NUS Law Working Paper 2020/013
NUS Asia-Pacific Centre for Environment Law Working Paper 20/01

The Shipping Sector And GHG Emissions: The Initial Strategy For A Zero-Carbon Pathway

Beatriz Garcia

Anita Foerster

Jolene Lin

B.Garcia@westernsydney.edu.au
anita.foerster@monash.edu.au
jolene.lin@nus.edu.sg

[April 2020]

THE SHIPPING SECTOR AND GHG EMISSIONS: THE INITIAL STRATEGY FOR A ZERO-CARBON PATHWAY

Beatriz Garcia,[λ] Anita Foerster[π] and Jolene Lin[Ω]

In 2018, the International Maritime Organization (IMO) announced the first sector-wide emission reduction target for international shipping: to limit emissions by at least 50% by 2050 compared to 2008. The roadmap to achieve this goal is the Initial IMO Strategy on Reduction of GHG Emissions from Ships, which proposes implementation measures for the short-term (2018-2023), mid-term (2023-2030) and long-term (beyond 2030). This article examines one of each type of candidate measures, notably National Action Plans, market-based mechanisms and alternative fuels, all of which are central to the implementation of the Initial Strategy due to their significant practical impact. We argue that National Action Plans, although not a suitable tool to tackle 'international' shipping emissions, can play a key role in mobilizing capacity and resources, and directing national action. In relation to market-based mechanisms, we find that a carbon tax might be a more efficient way to incentivize emissions reductions, when compared to emissions trading. Yet ultimately, the sector's decarbonization can only be truly achieved with zero-carbon fuels that are safe for human health and the environment. We explore the considerable barriers to the development and use of these fuels and consider how leading shipping companies and financial sector are beginning to shift capital and resources to this challenge, spurred by the new IMO targets and understandings of climate-related financial risks and opportunities.

Key words: international shipping, GHG emissions, national action plans, market-based mechanisms, alternative fuels

[λ] Senior Lecturer, School of Law, Western Sydney University (WSU), Awardee of the WSU Women's Research Fellowship; B.Garcia@westernsydney.edu.au. We are thankful to WSU generous support under the Women's Research Fellowship grant scheme that facilitated this research. We also thank Professor David Tait, (WSU School of Humanities & Communication Arts) for his generous support in all aspects of this project; as well as Ashraful Alam and Marija Yelavich (WSU School of Law) for their research assistance. Finally, we are grateful to Professor Martina Doblin (UTS Climate Change Cluster); Jan Hoffma (Chief, Trade Logistics Branch Division on Technology and Logistics, United Nations Conference on Trade and Development - UNCTAD) and Camille Bourgeon (Marine Environment Division, International Maritime Organization) for their time and insightful feedback.

[π]Anita Foerster, Senior Lecturer, Department of Business Law and Taxation, Monash Business School, Monash University; anita.foerster@monash.edu.au.

[Ω] Associate Professor, Faculty of Law, National University of Singapore; Director, Asia Pacific Centre for Environmental Law; jolene.lin@nus.edu.sg.

1. Introduction

International shipping carries around 80% of the global trade by volume.[1] Dry bulk carriers (iron ore, coal, grain and similar cargo) account for the largest share of the world fleet in dead-weight tonnage, followed by oil tankers (crude oil and by-products) and container ships.[2] While shipping has proven to be one of the most efficient means of transportation for bulk commodities worldwide,[3] in absolute terms shipping is a substantial emitter, accounting for approximately 2.2% of total global greenhouse gas [GHG] emissions.[4] Moreover, with the rapid growth in international trade in recent decades, emissions from international shipping continue to rise,[5] and are predicted to increase between 50% to 250% by 2050, unless action is taken.[6] The primary driver of this predicted increase is market demand in the three most significant sectors: oil tankers, containerships and bulk carriers.[7] Containerships are currently the largest emitters due to the premium they place on speed, as compared with tankers or bulk carriers.[8]

Maritime vessels burn fossil fuels (mainly heavy fuel oil and marine diesel oil) for propulsive power and to generate electricity on-board.[9] This produces both GHG and non-GHG emissions.[10] GHG emissions include carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O).[11] GHG emissions are directly related to total fuel consumption, and this can vary depending on various factors (hull shape and roughness, loading conditions, engine condition, weather conditions etc).[12] The main non-GHG emissions and air pollutants of concern are Sulphur Oxides (SO_x), which are harmful to human health and the environment.[13]

For decades, there have been no sector-wide GHG reduction targets in international shipping.[14] Article 2.2 of the 1997 Kyoto Protocol merely directs Annex 1 parties to pursue limitation of

---

[1] United Nations Conference on Trade and Development (UNCTAD), *Review of Maritime Transport* (UNCTAD/RMT/2018) p.23

[2] Ibid, p.23

[3] Branislav Dragoviš, Ernestos Tzannatos, Vassilis Tselentis, and Amalia-Venera Todorut, 'Energy Efficiency in the Shipping Sector – A Case Study' (2016) 2 University of Targu Jiu Economy Series 58

[4] Ibid, p.5490

[5] Jun Yuan, Szu Hui Ng, and Weng Sut Sou, 'Uncertainty Quantification of CO2 Emission Reduction for Maritime Shipping' (2016) 88 Energy Policy 113

[6] See Edmund Hughes 'Recent developments at IMO to address GHG emissions from ships' (*International Maritime Organization*, 2016) <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/UN%20Joint%20side%20event%20presentation.pdf > accessed 12 March 2020

[7] IMO, 'Third IMO GHG Study 2014' (*International Maritime Organization*) <http://www.imo.org/en/ourwork/environment/pollutionprevention/airpollution/pages/greenhouse-gas-studies-2014.aspx> accessed 12 March 2020 at [4.3]

[8] Harilaos N. Psaraftis and Christos A. Kontovas, 'Balancing the Economic and Environmental Performance of Maritime Transportation' (2010) 15(D) Transportation Research 458, 458

[9] Warren B. Fitzgerald, Oliver J. A. Howitt and Inga J. Smith, 'Greenhouse Gas Emissions from the International Maritime Transport of New Zealand's Imports and Exports' (2011) 39 Energy Policy1521, 1521

[10] Mia Mahmudur Rahim, Md. Tarikul Islam and Sanjaya Kuruppu, 'Regulating Global Shipping Corporations' Accountability for Reducing Greenhouse Gas Emissions in the Seas' (2016) 69 Marine Policy p.159, 162

[11] Supra note 9

[12] Ibid

[13] IMO, 'Sulphur 2020 – cutting sulphur oxide emissions' (*International Maritime Organization*) <http://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx> accessed 12 March 2020

[14] IMO, 'Second International Maritime Organization (IMO) Green House Gas (GHG) Study 2009' (*International Maritime Organization*)

GHG emissions from marine bunker fuels by working with the International Maritime Organization (IMO). The maritime transport sector was also excluded from Annex A of the Kyoto Protocol (which lists the sectors where national emission reductions should be attained);[15] and the IMO was singled out as the main regulatory body responsible. The subsequent 2015 Paris Agreement also made no reference to international shipping.[16] Notably, the 1982 United Nations Convention on the Law of the Sea (UNCLOS) does require States to establish international rules and standards through the IMO to prevent vessel-source pollution, as well as pollution of the marine environment from or through the atmosphere.[17] However, UNCLOS does not define specific obligations regarding GHG emissions. As such, although contested by the industry, the general perception is that the shipping sector has by and large 'escaped' international obligations under the climate change regime.[18]

Undoubtedly, environmental regulation in international shipping has broadened significantly over time, from oil spills, to ballast water control, invasive species, waste management, air pollutants such as SOx, and more recently GHG emissions.[19] Most progress has been made under the International Convention for the Prevention of Pollution from Ships (MARPOL). Since the late 1990s, the IMO has investigated several policy measures to reduce emissions.[20] The IMO has broad competence to regulate on environmental matters through the Maritime Environment Protection Committee (MEPC).[21] The most significant achievements implemented to date are the technical and operational measures adopted in the form of amendments to Annex VI of MARPOL.

In 2011,[22] the IMO amended MARPOL Annex VI to introduce new mandatory standards on energy efficiency to be achieved through two technical measures: the Energy Efficiency Design

<http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/SecondIMOGHGStudy2009.pdf> accessed 12 March 2020, Definitions

[15] Annex A of the 1997 Kyoto Protocol included the following sectors: energy, industrial processes, solvent and other product use, agriculture and waste.

[16] The emissions reduction goal of the 2017 Paris Agreement is established in Article 2.

[17] 1982 United Nations Convention on the Law of the Sea (UNCLOS), Article 212.

[18] The shipping industry claims that, although international shipping (and aviation) GHG emissions are excluded from the Kyoto Protocol, the responsibility for addressing the sector's emissions clearly rests with the IMO. The IMO (not the UNFCCC) is the only body that can effectively regulate *international* shipping emissions, which by their nature could not be covered under national quotas. GHG emissions from international shipping cannot be attributed to any particular economy either. The sector also recalls that international shipping has been subject to energy efficiency regulations for several years, see 'Reducing CO2 Emissions to Zero: The 'Paris Agreement for Shipping' (*International Chamber of Shipping*, 2018) <https://www.ics-shipping.org/docs/default-source/resources/reducing-co2-emissions-to-zero-the-paris-agreement-for-shipping.pdf?sfvrsn=7> accessed 12 March 2020 p.6.

[19] Jane Lister, René Taudal Poulsen and Stefano Ponte, 'Orchestrating Transnational Environmental Governance in Maritime Shipping' (2015) 34 Global Environmental Change Lister 188

[20] Supra note 9, p.152; see for example Conference of the Parties to the International Convention for the Prevention of Pollution from Ships (MARPOL Convention) in 1997, Resolution 8: CO2 Emissions from Ships

[21] 1948 Convention on the International Maritime Organization, Articles 37-41

[22] Introduced and made mandatory at the Maritime Environment Protection Committee (MEPC) 62nd session (July 2011) with the adoption of amendments to MARPOL Annex VI Resolution MEPC.203(62).

Index (EEDI)[23] and the Ship Energy Efficiency Management Plan (SEEMP).[24] These measures do not set sector wide emission reduction targets, but contribute to reduced emissions because more efficient ships use less fuel and emit less GHG. Parallel to these IMO developments, and in response to the regulatory gaps concerning GHG emissions in international shipping, the European Parliament adopted the Regulation on Monitoring, Reporting and Verification on Carbon Dioxide Emissions from Maritime Transport (EU-MRV) in 2015.[25] This requires shipowners and operators to monitor, verify and report CO2 emissions from vessels larger than 5,000 gross tonnage calling at European ports.[26]

Apart from the regulations noted above, there are a range of private regulatory measures, such as industry-led voluntary standards, that are increasingly being used in international shipping to address GHG emissions. Prominent examples include the Clean Shipping Index and Right Ship.[27] Commonly, these standards rank vessels on their GHG emissions or energy efficiency; and tend to be process-oriented, prescribing an appropriate conduct rather than a specific outcome.[28] To date, the main drivers for these standards are 'corporate consumers,' who pay for shipping services and have an economic interest in reducing fuel use through efficiency measures.[29]

Against this background of growing regulatory attention, the IMO announced in 2018 the first sector-wide emissions reduction target for international shipping: to cut down emissions by at least 50% by 2050 compared to 2008. The roadmap to achieve this goal is the Initial IMO Strategy on Reduction of GHG Emissions from Ships (Initial Strategy).[30] Widely celebrated as a 'watershed moment',[31] this resolution comes at a time when there is increasing recognition of the need for urgent climate action to meet the goals of the Paris Agreement. Given projections for ongoing growth in international trade through shipping, it is highly significant that the IMO has shifted beyond its previous focus on emissions intensity and efficiency to put forward an absolute emissions reduction target. This sends an important signal to the industry that rapid innovation is urgently needed.[32]

The aim of this article is to explore the implementation measures that have been put forward by the IMO to meet the 2050 target and comment on their feasibility and likely effectiveness.

---

[23] The Energy Efficiency Design Index (EEDI) introduces minimum efficiency design requirements for all *new ships,* Resolution MEPC.203(62) adopted at MEPC 62nd session (July 2011); International Chamber of Shipping, World Trade and the Reduction of CO2 Emissions United Nations Framework Convention on Climate Change (UNFCCC) 2014. In 2014, MEPC adopted amendments to the EEDI regulations to extend the scope of EEDI to: LNG carriers, ro-ro cargo ships (vehicle carriers), ro-ro cargo ships, ro-ro passenger ships and cruise passenger ships having non-conventional propulsion, Resolution MEPC.245(66), adopted on 4 April 2014.

[24] The Ship Energy Efficiency Management Plan (SEEMP) specifies a technological threshold for *all ships* to meet energy efficiency requirements, including for example reducing fuel consumption, Resolution MEPC.203(62).

[25] Regulation (EU) 2015/757 on the Monitoring, Reporting and Verification of Carbon Dioxide Emissions from Maritime Transport (EU-MRV Regulation), European Parliament and the Council of 29 April 2015 (entered into force on 1 July 2015)

[26] Chapter II, Article 4 EU-MRV Regulation.

[27] Supra note 19, p.190.

[28] Ibid, p.239.

[29] Ibid, p.232, 253

[30] Resolution MEPC.304(72), adopted on 13 April 2018 at MEPC 72nd Session (from 9 to 13 April 2018).

[31] See Fiona Harvey, 'Carbon dioxide from ships at sea to be regulated for first time' (*The Guardian,* 13 April 2018) <https://www.theguardian.com/environment/2018/apr/13/carbon-dioxide-from-ships-at-sea-to-be-regulated-for-first-time> accessed 12 March 2020

[32] See David Shukman, 'Global shipping in 'historic' climate deal' (*BBC News*, 13 April 2018) <http://www.bbc.com/news/science-environment-43759923> accessed 12 March 2020

The Initial Strategy proposes 'candidate measures' to achieve the target over three timeframes (short, medium and long-term).[33] These measures include technical and operational energy efficiency measures, with a focus on improving EEDI and SEEMP frameworks,[34] as well as technical cooperation and capacity building.[35] We identify three particular measures that are central for the implementation of the Initial Strategy: National Action Plans; market-based mechanisms; and alternative fuels. These are categorized as short, medium and long-term candidate measures, respectively. These measures are likely to have significant practical impact, through the creation of supportive domestic policies, introduction of market incentives for cleaner fuels, and shifting of resources and capital towards low or zero-carbon fuels.

After setting out the detail of the new IMO Strategy in Part 2, Part 3 explores the promise and the potential shortfalls of these three implementation measures. We argue that National Action Plans, although not suitable to tackle *international* shipping emissions, can play a key role in mobilizing national stakeholders and directing domestic action, notably in relation to port operations and infrastructure. With regard to market-based mechanisms, drawing from experience with the Kyoto Protocol's flexibility mechanisms, we find that a carbon tax might be a more efficient way to incentivize the uptake of alternative fuel options, as compared to emissions trading. Finally, we emphasize that the sector's decarbonization goal can only be truly achieved through the widespread use of alternative fuels that are safe for human health and the environment in large-scale shipping. However, there remain considerable barriers to the commercial deployment of these fuels at scale. In this context, we explore how leading shipping companies and financial sector actors are beginning to shift capital and resources to this challenge, spurred by the new IMO targets and broader understandings of climate-related financial risks and opportunities. We understand that the success of other candidate measures proposed by the IMO much depends on the commercial availability and reliability of alternative fuels. Given the long asset cycles associated with international vessels and the extent of supporting infrastructure development required, we emphasise the importance of prioritising the development and deployment of alternative fuels immediately, as a focus for ongoing IMO negotiations. It is in this context, that the IMO has perhaps the most important role to play – in ensuring a level-playing field and supporting developing and middle-income countries to access appropriate capacity-building and technical-assistance for the deployment of alternative fuels and associated port infrastructure.

2. Initial IMO Strategy on Reduction of GHG Emissions from Ships

2.1. Aims and Vision

The Initial Strategy, and the GHG emissions targets contained within, apply to all IMO member states and relate to *international* shipping emissions.[36] The IMO defines international shipping as shipping between ports of different countries.[37] The Strategy sets out three levels of ambition.[38] First, the carbon intensity of ships should decline through the implementation of further phases of the EEDI. Second, the carbon intensity of international shipping should

[33] Initial IMO Strategy on Reduction of GHG Emissions from Ships (Initial Strategy), para 4.1
[34] Initial Strategy, para 4.7. (1) (2)
[35] Initial Strategy, para 4.7. (7); 4.8 (2); 4.8 (5)
[36] Initial Strategy, para. 1.7
[37] While Domestic shipping refers to shipping between ports of the same country, see supra note 14
[38] Initial IMO Strategy, para 3, p5

decline by reducing emissions per transport work[39] by at least 40% by 2030, pursuing efforts towards 70% by 2050. Third, GHG emissions from international shipping should peak and decline as soon as possible and total annual emissions should be reduced by at least 50% by 2050 compared to 2008.[40] It is recognized that technological innovation and alternative bunker fuels and/or energy sources are key to achieving the three levels of ambition.[41]

Shipping is a commercial activity and regulatory measures adopted by the IMO are likely to impact international trade. For example, measures to reduce emissions (e.g. speed optimization, optimised routing, improved fleet planning and other logistics-based measures) may impact the overall logistical supply chain.[42] Therefore, the Initial Strategy also requires that emission reduction measures consider potential impacts on States, notably developing countries,[43] and involve evidence-based decision-making balanced with the precautionary approach.[44] The Strategy's guiding principles are those of non-discrimination and no favorable treatment, enshrined in MARPOL and other IMO conventions,[45] and the UNFCCC principle of Common but Differentiated Responsibilities.[46]

2.2. Implementation

The Initial Strategy proposes 'candidate measures' to implement the new emission reduction goals over three timeframes.[47]

Short-term measures (finalized and agreed between 2018 and 2023) involve improvements to existing energy efficiency frameworks (EEDI and SEEMP), [48] and future review of EEDI regulations.[49] Operational measures (e.g. speed optimization, speed reduction, etc.) are also proposed.[50] It is recognized that the logistics chain, including ports, should also be optimized, for example through developing infrastructure to support alternative low-carbon fuels or to provide on-shore power from renewable sources.[51] The IMO also encourages countries to develop National Action Plans (NAPs), which will be the basis for future national emissions reduction policies.[52]

Mid-term measures (finalized and agreed between 2023 and 2030) include the adoption of an implementation strategy for alternative low carbon and zero-carbon fuels, including the update

[39] Transport work can be defined as Gram of CO2 per tonne-nautical mile gCO2/tnm, see 'Calculating and Comparing CO2 Emissions from the Global Maritime Fleet' (*Rightship,* 2013)
[40] Initial Strategy, para 3.1, 3, page 6. The industry suggested that the baseline year for measuring shipping's emissions is 2008, when GHG emissions were at their highest, see 'Reducing CO2 Emissions to Zero: The Paris Agreement for Shipping,' (*International Chamber of Shipping* (ICS), 2018), p. 6.
[41] Initial Strategy, para 3.1, p5
[42] Supra note 8, p458
[43] MEPC 68 (MEPC 68/21, paras 4.18 to 4.19) and their specific emerging needs, as recognized in the Organization's Strategic Plan (Resolution A.1110(30))
[44] Resolution MEPC.67(37); Initial Strategy, para 3.2, p.6
[45] Initial Strategy, para 3.2, p.6
[46] 2015 Paris Agreement; Initial Strategy. para 3.2, p.6
[47] Initial Strategy, paragraph 4.1, p.7
[48] The IMO MEPC 66th Session, from 31 March – 4 April 2014. adopted resolution MEPC.203(62) on Inclusion of Regulations on Energy efficiency for ships in MARPOL Annex VI, introducing a mandatory Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP) measures for the energy efficiency of ships.
[49] Initial Strategy, para 4.7, p.7
[50] Initial Strategy, para 4.7, p.8
[51] Initial Strategy, para 4.7, p.8
[52] Initial Strategy, para 4.7, p.8

of NAPs to specifically consider such fuels.[53] They continue to include operational energy efficiency measures for both new and existing ships. Any measures adopted should follow a three-step approach that includes: data collection, data analysis, and decision-making on future measures.[54] Other mechanisms, particularly market-based mechanisms, should also be considered as mid-term candidate measures to incentivize emission reductions.[55]

The long-term measures (finalized and agreed beyond 2030) do not specify any particular mechanisms or approaches but commit more broadly to the development and use of zero-carbon or fossil-free fuels as a way to decarbonize the sector in the second half of the century.[56] There are a number of short and mid-term measures which underpin these longer term goals including initiating research and development activities addressing alternative and zero carbon fuels, developing incentives for first movers to develop and take up new technologies, developing a robust lifecycle GHG/carbon intensity guidelines for all types of alternative fuels,[57] and developing an implementation program for their effective uptake.[58]

In late 2018, MEPC approved a programme of follow up actions to 2023,[59] when the Strategy will be revised.[60] In 2019, MEPC adopted specific measures to support the implementation of the Initial Strategy,[61] including a forthcoming 4th IMO GHG Study,[62] further cooperation with ports,[63] an impact assessment procedure to evaluate measures adopted under the Strategy,[64] and a multi-donor trust fund for tackling GHG emissions.[65] Moreover, it was agreed that the third phase of EEDI should enter into effect earlier than initially planned (2022 instead of 2025) for several ship types.[66] MEPC has also called intersessional working group sessions to speed up the agreement on candidate measures.

---

[53] Initial Strategy, para 4.8, p.9

[54] Maritime Environment Protection Committee (MEPC) 68 (May 2015) agreed on this 3-step approach, IMO Regulation MEPC.263(68).

[55] Initial Strategy, para 4.8, 3, p.9

[56] Initial Strategy, para 4.9, 1, p.9

[57] Initial Strategy, para 4.7, 9, 10 and 11, p.7-8

[58] Initial Strategy, para 4.8, 1, p.8

[59] Adopted at MEPC 73rd session, 22-26 October 2018.

[60] IMO, 'Reducing greenhouse gas emissions from ships' (*International Maritime Organisation*) <http://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx> accessed 12 March 2020

[61] MEPC, 74th session, 13-17 May 2019

[62] MEPC, 73th session, 22-26 October 2018, MEPC 73/7.

[63] MEPC 323 Resolution, 74th session.

[64] MEPC 73/8 also approved the procedure for assessing impacts on States of candidate measures for reduction of GHG emissions from ships. It identifies four steps: 1) initial impact assessment, to be submitted as part of the initial proposal to the Committee for candidate measures, 2) submission of commenting document(s), if any, 3) comprehensive response, if requested by commenting document(s), 4) comprehensive impact assessment, if required by the MEPC.

[65] MEPC 73/7/4 agreed to establish a voluntary multi-donor trust fund ("GHG TC-Trust Fund"), to provide a dedicated source of financial support for technical cooperation and capacity-building activities.

[66] MEPC 74 agreed that the third phase of EEDI should enter into effect in 2022 for several ship types with up to 50% carbon intensity reduction for largest containerships, and established a correspondence group working on possible introduction of EEDI phase 4 (after 2025). The EEDI will be implemented in phases. Currently, it is in phase 1 (2015 to 2019). Phase 2 will run from 2020 to 2024 and Phase 3, from year 2025 onwards, See 'IMO Train the Trainer Course, Energy Efficiency Shipping Operation' (*International Maritime Organisation*, 2016) <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/IMO-Train-the-Trainer-Course.aspx> accessed 12 March 2020

3. The Promise and Shortfalls of Candidate Measures

3.1. National Action Plans

The Initial Strategy encourages countries to develop National Action Plans (NAPs) which propose policies and strategies to address GHG emissions from *international* shipping. NAPs must be developed in accordance with IMO guidelines (which are yet to be adopted), and should take into account the need to avoid unilateral or regional measures.[67]

National action plans or strategies are commonly used in multilateral environmental agreements, such as in the 1992 Convention on Biological Diversity (CBD)[68] or 1973 Convention on International Trade in Endangered Species of Fauna and Flora (CITES).[69] For example, the CBD requires States to develop National Biodiversity Strategy and Action Plans (NBSAP),[70] which reflect how the country intends to fulfil the objectives of the CBD, taking into consideration the national needs and circumstances.[71] The NBSAPs set up specific national actions and are recognised as an important tool for the implementation of the CBD used by nearly all member States.[72] This is similar to the aviation sector, which through the International Civil Aviation Organization (ICAO), calls on States to submit action plans outlining their domestic policies and actions, and annual reporting to ICAO on international aviation CO2 emissions.[73]

---

[67] Initial Strategy, Article 4.7, 6. MEPC 74 instructed the Intersessional Working Group on Reduction of GHG Emissions from Ships to 'consider [in their meetings in November 2019 and March 2020] a draft MEPC resolution urging Member States to develop and update a voluntary National Action Plan (NAP) with a view to contributing to reducing GHG emissions from international shipping, and develop associated guidelines,' see 'Greenhouse Gas Emissions' (*International Maritime Organization*) <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/GHG-Emissions.aspx> accessed 12 March 2020

[68] Article 6 (a), 1992 Convention on Biological Diversity (CBD). Also, according to Target 17 of Aichi Biodiversity. The main CBD COP decision that provide guidance for NBSAP are Decision IX/8 and Decision X/2.

[69] CITES) has also used national action plans, for example by requesting some member States to adopt National Ivory Action Plans as a practical domestic tool to control illegal trade in ivory At the Sixty-fourth meeting of the Standing Committee Bangkok (Thailand), 14 March 2013 SC64 Doc. 2, China, Kenya, Malaysia, Philippines, Thailand, Uganda, the United Republic of Tanzania and Viet Nam were requested to finalize their national ivory action plans, with time frames and milestones, and submit them to the CITES Secretariat.

[70] 1992 Convention on Biological Diversity (CBD), Article 6 (a). Also, according to Target 17 of Aichi Biodiversity, each Party should develop and adopt by 2015 an updated National Biodiversity Strategy and Action Plan (NBSAP). The main CBD COP decision that provide guidance for National Biodiversity Strategy and Action Plans (NBSAP) are Decision IX/8 and Decision X/2.

[71] For example, Brazil's NBSAP includes fisheries management systems, monitoring of biomes, restoration of native vegetation, control of invasive alien species, increased protected areas management capacity, among others, Brazil's NBSAP, See 'National Biodiversity: Strategy and Action Plan' (*Ministry of Environment*, 2017) <https://www.cbd.int/doc/world/br/br-nbsap-v3-en.pdf> accessed 12 March 2020

Australia's NBSAP focuses on increasing the extent of land managed by indigenous communities, public-private partnerships for biodiversity conservation, enhancing the connectivity of fragmented landscapes and seascapes, improving the use of ecological fire regimes, etc, see 'Australia's Biodiversity Conservation Strategy 2010-2030' (*National Resource Management Ministerial Council*, 2010) <https://www.cbd.int/doc/world/au/au-nbsap-v2-en.pdf> accessed 12 March 2020

[72] Currently only 6 parties to the CBD have not yet submitted their NBSAPs, Convention on Biological Diversity <https://www.cbd.int> accessed 12 March 2020

[73] Resolution A37-19: Consolidated statement of continuing International Civil Aviation Organization (ICAO) policies and practices related to environmental protection – Climate change, para 9

National action plans are useful for a number of reasons. They create or strengthen domestic law and policies, help inform how MEAs are implemented domestically, allow the sharing of information and best practices and facilitate a more coherent treaty implementation. Importantly, NAPs help to mobilise different sectors - public and private sectors as well as civil society - to work together towards a common goal.[74] NAPs are a sensible tool for the management of natural resources within national jurisdictions, such as plants, animal species and their natural habitats, as observed through the experience of the CBD or CITES. However, they may not be an ideal instrument to handle issues that transcend national boundaries, such as international shipping. By definition, emissions from international shipping occur between ports of different countries. Even if individual countries have NAPs in place, these cannot tackle emissions that occur when a ship goes from country A to B.

To say that NAPs are not well-suited to reduce emissions from international shipping does not mean that they have no value or should not be used. NAPs are a national policy tool that can guide domestic action, such as by incentivizing energy efficiency measures in ports (providing onshore power supply from renewable sources, optimizing port calls, facilitating just-in-time arrival of ships, and improving shipping logistics and supply chains). NAPs are particularly useful for improving port operations and infrastructure, as such measures can only be implemented domestically. Moreover, as observed with the CBD and other treaties, NAPs help engage national stakeholders and mobilise capacity and funding. As noted earlier, the IMO will adopt guidelines setting up common expectations and standards for NAPs. If all NAPs are prepared according to IMO guidelines and organised around meeting the new IMO targets, they can also be a coordinating mechanism to align national action towards global goals. As such, NAPs play a similar role to Nationally Determined Contributions (NDC) which intend to align domestic actions with the goals of the Paris Agreement.

In response to the Initial Strategy, the UK and Norway have already formulated NAPs: the UK Clean Maritime Plan and the Norwegian Action Plan for Green Shipping, both adopted in 2019.[75] The UK commits to zero emission ships by 2050, by creating non-tax incentives, fostering innovation through a Green Finance Initiative for shipping, among other measures.[76] The UK will also measure emissions from vessels operating domestically (including inland waterway vessels), extend North Sea Emissions Control Areas in internal waters and develop guidelines for ports to develop Air Quality Plans.[77] The Clean Maritime Council is the agency created to implement those commitments.[78] The UK recognizes that significant levels of investment in innovation will be required to trigger the scale of emission reductions required.[79] As such, the government will also explore alternative fuels, particularly hydrogen, ammonia, onboard batteries and electric engines,[80] and work on improving ports infrastructure for

[74] For example, the process of design and implementation of Brazil's NBSAP involved various sectors of society (federal, state and municipal governments, academia, corporations, civil society, representatives of indigenous peoples and traditional communities), see supra note 71, Part 1.3

[75] For example, the UK Clean Maritime Plan has been developed in close cooperation with the maritime industry and other stakeholders and created a Clean Maritime Council, see 'Clean Maritime Plan' (*United Kingdom Department for Transport*, 2019) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/815664/clean-maritime-plan.pdf> accessed 12 March 2020, p. 5

[76] Ibid, p 7

[77] Ibid, p. 21

[78] Ibid, p. 21

[79] Ibid, p. 42

[80] Ibid, p. 26

alternative fuels' transportation and bunkering.[81] A Maritime Emissions Regulation Advisory Service (MERAS) will be created in 2020 to support innovators using zero emission propulsion technologies.[82] The UK Clean Maritime Act also envisages the adoption of new safety regulations for the storage of alternative fuels, and for the planning and permissions required for new bunkering infrastructure.[83] Notably, UK's NAP establishes aspirational goals, rather than mandatory targets.[84]

Norway's NAP commits to reducing emissions from domestic shipping and fisheries by 50% by 2030 and developing low and zero-emission solutions for all types of vessels.[85] It establishes specific measures for each category of vessels. For example, cruise ships and ferries sailing in the West Norwegian Fjords, are expected to be emission-free by 2026.[86] The Government also envisages to renew the cargo fleet with funding from different domestic sources (Norwegian Export Credit Guarantee Agency, Export Credit Norway and Innovation Norway).[87] It also commits to reduce emissions from cargo ships in short sea shipping, through incentive schemes and including zero-emission transport requirements in public procurement processes.[88] Similar to the UK, Norway's NAP will focus on technological innovation for the uptake of alternative fuels and building related port infrastructure.[89] The aim is for ports to be emission-free by 2030.[90] Certain Norwegian ports are already offering onshore power facilities particularly for cruise ships,[91] and discounts for ships based on their Environmental Ship Index (ESI) performance.

The IMO currently has several initiatives to assist member States in reducing domestic shipping emissions. One of these is the Global Maritime Energy Efficiency Partnerships Project **(**GloMEEP),[92] which supports ten pilot countries[93] to adopt energy efficiency measures and cut down GHG emissions, by introducing legal and policy reforms, and developing capacity-building and public-private partnerships. GloMEEP has formulated various national guidelines, for example to control emissions and introduce energy efficiency measures for

[81] Ibid, p. 34
[82] Ibid, p. 44
[83] Ibid, p. 34
[84] Ibid, p. 27
[85] 'The Government's Action Plan for Green Shipping' (*Norwegian Government*, 2019) <https://www.regjeringen.no/contentassets/2ccd2f4e14d44bc88c93ac4effe78b2f/the-governments-action-plan-for-green-shipping.pdf> accessed 12 March 2020 (Norwegian Action Plan).
[86] Ibid, p. 38
[87] Ibid, p. 43
[88] Ibid, p. 43
[89] Ibid, p. 55
[90] Ibid, p. 55
[91] Ibid, p. 55
[92] Global Maritime Energy Efficiency Partnerships Project (GloMEEP), <https://glomeep.imo.org> accessed 12 March 2020; Global Industry Alliance to Support Low Carbon Shipping (GIA), <https://glomeep.imo.org/global-industry-alliance/global-industry-alliance-gia/> accessed 12 March 2020; Other initiatives include the Global Maritime Technology Network (GMN) project, funded by the European Union has established a network of five Maritime Technology Cooperation Centres (MTCCs) in Africa, Asia, the Caribbean, Latin America and the Pacific, <http://gmn.imo.org/> accessed 12 March 2020; GreenVoyage-2050 project, <http://www.imo.org/en/MediaCentre/PressBriefings/Pages/08-green-voyage-2050.aspx> accessed 12 March 2020.
[93] The Lead Pilot Countries of the GloMEEP project are: Argentina, China, Georgia, India, Jamaica, Malaysia, Morocco, Panama, Philippines and South Africa.

ships in port areas,[94] optimise energy consumption[95] and to assist countries in developing ship and port emission reduction strategies.[96]

A draft IMO resolution agreed in November 2019 proposes guidelines for countries to develop their NAPs.[97] It suggests that NAPs could include but are not limited to: a) improving domestic institutional and legislative arrangements for the implementation of IMO instruments, b) developing activities to enhance the energy efficiency of ships, c) initiating research and advancing the uptake of low and zero-carbon fuels, d) accelerating port emission reduction activities, e) fostering capacity-building, awareness-raising and regional cooperation, f) facilitating the development of infrastructure for green shipping. Member States that have already prepared NAPs are encouraged to share their experiences with the IMO, while the other States are invited to submit their NAPs as soon as possible. The text of the draft resolution will be put forward to the next MEPC session for adoption.

As observed in the UK and Norway, NAPs are a national policy tool which can build on, coordinate, and guide national actions among IMO member States to improve energy efficiency in shipping, enhance port infrastructure and operations, and to develop alternative fuels and technology. If NAPs are designed in alignment with the new IMO targets and guidelines, they can also be a coordination instrument to ensure that member States work towards common goals.

3.2 Market-Based Mechanisms

The use of market-based mechanisms (MBMs) is one of the most controversial candidate measures under the Initial Strategy and there is, as yet, no agreed MBM for the sector.[98] The IMO has discussed their use as a policy instrument for cost-effective abatement for many years,[99] in the form of a carbon tax, emissions trading under a cap and trade scheme, or a hybrid mechanism (combining tax and trading).[100] Yet the shipping industry remains skeptical of MBMs as a means to incentivize emission reductions, particularly the use of emissions trading at a regional scale,[101] preferring instead a globally applied bunker fuel levy.[102] Recently, the aviation sector, which has also developed GHG emissions approaches outside the framework

[94] GloMEEP Project Coordination Unit, IMO, Emissions Control and Energy Efficiency Measures for Ships in the Port Area, 2015.
[95] GloMEEP Project Coordination Unit, IMO, Study on the optimization of energy consumption as part of implementation of a Ship Energy Efficiency Management Plan (SEEMP) 2016.
[96] GloMEEP Port Emissions Toolkit, Development of Port Emissions Reduction Strategies (Guides No 1 and 2) 2018; and Ship Emissions Toolkit, Development of Port Emissions Reduction Strategies (Guides No 1, 2 and 3), 2018.
[97] IMO Draft Resolution MEPC.75/7/2 agreed by the IMO Intersessional Working Group on Reduction of GHG Emissions from Ships. It will be submitted to the 75th MEPC session, which was scheduled to take place from 30 March to 3 April 2020, but has been recently postponed, see <http://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/Default.aspx> accessed 13 March 2020.
[98] Supra note 40, p7
[99] In MPEC 59, the overwhelming majority agreed that MBMs should be a part of a comprehensive package of measures to regulate greenhouse gas emissions from international shipping, see Tsung-Chen Lee, Young-Tae Chang, and Paul T.W. Lee, 'Economy-wide impact analysis of a carbon tax on international container shipping' (2013) 58 Transportation Research 87–102, 88.
[100] Apollonia Miola, Marleen Marra, and Biagio Ciuffo, 'Designing a Climate Change Policy for the International Maritime Transport Sector: Market-Based Measures and Technological Options for Global and Regional Policy Actions' (2011) 39 Energy Policy, p.5491.
[101] Supra note 40, p.13
[102] Ibid, p.13

of the UNFCCC, opted for a global MBM scheme in the form of a Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which aims to address annual increases in total CO2 emissions from international civil aviation above 2020 levels.[103] CORSIA also introduced a Monitoring, Reporting and Verification (MRV) process for aircraft operators undertaking international flights.[104]

Experience with emissions trading in other relevant contexts, combined with the particular challenges of the international shipping sector, suggest that establishing a maritime Emissions Trading Scheme (ETS) could be administratively complex, highly contested, as well as time and resource intensive. A maritime ETS would require the adoption of an internationally agreed baseline of emissions for international shipping and the establishment of an MRV process, similar to CORSIA, to ensure that emissions are measured and reported in a standardised and comparable manner. The IMO will have the responsibility to create the institutional and legal frameworks governing such a scheme, and to oversee its functioning. The development of each component of the ETS requires time, as their rules must be internationally agreed. Significant capacity and funding is also required.

Experience implementing the three market-based mechanisms of the 1997 Kyoto Protocol (Joint Implementation,[105] Clean Development Mechanism[106] and Emissions Trading)[107] also underscore the need for careful design of MRV processes and the likely administrative complexity of developing a maritime ETS. Those mechanisms (known as flexibility mechanisms) generated emission reduction units that were used by developed countries (Annex I Parties) to meet reduction commitments under Article 3.[108] They were governed by an intricate set of rules and guidelines developed over time.[109] During the lifetime of the Kyoto Protocol, such rules and procedures were created to ensure *'transparency, efficiency and accountability'* through independent auditing and verification of project activities.[110] Consequently, a dedicated institutional structure, involving several designated bodies, was created to oversee their functioning.[111] The flexibility mechanisms have been widely discussed in academic literature,[112] where they have generally been criticized for creating complex, non-

[103] International aviation defines as civil aviation flights that depart in one country and arrive in a different country, Paragraph 5, Resolution A39-3: Consolidated statement of continuing ICAO policies and practices related to environmental protection – Global Market-based Measure (MBM) scheme.
[104] Volume IV: Part II, Chapter 2, Annex 16 - Environmental Protection, Volume IV – Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) adopted by the ICAO Council at its 214th Session (11 - 29 June 2018).
[105] 1997 Kyoto Protocol (Kyoto Protocol), Article 6
[106] Kyoto Protocol, Article 12
[107] Kyoto Protocol, Article 17
[108] The objective was to reduce their overall emissions of such gases by at least 5% below 1990 levels in the first commitment period, from 2008 to 2012, Kyoto Protocol, Article 3
[109] For example, the rules regarding the Clean Development Mechanism (CDM) were established under the Marrakesh Accords & Declaration, a set of agreements reached at the 7th Conference of the Parties (COP 7) to the United Nations Framework Convention on Climate Change, in 2001.
[110] Kyoto Protocol, Article 12, 7
[111] Kyoto Protocol, Article 6 (2), Article 12 (7), Article 17
[112] Naoki Matsuo, 'Key Elements related to the Emissions Trading for the Kyoto Protocol,' (1998) 25 Energy Policy 3, pp. 263-273; Ervin Nagy and Gisella Varga (eds.), 'Emissions Trading: Lessons Learned from the European Union and Kyoto Protocol Climate Change Programs,' (2009) Nova Science Publishers; Philippe Quirion, 'Complying with the Kyoto Protocol under uncertainty: Taxes or tradable permits?' (2010) 38 Energy Policy 5166–5173; Srikanth Subbarao, BobLloyd, 'Can the Clean Development Mechanism (CDM) deliver?,' (2011) 39 Energy Policy 1600-1611; Jung Eun, Kim David Popp, Andrew Prag, 'The Clean Development Mechanism and Neglected Environmental Technologies,' (2013) 55 Energy Policy 165-179; Thomas W.Thurner, ArunVarughese, 'Experiences of Project Developers around CDM Projects in South Africa,' (2013) 61 Energy

transparent and overly bureaucratic procedures.[113] If a maritime ETS is created, the IMO is likely to encounter similar challenges.

In light of the above challenges and complexities, we argue that a maritime carbon tax is a more suitable tool to incentivize emission reductions. Currently, fuel prices do not fully reflect associated environmental costs or externalities (climate change, health hazards, etc.).[114] A maritime carbon tax would take into account those negative externalities.[115] Generally, a carbon tax tracks the actual quantity of GHG emitted by the consumption of fossil fuels.[116] A maritime carbon tax would set up a price on GHGs emitted by ships engaged in international voyages,[117] based on fuel consumption. Put simply, the more emissions a ship generates, the more it pays.[118] In terms of institutional architecture, a carbon tax would require setting up tax levels and a phase-in schedule.[119] This may involve battles among countries to win tax concessions, but at least the core rule - a carbon tax based on carbon content - can form the base policy while the concessions are hammered out.[120] There are also examples of carbon taxes successfully being used at the national level. For example, Norway was one of the first countries to introduce a carbon tax in 1991, and currently more than 80% of Norwegian emissions are subject to a carbon tax.[121]

If a maritime carbon tax is introduced, ship owners could choose to invest in clean technologies and alternative fuels so that they do not pay or pay lower carbon taxes.[122] Alternatively, if they choose to pay the carbon tax, the tax revenue could be used to develop new technologies, alternative maritime fuels and support adaptation measures in ports located in vulnerable countries affected by climate change. The International Chamber of Shipping (ICS) has expressed support for a bunker fuel levy payable to a potential IMO climate fund, with some of the funds deployed to support research into new low carbon technologies, and the rollout of the expensive new bunkering infrastructure that will be required to supply low carbon fuels, particularly in the ports of developing nations.[123]

Policy 1271–1275; Xiaoyi Jiang, 'Legal Issues for Implementing the Clean Development Mechanism in China,' (2013) Springer; Rahel Aichele and Gabriel Felbermayr, 'The Effect of the Kyoto Protocol on Carbon Emissions,' (2013) 32 Journal of Policy Analysis and Management 731-757; Ken L. Mok, Seung H. Han, SeokjinChoi, 'The Implementation of Clean Development Mechanism (CDM) in the Construction and Built Environment Industry' (2014) 65 Energy Policy 512–523; Christian Almer, Ralph Winkler, 'Analyzing the Effectiveness of International Environmental Policies: The Case of the Kyoto Protocol,' (2017) 82 Journal of Environmental Economics and Management 125–151.

[113] The criticisms also relate to the fact that CDM has failed to deliver significant sustainable development benefits to communities, involved limited public participation and focused on limited types of projects, Srikanth Subbarao, Bob Lloyd, 'Can the Clean Development Mechanism (CDM) deliver?' (2011) 39 Energy Policy 1600-1611, 1610.

[114] UK CMP, p. 28.

[115] Shi-Ling Hsu, 'The Case for a Carbon Tax, Getting Past our hang-ups to Effective Climate Policy' (2011) Island Press

[116] Ibid, p. 87.

[117] See 'Do economists all favour a carbon tax?' (*The Economist*, 19 September 2011) <https://www.economist.com/free-exchange/2011/09/19/do-economists-all-favour-a-carbon-tax> accessed 12 March 2020

[118] See IMO's technical cooperation programme in Annual Report 2018 (*International Maritime Organization*, 2018) <http://www.imo.org/en/OurWork/TechnicalCooperation/Documents/Annual%20Report%20-%20Publications/2018%20Annual%20Report%20publication.pdf> accessed 12 March 2020

[119] Supra note 115, p.87

[120] Ibid

[121] Norwegian Action Plan, p. 61

[122] Tsan-Ming Choi, 'Carbon footprint tax on fashion supply chain systems' (2013) 68 Int J Adv Manuf Technol 835–847, 837

[123] Supra note 40, p 8

In the complicated world of domestic and international climate policy, one of the key advantages of a carbon tax is its breadth, simplicity, and ability to piggyback on existing regulatory frameworks.[124] This is particularly true to complex and transnational sectors such as international shipping. As pointed out by ICS, the shipping industry has a '*sound dislike of unnecessary complication*.'[125] Given the complications of many other GHG reduction policies and mechanisms, a carbon tax is probably the simplest and most straightforward approach.[126]

3.3 Alternative Fuels

Operational and efficiency measures, such as slow steaming and improvements in ship design, many of which are addressed by existing regulations or proposed as short-medium term measures, have an important role to play in reducing fuel consumption and therefore GHG emissions.[127] However, in order to realise the ambitious new IMO emissions reduction target, it is also widely recognized by the shipping industry,[128] and in the Initial Strategy,[129] that such measures are only part of the solution. The development and deployment of alternative low or zero-carbon fuels and/or energy sources for international shipping is critical to achieving decarbonisation targets.[130]

The Initial Strategy commits, as a short-term measure, to develop robust lifecycle GHG/carbon intensity guidelines for all types of alternative fuels, in addition to other related research and development measures.[131] Given the significant differences between the decarbonization potential of different alternative fuel options, as well as considerable variation in availability, cost and infrastructure requirements, these measures are critical to underpin long term decarbonization.

3.3.1 Decarbonisation potential and viability of alternative fuels

Heavy fuel oil is currently the dominant fuel for international shipping due to its economy and availability.[132] However, given that fuel oil costs account, on average, for more than 50% of a ship's operating expenses,[133] there are in-built incentives for efficiency measures and potential uptake of alternatives once they are cost-competitive. Global oil prices are volatile, and

---

[124] Supra note 115

[125]ICS, World Trade and the Reduction of CO2 Emissions United Nations Framework Convention on Climate Change (UNFCCC) 2014. The shipping industry comprises thousands of companies, most of which are Small and Medium Sized Enterprises (SMEs), see supra note 40, p 13

[126] Supra note 115, p. 146

[127] 'World Trade and the Reduction of CO2 Emissions United Nations Framework Convention on Climate Change (UNFCCC)' (*International Chamber of Shipping*, 2014) <https://www.ics-shipping.org/docs/default-source/resources/environmental-protection/shipping-world-trade-and-the-reduction-of-co2-emissions.pdf?sfvrsn=6> accessed 12 March 2020. See also Paul Balcombe, James Brierley, Chester Lewis, Line Skatvedt, Jamie Speirs, Adam Hawkes and Iain Staffell, 'How to decarbonise international shipping: options for fuels, technologies and policies' (2019) 182 Energy Conversion and Management, 72-88, 73, 79, 81.

[128] Supra note 40, p 10

[129] Initial Strategy, para 3.1, p.5.

[130] Supra note **Error! Bookmark not defined.**, at 81. For a summary of the literature on the potential emissions reductions associated with energy efficiency, ship design and fuel changes, see also Bouman EA, Lindstad E, Rialland AI, and Strømman AH, 'State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping – a review' (2017) 52 Transp Res Part D: Transp Environ 408–21.

[131] Initial Strategy para 4.7, 11, p.8

[132] Supra note 127, 74.

[133] Ibid, 80.

previous experiences of price fluctuations have prompted the uptake of alternative fuels such as liquified natural gas (LNG) as well as early research into hydrogen fuels.[134]

Conventional heavy fuel oil has a high Sulphur (SOx) content.[135] With the introduction of increasingly stringent fuel standards to manage non-GHG air pollutants such as SOx through MARPOL,[136] as well as the introduction of Emissions Control Areas [ECAs] with even stricter standards,[137] there is already considerable pressure on shipping companies to transition to alternative fuels with low sulphur. However, not all of these options align well with the Initial Strategy's decarbonisation target. For example, driven largely by fuel availability and competitive fuel cost,[138] LNG ships are already in commercial operation or under construction, particularly in Europe and the United States. While LNG fuels are compatible with new non-GHG air pollution standards, the decarbonization potential of LNG is far lower than the other alternative fuels discussed below, and in many situations may not be considerably better than current marine fuels.[139]

There are a number of fuels or energy sources with high decarbonization potential that are being actively pursued by industry.[140] One of the most prominent is biofuels. Biofuels are generally classified as 'conventional' (e.g. made from the sugars and oils in food crops grown on arable land), or 'advanced' (e.g. made from biomass waste by-products of food cultivation or other non-food biomass, including algae).[141]

Generally speaking, biofuels have considerably lower NOx, SOx and particulate emissions than conventional marine fuels.[142] Advanced biofuels also have significantly lower GHG emissions and many might be classified as 'carbon neutral', although the way in which

---

[134] Mohamed M Elgohary, Ibrahim S Seddiek and Ahmed M Salem, 'Overview of alternative fuels with emphasis on the potential of liquified natural gas as future marine fuel' (2015) 229(4) Journal of Engineering for the Marine Environment 365-375, 369.

[135] Deniz C, Zincir B, 'Environmental and economical assessment of alternative marine fuels' (2016) 113 J Cleaner Prod, 438–49.

[136] In 2008, MARPOL regulations regarding air pollution from shipping were significantly strengthened to include the 0.5% Sulphur limit in bunker fuels through Regulation 14, to be operative from 1 January 2020: Sulphur oxides (SOx) and Particulate Matter (PM) – Regulation 14; IMO Resolution MEPC.280(70). To ensure compliance and a 'level playing field', the IMO imposed a prohibition, from 1 March 2020, on the carriage of non-compliant fuel oil and adopted guidelines to support the consistent implementation of the sulphur limit. See 'Guidance to Shipping Companies and Crews on Preparing for Compliance with the 2020 'Global Sulphur Cap' for Ships' Fuel Oil in Accordance with MARPOL Annex VI', (*International Chamber of Shipping*) <http://www.ics-shipping.org/docs/default-source/resources/guidance-for-compliance-with-the-2020-global-sulphur-cap-july-2019.pdf?sfvrsn=24> accessed 12 March 2020

[137] Since 1 January 2015, the sulphur limit for fuel oil used by ships operating in Emission Control Areas (ECAs) designated by IMO for the control of sulphur oxides (SOX) has been 0.10% m/m. The ECAs established under MARPOL Annex VI for SOx are: the Baltic Sea area; the North Sea area; the North American area (covering designated coastal areas off the United States and Canada); and the United States Caribbean Sea area (waters around Puerto Rico and the United States Virgin Islands). 'The 2020 Global Sulphur Limit: Frequently Asked Questions' (*International Maritime Organization*) <http://www.imo.org/en/MediaCentre/HotTopics/GHG/Documents/2020%20sulphur%20limit%20FAQ%202019.pdf> accessed 12 March 2020

[138] Supra note 127, 76, and supra note 134, 373.

[139] While GHG emissions are also lower at the point of combustion, there is the potential for these emissions gains to be significantly eroded via methane (a highly potent GHG) leakage during combustion or in the value-supply chain. If methane emissions cannot be reduced, then the global warming potential of LNG is not radically different from existing conventional fuel oils: supra note 127, 76-77; supra note 134, 368-369; supra note 135, 373.

[140] For example, A.P. Moller Maersk, 'Sustainability Report' (2018), 14-15.

[141] Supra note 134, 368.

[142] Supra note 127, 77-78.

emissions are accounted for in relation to biofuels is complex and contested.[143] In terms of viability, it is possible to 'drop in' some types of biofuels to existing ships without expensive retrofitting measures, and these approaches are being explored by leading shipping companies.[144] However, the fuels themselves are currently significantly more expensive than conventional fuels, especially for advanced biofuels where production processes are immature.[145] As such, cost and availability remain significant barriers.

Hydrogen fuel cell technology is also receiving considerable attention, with the International Energy Association urging its accelerated development as part of the emerging low and zero carbon energy economy,[146] and many nations preparing strategic research and development plans to pursue these opportunities.[147]

While hydrogen fuel cells do not create direct GHG emissions, emissions associated with the hydrogen supply chain can be significant depending on its source. Much commercially available hydrogen is currently produced from fossil fuel feedstocks, for example via gasification of coal.[148] Zero-emissions hydrogen can be produced in two ways – renewable electricity can be used to split water into hydrogen and oxygen (electrolysis), or hydrogen can be produced from coal or methane, with carbon capture and storage (CCS) used to capture emissions.[149] CCS technology is however far from being proven at scale.[150] Further, producing hydrogen using electrolysis demands significant water resources and reliable renewable energy supply.

Despite the recent policy hype, there remain numerous barriers to fuel cell deployment at scale,[151] and there are only a small number of hydrogen shipping projects at different stages of development.[152] Current fuel cell technology does not yet meet the required power demand to propel large ships.[153] Costs of production, transport and storage remain prohibitively high. While some existing natural gas infrastructure could potentially be used for hydrogen, such infrastructure is itself not uniformly available among countries. Fuel storage requirements

---

[143] For example, for a biofuel to be considered carbon neutral, the total carbon sequestered by the energy crop must compensate for all above ground emissions (e.g. cultivation, processing, land use change etc)? See discussion in supra n 127, 78. See also, Slade R, Bauen A and Gross R, 'The Global Bioenergy Resource' (2014) 4 Nature Climate Change

[144] Christian Wienberg, 'How the World's Biggest Shipping Company Plans to Cut Emissions' (*Bloomberg News Articles*, 22 March 2019), <https://www.bloomberg.com/news/articles/2019-03-21/maersk-tests-biofuel-as-it-sets-sail-for-2050-carbon-neutrality accessed 12 March 2020

[145] Supra note 127, 78; Supra note 134, 368.

[146] 'The Future of Hydrogen' (*IEA*, 2019) <www.iea.org/publications/reports/thefutureofhydrogen/> accessed 12 March 2020

[147] For example, in Australia, the Council of Australian Governments released a National Hydrogen Strategy in November 2019, see 'Australia's National Hydrogen Strategy' (*Australian Government Department of Industry, Science, Energy and Resources*, November 2019) <https://www.industry.gov.au/data-and-publications/australias-national-hydrogen-strategy> accessed 12 March 2020

[148] Supra note 128, 10-11.

[149] Giles Parkinson, 'Shipping sunshine! Finkel launches race for clean hydrogen in an electric planet' (*Renew Economy*, 27 Nov 2019) <https://reneweconomy.com.au/shipping-sunshine-race-is-on-for-clean-hydrogen-in-an-electric-planet-63464/> accessed 12 March 2020

[150] Sabine Fuss et al, 'Negative Emissions Technology - Part 2: costs, potential and side effects' (2018) 13 Environmental Research Letters 1-47.

[151] Bryan Comer, 'Transitioning away from heavy oil in Arctic shipping -Working Paper' (2019) International Centre for Clean Transport.

[152] Tronstad T, Astrand HH, Haugom GP, Langfeldt L, 'Study on the use of fuel cells in shipping' (2017) European Maritime Safety Agency

[153] Supra note 127, 78-9; supra note 134, 369

onboard may be a barrier, particularly for retrofits, given large and specific storage requirements.

Electric propulsion systems also potentially offer decarbonization potential in the longer term, where renewable energy sources are used to achieve stored energy.[154] Currently, due to the low energy density of batteries relative to other fuels, batteries are only suitable for short voyages and generally as part of a hybrid system where they are used to boost output, optimise efficiency and reduce fuel consumption. However, in the longer term, larger high capacity batteries could conceivably be used as the primary energy source for larger ships and longer voyages.[155] While such large batteries are presently prohibitively expensive, costs are falling rapidly. Similarly, costs of renewable electricity for recharging are dropping.[156] Nonetheless, cost and availability remain key concerns. Further, a battery-powered shipping fleet would also potentially require considerable changes to global shipping routes to allow for battery recharging at port, as well as the development of a global recharging infrastructure.

Finally, wind and solar assisted ship propulsion is being pursued in some contexts. Given the size of the majority of global cargo ships, wind power is generally considered unsuitable as a sole energy source.[157] However conventional sails (and modern alternatives) can assist with ship propulsion and allow ships to greatly reduce fuel consumption yet maintain desired speed. For smaller cargo ships, wind power may be particularly effective.[158] Wind assistance systems are however in early development stages. Solar systems are also likely to have some potential application, either as wind/solar hybrid systems, or in augmenting on-board power requirements.[159]

3.3.2. Driving private sector investment in alternative fuels

As discussed above, the most promising alternative fuel options for the shipping industry face considerable barriers to widespread commercial uptake due to their early stage of development and the level of investment required in ship retrofit, new ship build technology or associated fuel supply chain and port infrastructure.

In Part 3.1 above, we argued that NAPs are an important mechanism to coordinate national action around ports and infrastructure and to support innovation in alternative fuels. In Part 3.2, we suggested that a maritime carbon tax would incentivise the development of low carbon shipping and noted that the revenue from such a tax could be directed to supporting research and development and providing incentives for the uptake of alternative fuels. To build on this discussion, we now consider how new understandings of climate change as a financial risk and/or opportunity may help to drive the private sector to allocate capital and resources to support alternative fuel development and deployment. This discussion extends the 2016 analysis by Professor Joanne Scott and colleagues of private regulatory standards addressing GHG emissions in international shipping.[160] These early standards generally sought to measure

[154] Supra note 128, 10.
[155] Ibid. See also, supra note 151.
[156] Supra note 127, 79.
[157] Supra note 127.
[158] Supra note 127, 79-80.
[159] Ibid.
[160] Joanne Scott, Tristan Smith, Nishatabbas Rehmatulla, Ben Milligan 'The Promise and Limits of Private Standards to Reduce Greenhouse Gas Emissions from Shipping' (2016) 29(2) Journal of Environmental Law, 234.

and rank ships on their energy efficiency and emissions intensity, with associated limitations in helping to shift the industry as a whole towards absolute or cumulative emissions reductions. Shipping companies, their corporate customers, financiers and institutional investors are now under increasing pressure to identify and manage climate-related financial risks. We suggest that this development has significant potential to expand upon existing private standards and initiatives in ways which are particularly focused on developing alternative fuels and achieving absolute emissions reductions.

Since the finalisation of the Paris Agreement, climate change has been increasingly treated as a source of unprecedented financial risk to businesses and investors.[161] In the international shipping context, these risks may manifest as follows. For shipping companies, the IMO emission targets currently take the form of non-binding, aspirational indicators of the direction of travel, with much of the detail on the pathways to achieve these targets still to be developed. However, given the recent regulatory activity of the IMO,[162] increased regulation in this area is not only possible but likely. Shipping companies may also be under increasing pressure from their corporate customers to offer low-carbon shipping options. These companies are themselves driven by regulatory and market pressures to address GHG emissions in their supply and value chains. Further, in the longer term, there is increasing uncertainty about future international trade in fossil fuel products, such as coal and oil, which currently make up a large proportion of total international shipping.[163] As importing countries move to phase out fossil fuel energy generation and transport systems in favour of renewables and electric transport, such trade is likely to decline and eventually collapse.[164] In addition, physical climate change impacts – such as increased storm activity, coastal flooding and sea level rise – may disrupt and add costs to international shipping operations, as well as interfere with supply chains for fuel and commodity transport. On the flipside, there are a range of business opportunities that emerge in the transition to a clean shipping sector, including in the development and deployment of new alternative fuel technologies and supply chain infrastructure.

These types of risks and opportunities are not only directly relevant to shipping companies and their corporate customers, but also to banks, institutional investors and other financial sector actors, who are increasingly concerned about their own exposure to climate risks through their lending arrangements, equity holdings or debt investments. For example, for banks and investors, the concern is that these risks may manifest as loan defaults and reductions in asset values and investment returns.[165]

Framing climate change as a financial risk issue has the effect of enlivening legal obligations to disclose these risks in financial reporting under company and securities law frameworks.[166]

---

[161] The push to recognise climate change as a financially material risk has been largely driven by financial sector stakeholders concerned about implications for the stability of financial systems. See e.g.: Taskforce on Climate-related Financial Disclosures [TCFD], 'Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures' (2017); Bank of England, 'The Bank of England's Response to Climate Change' (2017); and Network for Greening the Financial System, <https://www.ngfs.net/en/about-us/> accessed 12 March 2020

[162] See discussion of MARPOL regulation of non-GHG emissions: supra note 136.

[163] Supra note 7

[164] For example, see discussion of risks to South Africa's coal export industry in Matthew Huxham, Muhammed Anwar, David Nelson, 'Understanding the impact of a low carbon transition on South Africa' (2019) Climate Policy Institute.

[165] TCFD and Bank of England, supra note 161.

[166] For discussion in Australian context: Anita Foerster, Jacqueline Peel, Hari Osofsky, Brett McDonnell, 'Keeping good company in the transition to a low carbon economy? An evaluation of climate risk disclosure practices in Australia' (2017) 35(3) Company and Securities Law Journal 154-183.

Best practice approaches for climate risk disclosure are quickly consolidating in many jurisdictions around the recommendations of the Taskforce on Climate-related Financial Disclosures [TCFD], an industry-led voluntary standard.[167] The TCFD recommends that businesses and investors use scenario analysis to determine the potential financial impacts and opportunities associated with different climate change mitigation and energy transition scenarios and position their business strategy accordingly.[168] One of the key drivers for these developments in investor-owned companies is pressure from institutional investors.[169] In many jurisdictions, financial regulators are also increasingly scrutinising the disclosure of climate-related financial risks through their oversight of mainstream financial reporting.[170]

In parallel with the increased recognition of climate change as a financial risk issue, there is also a growing international emphasis on the critical role that financial stakeholders (particularly lenders and investors) play in society's response to climate change, given their considerable leverage over the flow of capital and resources. European policy developments in this area are particularly advanced and serve as model for similar initiatives elsewhere.[171] In 2018, the European Commission adopted an Action Plan on Sustainable Finance,[172] setting out a range of strategies to build a sustainable finance system,[173] and program of implementation (including new legislation) is already underway. Of particular interest is the EU-wide classification system (or taxonomy) which sets out a list of economic activities classified according to their contribution to sustainability policy objectives (including climate change

[167] See e.g., Principles for Responsible Investment, 'TCFD-based reporting to become mandatory for PRI signatories in 2020' (*PRI,* 19 February 2019) <https://www.unpri.org/news-and-press/tcfd-based-reporting-to-become-mandatory-for-pri-signatories-in-2020/4116.article> accessed 12 March 2020

[168] TCFD, supra note 161, s D. The TCFD also published further guidance on scenario analysis: 'Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities' (*TCFD,* June 2017).

[169] For example, Climate Action 100+ is a coalition of 450 institutional investors representing US$ 4 trillion assets under management that is strategically engaging with the world's largest corporate GHG emitters. One of the engagement demands is that companies disclose climate-related financial risks as per TCFD recommendations: 'Global Investors Driving Business Transition' (*Climate Acton 100+*) <http://www.climateaction100.org> accessed 12 March 2020

[170] In an Australian context, see statements by the heads of the Australian Securities and Investments Commission (ASIC) and the Australian Prudential Regulation Authority (APRA): Geoff Summerhayes (Commissioner, APRA) 'Australia's New Horizon: Climate Change Challenges and Prudential Risk' (Speech delivered at *Insurance Council of Australia Annual Forum*, Sydney, 17 February 2017); John Price (Commissioner, ASIC), 'Climate Change' (Keynote address, Centre for Policy Development: Financing a Sustainable Economy, Sydney, 18 June 2018). On 12 August 2019, ASIC released new guidance for the disclosure of climate-related financial risk in annual reports: 'Regulatory Guide 247: Effective disclosure in an operating and financial review' (*ASIC*, August 2019). APRA has also recently announced plans to develop a prudential practice guide focused on climate-related financial risks: 'Understanding and managing the financial risks of climate change' (APRA, 24 February 2020) <https://www.apra.gov.au/understanding-and-managing-financial-risks-of-climate-change?utm_source=Master+subscriber+list&utm_campaign=c0a5ecb4b5-EMAIL_CAMPAIGN_2020_02_24_04_00&utm_medium=email&utm_term=0_f588ec9669-c0a5ecb4b5-4239219> accessed 12 March 2020

[171] See e.g., The Asia Sustainable Finance Initiative <https://www.asfi.asia> accessed 12 March 2020; and Australian Sustainable Finance Initiative <https://www.sustainablefinance.org.au> accessed 12 March 2020

[172] European Commission, 'Action Plan: Financing Sustainable Growth' (*COM,* 2018)

[173] These include measures to clarify the legal duties of institutional investors regarding sustainability; to improve transparency around how sustainability is taken into account in investment decisions; to classify a taxonomy of sustainable activities to help direct finance to these activities; and to develop consistent sustainability benchmarks for financial products. See, Susanna Rust, 'European Commission unveils sustainable finance legislative proposals' (*IPE*, 24 Mary 2018) <https://www.ipe.com/news/esg/european-commission-unveils-sustainable-finance-legislative-proposals/10024869.article> accessed 12 March 2020

mitigation).[174] The taxonomy is intended to 'enable capital markets to identify and respond to investment opportunities that contribute to environmental policy objectives,' either by allocating capital to these activities or allowing financial stakeholders to engage with companies to influence their activities in line with sustainability criteria. Transport is one of the sectors for which substantial work has already been undertaken to identify sustainable activities and propose technical screening criteria to guide investment and financing decisions. To date, the main focus has been on land transport;[175] however sustainability criteria for maritime shipping will be developed in more detail in the next phase and is likely to involve prescriptions around zero direct emissions fleets and efficiency measures.[176]

There is some evidence that the developments described above are driving leading companies and investors to shift capital and resources to alternative fuel development. While the international shipping sector is characterized by considerable heterogeneity,[177] and smaller, privately-owned enterprises may not be subject to the same pressures, nor have access to the same resources as larger, investor-owned companies, the emerging trends are nonetheless quite powerful. They illustrate that the private sector is perceiving a business case for clean energy transition, based on risk assessments that customers are increasingly prepared to pay for their carbon footprint, that new technology will eventually be cheaper than oil and that the international community will unite to address climate change.[178]

For example, in 2018, A.P. Moller Maersk (Maersk), the world's largest shipping container company announced its intentions to be net-zero carbon by 2050, with an intermediate goal to cut emissions by 60% (relative to 2008 levels) by 2030.[179] In order to meet this target, Maersk has already invested in substantial efficiency gains, and is now focusing on alternative fuel development, committing to have carbon neutral vessels commercially viable and in operation by 2030.[180] Maersk is leading the industry in trialling the use of advanced biofuels in large scale shipping, partnering with some of its biggest clients and fuel suppliers.[181] The company is also involved in a range of projects developing hydrogen and battery options. Maersk notes that one of the key drivers is the 'investment community's increased focus on climate change and its impact on businesses seen from a financial risk perspective.'[182]

---

[174] EU Technical Expert Group on Sustainable Finance, 'Financing a Sustainable European Economy Taxonomy Technical Report' (2019) <https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/190618-sustainable-finance-teg-report-taxonomy_en.pdf> accessed 12 March 2020

[175] Ibid, 324-357

[176] Ibid, 328

[177] The shipping industry comprises thousands of companies, most of which are Small and Medium Sized Enterprises (SMEs) International Chamber of Shipping (2018), supra note 128, 13.

[178] Camila Domonoske, 'Giant Shipper best big on ending its carbon emissions. Will it pay off?' (*NPR,* 15 July 2019) <https://www.npr.org/2019/07/15/736565697/giant-shipper-bets-big-on-ending-its-carbon-emissions-will-it-pay-off> accessed 12 March 2020

[179] A.P. Moller Maersk supra note 140, 12-16.

[180] Mearsk claims to have reduced emissions from its activities by 41% relative to 2008 through fuel efficiency and other measures. See: 'DB Schenker and Maersk Work Together to Fight Ocean Pollution & CO2 Emissions' (*Maersk,* 30 Mary 2019) <https://www.maersk.com/news/articles/2019/05/30/db-schenker-and-maersk-work-together-to-fight-ocean-pollution-co2-emissions> accessed 12 March 2020; Taylor Johnson, 'Towards a zero-carbon future' (*Maersk*, 26 June 2019) <https://www.maersk.com/news/articles/2019/06/26/towards-a-zero-carbon-future> accessed 12 March 2020

[181] Wienberg, supra note 144

[182] Ibid

Strategic business coalitions are also emerging to drive progress on decarbonisation. For example, *Getting to Zero* is a coalition of more than 80 companies across the maritime, fuels and infrastructure value chains, as well as the finance sector.[183] The coalition aims to operationalise commercially viable, deep sea vessels powered by zero emissions fuels by 2030 and recognises that this will involve both developing the vessels and the future fuel supply chain. Despite the magnitude of the challenge, collective industry-led action of this nature can help build momentum and confidence throughout the sector.

Shipping companies are also facing increasing pressure from corporate customers to offer low carbon options. For example, Maersk reports that almost a quarter of their top 150 customers have set their own science-based emission reduction targets which include reducing emissions in the supply and value chain.[184] In 2014, Maersk partnered with DB Schenker, a global supply chain management and logistics company, to reduce GHG emissions on a per container basis by 20% by 2018.[185] Maersk's recent biofuels trial noted above was supported by a range of key customers including H&M Group who have themselves set carbon neutral targets throughout their value chain and are seeking to reduce transport emissions in order to meet these targets.[186] Similarly, the international mining and resource company, BHP Billiton (BHP), has announced commitments to disclose and set targets to reduce scope 3 GHG emissions[187] throughout their value chain.[188] Transportation emissions are singled out as an area in which BHP has the ability to influence service providers to reduce emissions. BHP has developed a program to measure emissions from their chartered marine fleet, benchmark the emissions performance of individual vessels, and implement vetting criteria to exclude vessels with poor emissions performance. As a result, the company reports reduced emissions from transportation; and notes that related shipping companies are responding by investing in technical and operational improvements to reduce emissions.[189]

A number of recent developments also suggest that shipping companies will need to demonstrate alignment with IMO decarbonisation targets in order to access finance. For example, the Poseidon Principles is a recent initiative in the banking sector aiming to integrate climate considerations into lending decisions to promote decarbonisation of the shipping sector. Signatories commit to measure and report, on an annual basis, the carbon intensity of their shipping portfolios relative to IMO decarbonisation trajectories produced for each ship

---

[183] 'Getting to Zero Coalition' (*Global Maritime Forum*) <https://www.globalmaritimeforum.org/getting-to-zero-coalition> accessed 12 March 2020

[184] A.P. Moller Maersk supra note 140, 15. A science-based target is a GHG emissions reduction target aligned with climate science and the goals of the Paris Agreement. The Science-based Target Initiative provides technical guidance and a process to assess and approve company targets: 'About the Science Based Targets Initiative' (*Science Based* Targets) <https://sciencebasedtargets.org/about-the-science-based-targets-initiative/> accessed 12 March 2020

[185] 'DB Schenker and Maersk Work Together to Fight Ocean Pollution & CO2 Emissions' (*Maersk,* 30 Mary 2019) <https://www.maersk.com/news/articles/2019/05/30/db-schenker-and-maersk-work-together-to-fight-ocean-pollution-co2-emissions> accessed 12 March 2020

[186] Wienberg, supra note 144.

[187] Scope 3 emissions refer to indirect emissions that occur in the value chain of the reporting company and may include upstream emissions (related to purchased or acquired goods or services) and downstream emissions (related to sold goods and services). See, 'Corporate Value Chain (Scope 3) Accounting and Reporting Standard' (GHG Protocol) <https://ghgprotocol.org/standards/scope-3-standard> accessed 12 March 2020

[188] 'Addressing Greenhouse Gas Emissions Beyond Our Operations: Understanding the 'scope 3' footprint of our value chain' (*BHP,* 2018) <https://www.bhp.com/media-and-insights/prospects/2018/08/addressing-greenhouse-gas-emissions-beyond-our-operations> accessed 12 March 2020.

[189] Ibid

type and size class; and to work with clients and partners to require emissions data on vessels within the portfolio in accordance with technical guidance requirements.[190]

The above discussion has focused particularly on initiatives which are being led and championed by the private sector. As Chircop notes, in maritime regulation, technology and commercial practices are likely to be significantly ahead of the regulator.[191] Nonetheless, it is important to also acknowledge the critical ongoing role to be played by the IMO (and its member States) to support, coordinate and facilitate these developments, as well as to ensure that developing and middle income countries are able to access appropriate capacity-building and technical-assistance to ensure that they are not disadvantaged. This is particularly important for least developed countries whose economies depend on international shipping for access to export markets and are likely to face considerable barriers in establishing new fuel industries and related supply chain and port infrastructure. The IMO has a number of projects already in place to support the industry to align with the goals of the Initial Strategy. These include technical and capacity-building programs with various levels of external funding, many of which target developing nations.[192] In May 2019, the IMO also established a voluntary multi-donor trust fund to provide a dedicated source of financial support for technical cooperation and capacity-building activities.[193] As such, while there are some support structures in place, much of this is dependant on voluntary contributions by member States and international donors. Going forward, the IMO can play an important coordinating role in strengthening this assistance.

4. Conclusions

The Initial Strategy provides the roadmap to achieving the new emission reduction target and signals the development of a new regulatory framework, which is likely to involve a mix of voluntary and compulsory candidate measures. In the coming years, IMO member States will negotiate and agree on the measures that will be used to implement the Strategy. Given the importance and the urgency of decarbonising the shipping industry, this article has explored the promise and shortfalls of three of the central candidate measures: National Action Plans (short-term), market-based mechanisms (mid-term) and alternative fuels (long-term) and made some recommendations for maximising their timeliness and effectiveness.

---

[190] 'About' (*Poseidon Principles*) <https://www.poseidonprinciples.org/about/> accessed 12 March 2020

[191] Aldo Chircop, 'The IMO Initial Strategy for the Reduction of GHGs from International Shipping: A Commentary' (2019) 34 The International Journal of Marine and Coastal Law, 482-512, 512.

[192] For example, the Global Industry Alliance is a new public-private partnership initiative of the IMO under the framework of the IMO GLOMEEP project that aims to bring together maritime industry leaders to collectively identify and develop innovative solutions to address common barriers to the uptake and implementation of energy efficiency technologies and operational measures: 'Global Industry Alliance Overview' (*GLOMEEP*) <https://glomeep.imo.org/global-industry-alliance/global-industry-alliance-gia/> accessed 12 March 2020

[193] 'UN agency pushes forward on shipping emissions reduction' (*International Maritime Organization*, 20 May 2019) <http://www.imo.org/en/MediaCentre/PressBriefings/Pages/11-MEPC-74-GHG.aspx> accessed 12 March 2020. At present the resources of the trust fund will include voluntary contributions from IMO Member States, UN Agencies and other entities. See 'Report of the Marine Environment Protection Committee on its Seventy-Fourth Session, Annex 17' (*International Maritime Organization*, 17 June 2019) <https://www.iadc.org/wp-content/uploads/2019/08/MEPC-74-18-Add.1-Report-Of-The-Marine-Environment-Protection-CommitteeOn-Its-Seventy-Fourth-Session-Secretariat-1.pdf> accessed 12 March 2020. See also Resolution MEPC.229(65), 'Promotion of Technical Co-operation and Transfer of Technology Relating to the Improvement of Energy Efficiency of Ships: Annex 4' (*International Maritime Organization*, 17 May 2013) <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/229%2865%29.pdf> accessed 12 March 2020

While NAPs are not considered to be a suitable tool to deal with *international* shipping emissions, early examples in the UK and Norway show that they do have an important role to play in mobilising national stakeholders, building capacity and funding for national action. NAPs are particularly relevant for domestic activities related to port operations, logistics and infrastructure as these measures can only be implemented at the country-level, but they can also be used to support innovation on alternative fuels. As the IMO develops guidelines and establishes common expectations and standards for NAPs, there is potential for NAPs to operate as a coordinating mechanism to align national action towards global goals, similar to NDCs in the framework of the Paris Agreement.

In terms of MBMs, we conclude that a maritime carbon tax is a simpler way to achieve emission reductions and incentivise the use of low-carbon fuels, when compared with an IMO-led emissions trading scheme. A carbon tax avoids some of the complexities associated with emissions trading schemes, as observed with the Kyoto Protocol's flexibility mechanisms. It would give a clear price signal to the industry: if shipping companies are required to pay for their emissions, this will drive them to invest in low-carbon fuels and technology, and ultimately pay a lower price for fuel consumption. The benefits of this measure will be amplified if the revenue from such a tax is directed to supporting the development and uptake of alternative fuels and ensuring access for developing countries.

Finally, given the long asset cycles associated with international vessels and the extent of supporting infrastructure development required, we emphasise the importance of prioritising the development and deployment of alternative fuels immediately as a main focus for ongoing IMO negotiations. While there is some encouraging evidence that the private sector is beginning to shift resources and capital to address this challenge, driven particularly by recognition of related financial risks and opportunities and the important signalling provided by the IMO decarbonisation target, it is important to note that it is large, well-resourced shipping companies that are currently investing in alternative fuels. When these alternatives become a more mainstream option for the sector, smaller companies and developing countries will require financial and technical assistance to adjust. It is in this context that the IMO has perhaps the most important role to play in ensuring a level-playing field and supporting developing countries to benefit from the development and deployment of alternative fuels.