vessels.[78] This debate highlights two fundamental elements required to achieve decarbonisation in shipping: political will and technical expertise of the industry.

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[75] H Zhang, 'Towards Global Green Shipping: The Development of International Regulations on Reduction of GHG Emissions from Ships' (2016) 16 Int'l Env't Agreements: Pol L & Econs 564.

[76] This produced the Copenhagen Agreement which was not covered in Section 1 as part of the international regulatory framework dealing with GHG emissions from shipping because of the lack of binding obligations for States. The 2015 Paris Agreement provides a balance between the top-down binding approach of the 1997 Kyoto Protocol and the absence of binding emission targets of the 2009 Copenhagen Agreement.

[77] Brazil, Saudi Arabia, and the United States were the leading objectors.

[78] S Baughen, 'Shipping and Climate Change' in B Soyer and A Tettenborn (eds), *Disruptive Technologies, Climate Change and Shipping*, Maritime and Transport Law Library (Informa Law from Routledge 2022) 131-134.

*3.1.1 The EEDI*

In July 2011, MEPC adopted the first global GHG reduction regime for an international industry sector. As mentioned above,[79] Chapter 4 of MARPOL Annex VI dealing with 'Regulations on the carbon intensity of international shipping', entered into force on 1 January 2013 and is the first legally binding instrument adopted since the 1997 Kyoto Protocol regarding climate change.[80]

It took 15 years for the IMO to align itself with the commitments of the KP and the UNFCCC. Although the KP is addressed to Annex I countries to the UNFCCC (i.e. developed States) and developing States, such as Panama and Bahamas, are significant contributors to the IMO, given the importance of shipping to their economies, such delay is not justifiable. Furthermore, as many shipowners choose to register their vessels with open-registry flags,[81] the deficiencies of the IMO are even more evident. Indeed, as noted by Tsimplis, the delays and the over-technicality of the IMO constitute grounds for avoiding the implementation of environmental norms.[82]

Chapter 4 of MARPOL Annex VI includes technical and operational measures relating to the energy efficiency of vessels, understood as the capacity to produce more transport services per consumed unit of fuel.[83] Under reg 20 of MARPOL Annex VI, the goal of Chapter 4 is to reduce the carbon intensity of international shipping, working towards the levels of ambition set out in the IMO Strategy. To achieve this goal, the vessels to which the chapter applies must comply with technical and operational carbon intensity requirements.[84]

Referring to technical requirements, the EEDI consists of a performance-based energy efficiency measure, notably a mathematical value prescribed for different types of vessels, expressed in g/t-$CO_2$

[79] See para 2.3.2.

[80] D Pyć, 'Ship Energy Efficiency Measures and Climate Protection' (2021) 23 International Community LR 241, 243; 246. See also E Hughes et al, 'Control of Emissions to Air from International Shipping' (2017) 31 Ocean YB 461.

[81] Generally as to the role played by open registries, see Stephen Girvin, 'Nationality requirements and implications for shipping enterprises' in Stephen Girvin & Vibe Ulfbeck (eds), *Maritime Organisation, Management and Liability: A Legal Analysis of New Challenges in the Maritime Industry* (Hart Publishing 2021) 27, 30.

[82] M Tsimplis, 'Shipping and the Marine Environment in the 21st Century' in M Clarke (ed), *Maritime Law Evolving: Thirty Years at Southampton* (Hart Publishing 2013) 125.

[83] E Røsæg, 'GHG Emissions from International Shipping' (2022) 63 Poredbeno Pomorsko Pravo (Comparative Maritime Law) 66.

[84] De La Rue (n 28) 992.

per tonne-mile.[85] Chapter 4 provides that the attained EEDI must be calculated for each vessel under the IMO guidelines and officially verified for each new vessel, to indicate its estimated performance in terms of energy efficiency. The attained EEDI must not exceed a maximum value (the required EEDI) that the Annex allows for the specific vessel type and size.[86]

The EEDI will be progressively reduced between 2015 and 2030 by up to 30 per cent.[87] As mentioned earlier,[88] the EEDI level increases every five years with an initial $CO_2$ reduction level of 10 per cent between 2015 and 2020, 20 per cent from 2020 to 2025, and 30 per cent from 2025 to 2030.[89]

The notion of 'new ships'[90] is defined in MARPOL Annex VI as a ship[91]

> for which the building contract is placed on or after 1 January 2013; or in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after 1 July 2013; or the delivery of which is on or after 1 July 2015.

Other vessels, referred to as 'existing ships', are subject to a similar but separate requirement that their attained Energy Efficiency Existing Ship Index (EEXI) must not exceed a specified maximum required EEXI. The EEXI, described in emissions per cargo tonne and mile, represents a carbon design efficiency indicator for vessels over 400 grt operating internationally.[92]

Annex VI covers vessel types that source 85 per cent of $CO_2$ emissions from international shipping.[93] The rationale is that the more stringent requirements will lead shipbuilders and ship designers to improve the energy efficiency of 'new ships'. As existing vessels in 2013 are not covered, this undermines the 30 per cent target of the EEDI, where reduction factors are set until 2030. The EEDI applies to the emissions from much of the world's merchant fleet, including tankers, bulk carriers, gas

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85 Røsæg (n 83) 63.
86 Regs 22.1 and 24.1. See also Reg 2.2 and J Lee, 'International Regulations of Greenhouse Gas Emissions from International Shipping: Issues and Possible Responses' (2019) 4 Asia Pac J Ocean L & Pol'y 63. See also de La Rue (n 28) 992 and Pyć (n 80) 246.
87 Tsimplis (n 4) 143.
88 See para 2.3.2.
89 Baughen (n 78) 129.
90 Reg 22.1.
91 Reg 2.2.18.
92 De La Rue (n 28) 993.
93 Pyć (n 80) 247.

carriers, general cargo vessels and container vessels, refrigerated cargo carriers, and combination carriers.[94] Passenger ships were not initially included. However, in 2014, MEPC adopted amendments to extend the scope of EEDI to LNG carriers, ro-ro vehicle carriers, ro-ro cargo vessels, ro-ro passenger vessels, and cruise passenger vessels having non-conventional propulsion.[95] Some vessels, such as icebreakers, are exempt from the EEDI requirement.[96] However, not all vessels pollute equally, and studies have demonstrated that liquefied natural gas carriers, cruise vessels, and container vessels are among the significant contributors. As some vessels are more extensively employed than others, bulk carriers are the most polluting, followed by container vessels and tankers.[97]

In 2025, vessels will be required to be at least 30 per cent more energy efficient than those built in 2014.[98] As mentioned by UNCTAD, the vessel's age is critical.[99] Some geographical considerations are necessary, and these differ from one trading area to another. Africa has the oldest bulkers, container vessels and oil tankers, followed by developing America for bulk carriers and oil tankers. Developing Asia and Oceania ranked joint third for oil tankers.[100] Moreover, as noted by Tsimplis, vessels may operate for 20-25 years on average and based on that, the 30 per cent reduction, if achieved, will occur around 2050.[101] Indeed, according to UNCTAD data, the global fleet has been ageing since 2011. By the number of vessels, the current average age is 21.9 years, and by carrying capacity 11.5 years. Bulk carriers remain the youngest vessels with an average age of 11.1 years, followed by container vessels at 13.7 years, and oil tankers at 19.7 years.[102] Compared to 2011, in 2022, the greatest proportional increase in average age is for container vessels, from 10.3 to 13.7 years, followed by oil tankers, from

94 Table 1.
95 Amendments to MARPOL Annex VI adopted by MEPC 66 through Resolution MEPC.25(66), 4 April 2014.
96 Amendments to MARPOL Annex VI and MEPC.1/Circ.795. See J Harrison, 'Atmospheric Pollution of the Marine Environment', in M Fitzmaurice et al, *The IMLI Manual on International Maritime Law* vol III (Oxford University Press 2016) 183.
97 M Tsimplis, 'Governance for Sustainable Development: The Value of Environmental Regulations and the Effect of Maritime Norms' (2022) 37 IJMCL 26.
98 Pyć (n 80) 247.
99 *Review of Maritime Transport* (n 73) 37.
100 Ibid.
101 Tsimplis (n 4) 143.
102 *Review of Maritime Transport* (n 73) 19.

16.4 to 19.7 years, and by general cargo vessels from 24.4 to 27.1 years. On the other hand, the average age of bulk carriers in 2017 was 8.8 years, which decreased from 13.3 to 11.1 years.[103]

The IMO has also adopted several guidelines. These include the 2013 Guidelines for Calculation of Reference Lines for Use with the Energy Efficiency Design Index (EEDI)[104] and the 2014 Guidelines, as amended, for calculating the attained Energy Efficiency Design Index (EEDI) for new vessels, as amended. The 2014 Guidelines on Survey and Certification of the EEDI are also relevant.[105] Regulations 5, 6, 7, 8, and 9 of MARPOL Annex VI deal with the procedures for the survey and certification of the EEDI.[106]

There are two assumptions behind the EEDI. First, technology will slowly improve, allowing vessels to emit increasingly lower emissions, with States parties to Annex VI called to promote technological development to achieve this aim.[107] Second, the world merchant fleet is expected to increase, according to the enormous demand for goods traded internationally, implying more vessels and cargo capacity, speed voyages, and emissions. However, according to the UNCTAD data published in 2022, the total fleet of seagoing merchant vessels amounted to 102,899 vessels of 100 grt and above, equivalent to 2,199,107 thousand dwt of capacity. Between 2021 and 2022, in dwt terms, the global commercial fleet grew by 2.95 per cent, representing a historically moderate growth rate and the second lowest since 2005. Over the same period, supported by robust global gas demand, the fleet of liquefied-gas carriers grew strongly by 8.15 per cent.[108]

### *3.1.2 The role of developing countries*

Developing countries play a critical role in reducing GHG emissions from vessels, particularly through the EEDI. Within the IMO, it was agreed that some States needed additional time to phase in the EEDI requirements. Accordingly, an exception was built into the regulations allowing States up to four years to comply with regs 20 and 21 in case of vessels of 400 grt and above. Although this provision was

[103] Ibid, 35.
[104] Resolution MEPC. 231(65).
[105] Resolution MEPC. 254(67).
[106] Pyć (n 80) 246.
[107] Regulation 23.2 Annex VI. Harrison (n 96) 184.
[108] *Review of Maritime Transport* (n 73) 33.

adopted on the understanding that it was primarily aimed at the administrations of developing countries, nothing in the text of the regulation prevents a developed country from also relying on this exception.[109]

At MEPC 63 (2012), an issue arose whether States which had taken advantage of the waiver would apply the first phase of the reduction targets after the expiry of the waiver or whether they were bound by the targets which applied to all other States. The MEPC preferred the latter view noting that a waiver under reg 19.4 should only be granted to individual vessels built during the waiver period and did not generally apply to postpone the implementation of the EEDI requirements for four years. This interpretation is in line with both the ordinary meaning and the spirit of the provision, although it significantly limits the benefits of the waiver.

Another way the new regulations seek to address the concerns of developing countries is through financial and technical assistance. However, the provisions in Annex VI are too weak and developed States can transfer their knowledge and technology to developing States, subject to national laws and policies.[110]

*3.1.3 'Grandfathering clauses' and the EEDI*

This section considers the many exceptions in international conventions dealing with GHG emissions from shipping, so-called 'grandfathering clauses' or 'sunset clauses'. Such clauses contain exceptions to the general legal regime justified by previous rights or practices. The origins of this term are found in various US states, with the adoption of laws in which the right to vote depended on whether a person was from a direct line of descent from a person who had the right to vote in 1866.[111]

In the maritime context, the Safety of Life at Sea Convention (SOLAS) includes such grandfathering clauses, providing construction standards for new vessels and entrusting standards for existing vessels to the discretion of flag States.[112] The justification is that regulation in shipping is too pervasive and has

[109] Harrison (n 96) 184.
[110] Ibid.
[111] H Robertson, 'If your grandfather could pollute, so can you: Environmental grandfather clauses and their role in environmental inequality' (1995) 45 Catholic University LR 131-180.
[112] Tsimplis (n 97) 17.

led to increased carriage costs. When investors complied with shipping market requirements, specific regulations were not in force, and it is argued that depriving them of reasonably expected investment benefits would be unfair.[113] In other words, existing 10, 20, or even 30 years old-vessels are exempted from fulfilling the requirements of the EEDI, which therefore becomes a measure addressed to 'new-generation ships' that do not appear attractive to investors.

Such arguments appear to be legitimate concerns from the industry perspective. As also emphasised by UNCTAD, the world fleet is ageing partly because shipowners and operators, uncertain about future fuel and carbon prices, regulations and technological developments, have delayed investment and are keeping their older vessels in operation.[114] However, delegations to the MEPC must seek to elaborate more sophisticated standards that consider those elements and devise incentives to stimulate the demand of shipowners to renew their fleets rather than providing loopholes that undermine IMO's credibility. This point is reinforced by the fact that regulations on vessel design do not fall within the discretion of States but within the IMO's exclusive domain.

Vessels exempt from environmental standards, including the EEDI, are employed until they become unusable. In other words, grandfathering exceptions prolong such vessels' lives. As a result, old vessels have become more attractive than newer vessels, and more pollutant vessels are used for longer than they would have been without environmental regulations. The Community of European Shipyards Associations (CESA) has highlighted this issue, showing that new vessels in short-sea shipping may have to reduce their speed to comply with the EEDI and that older vessels may be in service much longer than they should, as they are exempt from the EEDI requirements.[115] Grandfathering clauses, therefore, act as a disincentive for investing in more sustainable vessels and prevent new companies from entering the shipping market. As emphasised by Tsimplis, [116]

> their prevalence in maritime law indicates that environmental protection is considered by the regulatory framework as secondary when compared with the financial interests of shipowners

[113] Ibid.

[114] *Review of Maritime Transport* (n 73) 33.

[115] 'CO2 Reduction Requires Efficient Instruments Based on Sound Technical Solutions', submitted by the Community of European Shipyards' Association (CESA), Intersessional Meeting of the Greenhouse Gas Working Group 2nd Session, Agenda Item 2, IMO Doc GHG-WG 2/2/22 (6 February 2009) Annex 1, para 25–26.

[116] Tsimplis (n 97) 19.

> […] and the only reasonable explanation for their existence is the shipping sector's influence on the government departments involved in IMO negotiations.

### *3.1.4 The SEEMP*

The principal operational measure emanating from the IMO is the Ship Energy Efficiency Management Plan (SEEMP), as elaborated by the 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan and the other relevant IMO guidelines. This incentivises shipping companies that own, operate or control vessels to employ them in such a way as to optimise energy efficiency.[117]

Under the 2016 Guidelines, the SEEMP of each vessel is part of the company's energy management policy. According to reg 26 of MARPOL Annex VI, SEEMP may form[118] part of the Safety Management System (SMS)[119] required by the International Safety Management (ISM) Code[120] and which is mandatory under the SOLAS Convention.[121] The objective of the Code is to ensure 'safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property'.[122]

The ISM Code goes beyond the traditional conception of seaworthiness and the technical requirements of the vessel to protect the marine environment. It creates a set of rules whereby the shipowner or the company must create a chain of operational management both on land and on board, ensuring in the best possible way the safety of life, the safety of the environment and property. To achieve this goal, the management on shore, the master, the officers and the crew on board are all involved.[123]

Under the ISM Code, the international minimum standards concerning safety and environmental protection are evidenced by a document of compliance (DOC)[124] issued by the government of the flag

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[117] Tsimplis (n 4) 144.
[118] MARPOL, reg 26.1.
[119] ISM Code, para 1.4.
[120] De La Rue (n 28) 993. See also Lee (n 86) 64.
[121] SOLAS, Ch IX, reg 3, states that 'the company and the ship shall comply with the requirements of the International Safety Management Code. For the purposes of this regulation, the requirements of the Code shall be treated as mandatory.'
[122] ISM Code, para 1.2.1.
[123] H Honka, 'The Standard of the Vessel and the ISM Code' in J Schelin (ed), *Modern Law of Charterparties* (Axel Ax:son Johnson Institute of Maritime and Transport Law 2003) 106-107.
[124] ISM Code, para 13.

State, by an organisation recognised by that State, usually a classification society or by another government acting on behalf of the flag State. A safety management certificate (SMC) verifies that the ship operator and its shipboard management 'operate in accordance with the approved safety management system'.[125] The importance of the port State emerges through the frequent supervision of these and other certificates,[126] making safety and environmental standards subject to the scrutiny of the flag State in which vessels are registered.[127]

It is arguable whether classification societies may incur liability providing certification for vessels burning fuels not compliant with MARPOL Annex VI requirements. The French Court of Cassation highlighted the role of classification societies regarding environmental safeguards in the *Erika* incident in 1999. Registro Italiano Navale (RINA) was held liable for the offence of imprudence causing pollution under the Civil Liability Convention 1992 (CLC 1992), having renewed the ship's classification certificate without carrying out thickness measurements in accordance with the standards of the profession.[128] The French Court of Cassation also decided that the harm had resulted from RINA's own recklessness, and it could not enjoy the channelling of liability under the CLC 1992 system.[129]

Failure to prepare the SEEMP may amount to a breach by the shipowner of its seaworthiness obligation.[130] Compliance with the SEEMP and the ISM Code may, therefore, assist shipowners in proving the provision of a seaworthy vessel. In cases where the Hague or Hague-Visby Rules apply,[131] they may assist shipowners in establishing the exercise of due diligence to provide a seaworthy vessel[132] or the exercise of due care of the cargo.[133]

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[125] Ibid, para 13.7.

[126] See FAL.2/Circ.131 *List of certificates and documents required to be carried on board ships, 2017* (19 July 2017), including among others the 'AIS test report', the 'Continuous Synopsis Record' (CSR) and the 'International Oil Pollution Prevention Certificate'. See also SOLAS, Annex 1.

[127] See EB Watt and RMF Coles, *Ship Registration: Law and Practice* (3rd edn, Informa Law from Routledge 2018) 23.

[128] In particular, the Court found that areas suspected of substantial corrosion were to be regarded as an obvious sign that the state of the ship's structure gave cause for concern. See de La Rue (n 28) 143.

[129] See J De Bruyn, 'Liability of Classification Societies: Cases, Challenges and Future Perspectives' (2014) 45 JMLC 212.

[130] Generally, see Stephen Girvin, *Carriage of Goods by Sea* (3rd edn, Oxford University Press 2022) ch 24.

[131] As to which, see Hague (and Hague-Visby) Rules, art X. See ibid, [18.01]; [18.07].

[132] Pursuant to art III, r 1. See Girvin (n 130) [27.15].

[133] See art III, r 2. See Girvin, ibid, [27.35].

The SEEMP comprises two parts. The shipping company develops the first part as a vessel-specific plan and includes four steps: planning, implementation, monitoring, self-evaluation, and improvement. Its purpose is to provide mechanisms for shipping companies to improve the energy efficiency of vessel operations. Once shipping companies identify the measures, the implementation period of which must be indicated, they need to develop the procedures for energy management, define tasks, and assign them to qualified personnel. In other words, this part describes how each step should be applied and who the responsible persons are.

The second part relates to fuel consumption data. Under reg 26.2, all vessels larger than 5,000 grt (representing about 85 per cent of the total $CO_2$ emissions from international shipping) must include their SEEMP methodology in the plan, collect fuel consumption data starting from 2019 and submit the aggregate amounts to their flag State three months after the end of the calendar year.[134] The data is then submitted to the IMO Ship Fuel Oil Consumption Database, and the Secretary-General provides an annual report to the MEPC.[135]

There are several relevant safety parameters because weather conditions, the length of the voyage, tides, currents, and the need to maintain safe operations may require modifications of energy efficiency measures. Examples of standards to meet safety considerations include speed optimisation, weather routing, and hull maintenance.[136]

There was extensive debate concerning the purpose of reg 29, which deals with cooperation and transfer of technology to developing countries based on national laws. In particular, the SEEMP represents shipping companies, not flag administrations, and shipping companies can enjoy this assistance so long as their vessels are registered in developing States. As enforcement is restricted to inquiring whether an appropriate and valid International Energy Efficiency (IEE) Certificate is on board and there is a Statement of Compliance related to fuel oil consumption reporting, this does not require cooperation and technology transfer. Shipbuilders could cooperate through knowledge transfer, but with only a few shipbuilding countries involved – and with China as the largest shipbuilding country,

[134] De La Rue (n 28) 993.
[135] Tsimplis (n 4) 144. See also Baughen (n 78) 129.
[136] Pyć (n 80) 249.

also considered a developing shipbuilding country – this could generate unfair competition.[137] Technology transfer regulation needs to be improved to build sufficient capacity for developing countries to comply with the SEEMP and the EEDI. This can be done through the contribution of the shipping industry within the IMO, particularly among shipbuilders.

### 3.2 The position of shipbuilders

Shipbuilders play a primary role in the maritime industry in developing technical and operational measures and influencing the supply of vessels. They are free to choose the most appropriate technologies to achieve the goal of reduction of GHG emissions. The rationale is to stimulate innovation and development of the technical elements influencing the energy efficiency of a vessel.[138] Larger vessels tend to be newer and thus more modern and energy efficient. However, the modernisation of the vessel structure or the structure and equipment on board depends on age, the type of trade, the distance to be sailed, and the shipowner's willingness to invest.[139]

The cost of shipbuilding is an important factor based on which the shipowner makes investment decisions. As pointed out by Stopford, the factors determining the price of vessels include freight rates, the vessel's age, inflation (in the longer term), and market expectations of buyers and sellers.[140] On the demand side, the key factors are freight rates, the price of modern second-hand vessels, the financial liquidity of buyers, the availability of credit and, most importantly, expectations. From the shipyard supply viewpoint, the key issues are production costs, the number of berths available and the order book size.[141] Reducing GHG emissions from vessels will increase the cost of shipbuilding because of the adoption of new technologies. This may challenge the competitiveness of products and influence the number of orders. [142] The availability of technology for shipbuilders and architects to fulfil the GHG emissions reduction requirements is emerging.

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[137] Tsimplis (n 4) 144.
[138] Lee (n 86) 63.
[139] *Review of Maritime Transport* (n 73) 38.
[140] M Stopford, *Maritime Economics* (3rd edn, Routledge 2009) 204-206.
[141] Ibid, 209.
[142] Shi (n 67) 228.

Asian countries represent 95 per cent of the global market in shipbuilding, with China, the Republic of Korea, and Japan in the lead.[143] However, a major flaw is that no international or regional shipping NGO from this geographical area, including the Japan, Europe, China, Korea, and USA Shipbuilders' Association (JECKU) and the Asian Shipowners' Association (ASA),[144] have consultative status at the IMO.[145]

By contrast, European shipbuilders, representing the remaining 5 per cent of the market, are active actors in the industry and within the IMO. Within the IMO, the Community of European Shipyards' Associations (CESA)[146] is the leading regional shipping NGO representing shipbuilders within the IMO. CESA is also a member of another NGO, the Tripartite Working Group,[147] and the views of this Group also reflect those from the shipbuilding sector.

CESA played a significant role within the IMO in the technical and operational measures debate. In 2008, this NGO was more interested in operational measures (SEEMP) than technical measures (EEDI) and preferred voluntary measures to mandatory measures.[148] The reason is that SEEMP relates to operational measures falling within the remit of vessel operators. In contrast, the EEDI relates to technical measures on new vessels, which requires shipbuilders to invest more in research and development, upgrading technology to meet the EEDI requirements. The cost of shipbuilding might remain the same in the short term if the IMO relies more on operational measures rather than technical measures or considers proposed EEDI requirements to be voluntary.[149] At MEPC 59 (2009), CESA stated that it believed that the EEDI could not achieve any short-term GHG emissions reduction because it only applied to new vessels. It considers market-based measures a 'more effective solution' to address GHG emissions.[150]

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[143] Y Shi, 'Gigantic Shipbuilders under the IMO Mandate of GHG Emissions: With Special References to China, Japan and Korea' (2014) 7 J E Asia & Int;l L497.

[144] See <https://asianshipowners.org/> accessed 6 July 2023.

[145] Shi (n 67) 233.

[146] See <https://www.cesa.eu/> accessed 6 July 2023.

[147] Formed in 2007.

[148] This reflects the general position of shipbuilders that consider the SEEMP more effective than the EEDI.

[149] Shi (n 67) 230.

[150] 'Phase-in Implementation of the Energy Efficiency Design Index for Standard and Complex Ship Types', submitted by the Community of European Shipyards' Associations (CESA), MEPC 59th Session, Agenda Item 4, IMO Doc MEPC 59/4/38 (20 May 2009) para 3.

Although the CESA has highlighted the importance of MBMs in tackling the GHG issue, JECKU, in which some UNFCCC non-Annex I States are members, has stressed the importance of technical and operational measures and has ignored the MBMs in this regard.

### 3.3 The Carbon Intensity Indicator (CII)

The CII measures how efficiently a ship carries goods or passengers and the grams of $CO_2$ emitted per cargo-carrying capacity and nautical mile. Under MARPOL, reg 28, the CII determines the annual reduction factor needed to continuously improve the vessel's operational carbon intensity within a specific rating level. The performance level is recorded in the vessel's SEEMP.

Annual ratings from A to E are applied to vessels, becoming increasingly stringent towards 2030.[151] Each vessel needs to achieve an annual reduction of 1 per cent until 2023 and 2 per cent from 2023 to 2026. The first annual carbon intensity report will be completed in 2023, and the first rating will occur in 2024.[152] MEPC 76 left the issue of cuts until 2030, constituting the year of the intermediate target of CII reduction of at least 40 per cent in 2030 compared with the 2008 level.[153] Notably, the performance of vessels will be rated as 'A' (major superior), 'B' (minor superior), 'C' (moderate), 'D' (minor inferior), or 'E' (inferior). The ratings 'A', 'B', and 'C' are required for compliance, and corrective actions are required for vessels receiving 'D' for three consecutive years or 'E' for one year.[154] The aim is to lead shipowners to develop plans to achieve the rating 'C' or above.

The CII provision has no enforcement mechanism, and there are no consequences for failing to comply. If a vessel gets a D rating for three years or an E in one year, the shipowner has to make a new plan, get the administration's approval, and implement the plan. Again, there are no guidelines on the format of that plan, and there are no consequences if shipowners fail to implement the plan. However, port States could take action, limiting access to 'low rating' vessels. Indeed, MARPOL Annex VI follows the

[151] *Fuelling the Fourth Propulsion Revolution: An Opportunity for All* (ICS, 2022) 82.

[152] Zhu et al, 'Examining Existing Measures for Regulating Shipping Decarbonisation and Exploring the Way Forward' (2022) 28 JIML 109.

[153] Ibid.

[154] S Wang et al, 'Paradox of International Maritime Organisation's Carbon Intensity Indicator' (2021) 1 Communications in Transportation Research 1.

philosophy of UNCLOS,[155] attributing relevant powers of control and inspection to port States as a response to the lack of control by the flag State through reg 10. In accordance with reg 10.2, measures must be adopted to ensure that vessels do not sail unless compliant with Annex VI. However, reg 5.3 establishes that inspections are limited to verifying the presence of a valid certificate on board unless there are clear grounds for believing that the vessel's condition or its equipment 'does not correspond substantially with the particulars of the certificate'.[156] It was noted that in that case, or if the vessel does not carry a valid certificate, the party carrying out the inspection must ensure that the vessel shall not sail until it can proceed to sea without presenting an unreasonable threat of harm to the marine environment.[157] If a party takes any action against a ship, it must immediately inform the consul or diplomatic representative of the party whose flag the ship is entitled to fly under art 5.3.[158]

Despite the criticisms received, the CII has increased demand from the industry to use all the available tools to understand vessel performance better and address inefficiencies.[159]

### 3.4 Shipowners and charterers: MARPOL Annex VI

Decarbonisation represents 'an immense compliance task and an urgent need to understand the impact on the charterparty and other contractual arrangements under which each ship is operating'.[160] However, decarbonisation cannot be examined only through regulation. Being a significant portion of the world fleet is on charter,[161] it is necessary to consider emerging issues such as sharing costs between shipowners and charterers, maintaining energy efficiency, and consequences for failing to comply.[162] While shipowners and ship operators are indeed treated as the primary polluters in the shipping sector,[163] shipping contracts, standard form time charterparties and the clauses drafted by the Baltic

[155] See art 218.
[156] Reg 5.3.3.
[157] Y Tanaka, 'Regulation of Greenhouse Gas Emissions from International Shipping and Jurisdiction of States' (2016) 25 RECIEL 333, 341.
[158] Ibid.
[159] Enes Tunagur, 'Shipping Starts to Embrace Energy-efficiency Measures to Reach Net Zero Goals' *Lloyd's List* (London, 24 May 2023.
[160] ICS (n 151) 82.
[161] It is estimated that more than 50 per cent of the world fleet is operated by charterers, not by shipowners themselves. See Richard Clayton, 'Hull Coatings Go Hi-tech as Charterers Focus on Decarbonisation' *Lloyd's List* (London, 11 May 2023).
[162] ICS (n 151) 82.
[163] Harrison (n 96) 187.

and International Maritime Council (BIMCO) deal with the allocation of risk deriving from the new regulatory provisions concerning decarbonisation.[164]

The structure of shipping continues, nevertheless, to reward inefficiency, and there is little incentive for shipowners or charterers to improve the efficiency of their vessels or the basic structures of charterparty contracts.[165] In this changing time for shipping, BIMCO emphasised that contracts between shipowners and charterers use charterparties based on principles drawn up 100 years ago, such as Gencon and NYPE 46, leading to inefficiency and without relevance for decarbonisation.[166]

In 2018, MEPC 72 proposed amending reg 14 to include a ban on the carriage of non-compliant fuel for use on board the ship unless the ship was fitted with scrubbers. This proposal was passed at MEPC 73 and came into force on 1 March 2020.[167] When the IMO applied such sulphur limits of 0.50% m/m,[168] the BIMCO 2020 'Marine Fuel Sulphur Content Clause for Time Charter Parties' provided that shipowners were responsible for warranting that the vessel would have been compliant with the 'sulphur content requirements' and the charterer was tasked with supplying compliant fuel and warranting that bunker suppliers, bunker craft operators, and bunker surveyors used would have fulfiled the same requirements. If the charterer fails to comply with such provisions, an indemnity protects the shipowner from 'any or all losses, damages, liabilities, delays, deviations, claims, fines, costs, expenses, actions, proceedings, suits, demands'.[169]

Environmental concerns must be shared between shipowners and charterers. EEXI and CII may be expected to create conflicts between shipowners and charterers over whether vessels should slow down to get better ratings or speed up to deliver their cargo faster. In time charterparties, shipowners are, on the one hand, responsible for the costs related to the crew, insurance, maintenance and

[164] P Rebelo, 'BIMCO's Carbon Intensity Indicator Clause (CII) for Time Charters: Towards a New Era of Climate Drafting' (2022) 28 JIML 245. See also Girvin (n 130) 512.

[165] 'Decarbonisation is Shipping's D-Day' *Lloyd's List* (London, 9 June 2023).

[166] Richard Clayton, 'Most Charterparties "No Longer Fit for Purpose", Says BIMCO' *Lloyd's List* (London, 7 June 2023).

[167] K Lewins and M Loxham, 'Controlling PM by Proxy? International Regulation of Sulphur and PM Emissions from Shipping' [2020] LMCLQ 60.

[168] Reg 14.1.

[169] Rebelo (n 164) 243. The text of BIMCO Marine Fuel Sulphur Content Clause for Time Charterparties 2020 is available at <https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/2020_marine_fuel_sulphur_content_clause_for_time_charter_parties> accessed 30 June 2023.

classification of the vessel. Time charterers, on the other hand, are responsible for operational costs and purchasing bunkers and play a crucial role in reducing GHG emissions from vessels. The difficulty is that the so-called 'split incentives' constitute a significant market barrier to achieving energy efficiency in shipping. They imply that the party responsible for investing in energy efficiency (i.e. the shipowner) is not the party that will reap the financial return from the operation of the vessel (i.e. the charterer).[170] However, it cannot be ignored that time charterparties are also profitable for the shipowner who receives bi-monthly hire payments from the charterer.

Time charterparties are especially vulnerable to EEXI and CII. The CII could make charterers responsible for a shipowner's carbon intensity. The time charterers' traditional rights to employ the vessel for its commercial ends will be affected, as vessels may have to reduce cargo intake, deviate, or slow steam. There are also issues from the shipowner's perspective. For example, suppose shipowner X charters a vessel for six months to company Y, and Y insists on operating the vessel at the warranted speed, preventing the shipowner from achieving A or B as ratings. In such circumstances, X may lose commercial opportunities in the subsequent six months. Extending the voyage duration to comply with EEXI and CII could reduce a shipowner's earnings or put it in breach of 'due' or 'utmost' dispatch obligations[171] if protective clauses are not agreed upon, passing on costs from the charterer to the shipowner through a clause in the charterparty.[172] The result is that time charterparties often result in suboptimal performance, as shipowners are not incentivised to make proactive improvements to vessel efficiency, while static speed clauses constrain charterers.[173]

BIMCO's EEXI Transition clause for time charterparties released in 2021[174] was designed to improve collaboration. Under this clause, shipowners are required to effect any modifications to the vessel prior to the effective date (i.e. the vessel's next annual, intermediate or renewal survey, whichever comes first) on or after 1 January 2023.[175] Vessels required to modify their energy efficiency will use either

[170] J Scott et al, 'The Promise and Limits of Private Standards in Reducing Greenhouse Gas Emissions from Shipping' (2017) 29 J Envt'l L 241.
[171] See Girvin (n 130) ch 26.
[172] Special Report (n 51) 17.
[173] Richard Clayton, 'Charterparty Expectations Holding Back Decarbonisation Efforts' *Lloyd's List* (London, 30 May 2023).
[174] Available at <https://www.bimco.org/contracts-and-clauses/bimcoclauses/current/2021_eexi_transition_clause> accessed 22 June 2023.
[175] Definitions.

'engine power limitation' (EPL) or 'shaft power limitation' (SHaPoLi). EPL implies adjusting the parameters within an engine's control system, enabling the vessel to limit its engine power output when the pre-set limit is reached. This will require additional software installation, depending on whether the engine is mechanically or electronically controlled. SHaPoLi operates similarly, enabling the vessel to limit its shaft power output when the pre-set limit is reached, and it works by limiting the output power of controllable pitch propeller shafts.

Through EPL and SHaPoLi, the EEXI is not considered to revolutionise shipping technology. Rather, existing engine technology is adjusted, allowing charterers and shipowners to negotiate detailed clauses on vessel-performance impacts. It may be better for shipowners to notify the charterer of the time and location of such modifications to have the necessary freedom to source available technologies without seeking the charterer's approval.

However, the EEXI clause does not overcome the issue of split incentives, as the shipowner bears the whole cost of engine modifications and is responsible for any time lost to the charterer. Furthermore, the impact on warranted speed and consumption must be communicated to the charterer under clause (c)(v).[176]

As to CII, there has been criticism on several fronts, such as favouring ballast trips, being for the same miles the fuel consumption (and emissions) less due to the vessel being in light draft condition. Bad weather and port delays would also adversely affect the CII due to increased fuel consumption for the same miles travelled (for bad weather), or no miles travelled (for waiting at anchor).[177] Among these criticisms, not least the metrics. The industry has called for exemptions and methodology adjustments. The leading liner shipping company, MSC, called for revisions, as it claims the methodology will distort vessels' performance when spending longer time at ports. The industry is pushing the IMO to go further with correction factors that adjust for port waiting times and shorter voyages.[178] Shipowners have pointed out that the current CII regime would also discriminate against developing countries because

[176] Rebelo (164) 243-244. The text of BIMCO's EEXI Transition Clause for Time Charterparties 2021 is available at <https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/2021_eexi_transition_clause> accessed on 30 June 2023.

[177] Panos Zachariadis, 'CII May Be Flawed, But It Is Not Useless' *Lloyd's List* (London, 8 February 2023).

[178] Michelle Wiese Bockmann, 'Shipping Industry Signals Alarm Over 'Flawed' Carbon Intensity Indicator Metrics' *Lloyd's List* (London, 1 November 2022).

of time-waiting in ports, incentivising trade only between US and EU.[179] IMO plans to start a review process once the necessary data is gathered.[180] However, the US-based classification society, the American Bureau of Shipping (ABS), expects amendments at MEPC 80 in July.[181]

Concerning time charterparties, negotiations are getting difficult as shipowners want the vessel, when returned, to have a rating similar to that upon delivery, but charterers do not commit to this aim based on commercial reasons.[182] Accordingly, BIMCO developed its CII Clause for Time Charterparties.[183] Clause (b) contains a duty for parties, based on good faith, to work together to:

> i. share any findings and best practices that they may identify on potential improvements to the Vessel's energy efficiency; and ii. collect, share and report on a daily basis any relevant data that may assist the monitoring and assessment of the Vessel's compliance.

The BIMCO CII clause also provides the remedy of 'anticipatory breach', through which the shipowner may prove a 'reasonable likelihood' of the charterer not meeting the CII standard. This remedy does not give rise to termination rights; rather, it provides a high standard for justifying a 'firm inference' of the breach along with the risk of early notice of termination. Providing the charterer with notice of potential failings to meet the agreed CII also benefits the charterer. These cooperative measures allow the parties to take corrective action to honour their requisite obligations.[184]

In other words, the BIMCO CII clause is a standard of joint responsibility between the shipowner and the charterer. This implies that the charterer should be the first to address shipping-related environmental concerns, being the vessel operator, and the shipowner should not be penalised for the charterer's harmful environmental practices. However, this does not relieve the shipowner from reducing the carbon footprint of its fleet through investments and R&D, avoiding the charterer's conundrum of choosing between the environmental and efficient operation of the vessel.[185] The

[179] Enes Tunagur, 'Economou Calls for Flawed CII to Be Scrapped' *Lloyd's List* (London, 5 June 2023).
[180] Enes Tunagur, 'IMO To Address CII Concerns Post Review' *Lloyd's List* (London, 16 February 2023).
[181] Enes Tunagur, 'ABS Expects Carbon Intensity Indicator Amendments From MEPC 80' *Lloyd's List* (London, 16 May 2023).
[182] Cichen Shen, '"Flawed" CII Rating Complicates Charterparty Talks and Trade Designs' *Lloyd's List* (London, 3 May 2023).
[183] The text of BIMCO's CII Operations Clause for Time Charterparties 2022 is available at <https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/cii-operations-clause-2022> accessed 29 June 2023.
[184] Rebelo (n 164) 248.
[185] 'Making Charterers Pay for Carbon Is a First Step. Now For All the Others' *Lloyd's List* (London, 14 January 2022).

shipowner is not absolved of all responsibility and can seek damages where a charterer breaches the clause.

### 3.5 The obligation of seaworthiness

One solution to strengthen cooperation between shipowners and charterers, both potentially being 'carriers' under the Hague and Hague-Visby Rules,[186] is to make specific contractual arrangements related to GHG emissions from shipping in the obligation of seaworthiness, currently contained in art III, rule 1 of the Hague and Hague-Visby Rules. As used here, seaworthiness concerns the physical structure of the vessel and its equipment, including its engines and so-called 'documentary seaworthiness'.[187] As emphasised in *The CMA CGM Libra* case, [188] seaworthiness extends to having on board the appropriate documentation, in this case, properly marked charts and passage planning documentation suitable for a voyage from Xiamen to Hong Kong. The vessel grounded, resulting in damage and danger to the vessel and the cargo. Arrangements were made for salvage for approximately US$9.5 million, but other costs increased the claim made by the shipowners in general average against the cargo interests for a total of about US$13 million. While most paid their contribution in general average, about eight per cent did not, and the claim against these in the case was for about US$800,000. The cargo interests did not contribute, as they found failures by the shipowners of obligations of seaworthiness, due diligence, negligent navigation, and an issue of causation.[189]

A further example of documentary unseaworthiness is the failure to carry a valid International Sewage Pollution Prevention (ISPP) certificate under MARPOL Annex IV. In *The Rewa* case,[190] the arbitrator found that, as the certificates that the vessel was required to have and which evidenced its physical condition included an ISPP, the vessel should have been equipped with the necessary sewage facilities. This case concerned the sale and purchase of the ship, where the buyers refused to buy the vessel, also

[186] Art 1(a).
[187] Generally, see Girvin (n 130) [24.11]; [24,15]-[24,18].
[188] *Alize 1954 v Allianz Elementar Versicherungs AG (The CMA CGM Libra)* [2019] EWHC 481 (Admlty), [2019] 1 Lloyd's Rep 595, upheld in *Alize 1954 v Allianz Elementar Versicherungs AG* (*The CMA CGM Libra*) [2021] UKSC 51, [2021] 2 Lloyd's Rep 613.
[189] A Rogers, 'Weighing in the Balance: *The CMA CMG Libra*' (2020) 26 JIML 225.
[190] *Polestar Maritime Ltd v YHM Shipping Co Ltd (The Rewa)* [2012] EWCA Civ 153, [2012] 1 Lloyd's Rep 510.

relying on the failure of the provision of the ISPP certificate, affecting the physical condition of the vessel.

Arguably, the MARPOL Annex VI requirements and related certifications fall within the scope of the seaworthiness obligation.[191] As already noted, SEEMP, being included in the vessel's ISM documentation,[192] would be one of the criteria for assessing the vessel's seaworthiness. Article I(a) of the Hague and Hague-Visby Rules defines 'carrier' as including 'the owner or the charterer that enters into a contract of carriage with a shipper'.[193] Where a carrier provides a vessel that is incapable of burning compliant fuel, it will be unseaworthy. However, the vessel is also likely to be unseaworthy if the relevant certificate, namely the mandatory international air pollution prevention (IAPP) certificate relating to controlling emissions from vessels, is unavailable or not held on board.

# 4 Market-based measures (MBMs)

Technical and operational measures are part of the international strategy to reduce GHG emissions from shipping. However, they must be applied with other measures to achieve the IMO targets. This chapter analyses some of the shortcomings of MARPOL and the need to adopt MBMs, showing the contribution of the European Union (EU) and the position of developing countries and the shipping industry, notably shipowners and ship operators, about the debate at MEPC on MBMs.

## 4.1 Criticisms of MARPOL

MARPOL improved the situation from the largely unregulated status shipping enjoyed half a century ago and is characterised by a preventive framework, 'which moderates the position that the sea has unlimited capacity to assimilate pollution to one where the sea is still believed to have the ability to assimilate some pollution'.[194] Discharges and emissions are regulated through technical and operational rules and standards, implementing the preventive principle.

[191] Girvin (n 130) [24.18].
[192] See para 3.1.4.
[193] Art 1(a).
[194] Tsimplis (n 4) 147.

However, grandfathering clauses and the lack of incentives for 'greener' vessels do not encourage shipowners to develop good practices and improve the condition of the marine environment more than the low degree of protection provided by MARPOL.

As emissions are quantified per year and for all vessels, the GHG reduction regime is more developed than other parts of the instrument, allowing an assessment of the impact of shipping on the environment. Yet, the overall effect of shipping on the marine and atmospheric environment needs to be addressed through more rigorous approaches. In other words, MARPOL-compliant vessels are not automatically environmentally friendly.[195] In this context, complementary devices to technical and operational measures are necessary.

### 4.2 Definition and debate on market-based measures at the IMO

MBMs are defined by the Organisation for Economic Co-operation and Development (OECD) [196] as measures that

> […] seek to address the market failure of 'environmental externalities' either by incorporating the external cost of production or consumption activities through taxes or charges on processes or products, or by creating property rights and facilitating the establishment of a proxy market for the use of environmental services.

MBMs could play a central role in IMO's strategy to reduce GHG emissions from shipping. However, the discussions on MBMs, which started at MEPC 56 in 2006, have not progressed since MEPC 65 in 2013. They apply the 'polluter pays' principle (PPP), internalising the negative external environmental cost of the emissions by forcing the polluter to pay compensation. The Civil Liability Convention 1969 (CLC 1969) represents the classic embodiment of this principle and it was adopted by the IMO placing strict liability on tanker-owners. However, liability is limited according to vessel size, unless the damage is the result of a personal act or omission of the shipowner with the intent to cause damage or recklessly and

[195] Ibid.

[196] *Market-based Instruments* (OECD, 2007) available at <http://stats.oecd.org/glossary/detail.asp?ID=7214> accessed 25 June 2023.

with knowledge that such damage would probably result.[197] The CLC 1969 also provides compulsory insurance with direct action against the insurer.[198]

The 1971 Fund Convention is a supplementary scheme allowing for additional compensation for the victims of oil pollution, which is financed by the oil industry. If the cost of damage exceeds the limits of liability of the tanker-owner, claims can be made against the fund. Liability is also limited under the 1971 Fund Convention and the channelling of liability onto the shipowner can only be circumvented under the same conditions.[199]

MBMs include environmental taxes, subsidies, and emission trading systems.[200] The main two types, and related variants, of MBM under discussion at the IMO are an International Greenhouse Gas (GHG) Fund for Shipping and a Maritime Emissions Trading Scheme.[201]

An International GHG Fund would apply a levy on bunker fuel purchases, incentivising shipowners to reduce fuel consumption, and the revenues from the Fund could be used to offset emissions credits from other sectors. The costs of ensuring compliance for individual shipowners would be predictable, given that the bunker fuel levy would be fixed for a certain period. Flag States and port States would ensure that individual vessels comply with the requirements to pay the bunker fuel levy. The International Chamber of Shipping (ICS), representing more than 80 per cent of the world's merchant fleet, has proposed a 'Fund and Reward' system to meet 2050 net-zero carbon goals. Shipowners will make mandatory contributions per tonne of carbon dioxide emitted to create a new IMO fund that will be used to reward first movers of alternative fuels that are used to cut carbon dioxide emissions, as well as sustainable biofuels, synthetic fuels, and new technologies.[202]

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[197] J Adshead, 'The Application and Development of the Polluter-Pays Principle across Jurisdictions in Liability for Marine Oil Pollution: The Tales of the "Erika" and the "Prestige"' (2018) 30 J Envt'l L 432.

[198] Tsimplis (n 55) 408.

[199] Adshead (n 197) 432.

[200] G Mallouppas and EA Yfantis, 'Decarbonization in Shipping Industry: A Review of Research, Technology Development, and Innovation Proposals' (2021) J Mar Sci Eng 5.

[201] Harrison (n 96) 186.

[202] Megawati Wijaya, 'ICS Spells Out Details on "Fund and Reward" System To Achieve Net Zero' *Lloyd's List* (London, 16 February 2023).

Through a Maritime Emissions Trading Scheme, shipowners would have to surrender 'emissions credits' to cover their emissions rather than paying a fixed levy. Credits can be distributed by way of example, through auctioning. However, the price of credits may fluctuate depending on supply and demand, and the cost of complying for shipowners may be more unpredictable.[203] By limiting the number of credits allocated, this measure can restrict GHG emissions. Moreover, flag States must manage the surrender of emissions credits by vessels flying their flag.[204]

A further debatable issue concerns how to use the collected revenue for both schemes. Options include offsetting through the purchase of approved carbon reduction credits; providing a rebate to developing countries; directly financing mitigation and adaptation activities in developing countries; funding the improvement of maritime transport infrastructure in developing countries; supporting research and development in the field of energy efficiency of shipping; contributing towards the IMO's International Technical Cooperation Programme.

At MEPC 59, it was suggested that there was a general preference for the more significant part of any funds generated by an MBM to be used for climate change purposes in developing countries through existing or new funding mechanisms under the UNFCCC or other international organisations and that the distribution of funds in this way would satisfy the CBDR principle.[205]

### 4.3 The role of the European Union and differences with the IMO

#### *4.3.1 The MRV Shipping Regulation*

The European Union (EU) has strongly influenced the work of the IMO regarding GHG emissions from shipping.[206] In 2013, the EU began discussions concerning the Monitoring, Reporting, and Verification (MRV) of $CO_2$ emissions for vessels of over 5,000 grt calling at EU ports. In 2015, the MRV became mandatory through Regulation 2015/757 (the MRV Shipping Regulation).[207] The EU monitoring scheme

[203] Declan Bush, 'How Japan's Carbon Levy and Rebate Scheme Would Work' *Lloyd's List* (London, 8 April 2022).
[204] Harrison (n 96) 186.
[205] Ibid, 187-188.
[206] Baughen (n 78) 130.
[207] [2015] OJ L 123/55. See S Baughen, 'What Is EU Maritime Law – and Will the UK Miss It after Brexit?' in S Jia and LL Zhao (eds), *Commercial and Maritime Law in China and Europe* (Informa Law from Routledge 2023) 23.

started on 1 January 2018, with the first reporting deadline on 30 April 2019.[208] In 2016, the IMO DCS entered into force for vessels of 5,000 grt and above trading internationally, setting as the first reporting date as 1 January 2019.[209]

The MRV Shipping Regulation follows the cost-efficiency principle, applying to $CO_2$ emissions released by vessels above 5,000 grt calling at ports in the EU.[210] It requires reporting three items – actual cargo carried onboard, fuel consumed, and $CO_2$ emitted.[211] Moreover, it monitors, verifies, and reports GHG emissions from voyages within the EU, incoming voyages from a non-Union port to a port within the Union, and outgoing voyages from a Union port to a non-Union port, regardless of the vessels' flag.[212] The regulation is, in other words, flag blind.[213] All vessels are subject to obligations under the MRV Shipping Regulation upon entry to a port in the jurisdiction of a Member State. The duty only applies when the vessel stops to load or unload cargo or to embark or disembark passengers.

Shipping companies must monitor, verify and report annual $CO_2$ emissions and other relevant information from their vessels' voyages during a reporting period, typically one year. The monitoring and the reporting must be complete and cover $CO_2$ emissions from the combustion of fuels while the vessels are at sea and berth. The MRV Shipping Regulation emphasises that the information must be reliable and accurate. Shipowners must prepare a monitoring plan explaining how they intend to monitor the relevant parameters required by the MRV Shipping Regulation. After assessing the monitoring plan by an accredited verifier, shipowners must monitor and report the different parameters, preparing an emission report through an electronic inspection database known as THETIS, which is maintained and hosted by the European Maritime Safety Agency (EMSA). EMSA has subsequently developed a new module in THETIS, namely THETIS-MRV, which enables companies responsible for operating large vessels using EU ports to report their $CO_2$ emissions under the MRV Shipping Regulation. THETIS-MRV includes a mandatory and a voluntary module. Under the mandatory

[208] Baughen (n 78) 130.
[209] S Lagouvardou et al, 'A Literature Survey on Market-Based Measures for the Decarbonization of Shipping' (2020) Sustainability 3.
[210] EJ Eftestøl and E Yliheljo, 'Paving the way for a European Emissions Trading System for shipping – EU and IMO on different paths' in B Soyer and A Tettenborn (eds), *Disruptive Technologies, Climate Change and Shipping* (Informa Law from Routledge 2022) 186.
[211] Baughen (n 207) 23.
[212] I Christodoulou-Varotsi, *Marine Pollution Control* (Informa Law from Routledge 2018) 190.
[213] Baughen (n 78) 130.

module, companies will generate Emission Reports, which will be assessed by Verifiers, who will issue an electronic Document of Compliance in the system. Companies may draft their monitoring plans through the voluntary module, and the system will make them available for verifiers' assessment.[214]

The intention behind the EU MRV Regulation was that it should work as a pilot or a model for a global mechanism, and it has undoubtedly speeded up the process within the IMO, which, as noted above, adopted the IMO DCS for fuel consumption of vessels in 2016.[215] Indeed the interaction with the IMO also influenced the EU. In 2019, the EU proposed an amendment to the EU MVR Shipping Regulation to adapt to the IMO DCS. The proposed revision aims to facilitate the coinciding implementation of the two systems while preserving the objectives of the current EU legislation, mainly to keep the monitored and verified $CO_2$ emissions data at the individual vessel level and stimulate innovations and energy efficiency solutions. The proposal also aims to reduce the administrative burden and associated costs for vessels that must be reported under both systems.[216]

*4.3.2 Relationship between EU MRV Shipping Regulation and IMO DCS*

The IMO DCS for fuel oil consumption of vessels entered into force on 1 March 2018 and is contained in MARPOL Annex VI reg 27. It applies from the calendar year 2019.[217] Under the framework, vessels of 5,000 grt and above are required to collect consumption data for each type of fuel oil they use and other, additional, specified data, including proxies for transport work. According to reg 27, the collected data must be reported to the flag State within three months after the end of each calendar year.[218] Having determined that the data has been reported per the requirements, the flag State should issue a Statement of Compliance to the vessel.[219] The SEEMP must include a description of the methodology used to collect the data and the processes used to report the data to the vessel's flag State.[220]

[214] Eftestøl and Yliheljo (n 210) 187.
[215] Resolution MEPC.278(70).
[216] Eftestøl and Yliheljo (n 210) 187-188.
[217] See MARPOL, Annex VI, reg 27.1.
[218] Ibid, reg 27.3.
[219] Ibid, reg 6.6, and Resolution MEPC.348(78), 2022 Guidelines for Administration Verification of Ship Fuel Consumption Data and Operational Carbon Intensity. See de La Rue (n 28) 993.
[220] Reg 26.2.

The EU MRV system and the IMO DCS overlap in many aspects, particularly regarding measuring $CO_2$ emissions. However, the systems are divided regarding utilising the emissions information. While the emission information collected by the EU is made publicly available and ready to be used in a potential EU ETS, the information gathered by IMO is confidential and not publicly available.[221] According to the IMO system, governments that have ratified MARPOL Annex VI shall have access to the data of all vessels in an anonymised format strictly for their analysis and consideration.[222]

Under the MRV Shipping Regulation, an accredited verifier verifies the calculations and sends these to THETIS. Under the IMO DCS, verification is carried out by the flag State, following national procedures.[223]

*4.3.3 The EU Emissions Trading Scheme (ETS)*

The MRV Shipping Regulation is designed with the requirements on information used for the EU Emissions Trading Scheme (EU ETS) in mind.[224] The EU ETS was put into place by the Commission in 2005, and in November 2022, the EU reached a preliminary agreement to include shipping in the EU ETS.[225] The inclusion of shipping in the carbon market is part of the EU's 'Fit for 55' package, which aims to cut GHG emissions by at least 55 per cent by 2030 compared with 1990 levels. In April 2023, the European Parliament voted to include shipping in the EU ETS from 2024, providing a three-year phase-in period where companies will buy allowances for 40 per cent of emissions in 2024, gradually increasing to 75 per cent in 2025 and 100 per cent in 2026. The measure will come into force in 2024 following approval by the European Council.[226]

Despite its cost to shipping companies, estimated between €6 billion (US$6.6 billion) and €7 billion,[227] the EU ETS is considered by Brussels an essential tool for reducing GHG emissions cost-effectively. The

[221] Eftestøl and Yliheljo (n 210) 188.
[222] Ibid.
[223] Baughen (n 78) 130.
[224] Christodoulou-Varotsi (n 212) 191.
[225] Michelle Wiese Bockmann, 'EU Reaches Preliminary Agreement To Include Shipping in ETS From 2024' *Lloyd's List* (London, 30 November 2022).
[226] Richard Meade, 'IMO and EU Eye Convergence of Regional and Global Regulation' *Lloyd's List* (London, 5 June 2023).
[227] Enes Tunagur, 'EU Parliament Approves Shipping's Inclusion In Regional Carbon Market' *Lloyd's List* (London, 18 April 2023).

EU represents the world's first primary carbon market and remains the biggest, covering around 45 per cent of the EU's GHG emissions. The EU ETS implies a 'cap and trade' principle with a single EU-wide cap set for the total GHG emissions covered by the system. [228] Within the cap, companies receive or can buy European emission allowances (EEAs) free of charge or can be bought and traded as needed. An EEA allows the holder to emit one tonne of GHG within a calendar year, and its price was estimated at around €79 (US$85) per tonne in June 2023.[229] The expectation is that this price will increase over the years since the total quantity of EEAs will decrease yearly. From 2021 to 2030, the decrease will be subject to an annual linear factor of 2.2 per cent.[230]

The purpose of the EU ETS is to promote reductions of GHG in a cost-effective and economically efficient manner. Emissions from trading sectors are capped at set emission reduction levels, and a corresponding amount of emission allowances are created and allocated to the market. This mechanism again implements the 'polluter pays' principle. The creation of transferable pollution rights aims to achieve optimal market allocation. In other words, individuals valuing them the highest will acquire these rights. Accordingly, the right to pollute is considered a production factor, such as fuel or raw material.[231]

The transferability and allocation of pollution rights through market bargaining sets the mechanism apart from traditional command-and-control environmental licenses. However, emissions trading contains some elements of conventional administrative command-and-control regulation: the allowances are created and partially allocated to the market based on decisions adopted by national authorities and the Commission. The environmental integrity and effectiveness of the system depend on accurate information on emissions from GHG sources. Hence, in addition to surrendering allowances, regulated entities must monitor, verify, and report GHG emissions annually following a pre-approved plan. Should they fail to fulfil these compliance obligations, they face an administrative fee

[228] Christodoulou-Varotsi (n 212) 190.
[229] Enes Tunagur, 'Green Ammonia Needs $200 Carbon Tax To Be Competitive' *Lloyd's List* (London, 7 June 2023).
[230] AJ Braakman, 'Climate and Covid-19: Will the Shipping Industry Succeed in Charting the Right Course Between Scylla and Charybdis?' (2020) 26 JIML 104-105.
[231] Eftestøl and Yliheljo (n 210) 189.

determined by national authorities in addition to having their name published on a blacklist. National authorities supervise all of the compliance obligations.[232]

As noted by Baughen, there is no violation of UNCLOS by the EU ETS system of voyages in and out of the EU, even though this will affect vessels flagged in the non-EU States.[233] States have complete sovereignty over their internal waters, including ports, which gives the port State jurisdiction over all vessels in those waters. Regional measures are also permitted under UNCLOS, art 311.3.[234]

Port sovereignty is subject to the publicity requirements in UNCLOS, art 211.3, regarding the prevention, reduction, and control of marine environment pollution as a condition for the entry of foreign vessels into ports. This also applies to the principles preventing discrimination between vessels based on UNCLOS, art 277 and requiring good faith and non-abuse of rights in UNCLOS, art 300. Including international shipping in the ETS on a non-discriminatory basis will not violate these principles, even though it has extra-territorial effect.

*4.3.4 The IMO discussions on a carbon levy*

As suggested by the European Commission, creating a cap and trade system for emissions from transport is based on giving carbon a value.[235] This may be generated through emissions trading but can also be generated through a carbon levy. A carbon levy implies that an exact price is placed on $CO_2$ or imposed through other costs that imply a carbon value. Under a carbon levy, the cost of controlling emissions would be certain because it would be equal to the levy. Compared to a cap and trade system, there is no predetermined limit on emissions, and the overall volume of emissions remains unknown. In other words, the levy does not guarantee the emissions cut since shipping companies could decide to pay the money and keep burning dirty fuel simply.[236] The levy is adjustable over time because of

[232] Ibid.

[233] Baughen (n 78) 142.

[234] This is as follows: 'Two or more States Parties may conclude agreements modifying or suspending the operation of provisions of this Convention, applicable solely to the relations between them, provided that such agreements do not relate to a provision derogation from which is incompatible with the effective execution of the object and purpose of this Convention, and provided further that such agreements shall not affect the application of the basic principles embodied herein, and that the provisions of such agreements do not affect the enjoyment by other States Parties of their rights or the performance of their obligations under this Convention'.

[235] Christodoulou-Varotsi (n 212) 190.

[236] Bush (n 203).

technical criteria or political considerations rather than the supply and demand of emission allowances. An important feature of a carbon levy is that funds can be collected and distributed, for instance, towards research and development. At the IMO, ten countries, including China, India, and Brazil, have supported carbon levies to finance shipping decarbonisation goals.[237]

The EU ETS and the levy discussed by the IMO are based on the information and imply a price on carbon emissions. Carbon pricing regulation also affects non-economic aspects of decision-making through the perceived reputational risks associated with high-emitting clients. Unlike the EU, the IMO is not preparing for a cap and trade system to reduce emissions from international shipping. However, as a matter of urgency, it aims to phase them out as soon as possible in this century, and technological innovation and the global introduction of alternative fuels and energy sources for international shipping are considered integral to achieving that overall ambition.[238]

Through the DCS, the IMO aims to enforce a global carbon levy for international shipping and financing research and development, technological innovation, and the global introduction of alternative fuels and energy sources. The EU and the IMO are developing different strategies. In both systems, gathering information is essential, but how the information will be used radically differs.[239] It has been pointed out that the EU will likely take the leading global role in shipping decarbonisation with its renewable marine fuel targets and including shipping in the EU ETS unless the IMO adopts more ambitious targets and MBMs soon.[240] However, the Commission seems also ready to consider the option of a fuel levy, rather than an ETS, within the IMO. Indeed, Brussels knows that a levy is more likely to be agreed upon within the IMO, where only a few EU States are pushing for an ETS. Such divergence in approach implies the possibility of shipping dealing with the EU ETS and a global fuel levy, raising the issue of 'double counting' the same emissions. It remains unclear how the IMO approach could converge with the EU ETS.[241] Moreover, it has been emphasised that delaying action by the IMO will generate more shipping

[237] Michelle Wiese Bockmann, 'China and India Among Developing Countries Seeking Delay In Revision of Shipping's Emission Strategy' *Lloyd's List* (London, 15 February 2023).
[238] Eftestøl and Yliheljo (n 210) 191.
[239] Ibid, 192.
[240] Enes Tunagur, 'Zero-emissions Bunkering Shows Promise Amid Tangible Demand Signals' *Lloyd's List* (London, 24 May 2023).
[241] Meade (n 226).

decarbonisation costs and could lead to different tiers of overlapping regional regulations.[242] Indeed, in the US, some senators have proposed levying a carbon tax on cargo vessels over 10,000 grt calling at US ports, starting in 2024.[243]

### 4.4 The position of developing countries

The discussions at the IMO on MBMs have not yet produced any concrete results yet. For three reasons, many developing countries oppose adopting any MBMs.[244] First, MBMs are characterised by uncertainty concerning the carbon market. Second, implementing MBMs requires countries to have similar economic and technological development levels to avoid unfair competition. Third, the NMFT principle[245] incorporated in most MBM proposals would need to be more suitable for balancing the interests of developed and developing countries.

Some MBMs, such as the EU ETS, violate World Trade Organisation (WTO) obligations to flag State members of that organisation. For instance, the 'Port State Levy' proposed by Jamaica envisages levying a globally uniform emissions charge on all vessels calling at their respective ports based on the amount of pollution the vessel produces during the voyage. Measuring the amount of pollution by the fuel consumed would not represent an accurate indicator because of the different vessel types and operational methods, leading to the differentiated treatment of vessel types. This might contravene the fundamental principle of the most favoured nation (MFN) under the General Agreement on Tariffs and Trade (GATT), art I.[246]

In particular, any favourable treatment extended to any nation must also extend to all WTO members without discrimination. However, the EU ETS cannot be considered discriminatory, as it applies to all vessels or shipowners regardless of their flag. [247] Moreover, under GATT, art 5, members enable freedom of transit for goods, vessels, and other means of transport. The EU ETS imposes a cap and

[242] Enes Tunagur, 'Delaying IMO Action Will Increase Decarbonisation Costs and Risk Fragmented Regulation, UN Warns' *Lloyd's List* (London, 12 June 2023).
[243] Tomer Raanan, 'US Lawmakers Propose Carbon Tax On Shipping' *Lloyd's List* (London, 9 June 2023).
[244] For example, China, India, and Brazil.
[245] See para 2.4.
[246] E Røsæg, 'The Aviation and Shipping Exemptions in the Paris Agreement on Climate Change' (2021) 27 JIML 61. See also Shi (n 64) 211-212.
[247] Baughen (n 78) 144.

trade system, where the allocation of pollution rights depends on the bargaining in the market. Where the price of these pollution rights is determined according to the vessel's nationality, the legitimacy of the EU measure would be called into question, but no evidence of this was found.[248]

### 4.5 The position of the shipping industry and the main proposals at the IMO

Within the MEPC, shipowners' interests are represented by the Round Table of International Shipping Associations (Round Table), the members of which are the International Chamber of Shipping (ICS), BIMCO, the International Association of Independent Tanker Owners (INTERTANKO), and the International Association of Dry Cargo Shipowners (INTERCARGO).[249]

In 2020, the ICS, BIMCO, and other shipping industry representatives proposed establishing a mandatory contribution fund per ton of fuel oil purchased by the IMO. Revenues were estimated at US$5 billion, aiming to enhance research and development for low and zero-carbon fuel and promote the development of commercially viable zero-carbon emission vessels by the early 2030s.[250]

The contribution of BIMCO is particularly significant, considering that the targets for the level of reduction should be set for each industry by governments in proportion to the amount of $CO_2$ emitted by that particular industry. It also emphasised that the IMO should be the MBMs regulator. Moreover, any form of MBM should fulfil the nine IMO principles.[251] BIMCO did not support the EU ETS, considering the industry's global nature and mobility, stating that 'IMO should be allowed to complete its work on $CO_2$ emissions from vessels without undue obstruction from regional institutions'.[252]

At MEPC 59, the Cruise Lines International Association (CLIA) proposed three principles for MBMs, namely NMFT, high quality, multiple benefit carbon mitigation investments, and CBDR. CLIA explained that a framework established by the IMO to reduce GHG emissions from shipping should respect both the NMFT and the CBDR principles through 'not unduly penaliz[ing] vessels based upon their trading

[248] Ibid.
[249] Shi (n 67) 235.
[250] Proposal to Establish an International Maritime Research and Development Board (IMRB) by ICS, BIMCO, CLIA, INTERCARGO, INTERFERRY, INTERTANKO; IPTA, and WSC MEPC 75/7/4; IMO: London, UK, 2020. Lagouvardou (n 203) 8.
[251] See para 3.1.
[252] T Skaanild, 'Emissions Reduction and Emissions Trade Systems in Shipping: A BIMCO Perspective' in HJ Koch et al (eds), *Climate Change and Environmental Hazards related to Shipping* (Martinus Nijhoff 2013) 162-163.

routes or flag' and 'ensuring a portion of the redistributed funds are applied to those areas where a net benefit is achieved by a non-Annex I party through a market-based instrument'.[253]

INTERTANKO argued that the IMO should be the organisation governing MBMs and that these must be specific to the shipping industry. Moreover, in its view, such MBMs must effectively contribute to reducing total GHG emissions and be environmentally sustainable without a negative impact on global trade and growth, characterised by efficient and credible enforcement and monitoring. INTERTANKO also reiterated that MBMs 'should be binding and equally applicable to all ships'. [254]

ICS also indicated its preference for the IMO as the competent organisation. It emphasised the NMFT principle, stressing 'if there is a need' to accommodate CBDR. Moreover, ICS set two priorities for the disbursement of funds generated from MBMs: a mitigation and adaption scheme and research and development.[255]

CLIA, INTERTANKO, and ICS all respect the role of the IMO as the regulator of any MBM and respect the NMFT principle. However, INTERTANKO did not explicitly raise the CBDR principle. CLIA underscored the NMFT and CBDR principles and identified the means for achieving these principles. ICS stressed the NMFT principle and seemed reluctant to accept the CBDR principle. The two priorities ICS identified should have mentioned developing countries' interests. In a joint official statement, the Round Table asserted that the CBDR principle 'cannot be practically applied to ships in light of the nature of international shipping operations'. Instead, it preferred the NMFT principle to maintain a level playing field for international shipping. Shipowners and ship operators must still reach a consensus on the CBDR principle. CLIA would be more feasible if a compromise is achieved between developed and developing countries.[256]

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[253] Consideration of Adoption of Three Principles for Market-based Instruments, submitted by Cruise Lines International Association (CLIA), MEPC 59th Session, Agenda Item 4, IMO Doc MEPC 59/4/32 (8 May 2009) para 1.

[254] Comments on MEPC 59/4/8 and MEPC 59/4/9 relating to the Energy Efficiency Design Index, the Ship Energy Management Plan and Possible Market-based Instruments, submitted by INTERTANKO, MEPC 59th Session, Agenda Item 4, IMO Doc MEPC 59/4/43 (22 May 2009) para 9.

[255] Control of Greenhouse Gas Emissions from International Maritime Transport, submitted by the International Chamber of Shipping (ICS), MEPC 60th Session, Agenda Item 4, IMO Doc MEPC 60/4/13 (15 January 2010) para 9.1.

[256] Shi (n 67) 244-245.

At MEPC 64 in 2012, ICS supported a levy or a compensation fund that should relate to the actual fuel consumption of individual vessels in service. ICS asserted that such a scheme would ensure that: a level playing field was maintained; serious market distortion was avoided; system management was easier; and the desired transparency was provided.[257] Compared with the views from ICS, the Round Table opposed any ETS because it would be 'unworkable' for the shipping industry. Similarly, the Asian Shipowners Forum (ASF) has also opposed an ETS because it would be less enforceable, unreasonably costly, and might favourite other sectors than shipping. ASF also asserted that MBMs, such as the proposed global bunker levy and ETS, would be premature and did not express any preferred MBMs, that do not seem to be accepted by the Asian shipping industry.[258]

In conclusion, international shipowners' and ship operators' associations are more interested in levy or compensation fund-based MBMs than ETS and other MBM proposals.[259] Two factors might contribute to this preference. First, the shipping industry is more concerned about the sound development of the global shipping market than reducing GHG emissions from vessels. A levy or a compensation fund could achieve this goal more quickly than a global ETS, as the latter imposes a cap and trade system for international shipping, limiting its development and leading to carbon leakage. As BIMCO emphasised, shipping should not be a 'cash cow' in tackling climate change.[260]

Second, to maintain the status of the IMO as the only regulator of MBMs, the global shipowners' and ship operators' associations prefer a levy or a compensation fund. Surprisingly, while international shipowners' and ship operators' associations oppose an ETS, some national shipowners' associations in Europe, such as Germany and Norway, supported an ETS applied to the shipping industry.[261]

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[257] Operational Energy Efficiency of New and Existing Ships, submitted by the International Chamber of Shipping (ICS), MEPC 64th Session, Agenda Item 5, IMO Doc MEPC 64/5/11 (27 July 2012) para 11.

[258] Shi (n 67) 246-247.

[259] Michelle Wiese Bockmann, 'Global Carbon Levy On Shipping Endorsed By Industry Leaders — Study' *Lloyd's List* (London, 25 October 2021).

[260] Skaanild (n 252) 163.

[261] Shi (n 67) 247.

# 5 Alternative fuels

The IMO considers alternative fuels and renewable energy sources essential to meet its 2050 Level of Ambition. In the longer term, shipowners will need to use alternative fuels within the next 15 years in the context of global warming.[262] At the current stage of technological development, liquefied natural gas (LNG), hydrogen, ammonia, biofuels, and methanol seem to be the most desired options by shipowners and ship operators as alternatives to bunker fuel. This section outlines the main characteristics, safety regulations, and environmental safeguards concerning these types of fuels.

## 5.1 Current situation

The shipping sector uses less refined and processed fuels than road transportation and aviation. The primary fuel used in the shipping sector is heavy fuel oil (HFO), which has a very high viscosity and contains large amounts of sulphur, which, when combusted, releases harmful sulphur oxide emissions. The shipping sector also uses other fuels with lower viscosity levels and lower sulphur content, such as marine gas oil (MGO), which is used for smaller vessels, and marine diesel oil (MDO).[263]

The shipping industry is no longer at a stage where decarbonisation efforts are a technology question.[264] According to recent studies, shipowners consider that LNG, which already fuels some container vessels, hydrogen, ammonia, biofuels, and methanol, are the frontrunners.[265] There are currently pilot and demonstration projects in shipping, including 45 vessels focusing on hydrogen, 40 on ammonia and 25 on methanol. Most hydrogen projects concern small vessels, while ammonia projects are for large vessels, and methanol projects are split between both.[266] Shipowners consider regulatory and technological uncertainty as the most significant constraints on investment in emissions reduction.[267] Still, today there is no reason from a technological or commercial development point of

[262] Baughen (n 78) 134.
[263] Mallouppas and Yfantis (n 200) 7.
[264] Enes Tunagur, 'Shipping Decarbonisation is not a Technology Question Anymore, says Trafigura' *Lloyd's List* (London, 17 March 2023).
[265] Enes Tunagur, '"Low Maturity of Solutions" the Main Barrier to Decarbonisation, Lloyd's List Survey Finds' *Lloyd's List* (London, 22 May 2023).
[266] *Global Hydrogen Review 2022* (IEA, 2022) 52.
[267] Tunagur (n 264).

view not to be able to reach pathways of greenhouse gas reduction.[268] Small and medium shipowners must not be left behind in achieving decarbonisation targets. The average shipowner owns around four and a half vessels, and approximately 60 per cent of vessels on the water today are owned by shipowners with fewer than 20 vessels. Therefore, the role of these less visible players is crucial. However, such shipowners have limited awareness of the available operational and technological efficiency solutions and lack concrete plans to incorporate alternative fuels.[269]

The EU, meanwhile, consolidated its place as the front-runner in the green fuel market. In March 2023, the EU reached a provisional agreement on more ambitious renewable energy targets under the Renewable Energy Directive[270] by using various methods, including a sub-target for renewable hydrogen and advanced biofuels in the transport sector. The agreement allows Member States to choose between a binding 14.5 per cent GHG emission reduction target for the transport sector by 2030, or a binding target of at least 29 per cent share of renewables within the final energy consumption in the transport sector by 2030.[271]

## 5.2 LNG

### *5.2.1 General characteristics*

Low-carbon fuels are expensive compared with conventional bunker fuel. Among alternative fuels, LNG is already in use.[272] LNG is a fossil fuel that offers low emissions compared to HFO and is stored in

[268] Richard Meade, 'Uncertainty is Holding Back Industry Decarbonisation, Not Technology' *Lloyd's List* (London, 25 May 2023).

[269] Linton Nightingale, 'Small Shipowners Must Not be Forgotten in Zero-carbon Race' *Lloyd's List* (London, 7 June 2023). See also Richard Meade, 'Shipping's Carbon Ambitions Suffer a Serious Credibility Gap' *Lloyd's List* (London, 26 May 2023) and Enes Tunagur 'Industry Decarbonisation in Danger of Stalling Unless Smaller Shipowners Invest In Latest Efficiency Measures' *Lloyd's List* (London, 9 June 2023).

[270] Directive 2018/2001/EU, in force in December 2018. See [2018] OJ L328/82.

[271] Enes Tunagur, 'EU Agrees To Boost Hydrogen and Biofuel Targets For Transport' *Lloyd's List* (London, 30 March 2023).

[272] Mallouppas and Yfantis (n 200) 32.

cryogenic conditions at -162°C on board vessels. [273] Its use is supported by established engine technologies, such as dual fuel[274] in combination with HFO or MGO.[275]

LNG is currently considered the best solution available[276] by the industry, including shipowners and oil companies (unsurprisingly), being able to compete with bunker fuel for its affordable price.[277] LNG is today the cleanest fuel for shipping which can be produced in meaningful volumes.[278] Its advantage is the ability to reduce $SO_x$ emissions and particulate matter by almost 100 per cent compared to conventional fuel oil. The reduction in $CO_2$ emissions is about 25 per cent.[279] By way of example, CMA CGM is focusing its attention on LNG.[280]

LNG has qualities that make it less likely to cause pollution damage than traditional fuel oil. As the density of LNG is considerably less than that of water,[281] if LNG spills over water, it will float on top and rapidly vaporise, and no traditional clean-up of pollution damage would be necessary, as is the case for an oil spill.[282]

The major disadvantage is 'methane slip' or unburned methane from vessel engines.[283] Indeed, LNG handling and combustion implies the release of methane, constituting a GHG with a global warming potential 28 times higher than $CO_2$ over 100 years and 84 times higher over 20 years. Methane slip can also occur during the bunkering phase and upstream in fuel production, processing, and transmission.[284]

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[273] *Pathways to Sustainable Shipping* (ABS, 2020) 15.

[274] i.e. engines fuelled by alternative and bunker fuel.

[275] KE Nelson and S Da Ponte, 'Commercial Vessel Air Emissions: Climate Change Impacts and Enforcement' (2021) 69 Dep't of Just J Fed L & Prac 17. See also ABS (n 273) 15.

[276] Enes Tunagur, 'Economou calls for flawed CII to be scrapped' *Lloyd's List* (London, 5 June 2023). See also Michelle Wiese Bockmann, 'Shell rules out ammonia – for now – as alternative marine fuel in decarbonisation report' *Lloyd's List* (London, 1 June 2023).

[277] *The Future of Hydrogen – Report prepared by the IEA for the G20, Japan* (IEA, 2019) 140. See also Enes Tunagur, 'Green ammonia needs $200 carbon tax to be competitive' *Lloyd's List* (London, 7 June 2023).

[278] Mallouppas and Yfantis (n 200) 11.

[279] Baughen (n 78) 135.

[280] Special Report (n 51) 8.

[281] 3.9 pounds per gallon, as opposed to 8.3 pounds per gallon.

[282] J Xu, D Testa and PK Mukherjee, 'The Use of LNG as a Marine Fuel: Civil Liability Considerations from an International Perspective' (2017) 29 J Envt'l L 131.

[283] Enes Tunagur, 'Campaign launched against use of LNG as a marine fuel' *Lloyd's List* (London, 4 April 2023).

[284] Christodoulou-Varotsi (n 212) 202.

There are currently 700 liquefied natural gas-capable vessels in the global fleet.[285] Among others, in service and on order, these include: 234 container vessels, 169 tankers, 145 PCTC/ro-ro cargo vessels, 83 passenger ferries, and 68 bulk carriers, among others.[286] However, few of them regularly use LNG and many crews trained on LNG have become less familiar with the requirements of onboard equipment and bunkering procedures,[287] as infrastructures worldwide are limited. As for other alternative fuels, LNG requires substantial investments in bunkering facilities.[288] While ports and shipowners in northern Europe have led the way, in the US, several ports on the Gulf Coast are being developed, and in Asia, the Port of Singapore is leading.[289]

*5.2.2 Safety regulations*

With a gaseous flashpoint[290] lower than 60˚C, LNG could not be considered as fuel under the 1974 International Convention for the Safety of Life at Seas (SOLAS), which requires flag States to ensure that their vessels comply with minimum safety standards in construction, equipment, and operation.[291] SOLAS derives from when coal-powered vessels were in operation, and it was the start of the transition to oil-fuelled vessels. As such, the majority of its requirements for fuels are based on the distillate and residual fuels derived from petroleum refining.

The IMO addressed the particular aspects concerning the safe use of LNG as fuel through the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk Code (IGC Code) and the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code).[292]

The IGC Code was developed from the experience of carrying LNG in bulk on gas carriers.[293] Initially, it only permitted the burning of natural gas (methane) cargo as fuel to control the pressure and

[285] N Brown, 'Decarbonisation to Drive Change' *Lloyd's List* (London, 22 May 2023).
[286] Rob Willmington, 'Dual-fuel Methanol Orderbook Keeps on Growing' *Lloyd's List* (London, 22 May 2023).
[287] Brown (n 285).
[288] Psaraftis (n 17) 16.
[289] ABS (n 273) 24.
[290] i.e. the point where the fuel burns.
[291] Tsimplis (n 57) 383.
[292] ABS (n 273) 33.
[293] MEPC.225(64). See <https://imorules.com/IBC.html> accessed 14 June 2023.

temperature of LNG cargo by consuming the boil-off gas from LNG stored in low-pressure bulk storage tanks. Today, it allows gases other than natural gas to be used as fuel, if acceptable to the administration, with other cargo gases as well, ensuring the same level of safety as natural gas in the Code. However, the use of cargo identified as toxic in Chapter 19 is not allowed.[294]

The IGF Code was adopted by the Maritime Safety Committee (MSC) of the IMO in June 2015 in order to provide an international standard for the safety of vessels using low-flashpoint fuel other than vessels covered by the IGC Code.[295] This Code provides a global standard for vessels using low-flashpoint fuel and defines the safety requirements for constructing and operating LNG-fuelled vessels. It aims to provide mandatory provisions for the arrangement, installation, control, and monitoring of machinery, equipment, and systems using low-flashpoint fuel to minimise the risk to the vessel, its crew, and the environment, considering the nature of the fuels involved. The provisions of the IGF Code are mandatory under SOLAS, Chapter VII, reg 12. [296] Part 1 of the IGF Code covers only natural gas, but other fuels can be used as well, provided that they meet the intent of the goals and functional requirements and provide an equivalent level of safety.[297]

*5.2.3 Environmental safeguards*

MARPOL Annex VI is relevant in considering LNG as fuel. Regulations 13 and 14 limit $NO_x$ and $SO_x$ emissions from vessels. In this regard, LNG represents an alternative fuel that allows vessels to operate with significantly lower pollutant emissions, particularly a 95 to 100 per cent reduction in $SO_x$ emissions and up to 90 per cent reduction in $NO_x$, depending on engine technology. Moreover, the IMO reduction of the global sulphur cap to 0.50 per cent by 2020 is to be considered.

Finally, under Annex VI, reg 4.1, flag States may

> allow any fitting, material, appliance, or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by Annex VI if such fitting, material, appliance or apparatus or other procedures, alternative fuel oils, or

[294] ABS (n 273) 33.
[295] Resolution MSC.391(95).
[296] See SOLAS, Ch VII, Part C. Resolution MSC.392(95) entered into force on 1 January 2017.
[297] ABS (n 273) 33.

> compliance methods are at least as effective in terms of emissions reductions as that required by the Annex, including any of the standards set forth in regs 13 and 14.

LNG as fuel may be considered an 'equivalent' under reg 4. Moreover, under reg 4.2,

> the flag State which allows a fitting, material, appliance or apparatus or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex shall communicate to the IMO for circulation to the Parties particulars thereof, for their information and appropriate action, if any.

Regulation 4 further determines that any relevant guidelines developed by the IMO on the equivalents should be considered by flag States, which must endeavour not to impair or damage its environment, human health, property, or resources or those of other States.

### 5.3 Hydrogen

#### *5.3.1 General characteristics*

Hydrogen-based fuels represent a significant opportunity for the shipping sector. However, there is a big gap in achieving the 1.5˚C target of the Paris Agreement.[298]

Hydrogen emits zero $CO_2$, zero $SO_x$, and negligible amounts of $NO_x$. Several varieties, such as grey or brown hydrogen, are made using fossil fuels like oil and coal, emitting $CO_2$ into the air when combusting.[299] The advantage of current grey hydrogen is that it tends to be produced very close to where it is used, with low transport needs.[300] Blue hydrogen is made similarly, but carbon Carbon Capture and Sequestration (CCS) technologies prevent $CO_2$ from being released, enabling the captured carbon to be safely stored deep underground or utilised in industrial processes.[301] Finally, green hydrogen, representing the cleanest variety, produces zero-carbon emissions and is made using

[298] ICS (n 14) 4.
[299] Baughen (n 78) 136.
[300] ICS (n 14) 5.
[301] CCS refers to technologies able to remove $CO_2$ from vessel exhaust gas or the atmosphere and store it for subsequent use. $CO_2$ can be removed either from the exhaust gas of marine engines or directly from the atmosphere (direct air capture). Both technologies are based on the same fundamental principles, but removing $CO_2$ from the exhaust gas requires less energy because of its higher $CO_2$ concentration compared to air. See ABS (n 273) 41.

electrolysis powered by renewable energy, such as offshore wind.[302] However, green hydrogen producer countries are likely to be distant from consumer markets, and transportation will necessarily occur either by pipeline or vessel. In the case of long distances, shipping is considered the preferable mode of transport.[303] Research has also shown that the global green hydrogen supply will remain scarce until 2035.[304] Japan, South Korea and Germany planned to stimulate industrial demand for hydrogen and ammonia fuels, while trade deals with countries such as Australia, Saudi Arabia and Chile, and Singapore and the Netherlands are considered future international trading hubs for hydrogen.[305]

An essential factor encouraging the employment of hydrogen as a fuel on an internationally agreed basis is that it can be blended with fossil fuels in mixtures. However, hydrogen has safety risks, given its high inflammable potential.[306] The availability and low volumetric energy density of hydrogen also require significant additional infrastructure and new designs for vessels.[307]

Studies have shown that vessels serving long-distance maritime trade routes are the most suitable for hydrogen and ammonia.[308] Indeed, liquid hydrogen storage requires at least five times more volume than conventional oil fuels, and ammonia requires three times more volume. Therefore, the space requirements of fuel cells could be an issue, especially for smaller vessels.[309] In the longer term, this could require the redesign of vessels, shorter distance trips and more frequent refuelling, reduced cargo volumes, or a mix of these operational factors, considering ship and cargo types and routes.[310]

[302] Baughen (n 78) 136.
[303] ICS (n 14) 5.
[304] Enes Tunagur, 'Green Hydrogen Breakthrough Unlikely Before 2035, Study Finds' *Lloyd's List* (London, 13 March 2023).
[305] ICS (n 14) 27-28.
[306] IEA (n 266) 28.
[307] Mallouppas and Yfantis (n 200) 8.
[308] IEA (n 266) 140.
[309] Ibid.
[310] Ibid.

*5.3.2 Regulations*

International regulations and standards are currently unclear or not written with new uses of hydrogen in mind, such as fuel in shipping, and do not allow exploitation of the full benefits hydrogen can provide.[311]

In April 2022, the IMO MSC approved interim guidelines for the safety of vessels using fuel cell power installations. As mentioned above, the IGF Code was adopted for fuel storage and fuel supply to the fuel cells. While initially written for liquefied natural gas, it was found that it can apply to hydrogen. However, specific norms should be developed by the IMO to facilitate the wider adoption of hydrogen and hydrogen-based fuels in international shipping.[312]

**5.4 Ammonia**

*5.4.1 General characteristics*

Ammonia is essential in global agricultural systems because of its use as fertiliser. Indeed, about 70 per cent of ammonia is used for fertilisers, while the remainder is used for various industrial applications, such as plastics, explosives, and synthetic fibres.[313]

Produced commercially via the 'Haber-Bosch process',[314] ammonia emits zero $CO_2$ and $SO_2$ and close to zero $NO_2$. When used in a fuel cell, it requires less cargo space than hydrogen. However, high prices prevent the large-scale adoption of ammonia as an alternative fuel, and it is a highly toxic substance.[315] Safety concerns have emerged, delaying progress in the fuel's uptake in the shipping industry and testing for ship-to-ship ammonia transfers in port areas. Recent developments suggest ammonia bunkering could become a reality later this decade.[316] It is estimated there is ammonia-bunkering infrastructure at over 150 ports, including 49 in Europe and Russia and 51 in Asia. Some of these ports,

[311] Ibid, 28.
[312] IEA (n 266) 52.
[313] *Ammonia Technology Roadmap Towards More Sustainable Nitrogen Fertiliser Production* (IEA, 2021) 8.
[314] A process which combines hydrogen and nitrogen through high temperatures and a catalyst: see Mallouppas and Yfantis (n 200) 10.
[315] Baughen (n 78) 138.
[316] Enes Tunagur, 'Ammonia Supply Chain Getting Ready for Shipping, Despite Delays' *Lloyd's List* (London, 8 June 2023).

such as Rotterdam, are planning additional ammonia infrastructure while other ports, such as Singapore, which do not have ammonia infrastructure, are planning how to enable ammonia bunkering for use by international shipping.[317] The Maritime and Port Authority of Singapore has publicly stated that such tests in the port area would not happen in 2023, as previously envisaged by the Global Centre for Maritime Decarbonisation.[318]

Chemical fuels, such as ammonia or methanol, are attractive for the transport sector, as there is extensive experience in transporting them globally, meaning that transport costs are already well-known to the industry and relatively low.[319] According to Katharine Palmer, the UN Framework Convention on Climate Change shipping lead, ammonia could be the cheapest fuel to produce among alternative fuels.[320]

*5.4.2 Safety regulations*

The primary legal instrument is SOLAS, which, as mentioned above, does not allow using conventional fuel oils with less than a 60˚C flashpoint, except for emergency generator use.[321] For this reason, the IMO adopted the IGF Code in 2015. The original 1993 IGC Code only permitted burning natural gas as a fuel.[322] However, following the IMO's adoption of the revised IGC Code in May 2014,[323] the option to burn other alternative cargoes was introduced under a new section, 'alternative fuels and technologies'.

The IGC Code includes requirements concerning the toxic and corrosive nature of the carriage of ammonia, such as gas and vapour detection to be suitable for toxicity, cargo tank gauging instrumentation to be of indirect or closed type, and materials to be resistant to the corrosive nature of ammonia. In addition, the Code requires standard personnel protective equipment for gas carriers, including aprons, eye protection, first-aid equipment, and full protective safety outfits and air sets. The

[317] ICS (14) 52-53.
[318] Tunagur (n 298).
[319] ICS (n 151) 39.
[320] Special Report (n 51) 8.
[321] Where the flashpoint limit is 43˚C.
[322] See ch 16.
[323] This entered into force on 1 July 2016: see Resolution MSC.370(93).

carriage of ammonia also requires respiratory and eye protection for the emergency escape of every person on board.

The ISM Code also comes into play. It requires ship operators to assess all risks for the vessel, personnel, and the environment and to establish appropriate safeguards. Notwithstanding the possible inclusion of ammonia as fuel under the IGF Code, the ISM Code is always relevant in safety matters.[324]

*5.4.3 Environmental safeguards*

MARPOL Annex VI, reg 13, concerned with reducing the harmful effects of $NO_x$ emissions on human health and the environment, sets out the limits for their emissions from vessel diesel engines. It mandates that all marine diesel engines greater than 130 kW be installed on vessels subject to MARPOL Annex VI, except engines used for emergencies.

Currently, ammonia is considered to fall under the Annex VI definition of 'fuel oil', which includes '… any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including gas, distillate, and residual fuels'. This needs to be considered while developing the IMO instruments for applying ammonia as a marine fuel.

Moreover, by limiting the sulphur content of marine fuels, MARPOL Annex VI, reg 14, restricts the volume of $SO_x$ and PM emitted to the atmosphere from fuel oil-consuming equipment on board vessels.

Ammonia is also sulphur free and therefore provides a way to comply with and go well beyond the requirements under reg 14. In addition, reg 18 includes criteria for flag States, fuel suppliers, shipowners, and ship operators concerning fuel oil availability and quality.

Furthermore, the fuel supplier needs to document the fuel-sulphur content within the Bunker Delivery Note (BDN). The BDN must be accompanied by a sealed sample of the fuel, known as the 'MARPOL sample'. However, reg 18.4 clarifies that the BDN and fuel sample requirements do not apply to gaseous fuels such as LNG. Similar exemptions may apply to ammonia.

[324] ISM Code, paras 2.1 and 2.2.

## 5.5 Biofuels

### *5.5.1 General characteristics*

Biofuels come from organic matter available on a renewable or recurring basis (biomass), such as food crops and waste products.[325] They can be liquid or gaseous. Both are often considered advantageous from a technical perspective due to their potential to replace fossil-derived fuels, take advantage of existing infrastructure and equipment, and reduce carbon emissions. They are estimated to be capable of reducing $CO_2$ emissions between 25 and 100 per cent. In particular, biodiesels from fats, oils and greases (FOGs) are the most suitable short-term alternative fuel for the sector to support the IMO Strategy.[326]

However, the availability and costs of biofuels are uncertain, and the use of such fuels would be greatly limited owing to the low supply of waste FOGs in conjunction with high competition from other transport sectors. Biofuels are expected to be helpful for part of the shipping sector, but they will become increasingly scarce and costly.[327] Fischer Tropsch (FT) diesel, a particular type of biofuel made from lignocellulosic biomass, provides more significant GHG reductions and has a much higher feedstock availability, making it a better long-term bet. However, its near-term use is limited by its high costs and lower technological readiness.[328]

Research has shown that biofuels are set to become the main alternative fuel, replacing LNG. The uptake of biofuel-based marine fuels has risen sharply in recent years, with volumes at the port of Rotterdam reaching 790,000 tonnes in 2022, up from 301,000 tonnes in 2021.[329] By way of example, Hapag-Lloyd is focusing its decarbonisation strategy on biofuels.[330]

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[325] Christodoulou-Varotsi (n 212) 203.
[326] Baughen (n 78) 138-139.
[327] Special Report (n 51) 8.
[328] Baughen (n 78) 139. See also IEA (n 277) 139.
[329] Enes Tunagur, 'Biofuels Replace LNG As Most Popular Alternative Fuel, Survey Shows' *Lloyd's List* (London, 23 March 2023).
[330] James Baker, 'Hapag-Lloyd and DHL Join Forces On Biofuels' *Lloyd's List* (London, 7 July 2022).

*5.5.2 Safety regulations*

The current regulatory regimes encourage the adoption of biofuels, which already refer to biofuels in existing standards, rules, or codes of practice for handling the corresponding petroleum or fossil-based fuel types.

SOLAS contains no prescriptive requirements for using biodiesels as fuel, as they are not explicitly covered. However, aspects such as the overall structure of the vessel, its layout, machinery space, and equipment are included. All these elements are relevant for fuel systems and equipment using biofuels.

*5.5.3 Environmental safeguards*

MARPOL Annex VI reg 13 sets the limits for $NO_x$ emissions from vessels' diesel engines to reduce the harmful effects of NOx emissions on human health and the environment. It mandates compliance for all marine diesel engines greater than 130 kW installed on vessels subject to MARPOL Annex VI with the applicable emission limit, except for those used solely for emergencies. Moreover, reg 18 addresses fuel oil quality, preventing an engine from exceeding the applicable $NO_x$ emission limit when consuming fuels derived by methods other than petroleum refining.

As mentioned above,[331] reg 4 is also relevant, providing the employment of 'equivalents' to be applied under flag States agreements on a vessel-specific basis. In February 2022, the IMO Secretariat reported 13 cases in the Global Integrated Shipping Information System (GISIS) database of vessels using biofuels as an 'equivalent' under reg 4.2.

MARPOL Annex VI, reg 14, restricts the amount of $SO_x$ and PM emitted by all fuel oil-consuming equipment on board vessels by limiting the sulphur content of marine fuels.

In line with reg 13 limits for $NO_x$, the IMO adopted initial fuel sulphur content limits later updated with the 2008 revisions of Annex VI. It also provided separate fuel sulphur content limits to be applied globally and within ECAs. Biofuels are inherently low in sulphur or are sulphur-free, so compliance with

[331] See para 5.2.3.

reg 14 is reached for many liquid or gaseous biofuels. Biofuels, therefore, provide a way to comply with the IMO's regulations and reduce the quantities of $SO_x$ emitted by the maritime industry.

Furthermore, reg 18 outlines requirements for the availability and quality of fuels to administrations, fuel suppliers, shipowners, and ship operators. As mentioned above,[332] these requirements include obligations on the fuel supplier to document the fuel-sulphur content in the BDN, which a sealed fuel sample must accompany. However, reg 18.4 states that the BDN and fuel sample requirements do not apply to gaseous fuels such as LNG, and similar exemptions apply to the equivalent gaseous biofuels.

Finally, reg 18.3 is also relevant, including the general fuel properties required for hydrocarbon fuel oils mainly derived from petroleum refining and fuel oil for combustion purposes derived by methods other than petroleum refining. Liquid biofuels fall into the latter category. The regulation restricts fuels from containing inorganic acid, jeopardising the safety of vessels or adversely affecting machinery performance, harming or being harmful to personnel, and contributing to additional air pollution.

## 5.6 Methanol and ethanol

### *5.6.1 General characteristics*

Methyl and ethyl alcohol fuels, also called methanol and ethanol, are colourless, flammable liquids, representing good potential alternatives for reducing both the emissions and carbon footprint of vessel operations. In particular, methanol is the simplest of alcohols and is widely used in the chemical industry.[333] It is mainly produced from natural gas and has a $CO_2$ emissions reduction potential of around 25 per cent compared to HFO, 99 per cent for $SO_x$, 60 per cent for $NO_x$ and 95 per cent for PM.[334] Methanol is available in large quantities and can be made from many resources, including natural gas, renewable energy resources, such as CCS, industrial waste, municipal waste, or biomass. This significantly reduces its greenhouse impact. A significant advantage is that using methanol or ethanol requires only minor modifications to existing combustion engines for vessels and bunkering

[332] See para 5.4.3
[333] IEA (n 266) 100.
[334] Baughen (n 78) 138.

infrastructure. However, the $CO_2$ emissions reduction potential is low compared to other alternative fuels.[335]

There has been a substantial shift in shipowners ordering dual-fuel vessels capable of methanol-fuel operations.[336] Most of these orders have been for container vessels and first-movers in the dry bulk segment.[337] Maersk is developing its decarbonisation strategy on methanol.[338]

*5.6.2 Safety regulations*

Methanol and ethanol flashpoints are below the minimum flashpoint for marine fuels specified in SOLAS.[339] A risk assessment or evaluation must be carried out for each case demonstrating fire safety equivalent to conventional fuels, and guidelines are currently in draft for the use of methanol and ethanol fuels on vessels for future incorporation in the IGF Code.[340]

As noted above,[341] methanol is widely used in the chemical industry, and the handling, transport, and use of methanol and ethanol is a long-established practice in the chemical industry. There is already experience in transporting methanol and ethanol as cargo in the maritime sector.[342] Moreover, in 2020, interim guidelines for the safety of vessels using methanol were adopted and have allowed for its use.[343]

*5.6.3 Environmental safeguards*

The International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) has to be considered; indeed, both methyl alcohol and ethyl alcohol are contained in the Code. Moreover, MARPOL Annex II, concerning pollution from noxious and liquid substances, stipulates that compliance with this Code is mandatory. Finally, it is worth recalling that the Joint Group

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335 Ibid.
336 Rob Willmington, 'Dual-fuel Methanol Orderbook Keeps On Growing' *Lloyd's List* (London, 22 May 2023).
337 Enes Tunagur, 'Zero-emissions Bunkering Shows Promise Amid Tangible Demand Signals' *Lloyd's List* (London, 24 May 2023).
338 Special Report (n 51) 8.
339 *Study on the Use of Ethyl and Methyl Alcohol as Alternative Fuels in Shipping* (EMSA, 2017) 2.
340 Ibid.
341 See para 5.4.1.
342 IEA (n 266) 139.
343 Ibid, 52.

of Experts on the Scientific Aspects of Marine Environment Protection (GESAMP) dedicated its Working Group 1 to the 'Environmental Hazards of Harmful Substances' carried by vessels, delivering the assessments of the substances concerned to the IMO.[344]

## 6 Conclusions

This paper has outlined the merits and gaps of the current international legal framework on GHG emissions from vessels, particularly focusing on MEPC regulations and showing how environmental, safety, and commercial considerations emerge in reducing GHG emissions.

The technical and operational measures adopted by the IMO, such as the EEDI, the SEEMP, the EEXI and the CII, stimulated the industry to align itself with the 1.5°C target of the Paris Agreement. To complement the effects of these short-term measures, the design of MBMs, notably an ETS or a carbon levy for shipping, has been discussed. Finally, alternative fuels were considered, such as LNG, hydrogen, ammonia, biofuels, and methanol. The industry has already explored these fuels, but further R&D and investment is needed.

In the author's view, alternative fuels are the turning point of decarbonisation. The technical and operational measures have shown gaps in feasibility and transparency for shipowners and charterers, such as the metrics of the CII. BIMCO therefore developed climate clauses in charterparties to share the burden of reducing GHG emissions from vessels and determine accountability. Privately-ordered forms of contract can contribute to reducing the carbon footprint of shipping, but this needs to be complemented at the IMO level. In other words, on the one hand, shipowners and charterers must improve their climate practices and commitments; on the other hand, they need clarity and feasibility from the IMO.

Regarding MBMs, the discussion is at an impasse between delegations supporting the CBDR and the NMFT principles. The IMO is, therefore, struggling to decide whether an ETS or a carbon levy is appropriate to accompany the short-term measures. The risk is fragmented and overlapping regimes for international shipping with the emergence of regional frameworks to reduce GHG emissions from

[344] See <http://www.gesamp.org/work/groups/1> accessed 27 June 2023.

vessels, such as in the EU and the US. Maritime trade operators need uniform rules to avoid compliance according to the geographical area of business.

In this context, alternative fuels shape the path to achieving long-term shipping stability concerning reducing GHG emissions. The industry already employs them, and their use is expected to grow. However, at present, IMO's regulations are on a 'tank-to-wake' basis, meaning that only the emissions of direct fuel combustion and use on board a vessel are considered.[345] This approach to emissions does not consider the climate impacts on the entire energy supply chain. Therefore, a possible zero-emission target could become an empty gesture for climate action, disincentivising investments in green energy and encouraging continued investments in fossil fuels, moving emissions from ship exhausts to the energy supply chain.

To contribute to the goals of the Paris Agreement, the IMO must adopt a 'well-to-wake' approach to consider the entire lifecycle of GHG fuel emissions from production to use. A well-to-wake approach will spur a strong demand signal for green fuels and incentivise investments and uptake, providing clarity and confidence for investors, businesses, and decision-makers. It creates a strong demand signal for green fuels, enabling fuel suppliers and ports to invest in production and bunkering facilities.

Only through a well-to-wake approach can the IMO shape shipping's fuel and energy transition, making fuel production commercially viable, globally available, and accessible for all countries and companies.

[345] 'The Success of IMO's New Emission-reduction Strategy Hinges On a Well-to-wake Approach' *Lloyd's List* (London, 26 June 2023).