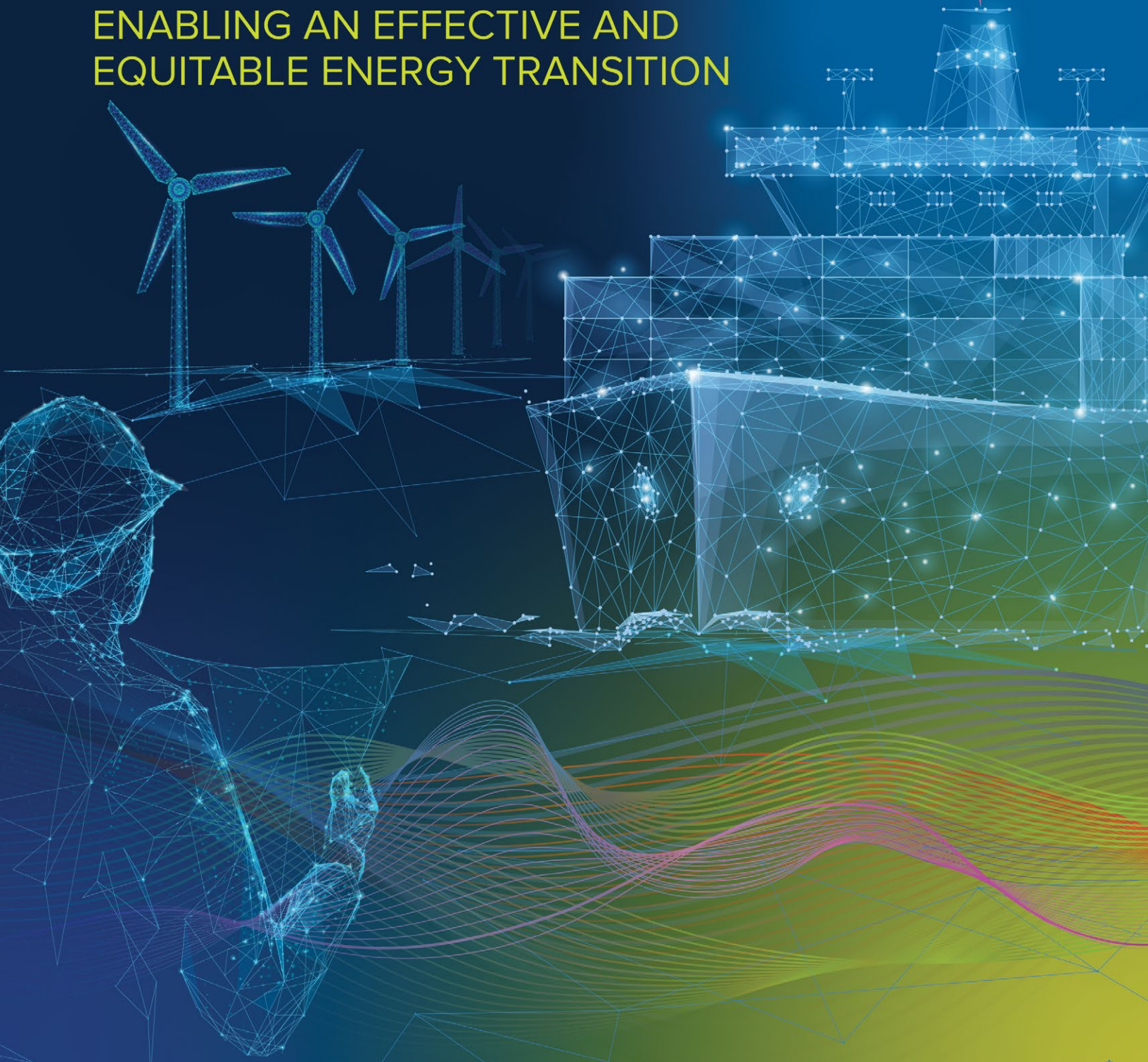
THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

CARBON REVENUES FROM INTERNATIONAL SHIPPING:

ENABLING AN EFFECTIVE AND EQUITABLE ENERGY TRANSITION

Technical PAPER



1818 H Street NW Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

This work was lead authored by Goran Dominioni (Dublin City University), and Dominik Englert (World Bank).

Attribution—Please cite the work as follows: Dominioni, G.; Englert, D.. 2022. Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition – Technical Paper. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/37240 License: CC BY 3.0 IGO.

This document is version 1.0 from 1 April 2022.

Cover photo: © Igor Korchak, Inkoly and Antoniokhr / iStock. Used with the permission of Igor Korchak, Inkoly and Antoniokhr / iStock. Further permission is required for reuse.

TABLE OF CONTENT

TABLES

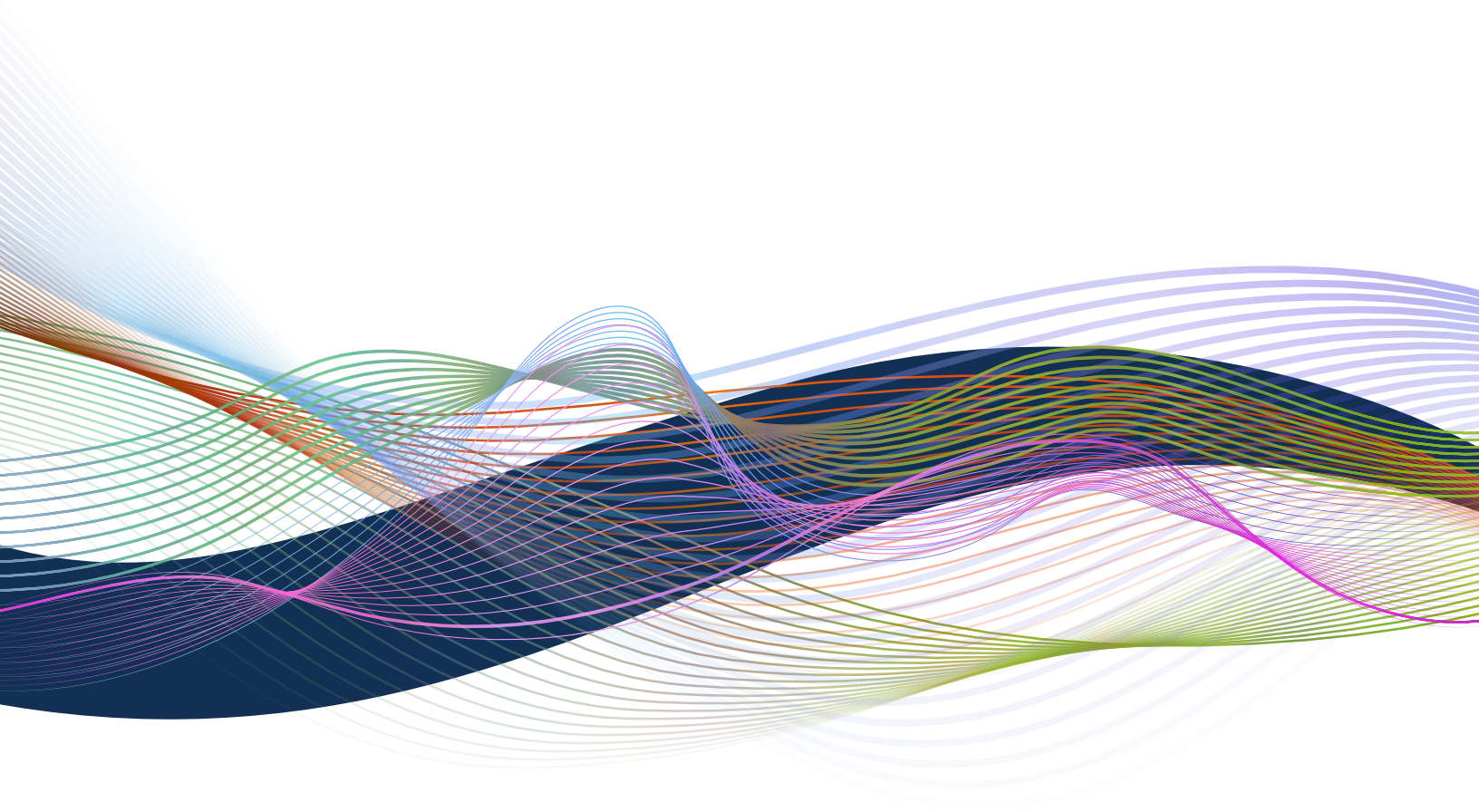
FIGURES

BOXES

photo: *iStock Photo / Gelia*

PREAMBLE

The World Bank has undertaken analytical work on the use, recipients, and management of potential carbon revenues from international maritime transport. This document Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition – Technical Paper is accompanied by a high-level summary of the key findings entitled Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition – Summary for Policymakers.[1]



1 Dominioni, G.; Englert, D.; Salgmann, R.; and Brown, J. 2022. Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition – Summary for Policymakers. Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/37241 License: CC BY 3.0 IGO.

ACKNOWLEDGEMENTS

The preparation of this technical paper was led by the World Bank, based on expert input from Dublin City University.

The World Bank team responsible for this report was led by Dominik Englert, and comprised Jennifer Brown, Priyank Lathwal, Yoomin Lee, Rico Salgmann, and Michael Wilson.

The Dublin City University team was led by Goran Dominioni, and comprised Jennifer Archer.

The peer reviewers were Joseph Pryor and Christophe de Gouvello from the World Bank as well as Jan Hoffmann of the United Nations Conference on Trade and Development and, Jan-Christoph Napierski and Sarah Ahlen Bjork of the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping. Additional valuable feedback and perspectives were provided by Jyoti Bisbey of the World Bank, Tristan Smith and Isabelle Rojon of University Maritime Advisory Services, Jasper Faber of CE Delft, and Pierre-Jean Bordahandy of University of the South Pacific.

The World Bank team would like to express its great appreciation to Richard Martin Humphreys and Binyam Reja at the World Bank for their expert guidance and constructive suggestions during the planning, development and finalization of this research. Their willingness to give their time and support so generously was highly valued.

The World Bank team is particularly grateful to Veronica Gadea and Jeff Dean Lawrence at the World Bank for the compelling graphic design.

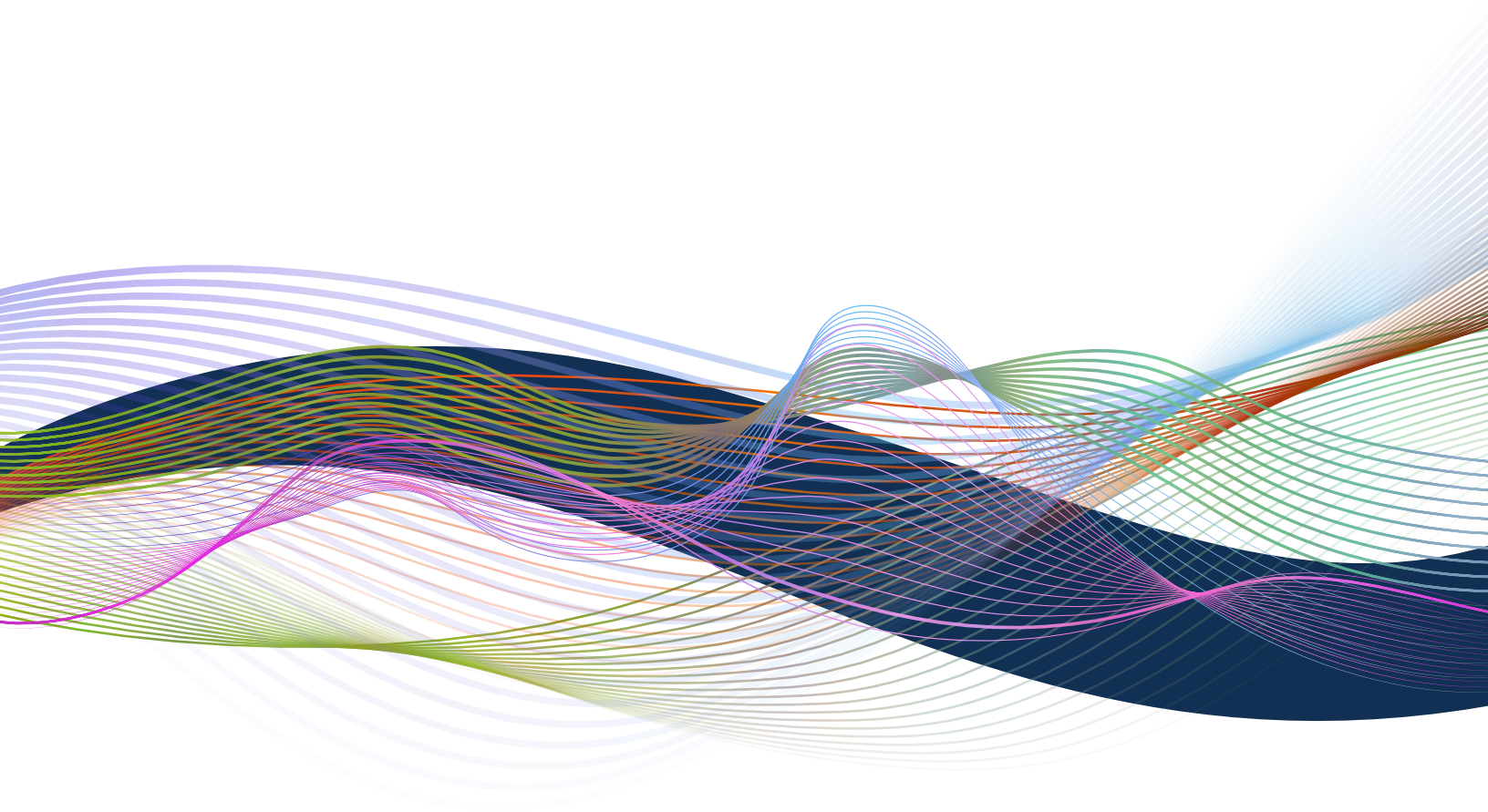
This report is part of the products and activities prepared under the Decarbonization of Transport Flagship (P174863).

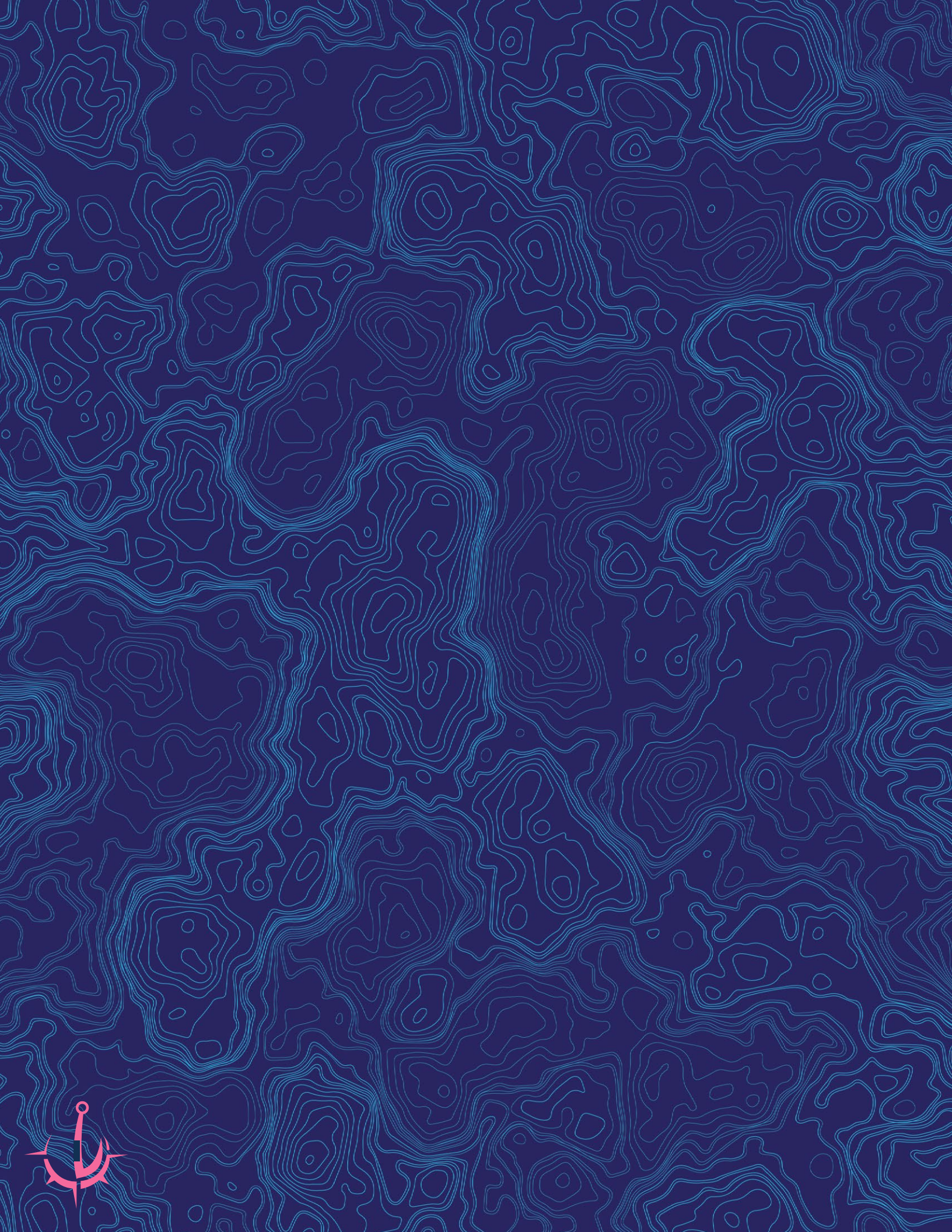
THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

ABBREVIATIONS

ACRONYM	DEFINITION
CBDR-RC	Common but Differentiated Responsibilities and Respective Capabilities
CIF	Climate Investment Funds
CII	Carbon Intensity Indicator
CO2	Carbon dioxide
COP15	15th Conference of the Parties
COP26	26th Conference of the Parties
DNI	Disproportionate negative impacts
EEXI	Energy Efficiency Existing Ship Index
ETC	Energy Transitions Commission for the Global Maritime Forum for the Getting to Zero Coalition
ETS	Emission Trading System
EU	European Union
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
ICS	International Chamber of Shipping
IMF	International Monetary Fund
IMO	International Maritime Organization
IMRB	International Maritime Research and Development Board
IMRF	International Maritime Research Fund
Initial IMO GHG Strategy	International Maritime Organization's Initial Strategy on the Reduction of Greenhouse Gas Emissions from Ships
IOPC	International Oil Pollution Compensation Funds
LDCs	Least Developed Countries
LNG	Liquified Natural Gas
MEPC	Marine Environment Protection Committee
MSR	Market Stability Reserve
ODI	Overseas Development Institute
OECD	Organisation for Economic Co-operation and Development
PCM	Price Control Mechanisms
R&D	Research and Development
RAG	Red-Amber-Green

SCC	Social Cost of Carbon
SDG	Sustainable Development Goals
SIDS	Small Island Developing States
TTP	Tank-to-Propeller
UMAS	University Maritime Advisory Services
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States
WTT	Well-to-Tank
WTW	Well-to-Wake
$	United States dollar
€	Euros
°C	Degrees Celsius





ºEXECUTIVE SUMMARY

WHY A TECHNICAL PAPER ON THE USE, RECIPIENTS, AND MANAGEMENT, OF CARBON REVENUES FROM SHIPPING?

Recent submissions to the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) discuss measures that could be adopted to reduce greenhouse gas (GHG) emissions from shipping. These submissions contribute to the debate on how to achieve the climate change mitigation targets adopted by the IMO in its Initial IMO Strategy on the reduction of GHG emissions from ships (hereafter called "Initial IMO GHG Strategy"). The Initial IMO GHG Strategy aims to reduce annual GHG emissions from international shipping by at least 50 per cent by 2050 compared to 2008 while pursuing efforts to peak GHG emissions from the international shipping sector as soon as possible and set international shipping on a pathway consistent with the temperature goals of the Paris Agreement. Analysts agree that the current regulatory framework will need to be supplemented with stringent additional measures to achieve these aims. Recently, discussions at the MEPC have started focusing on what measures could be implemented in the mid-term, i.e., between 2023 and 2030.

Some types of mid-term measures could raise significant revenues. While the main aim of mid-term measures is to induce GHG reductions in the sector, some types of carbon pricing instruments, ideally covering full well-to-wake (WTW) emissions, would also raise revenues. This applies to carbon levies[2] and cap-and-trade schemes when allowances are sold to regulated entities. Recent studies and projections indicate that revenues that could be raised from pricing carbon in shipping could be significant. Carbon pricing applied in a scenario where the minimum climate change mitigation targets of the Initial IMO GHG Strategy are met could raise between $1.3 trillion to $2.6 trillion[3] in total; in a full decarbonization scenario by 2050, revenues could be between $1 trillion to $2 trillion (Baresic et al. 2022).[4] According to another study, a flat carbon levy of $250/ton of GHG would raise $3.7 trillion by 2050 (Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, 2021). Based on a recent submission to the IMO, we estimate that annual carbon revenues could amount to over $60 billion per year.

These carbon revenues could potentially allow for the implementation of additional actions. The revenues may create opportunities such as: helping to align the decarbonization of international shipping with guiding principles of the Initial IMO GHG Strategy, achieving additional climate and non-climate development benefits, addressing political concerns that may hinder higher ambition in decarbonizing the shipping sector, and removing existing

2 The term carbon levy is sometimes used interchangeably with carbon tax. This report uses the term carbon levy, but this should not be seen as indicating a preference for a particular design of the instrument.
3 All dollar amounts are in US dollars unless otherwise indicated.
4 Notice that this analysis assumes that carbon pricing is implemented as a standalone measure.

market barriers and market failures which represent obstacles to exploiting shipping's full GHG abatement potential.

There is an ongoing debate at the MEPC on how potential carbon revenues from international shipping could be used, managed, and governed. This technical paper aims to contribute to this debate by addressing three questions:

- What could carbon revenues from international shipping be used for?
- Who could be the recipients of carbon revenues from international shipping?
- How could adequate governance and management of carbon revenues from international shipping be imagined?

The possible answers to these questions are explored in detail in this paper.

WHAT COULD CARBON REVENUES FROM INTERNATIONAL SHIPPING BE USED FOR?

The technical paper distinguishes seven potential carbon revenue use options and assesses their alignment with the Initial IMO GHG Strategy, their potential climate and other development benefits, their need for active management, and their potential political acceptability from the industry perspective. The options considered are: 1) financing in-sector climate change mitigation, 2) enhancing maritime transport infrastructure and capacity, 3) financing broader climate aims, 4) financing broader development aims, 5) financing the general fiscal budget, 6) covering administrative and enforcement costs, or 7) implementing a revenue-neutral feebate scheme.

Analyzing alignment with the Initial IMO GHG Strategy

Alignment with the Initial IMO GHG Strategy is assessed by analyzing the alignment of revenue use options with guiding principles of the Initial IMO GHG Strategy. Particular attention is given to the following principles due to their relevance in recent submissions to the IMO and related discussions at the MEPC:

- **Addressing the need to be cognizant of the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC).** Generally, CBDR-RC has two components. The first component establishes a responsibility for all countries to address climate change. The second component requires granting less stringent/more favorable conditions to countries that have contributed (or are projected to contribute) less to climate change or have less capacity to address climate change.

- **Addressing disproportionately negative impacts (DNI) and paying particular attention to the needs of Least Developed Countries (LDCs) and Small Island Developing States (SIDS).** Adopting mid-term measures in international shipping can have negative impacts on some States, for instance by affecting their gross domestic product and trade patterns. The risks of DNI are likely to be particularly high for LDCs and SIDS.

This technical paper also discusses the alignment of the carbon revenue use options mentioned above with relevant principles that are not explicitly mentioned in the Initial IMO GHG Strategy but that some stakeholders consider applying in the context of the implementation of mid-term measures:

- **The principle of Highest Possible Ambition:** The principle of Highest Possible Ambition is recognized in the Paris Agreement and creates the expectation that parties to the agreement will put in place their best efforts to set and achieve climate change mitigation targets.

- **The Polluter Pays principle:** The meaning of the Polluter Pays principle in climate change law and policy is debated. A common view is that this principle implies that the polluter should bear the costs of preventing pollution and implementing control measures (OECD, 1972; OECD, 1974).

This technical paper acknowledges that there may be different positions among IMO Member States on whether addressing DNI satisfies the need to be cognizant of the CBDR-RC principle. This technical paper is agnostic on whether addressing DNI addresses the need to consider the CBDR-RC principle. The technical paper simply distinguishes between whether a particular carbon revenue use aligns with DNI and/or the need to consider the CBDR-RC principle, since DNI and CBDR-RC may represent different issues according to some IMO Member States.

This technical paper also acknowledges that there may be potential limits to satisfy the need to consider CBDR-RC (e.g., no more favorable treatment). However, the analysis of these issues goes beyond the scope of this technical paper.

While some of the guiding principles of the Initial IMO GHG Strategy could also be operationalized by implementing exemptions, this approach poses the risk of adverse consequences and does not guarantee an equitable transition. Addressing the need to be cognizant of CBDR-RC and addressing DNI via exemptions may yield a number of adverse consequences. These include, for instance, a situation where shipping companies reassign older vessels which are usually less energy-efficient and less safe to exempted routes to deploy their newest, more energy-efficient vessels on routes covered by a market-based measure. Exemptions also reduce the incentive to transition to zero-carbon fuels and technologies on exempted routes (CE DELFT 2021). Further, the benefits of exemptions, in terms of lower transport costs–which can translate into lower costs of transported commodities, would be shared by both the exporting and the importing country. This sharing of benefits could undermine the aim of ensuring an equitable transition if the importing or

the exporting country was a developed country not necessarily needing support (Dominioni, Heine and Martinez-Romera, 2018). For these reasons, the technical paper favors the use of carbon revenues to address the need to be cognizant of the CBDR-RC principle and to address DNI.[5]

Key findings

Table 1 summarizes the key findings of the analysis using a Red-Amber-Green (RAG) matrix.[6] Table 1 reports the key findings on the potential alignment of each carbon revenue use option with the Initial IMO GHG Strategy. The analysis assumes that carbon revenues are spent adequately, without misuse due to, for instance, poor governance or corruption. This technical paper distinguishes two potential ways to address the need to be cognizant of CBDR-RC, and two ways to address DNI through carbon revenue use. In addition to the alignment with the Initial IMO GHG Strategy, Table 1 also assesses the potential alignment with selected desirable key features of a carbon pricing mechanism in international shipping. These are the potential for climate benefits, the potential for development benefits, the absence of a need for active management of the revenues, as well as the political feasibility from an industry perspective. Ultimately, this table seeks to highlight the unique value proposition of each individual revenue use option considered.

5 The need to apply IMO regulations to all ships was recognized by the IMO Secretariat in 2011 (IMO Secretariat, 2011).
6 Under RAG, options are marked, with green indicating a more positive evaluation, red a less positive evaluation, and amber an evaluation between green and red.

photo: *iStock Photo / Sabine Wagner*

TABLE 1: REVENUE USES, THEIR POTENTIAL ALIGNMENT WITH THE INITIAL IMO GHG STRATEGY AND OTHER SELECTED DESIRABLE KEY FEATURES

CRITERIA		1 FINANCING IN-SECTOR CLIMATE CHANGE MITIGATION	2 ENHANCING MARITIME INFRASTRUCTURE AND CAPACITY	3 FINANCING BROADER CLIMATE AIMS	4 FINANCING BROADER DEVELOPMENT AIMS	5 FINANCING THE GENERAL BUDGET	6 COVERING ADMINISTRATIVE AND ENFORCEMENT COSTS	7 IMPLEMENTING A REVENUE-NEUTRAL FEEBATE
Potential Alignment with the Initial IMO GHG Strategy Principles	Narrow CBDR-RC*							
	Broad CBDR-RC*							
	Avoiding DNI							
	Remedying DNI							
	Polluter Pays							
	Highest Possible Ambition							
Selected Desirable Key Features	Potential Climate Benefits**							
	Potential Development Benefits**							
	No Need for Active Management							
	Political Feasibility – Industry Perspective							
	"Unique value proposition"	Opportunity to lower the carbon price level needed to decarbonize shipping	Extension of the options to address DNI through sector-specific but not necessarily climate-related financing	Highest potential climate benefits	Highest potential development benefits	Greatest flexibility for recipient countries to use carbon revenues	Instrumental for proper functioning of carbon pricing instrument	Only option that does not require active management of revenues

* "Broad CBDR-RC" is understood as encompassing "narrow CBDR-RC". Thus, any carbon revenue use that satisfies the latter appears also aligned with the former.

** Note: The results presented in this table describe the potential of each revenue use option to deliver climate and development benefits and align with the Initial IMO GHG Strategy under the assumption that carbon revenues are adequately spent (e.g., corruption and poor governance do not lead to carbon revenue misuse).

Under a Red-Amber-Green (RAG) matrix, options are marked, with green indicating a more positive evaluation, red a less positive evaluation, and amber an evaluation between green and red. Green = highly aligned | Amber = partially aligned | Red = less aligned.

Some carbon revenue uses appear more aligned with certain interpretations of the Initial IMO GHG Strategy than others. The analysis indicates that the following carbon revenue uses have the potential to be more aligned with the interpretations of the Initial IMO GHG Strategy considered in this technical paper: financing shipping's decarbonization, enhancing maritime transport infrastructure and capacity, financing climate change needs more broadly, and covering administrative and enforcement costs. Other revenue use options seem to be less aligned with the Initial IMO GHG Strategy. This conclusion does not exclude the possibility that these alternative revenue use options may have other strengths worth of consideration, often emphasized by the unique value proposition of each individual revenue use option.

There is a case to use a meaningful share of carbon revenues to finance shipping's decarbonization and also to enhance maritime transport infrastructure and capacity. Financing in-sector climate change mitigation could speed up the decarbonization of shipping. In addition, financing shipping decarbonization may allow achieving the Initial IMO GHG Strategy mitigation targets by implementing a lower carbon price. Another reason that could favor spending carbon revenues to finance in-sector climate change mitigation and enhance maritime transport infrastructure and capacity is to prevent DNI instead of remedying for them. Furthermore, financing both types of in-sector uses would allow for the possibility of covering both in-sector adaptation and mitigation activities. Lastly, shipping-related carbon revenue uses, such as financing shipping's decarbonization, enhancing maritime transport infrastructure and capacity, and rewarding energy efficiency or GHG intensity through a feebate scheme, may allow implementing a more ambitious carbon pricing instrument because these revenue uses may be more aligned with the sector-specific interests of key shipping stakeholders.

However, the case for using *all* carbon revenues to finance shipping's decarbonization appears rather weak. As discussed above, revenue raised through carbon pricing in shipping could be between $1 trillion and $3.7 trillion (Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping 2021; Baresic et al. 2022).[7] Existing research suggests that meeting the temperature target set in the Initial IMO GHG Strategy requires $1 trillion to $1.4 trillion (Krantz, Sogaard and Smith 2020), and full decarbonization by 2050 requires about $1.4 trillion to $1.9 trillion (Baresic et al. 2022). Since this figure includes private sector investments, the revenues raised by a carbon pricing instrument are likely to exceed the need of the sector to meet the minimum targets of the Initial IMO GHG Strategy and perhaps also the investments needed to fully decarbonize the sector. Financing broader climate and development goals has the potential to yield climate and development benefits more cost-effectively than a narrow revenue use that focuses on shipping-related activities only because it is unlikely that all the cheapest mitigation or development opportunities available are related to the international maritime transport sector. Thus, there is a limit to the amount that can be spent effectively on the decarbonization of the shipping sector, and the case for using carbon revenues *exclusively* to finance shipping's decarbonization is not very strong *per se*.

A viable way forward from a political view would be to agree on splitting the carbon revenues between in-sector use, out-of-sector use and covering administrative and enforcement costs. This would mean that part of the carbon revenues would be allocated

7 Notice that this analysis assumes that carbon pricing is implemented as a standalone measure.

to financing in-sector climate change mitigation (e.g., building a zero-carbon bunker fuel supply infrastructure) and enhancing maritime transport infrastructure and capacity. While financial support for adaptation is particularly important for countries disproportionately exposed to climate change, such as many LDCs and SIDS, financing in-sector mitigation can help reduce the burden of the transition on the shipping industry. Another part would be allocated to wider climate and/or development goals not necessarily related to shipping. A share of the carbon revenues used in-sector and out-of-sector, respectively, would be allocated to selected countries (for instance, to address the need to consider CBDR-RC and to address DNI), and another share would be allocated globally to in-sector and out-of-sector climate action.

WHO COULD BE THE RECIPIENTS OF CARBON REVENUES FROM INTERNATIONAL SHIPPING?

This technical paper discusses how carbon revenues from international shipping could be allocated among three main potential groups of recipients: 1) governments, 2) the shipping industry, and 3) the private sector more broadly. Funding would be disbursed to groups of recipients through a—potentially third-party governed—fund. Ideally, the decision on the recipients of carbon revenues would be based on who is best positioned to achieve the aims of different carbon revenue uses. Three broad aims of carbon revenue use can be considered as follows:

- Achieving maximum climate and/or development outcomes;
- Supporting an equitable transition;
- Ensuring an adequate functioning of the mid-term measure and the distribution of revenues.

Achieving maximum climate and/or development outcomes

Climate and development finance can target either the public or the private sector: the two types of finance are complementary. Usually, climate and development finance that targets the public sector of developing countries can support the setting up of adequate public institutions, the financing of public investments, and the implementation of policies that enable subsequent private sector investments. Climate and development finance that targets the private sector most often complements these efforts by directly supporting companies and related advisory services. The complementarity of public- and private-oriented climate and development finance may also exist if a share of carbon revenues was dedicated to reducing GHG emissions from shipping or to enhancing maritime transport infrastructure and capacity.

The complementarity of climate and development finance that targets the public and the private sector suggests that dedicating a share of carbon revenues from international shipping to both types of finance is likely beneficial. The optimal allocation of carbon revenues from international shipping to governments and private actors may depend on the specific revenue use.

Supporting an equitable transition

If the need to be cognizant of CBDR-RC and the Polluter Pays principle was satisfied by directing carbon revenues to selected developing countries, this need could be more easily addressed by distributing revenues to governments than to private sector actors (including the shipping industry). The relationship between a company and a country can be difficult to establish because the company may be incorporated in one country and operate primarily in a second country, with a workforce primarily composed of nationals of a third country. In international shipping, the relationship between a country and a ship can be particularly difficult to establish due to the ship's registered flag, inter-jurisdictional trading as well as the domicile of the company owning and/or operating a vessel such as a charterer, which may be different. Thus, addressing the need to be cognizant of CBDR-RC through carbon revenue use is likely more easily achieved if recipients are sovereign governments with clear affiliations to a country. A similar logic applies for the implementation of certain interpretations of the Polluter Pays principle, if this is addressed by channeling carbon revenues to climate-vulnerable countries for climate change mitigation and adaptation activities.

Addressing DNI on States may require channeling a greater share of carbon revenues to governments than CBDR-RC considerations alone would suggest. Remedying DNI presents issues similar to those that apply to using carbon revenues to address the need to be cognizant of CBDR-RC: the difficulty of linking companies to any one country militates in favor of distributing carbon revenues to governments, not the shipping industry or the private sector more broadly. Two arguments would support a similar conclusion if DNI were addressed through avoidance (ex ante). First, arguably, governments are better positioned to protect their own interests (avoiding DNI on States) than individual private companies. Second, this approach makes the government recipient more accountable than if carbon revenues were distributed to private sector actors. Higher accountability of the recipient can lead to more effective use of carbon revenues.

Ensuring an adequate functioning of the mid-term measure and the distribution of revenues

Ensuring an adequate functioning of the mid-term measure is also likely to require dedicating a share of carbon revenues to governments. Guaranteeing the adequate functioning of the mid-term measure (e.g., administration and enforcement activities) will put a transactional burden on governments, the IMO, and any other potential organization involved in these activities. Part of the carbon revenues could cover these costs.

The analysis presented in this technical paper suggests that a significant share of carbon revenues should go to the governments of developing countries. As discussed above, this is necessary to address equity concerns related to the need to address DNI, the need to be cognizant of CBDR-RC, and to support an adequate functioning of the mid-term measure. Distributing carbon revenues to governments can also help to maximize climate and development outcomes. Achieving climate and development outcomes most effectively, however, may require splitting revenues among governments and private sector actors, including, potentially, the shipping industry. On these grounds, a certain share of carbon revenues could be disbursed to the private sector, too.

HOW COULD ADEQUATE GOVERNANCE AND MANAGEMENT OF CARBON REVENUES FROM INTERNATIONAL SHIPPING BE IMAGINED?

The technical paper discusses five key topics related to the governance and management of carbon revenues from shipping. These topics are 1) whether revenues should be disbursed by an existing fund or a new fund; 2) the role of the IMO in the governance of carbon revenues from shipping; 3) how to address challenges of managing carbon revenues actively; 4) how to select revenue distribution criteria if a new fund was to be created; 5) how to ensure that no country is left behind in the distribution of carbon revenues. The key findings of the analysis are presented below.

The case to disburse revenues through a new fund seems stronger for carbon revenues dedicated exclusively to sector-specific goals than for revenues used for more general climate or development finance. Carbon revenues could be disbursed through an existing or a new fund. In making the choice between these two options, the following considerations will need to be taken into account:

- **Donor-recipient dynamics:** Carbon revenues from international shipping are not easily attributable to a specific country. They, therefore, do not reflect the common donor-recipient dynamics that characterize many climate finance funds today. This feature of carbon revenues from international shipping may suggest disbursing them through a new fund that does not reflect common donor-recipient dynamics.

- **Sector specificities:** Carbon revenue uses that are more related to shipping's decarbonization may pose sector-specific challenges that can justify creating a specialized fund with a clear mission, specific expertise, and decision-making processes tailored to the sector's needs. These specific needs are not necessarily present if carbon revenues are more generally dedicated to climate or development finance. However, if carbon revenues were used to finance land-based investments in zero-carbon bunker fuels through a shipping decarbonization-specialized fund, it would be important that the relevant non-shipping-related expertise is included in the governance of the fund.

- **Redundancy:** The fragmentation of climate and development finance and the lack of strong coordination mechanisms among funds create risks of redundant investments. Creating a new fund may further exacerbate this problem. The duplication of efforts tends to be less of an issue when funds have a specific mission, as it could be for a fund that aims to finance investments related to shipping decarbonization. Risks of effort duplication might be higher for shipping decarbonization investments related to the production and distribution of zero-carbon bunker fuels.

- **Fragmentation of finance and reporting:** Creating a new fund with its own access criteria would further increase the fragmentation of climate and development finance and risk increasing the burden for potential recipients. Setting up training and support services for potential recipients—especially recipients with restricted capacity—may help address this issue.

- **Operational costs:** Running a new fund is likely to cause higher operational costs than channeling funding through an existing fund.

- **Transaction costs:** The benefits of creating a new fund will need to be balanced against the potential additional costs and time needed to set it up.

Overall, the analysis indicates that the case for a new fund is stronger if revenues were used in-sector than if revenues were used out-of-sector. This is because, if revenues were used in-sector, the benefits of disbursing carbon revenues through a new fund would likely be higher (e.g., addressing sector-specific needs and ensuring that adequate expertise is present in the fund), and risks would likely be lower (e.g., avoiding duplication of efforts) than if revenues were used for more general climate or development finance. In contrast, the case for using an existing fund appears stronger for out-of-sector revenue uses than for in-sector ones.

Governance arrangements suggests that the IMO needs to have a strong role in sector-related revenue uses but a lesser one in their use for wider climate and/or development aims. The IMO is uniquely positioned to have a strong say in the governance of carbon revenues used to finance shipping-related investments. However, the IMO appears less well positioned to govern broader types of carbon revenue uses, such as financing climate mitigation and adaptation or development more generally in other sectors. Governance arrangements of carbon revenues from international shipping should reflect these considerations.

If a new fund was established, relying on the trustee services of an organization with substantial experience in managing climate and development finance may reduce the need to rely on passive forms of carbon revenue use. Relying on passive forms of carbon revenue use, such as a revenue-neutral feebate scheme, would have the key advantage of higher cost-effectiveness of carbon revenue management compared to uses that require active management. However, some carbon revenue-use options that require active management might be preferred on other grounds (for example, potential climate, development, or distributional outcomes). If the active management revenue-use option was

preferred and a new fund was established (either for shipping-specific funding or for climate or development finance more generally), relying on the trustee services of an existing organization with substantial experience in climate change finance can kickstart and facilitate its functioning and create trust among stakeholders. Entrusting the management of carbon revenues from shipping to a global organization would help ensure that the interests of all the main stakeholders of international shipping are represented.

Lessons learned from managing previous climate finance funds could be harnessed to help establish adequate criteria for distributing carbon revenues from international shipping and ensure that no one is left behind. There is significant expertise in many development organizations on how to set up adequate resource allocation frameworks and ensure that potential recipients with a lower capacity to access funding are not put at a disadvantage. This experience could be harnessed to ensure that carbon revenues from shipping are adequately disbursed. A key option to make access to funding more inclusive is to reserve a share of carbon revenues for selected countries (e.g., some LDCs, SIDS, and African countries) and organize the access through a less competitive and simplified application processes.

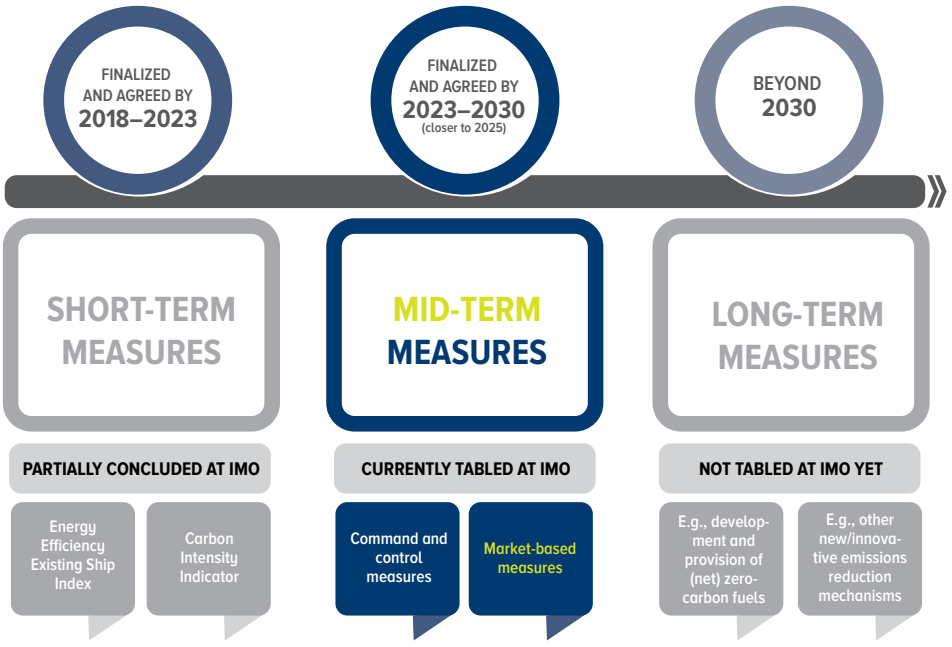
In the case of a revenue-raising mid-term measure, action should be taken to ensure that the potential volatility of carbon revenues does not threaten the financial viability of projects to be funded. Experience shows that unexpected drops in carbon revenue raised can pose risks for the realization of projects to be financed. Two main options to address such risks are 1) to design a carbon pricing instrument that yields predictable revenue flows (e.g., if carbon pricing is implemented via cap-and-trade, by making the level of the carbon price applied more predictable over a certain timeframe through a price floor), or 2) to create a reserve which can help mitigate financial risks.

1. INTRODUCTION

In 2018, the International Maritime Organization (IMO) adopted the *Initial IMO Strategy on the reduction of GHG emissions from ships* (Initial IMO GHG Strategy) to guide the reduction of greenhouse gas (GHG) emissions from the sector (IMO 2018). The Initial IMO GHG Strategy aims to reduce annual GHG emissions from the international shipping sector by at least 50 per cent by 2050 compared to 2008, while pursuing efforts to peak GHG emissions from the international shipping sector as soon as possible and set the international shipping on a pathway consistent with the temperature goals of the Paris Agreement. Increasingly, stakeholders have been calling for even more ambitious action—i.e., to fully decarbonize the sector by mid-century (GMF 2021).

Achieving the GHG emissions reduction targets of the Initial IMO GHG Strategy requires implementing effective mid-term measures. Market forces alone will not be sufficient to close the gap between current prices of fossil-based bunker fuels and zero-carbon bunker fuels. Consequently, existing short-term regulations will need to be complemented with more stringent mid-term ones (Baresic et al. 2022). The Initial IMO GHG Strategy envisions mid-term measures to be finalized and agreed soon (between 2023 and 2030). Recent submissions to the Marine Environment Protection Committee (MEPC) discuss different types of mid-term measures that could be adopted to support the achievement of the Initial IMO GHG Strategy targets (for example, Austria et al. 2021; Belgium et al. 2019; United Kingdom 2020; Denmark et al. 2021; ICS and Intercrop 2021; Marshall Islands and Solomon Islands 2021a; Norway 2021a; Norway 2021b; Norway 2021c).

FIGURE 1: MEASURES ENVISAGED UNDER THE INITIAL IMO GHG STRATEGY WITH RESPECTIVE TIMELINES



Some types of mid-term measures can raise revenues. Two kinds of mid-term measures that can raise revenues are carbon levies[8] and some forms of cap-and-trade.[9] The primary aim of these instruments is to put a price on GHG emissions and thereby incentivize the decarbonization of the sector.[10] If the level of carbon pricing is set accordingly, these measures also make polluters internalize the social cost of climate change, thereby ensuring that the costs of the shipping industry reflect the climate-related harm caused by this sector. At the United Nations Framework Convention on Climate Change (UNFCCC) 26th Conference of the Parties (COP26), the Climate Vulnerable Forum, consisting of 55 governments, called in its Dhaka-Glasgow Declaration for "establishing a mandatory GHG levy on international shipping to ensure that IMO emission measures are fully aligned with a 1.5°C pathway" (CVF 2021). At the same event, more than 230 industry leaders also emphasized the need for meaningful market-based measures in the form of carbon pricing in their collective call for action for shipping decarbonization (GMF 2021).

These carbon revenues can create opportunities for additional actions. As indicated, besides inducing mitigation, abatements and correcting an externality, carbon pricing instruments can also raise revenues, thereby potentially allowing for the implementation of additional actions. Such additional actions can include, for instance: helping to align the decarbonization of international shipping with the Initial IMO GHG Strategy, achieving additional climate and non-climate development benefits, or addressing political concerns that hinder higher ambition in decarbonizing the shipping sector. Due to their double benefit of inducing mitigation and raising revenues, revenue-raising carbon pricing instruments deserve particular attention.

There is an ongoing debate at MEPC on how potential carbon revenues from international shipping could be used, managed, and governed. Many recent submissions have discussed options for carbon revenue use and for how to ensure an adequate management and governance of carbon revenues (examples include: Argentina et al. 2021; Denmark et al. 2021; Marshall Islands and Solomon Islands 2021a; ICS and Intercargo 2021; Norway 2021b; Norway 2021c). Some Member States have expressed their views on these issues at MEPC 75 and MEPC 76, for instance regarding the establishment of an international maritime research and development board (IMRB), its governance structure, and its relation with the implementation of a market-based measure.

This technical paper aims to contribute to this debate by addressing three questions. The technical paper starts by discussing the types of mid-term measures that can raise revenues and how the design of these measures can affect the amount and predictability of revenues raised (**Chapter 2**), before exploring the following three broad questions:

8 The term "carbon levy" is sometimes used interchangeably with "carbon tax". This report adopts the term "carbon levy" but this should not be seen as indicating a preference for a particular design of the carbon pricing instrument.

9 There are other types of measures that could raise revenues, such as fuel levies that do not target the carbon content or emissions released in burning bunker fuels. This report does not discuss these alternative options because they are less effective in inducing GHG abatements compared to carbon levies and cap-and-trade.

10 In particular, these instruments can induce GHG emission abatements by incentivizing the development and uptake of zero-carbon bunker fuels and low- or zero-carbon technical measures, the uptake of low-carbon operational measures, and the shift in consumer demand towards lighter or short-distance products (Parry et al. 2018). Zero-carbon bunker fuels, low- or zero-carbon technical measures, and low-carbon operational measures are further discussed in section 3.2.1.

- **Chapter 3: What could carbon revenues from international shipping be used for?** To answer this question, section 3.2 lays out seven carbon revenue use options and assesses their alignment with the Initial IMO GHG Strategy, their climate and other development benefits, their potential political acceptability from the industry perspective, and their need for active management. The options considered are: 1) financing in-sector climate change mitigation, 2) enhancing maritime transport infrastructure and capacity, 3) financing broader climate aims, 4) financing broader development aims, 5) financing the general fiscal budget, 6) covering administrative and enforcement costs, or 7) implementing a revenue-neutral feebate scheme. The analysis presented in section 3.2 builds on section 3.1, which analyzes how revenue use could help put in practice guiding principles of the Initial IMO GHG Strategy.

- **Chapter 4: Who could be the recipients of carbon revenues from international shipping?** This technical paper discusses who among three potential groups of recipients could receive carbon revenues if the following broad aims were pursued: 1) maximize climate and other development benefits, 2) support an equitable transition, or 3) support the adequate functioning of the mid-term measures and the distribution of revenues. The three potential recipient groups considered in this technical paper are governments, the shipping sector, and the private sector more broadly. Revenues would be distributed among these potential groups of recipients through a fund.

- **Chapters 5 and 6: How could adequate governance and management of carbon revenues from international shipping be imagined?** On this aspect of the subject, this technical paper sheds light on two key topics related to the governance of carbon revenues from shipping which have been subject to recent debates at the MEPC: 1) whether revenues should be disbursed by an existing fund or a new fund (discussed in section 5.1); and 2) the role of the IMO in the governance of carbon revenues from shipping (discussed in section 5.2). In addition, the technical paper focuses on three further aspects of managing carbon revenues: 1) how to address challenges of managing carbon revenues actively (section 6.1); 2) how to select revenue distribution criteria if a new fund was created (section 6.2); and 3) how to ensure that no country is left behind in the distribution of carbon revenues (section 6.3).

- **Chapter 7** concludes this technical paper and presents the key findings.

2. MID-TERM MEASURES AND CARBON REVENUES

This chapter discusses types of mid-term measures that can raise revenues focusing on design features which affect the amount and predictability of revenue raised. The amount of revenues raised depends on the greenhouse gas (GHG) emissions covered and the level of the carbon price. These two aspects are discussed in subsection 2.1.1. The predictability of the revenue raised depends on the predictability of the GHG emissions covered and of the carbon price applied; these two aspects are discussed in subsection 2.1.2. The predictability of the revenue raised is important for carbon revenue use because unpredictable revenue flows can create fiscal risks. Section 2.2 discusses how potential fiscal risks could be reduced. Section 2.1 is complemented by Annex 1, and together, these two parts of the technical paper also serve as an introduction to cap-and-trade and carbon levies for readers not familiar with the basics of carbon pricing. Readers familiar with this topic are asked to move directly to section 2.2.

There are obviously other types of potential mid-term measures that can reduce GHG emissions but do not raise revenues. These measures could be implemented as substitutes or complements of the measures discussed in this chapter and are briefly reviewed in Box 1.

BOX 1: NON-REVENUE RAISING MID-TERM MEASURES

There are various types of mid-term measures that could reduce GHG emissions but do not raise revenues. These include both command and control policies, such as performance standards and fuel emission standards, and market-based measures, such as baseline-and-credit, subsidies, and cap-and-trade schemes when allowances are distributed for free. This box briefly introduces these measures indicating their basic structure and the type of GHG mitigation incentives they can set.

An example of a command and control instrument is that of performance standards. These standards mandate the achievement of a GHG emission goal without dictating the adoption of particular technologies. There are different types of performance standards, each providing different incentives to reduce emissions. Recently, the International Maritime Organization (IMO) has implemented two types of performance standards that aim to reduce GHG emissions: Energy Efficiency Existing Ship Index (EEXI) and Carbon Intensity Indicator (CII). EEXI is a technical measure that requires new ships to meet a level of energy efficiency per capacity mile. Focusing on ship design, EEXI incentivizes the research, development, and adoption of low-and zero-carbon technologies and fuels. In return, the CII measures how efficiently a ship transports goods or passengers and is measured in grams of CO2 emitted per cargo-carrying capacity and nautical mile (DNV n.d.). It is an operational measure under which ships are expected to achieve a CII on a yearly basis, based on which they are given an annual rating ranging

continues on page 7

from A to E. Ships can meet the standard through a variety of actions, including speed reduction and optimization, use of low- or zero-carbon fuels or alternative sources, or adopting technologies that improve energy efficiency. To the extent that performance standards result in an increase in transport costs, they may incentivize trade switches towards lighter and less-distant products. Performance standards implemented so far are deemed insufficient to meet the Initial IMO GHG Strategy mitigation targets and will need to be complemented with other policies (Baresic et al. 2022).

Another form of command and control regulation that could be implemented to decarbonize international shipping is fuel emission standards. A fuel emission standard sets a limit on the maximum GHG emissions of a fuel. Fuel emission standards do not mandate the adoption of any specific technology, fuel type, or compliance strategy. A fuel emission standard incentivizes research, development, and deployment of low-GHG fuels. To the extent that the instrument results in an increase in fuel prices, it can also incentivize trade switches towards lighter and less-distant products (Yeh et al. 2016).

A type of market-based measure that does not raise revenues is baseline-and-credit. Under a baseline-and-credit scheme, a GHG emission intensity benchmark is set against a baseline. Entities that emit less than the baseline receive credits that they can sell to entities that emit more than the baseline. Baseline-and-credit incentivizes investments in low- and zero-carbon fuels and technologies, as well as other action that improves the operational efficiency or reduces the carbon intensity of shipping. This carbon pricing instrument can also incentivize trade shifts towards lighter and lower-distance goods transportation.

Green subsidies are another type of market-based measure. In the context of shipping decarbonization, green subsidies could support the research, development, and deployment of zero-carbon fuels or other zero-or-low carbon technologies (Baresic et al. 2022).

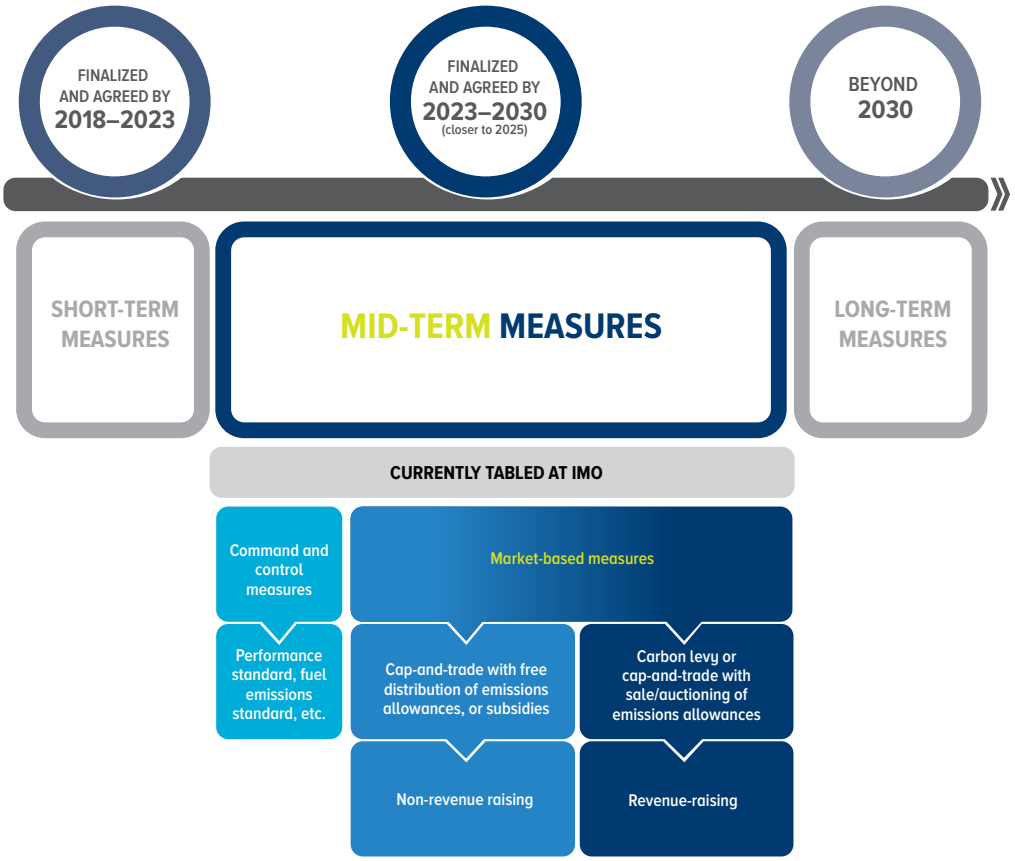
Another type of market-based measure that does not raise revenues is a cap-and-trade scheme where allowances are distributed for free. To then reduce GHG emissions still further, a cap-and-trade scheme needs a reduction factor for the available allowances over time. Cap-and-trade schemes are further discussed in the main text.

2.1 REVENUE-RAISING MID-TERM MEASURES: KEY FEATURES

Two types of mid-term measures that can raise revenues are carbon levies and cap-and-trade schemes. Carbon levies are levies that target the carbon content or GHG emissions released in consuming bunker fuels. Under a cap-and-trade scheme, authorities set a cap on GHG emissions and allocate GHG emission allowances among regulated agents. Allowances can be distributed for free or sold (either at a fixed price or through an auction). It is only when allowances are sold that cap-and-trade schemes can raise revenues. The regulated entities are requested to surrender these allowances for their GHG emissions at the end of each compliance period (most often annually) and can exchange them on the

secondary market. The remainder of this sub-section discusses key aspects of carbon levies and cap-and-trade schemes that are relevant for the amount and predictability of carbon revenue raised: that is, the GHG emissions covered, the level of carbon price applied, and the predictability of GHG emissions covered and of the carbon price applied.

FIGURE 2: POSSIBLE MARKET-BASED MEASURES AND THEIR POTENTIAL TO RAISE REVENUES IN THE CONTEXT OF THE INITIAL IMO GHG STRATEGY



2.1.1 GHG emissions covered, and level of carbon price applied

Various factors determine the amount of GHG emissions under a specific carbon pricing instrument. In the shipping sector, these factors include: 1) the geographical scope of the scheme and type of vessels covered by it;[11] 2) the type of GHGs under the carbon pricing instrument (e.g., carbon dioxide, methane, black carbon); and 3) whether the carbon pricing instrument covers well-to-tank (WTT) GHG emissions (i.e., up- and midstream),[12] tank-to-propeller (TTP) GHG emissions (i.e., downstream GHG emissions),[13] or full well-to-wake (WTW) GHG emissions (i.e., up-, mid-, and downstream GHG emissions).[14] Annex 1 discusses the importance of covering WTW GHG emissions under a lifecycle analysis approach to

11 In this analysis, a global coverage is assumed. The total number of compliance agents under a carbon pricing scheme in international shipping depends on how far upstream (e.g. at the level of the bunker fuel suppliers) or downstream (e.g. at the level of each individual vessel) a carbon price may be applied. As a consequence, the number could range from 45 licensed bunker fuel suppliers as of 2021 (Reuters, 2021) to up to 100,000 vessels of 100 gross tons and above (UNCTAD, 2021).
12 WTT covers GHG emissions released upstream, in the extraction, production, and transportation of a bunker fuel.
13 TTP covers downstream GHG emissions from the combustion of a bunker fuel on a vessel.
14 These include both TTP and WTT GHG emissions.

ensure the environmental integrity of the carbon pricing instrument and to prevent the continued use of less carbon-intensive fossil fuels which appear favorable when considering TTP emissions only.

There are mostly two main benchmark carbon prices that a carbon levy or a cap-and-trade scheme could aim to apply (IMF 2019).[15] One option is to apply the carbon price equal to the social cost of carbon (SCC). The SCC reflects the harm generated by releasing an additional ton of GHG— e.g., future harm due to more frequent droughts and sea level rising—expressed in present monetary value (Nordhaus 2017). Estimates of the SCC can vary significantly, depending on the assumptions used in the analysis. These relate, for instance, to what quantity of GHGs will be emitted in the future and the discount rate applied to future damages. Recent estimates vary from $10 to $1000 per ton of carbon.[16] Setting the carbon price level at the SCC internalizes the climate externality, ensuring that the costs of the shipping industry account for the climate harm caused by maritime transport. An alternative option to the SCC is to estimate the carbon price level needed to deliver a specific mitigation or temperature target. For instance, Baresic et al. (2022) find that meeting the minimum mitigation target of the Initial IMO GHG Strategy requires implementing an average carbon price of $173 per ton of carbon. This estimate assumes no in-sector recycling of revenues; the price could be lower if revenues are used for in-sector mitigation.

Historically, the most ambitious carbon price levels have been applied through carbon levies, not cap-and-trade schemes. Regulators have a higher degree of control over the carbon price applied under a carbon levy because they can set this level directly. Under cap-and-trade schemes, there are factors not controlled by regulators that can determine the level of carbon price applied, such as the business cycle, weather conditions, and speculation (Friedrich et al. 2020). Historically, allowance prices in major cap-and-trade schemes have been remarkably low. Recent reforms have been implemented to address this issue, as discussed in the next section.

2.1.2 Predictability of the carbon price applied and the GHG emissions covered

A key feature of any carbon pricing scheme is the predictability of the carbon price applied, which also influences the predictability of the revenue raised. This subsection discusses key design features of carbon levies and cap-and-trade that influence the predictability of the carbon price applied. In addition, it discusses the predictability of the GHG emissions covered.

Simple forms of carbon levies tend to apply a more predictable carbon price level than simple forms of cap-and-trade schemes. Under a carbon levy, the price level applied can be made highly predictable—for instance, if the rate varies according to a predetermined schedule that is difficult to change (e.g., because changing the schedule would require undergoing difficult political negotiations). As discussed above, under simple forms of cap-and-trade schemes, the price applied is determined by various factors, some of which are

15 For a broader review of potential ways to establish carbon price levels see Parry et al. (2018).
16 See Ricke et al. (2018), reviewing some of the recent studies on the SCC.

not easily controlled by regulators (e.g., economic recessions). The carbon price applied under cap-and-trade schemes is therefore less predictable, both in the short and in the long term.

Price control mechanisms (PCMs) can help to stabilize allowance prices in cap-and-trade schemes. There is some evidence that PCMs are proving resilient to a significant macroeconomic shock like the COVID-19 pandemic. An example is the European Union (EU) Emission Trading System (ETS) Market Stability Reserve (Azarova and Mier 2021). Box 2 discusses some of the main types of PCMs in use so far.

BOX 2: TYPES OF PRICE CONTROL MECHANISMS

There are different types of PCMs currently adopted in cap-and-trade systems around the world. Two relevant dimensions along which PCMs can be distinguished are: 1) whether they are price-based, or 2) whether they are automatic.

Most PCMs currently in place are price-based. Under a price-based PCM, a price ceiling or floor is triggered when the price of allowances reaches an upper limit or a lower one, respectively (Galdi et al. 2021). For instance, the California ETS contains a price ceiling: if a price threshold is passed, new allowances are offered at the price ceiling (Sullivan et al. 2021).

The main exception is the EU ETS Market Stability Reserve (MSR). The EU ETS allows banking of allowances, meaning that regulated entities that have a surplus of allowances at the end of a trading phase can decide to keep them and use them in the next trading phase. Under the MSR, allowances are injected or withdrawn from the EU ETS market based on the quantity of allowances in the market.

Some PCMs are automatic, while others necessitate action by regulators to be activated. Automatic PCMs leave no discretion on whether they are triggered, meaning that once the conditions are met for their activation, regulators have no discretion on whether the mechanism is activated. The California ETS is an example of a scheme with an automatic PCM. Other types of PCMs need to be activated. For instance, regulators have discretion on whether to activate PCMs in many of the subnational ETS systems implemented in China (Galdi et al. 2021).

Well-designed PCMs can effectively reduce differences between carbon levies and cap-and-trade schemes (Dominioni and Faure 2022). By making the carbon price applied more predictable and controllable, well-designed PCMs can reduce the differences between carbon levies and cap-and-trade schemes. Some significant differences between these two carbon pricing instruments will remain, however, such as the higher short-term variability of carbon prices under cap-and-trade schemes and the lower certainty of emission reductions. These differences are further discussed in Annex 1.

Another determinant of the predictability of the revenue raised is the predictability of the GHG emissions covered. There is significant data available on the GHG emissions from shipping which allow for credible predictions about the long-term GHG emissions from the sector (IMO, 2020). However, in the short-term, GHG emissions can be difficult to predict, especially due to potential drops in the demand for shipping services linked to economic downturns in large trading countries and the ensuing reductions in GHG emissions from the sector.

2.2 RELEVANCE FOR REVENUE RAISING

The GHG coverage of the carbon pricing instrument, the carbon price applied, and the price predictability have important implications for the revenues raised through carbon pricing. Carbon revenues are the product of the carbon price applied and the GHG emissions covered by the carbon pricing instrument. Thus, yearly carbon revenues may vary over time due to changes in the carbon price applied and/or the emissions released. If the carbon pricing instrument is effective in decarbonizing the sector, at some point, the carbon revenues raised yearly will decline and will eventually reach zero.[17]

Unpredictable carbon price levels can create fiscal risks. Since the level of carbon price applied is one of the factors that determines revenue raised, less predictable carbon price levels can create fiscal risks. Imagine that a project, (partly) financed by carbon revenues, requires a certain amount of money raised from the carbon pricing instrument to be invested every year. Unexpected fluctuations in revenue streams may jeopardize the realization of such a project if the funding available becomes insufficient to cover the programmed expenses.

Creating reserves can help to address fiscal risks. The share of revenues allocated to reserves will need to be tailored to the degree of unpredictability of revenue flows—which will partially depend on the carbon pricing instrument design (as explained in section 2.1)—and the type of projects financed (e.g., projects financed through revenues to be raised in the future vs. projects financed through revenues already raised). Establishing an adequate long-term investment plan can help minimize fiscal risks in case revenues decrease over time due to reduced emissions from the sector.

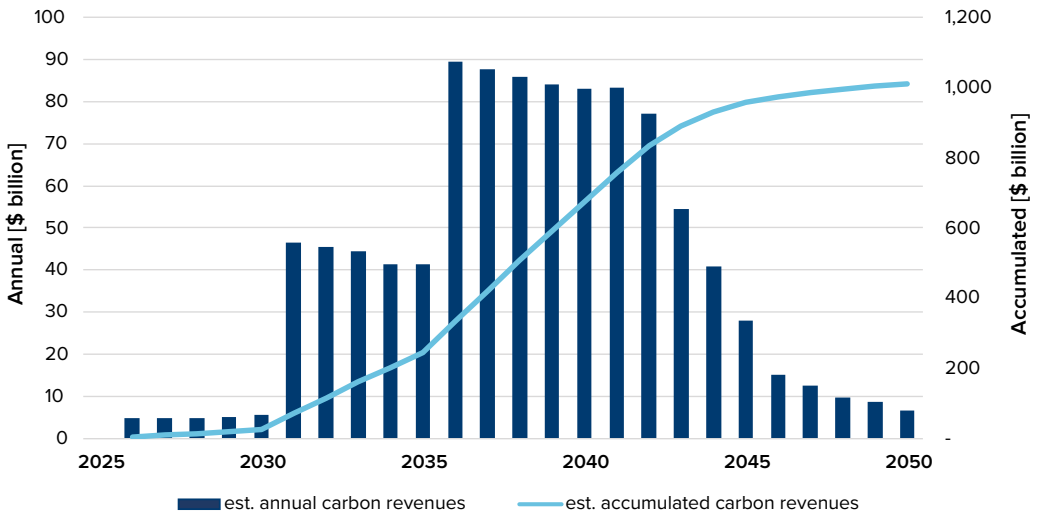
17 There can be trade-offs between the level of the levy and the amount of revenue raised (Laffer curve).

3. USING CARBON REVENUES FROM INTERNATIONAL SHIPPING

Implementing carbon pricing in international shipping can raise significant revenues. A recent study finds that a carbon price applied in a scenario where the minimum mitigation targets of the Initial IMO GHG Strategy are met could raise between $1.3 to $2.6 trillion in total (Baresic et al. 2022). Under a full decarbonization scenario, carbon revenues raised would be between $1 and $2 trillion (Baresic et al. 2022). According to another study, a flat carbon levy of $250/ton of GHG would raise $3.7 trillion by 2050 (Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping 2021). Depending on different modelling assumptions, estimates for carbon revenues from international shipping could imply an average of around $40 to $60 billion of annual revenues (see Box 3).

BOX 3: POTENTIAL SCALE OF CARBON REVENUES FROM INTERNATIONAL SHIPPING BASED ON TWO SELECTED EXAMPLES

FIGURE B3.1: 100% REVENUE RECYCLING TO SUPPORT SHIPPING'S DECARBONIZATION



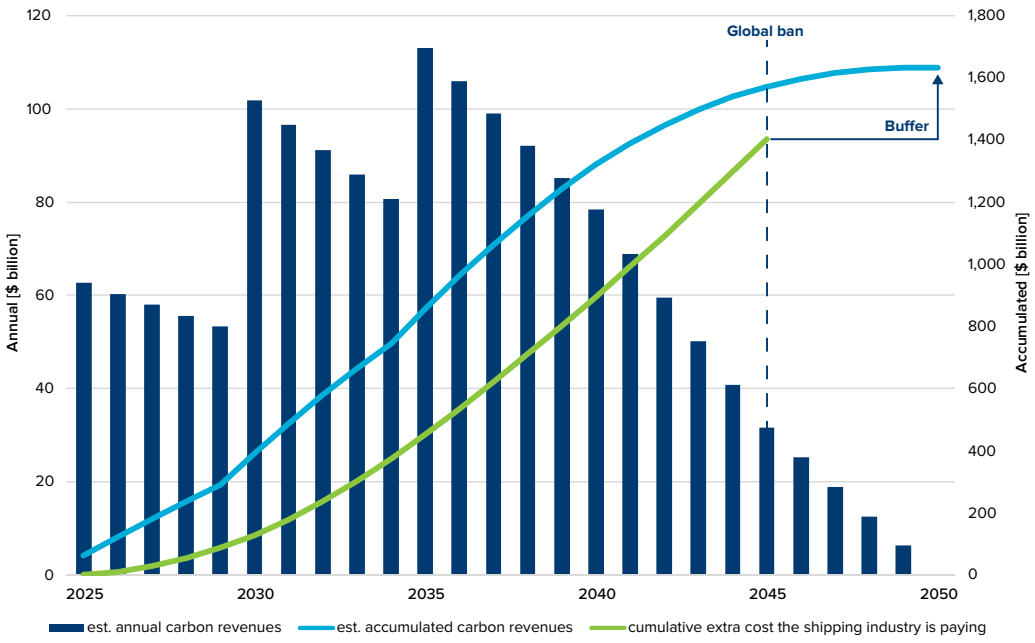
Based on techno-economic modelling conducted for the Getting to Zero Coalition[a] it is estimated that to fully decarbonize international shipping by 2050, the average carbon price would need to be around $191/ton CO2 and reach a maximum of around $358/ton CO2. Carbon prices could however be lower if revenues generated by the market-based measures are recycled to further support decarbonization of shipping, for example by subsidizing the deployment of zero-emission fuels and technologies. If 100 percent of revenues were recycled to support shipping decarbonization, in theory, this could lower the carbon price level by up to half, i.e., to an average of $96/ton CO2 and a maximum of $179/ton CO2 (but this would mean no revenues are left for other purposes, such as enabling an equitable transition). Depending on the level of revenue recycling, the average amount of revenue collected would range between $41 billion and

continues on page 14

$81 billion per annum, totaling between $1 trillion and $2 trillion.

Note:* *The collected revenue should be considered in terms of the total amount of available revenue which can be distributed over the period of decarbonization (from 2025–2050), rather than assuming the revenue will be deployed only in the year it is collected. This scenario generally provides more subsidy/support for zero-emission fuels early in the transition when price spreads to zero-emission fuels are expected to be highest, and less towards the end of the transition when zero-emission fuels are more established and have a lower price spread.*

FIGURE B3.2: 'EARMARK AND RETURN' WITH BUFFER FOR WIDER USE



The Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping[b] illustrates an 'earmark and return' global carbon levy system, coupled with a global ban on fossil-fueled vessels once most of the fleet has transitioned to alternative bunker fuels. Based on such an earmark and return logic, the carbon levy needs to be at least large enough to cover the cumulative extra cost the shipping industry is paying relative to a fossil fuel baseline in a transition to zero emissions by 2050. The projections above are made assuming a carbon price starting at $50 (2025) with two hikes to $100 (2030) and $150 (2035) respectively. With these assumptions, the levy scheme accumulates funds to cover the extra cost for alternative fuels to the shipping industry. Additionally, the scheme accumulates carbon revenues of approx. $300 billion as a buffer, which can be used to address DNI amongst others.

Note:* *The data related to the earmark and return proposal stems from the Industry Transition Strategy. It is important to note that the accumulated cost gap during the transition is the difference between estimates of the cost of production of alternative fuels and the baseline cost being a forward-looking curve for the price of very low sulphur fuel oil (VLSFO) and liquified natural gas (LNG). The carbon price levels required to facilitate a transition (and enabling a buffer as well) would change with a) the fossil fuel price assumptions and b) the impact of key assumptions underlying the alternative fuels cost, e.g., levelized cost of electricity.*

continues on page 15

**The notes were provided by the respective authors of the two studies.*

a Baresic, Domagoj, Isabelle Rojon, Alison Shaw, and Nishatabbas Rehmatulla. (2022). "Closing the Gap: An Overview of the Policy Options to Close the Competitiveness Gap and Enable an Equitable Zero-Emission Fuel Transition in Shipping." Prepared by UMAS, London. Link

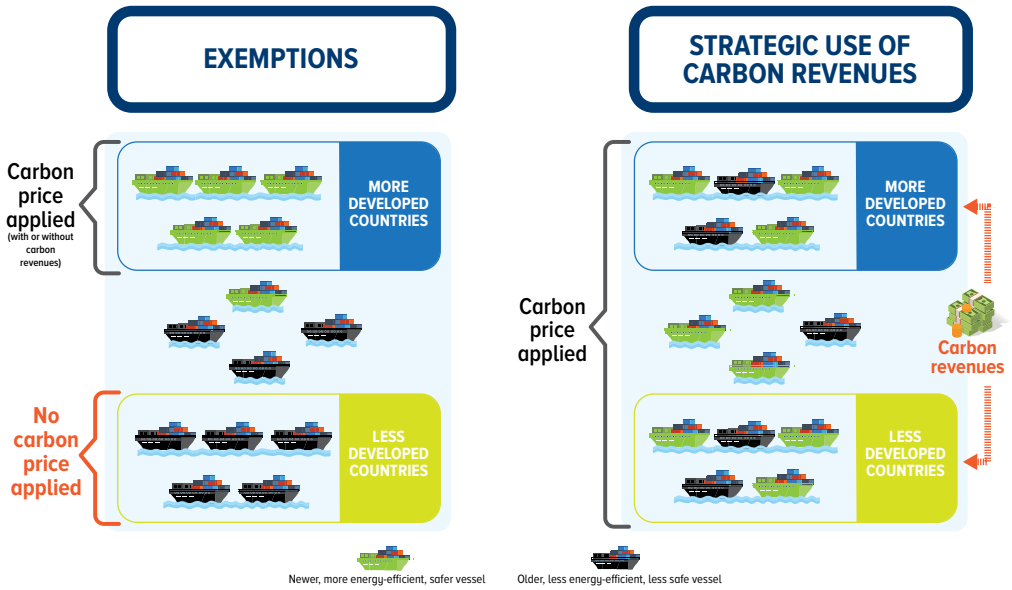
b Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping. 2021. "Industry Transition Strategy." Copenhagen: Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping. Link

Raising these revenues offers the opportunity to implement an additional set of actions. The Initial IMO GHG Strategy sets the goal to reduce greenhouse gas (GHG) emissions from international shipping to zero and includes guiding principles that are to guide the decarbonization process. This chapter discusses how carbon revenue use could help align the decarbonization of international shipping with the guiding principles of the Initial IMO GHG Strategy (section 3.1). This analysis informs the second part of this chapter (section 3.2), which discusses how various options for carbon revenue use: 1) would align with the Initial IMO GHG Strategy; 2) would deliver climate and non-climate development benefits; 3) are likely to perform in terms of political acceptability, and 4) would require active management of funding.

3.1 GUIDING PRINCIPLES OF THE INITIAL IMO GHG STRATEGY AND CARBON REVENUE USE

This section discusses how carbon revenue use can help to align the decarbonization of international shipping with the Initial IMO GHG Strategy. Particular attention is given to the principles of addressing the need to be cognizant of the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) and addressing disproportionately negative impacts (DNI). This focus is due to the relevance of these two principles in recent submissions to the International Maritime Organization (IMO) and related discussions at the Marine Environment Protection Committee (MEPC). The section also discusses other relevant principles that are not explicitly mentioned in the Initial IMO GHG Strategy, but which have been put forward by some stakeholders as applicable in the context of mid-term measures. These are the principle of Highest Possible Ambition and the Polluter Pays principle (Marshall Islands and Solomon Islands, 2021a). Before starting the analysis, two clarifications are due.

FIGURE 3: TWO MAIN SOLUTIONS CONSIDERED TO ADDRESS THE CHALLENGES RESULTING FROM THE NEED FOR AN EQUITABLE TRANSITION



First, while some of the guiding principles of the Initial IMO GHG Strategy could be operationalized also by implementing exemptions, this approach poses the risks of adverse consequences and does not guarantee an equitable transition. In the context of carbon pricing in international shipping, addressing the need to be cognizant of CBDR-RC or addressing DNI could also take the form of regulatory exemptions[18] (e.g., for certain routes) or lower carbon prices on routes from/to developing countries or disproportionately negatively affected countries. However, exemptions may yield a number of adverse consequences, such as the deployment of older, usually less energy-efficient vessels on these exempted routes. This may pose safety and local pollution problems and distort competition (Dominioni, Heine, and Martinez Romera 2018; Psaraftis and Lagouvardou 2019; CE DELFT 2021). In addition, route-based exemptions imply that investments to reduce emissions are weakened on certain routes, potentially leaving some countries behind on the uptake of low- and zero-carbon technologies and the related economic opportunities (CE DELFT 2021). Furthermore, exemptions grant benefits that could be shared with developed countries that import from and export to developing countries (Dominioni, Heine, and Martinez Romera 2018), thus potentially undermining the aim of ensuring an equitable transition. For all these reasons, route-based exemptions appear to be an inferior approach to address the need to be cognizant of CBDR-RC and address DNI compared to carbon-revenue use.

Second, this technical paper is agnostic on whether further principles included in other International Maritime Organization (IMO) instruments may represent an obstacle to address the need to be cognizant of CBDR-RC through carbon revenue use. For instance, the Initial IMO GHG Strategy recognizes the need to be cognizant of "the principle of non-discrimination and the principle of no more favorable treatment, enshrined in the

18 Note, however, that full exemptions implemented without being phased out over time may not be compatible with CBDR-RC, as discussed below in section 3.1.1.

International Convention for the Prevention of Pollution from Ships (MARPOL) and other IMO conventions" (IMO 2018 at 3.2.1.1). There is a debate on whether these principles are an obstacle to addressing the need to be cognizant of CBDR-RC. Past negotiations have not clarified whether these principles are incompatible with CBDR-RC and whether they apply only to ships or also to countries. IMO Member States have held disparate positions on these points (Aidun, Metzger, and Gerrard 2021). This technical paper does not take a position on this question.

3.1.1 The need to be cognizant of the principle of CBDR-RC

The Initial IMO GHG Strategy recognizes as a guiding principle the need to be cognizant of principles such as CBDR-RC. In particular, it requires to be cognizant of the principle of CBDR-RC "in the light of different national circumstances, enshrined in the United Nations Framework Convention on Climate Change (UNFCCC), its Kyoto Protocol and the Paris Agreement." (IMO 2018 at 3.2.1.2) The meaning of CBDR-RC is debated,[19] but generally it has two main components. The first component concerns the common responsibility[20] of states to address the climate problem, and the second component concerns the need to account for differing circumstances among states regarding their contribution to the climate problem and their ability to address it (Sands and Peel 2012). The differentiated responsibility component suggests granting more favorable conditions to countries that have contributed (or are projected to contribute) less to climate change and/or have less capacity to address climate change. In the Paris Agreement's version of the CBDR-RC principle, the responsibilities and capabilities of states need to be read in a flexible and dynamic manner ("in the light of different national circumstances"), which might allow accounting for further elements in the positive differentiation, such as population size, abatement costs, and opportunity costs (Voigt and Ferreira 2016). Although the CBDR-RC principle represents one of the cornerstones of the UNFCCC regime, the exact meaning of CBDR-RC is debated and the IMO has not adopted a formal definition of this principle yet.

Carbon revenue use may help to address the need to be cognizant of the principle of CBDR-RC in a targeted manner. Research suggests that the operationalization of the CBDR-RC principle could take various forms. A distinction exists between differentiation 1) in central obligations and in the implementation of central obligations, and 2) in provisions granting assistance (Martinez Romera and van Asselt, 2015). If the choice was made to address the need to be cognizant of CBDR-RC via assistance measures, strategic revenue use could be a way to do so. In particular, this need could be addressed by distributing carbon revenues to selected countries based on their contribution to climate change and their capacity to address the climate challenge.[21]

Since the IMO has not adopted a definition of CBDR-RC, it is unclear whether addressing the need to be cognizant of CBDR-RC calls for specific revenue uses. On the one hand, the "capacity" component of CBDR-RC may call for revenue uses that support countries with less capacity to address climate change by financing climate change mitigation and adaptation

19 For a fuller discussion, see Rajamani (2016)
20 Implementing full exemptions on certain routes could be incompatible with the common responsibility component of CBDR-RC, especially if these exemptions are not phased out over time.
21 An adequate distribution key would need to be agreed upon. While there are methodologies to estimate the historical GHG emissions of countries (see, for instance Hohne et al. 2011), identifying countries' capacity to address climate change is likely more challenging—at least from a political standpoint.

projects in these countries. On the other hand, the "historical and future contribution to climate change" component may call for reducing the costs of mitigation and adaptation in countries that have contributed (or are expected to contribute) less to climate change. However, what counts as reducing the costs of mitigation and adaptation is not clear yet. IMO Member States could decide to limit the possibility to address the need to be cognizant of CBDR-RC to revenue-use options that focus more narrowly on delivering mitigation and adaptation outcomes in selected countries. Alternatively, IMO Member States could take a broader approach and decide to distribute carbon revenues to selected countries without earmarking them for climate change mitigation and adaptation. This latter approach may imply, for instance, addressing this need via periodic (or a lump sum) payments to selected countries without requiring recipient countries to prove that this funding has been used for particular climate readiness purposes.

This technical paper distinguishes two possible broad ways to address the need to be cognizant of CBDR-RC via carbon revenue use:

- **Narrow approach:** Under this narrow approach, financing climate change mitigation and/or adaptation activities in selected countries can address the need to be cognizant of CBDR-RC.

- **Broad approach:** Under this broad approach, both earmarked financing (e.g., for climate change mitigation) and non-earmarked financing of projects in selected countries can address the need to be cognizant of CBDR-RC. The broad approach encompasses the narrow approach. Thus, any carbon revenue use that aligns with the narrow approach is also aligned with the broad approach.

3.1.2 The need to consider, assess, and address the impacts on States

In international shipping, the possibility of DNI due to the implementation of mid-term measures represents one of the more contentious points in the debate on these measures. There are concerns about the effects of adopting mid-term measures[22] in international shipping on maritime transport costs and on the availability, frequency, and speed of shipping services (CE DELFT, 2021). For instance, an increase in maritime transport costs could negatively impact a state by affecting its gross domestic product and trade patterns,[23] with further potential repercussions on the provision of essential goods or services, such as food commodities or disaster response services. Rojon et al. (2021) review existing research on the likely impact of carbon pricing on transport costs and find that most studies conclude that carbon pricing may increase transport costs by 0.4 percent to 16 percent.[24] In return, impacts on import prices are found to be generally small in most studies (below one percent). Yet, commodities with a low value per unit of mass/volume tend to experience

22 These potential disproportionately negative effects of mid-term measures need to be distinguished from the negative impacts of climate change per se.

23 Note, however, that some countries may also benefit from the introduction of a carbon price in international shipping. For instance, evidence suggests that some countries may experience a positive effect on their GDP (CE DELFT, 2021).

24 These results vary depending on the assumed level of fuel price, carbon price, and the transport segment and/or product (Rojon et al. 2021).

higher impacts (Rojon et al. 2021). Some countries, such as Least Developed Countries (LDCs) and Small Island Developing States (SIDS), are likely to experience a greater increase in transport costs and related import prices than others (Rojon et al. 2021).[25] This can be due to various factors, including the higher reliance of LDCs and SIDS on maritime transport, the lack of opportunity to benefit from economies of scale, and the relatively energy-inefficient vessels that serve them.

The Initial IMO GHG Strategy calls for assessing and addressing DNI and for paying particular attention to the needs of LDCs and SIDS.[26] The Initial IMO GHG Strategy mentions a (non-exhaustive) list of factors to assess these impacts.[27] However, there is uncertainty both on how to define, measure, and potentially address DNI.[28] Discussions at MEPC 76 testify that the risks of DNI are a major concern for certain countries.

IMO Member States appear to have different positions on whether addressing DNI also addresses the need to be cognizant of CBDR-RC. This technical paper is agnostic on whether addressing DNI also addresses the need to be cognizant of CBDR-RC. The technical paper simply examines whether a particular carbon revenue use would be aligned with addressing the need to be cognizant of CBDR-RC and/or address DNI since, according to some IMO Member States, DNI and CBDR-RC represent different issues.

In general, two broad options to address DNI through carbon revenue use can be imagined:[29]

- **Avoiding DNI through carbon revenue use:** Under this option, carbon revenues are spent on reducing DNI before DNI occur (meaning that DNI are addressed ex ante). In this technical paper, avoidance refers both to partial and full avoidance.

- **Remedying DNI through carbon revenue use:** Under this option, DNI are not directly addressed, but revenues are primarily distributed to countries subject to DNI.

Avoiding DNI and remedying DNI may differ in terms of amount of revenues needed, the timing of spending, and type of disbursements. The monetary costs of avoiding

25 The consequences of higher import prices could be particularly severe in some SIDS. All SIDS have a trade deficit and for many SIDS a large part of their imports consist of goods needed to satisfy basic needs such as food, energy products, and pharmaceuticals (Psaraftis and Zis, 2021; CE DELFT, 2021). Furthermore, SIDS could also be subject to DNI due to their distance from their trading partners (CE DELFT, 2021).

26 In addressing potential DNI, the Initial IMO GHG Strategy emphasizes the need to pay particular attention to the needs of LDCs and SIDS. In the context of shipping decarbonization, it requires the carrying out of an initial and comprehensive impact assessment to ensure that LDCs and SIDS are not disadvantaged by the implementation of a GHG mitigation measure compared to other States, and that the measure does not have negative economic impacts on these countries (Aidun, Metzger, and Gerrard 2021).

27 These eight criteria are: geographic remoteness of and connectivity to main markets; cargo value and type; transport dependency; transport costs; food security; disaster response; cost-effectiveness; and socioeconomic progress and development.

28 At a Carbon Pricing Leadership Coalition/Singapore Maritime Port Authority workshop hosted by the World Bank, a list of non-exhaustive indicators to operationalize impacts were identified (MPA Singapore/CPLC, 2019): maritime transport costs; gross domestic product (GDP); UNCTADstat connectivity index; ratio of trade/GDP; energy import prices; maritime safety standards; ratio of perishable cargo/total cargo; food prices; purchasing parity; volume of food imported; historical/projected vulnerability to natural disasters; and governance capacity.

29 The impact assessment procedure described in MEPC.1/Circ.885 provides examples of how addressing disproportionately negative impacts could be operationalized, and suggests that these impacts could be avoided, remedied, or mitigated. The language used in this report reflects that used in MEPC.1/Circ.885.

harm can be significantly different from the amounts needed to remedy that harm, but it is difficult to know in the abstract whether avoiding DNI ex ante would require a higher amount of revenues than remedying them. The timescale of funding avoidance or remediation activities can also differ. Avoidance necessarily occurs ex ante (before the DNI occur), but remediation can be both ex ante or ex post (i.e., before the DNI occurs or after the DNI occurred). Building infrastructure that prevents DNI may take time (e.g., infrastructure that improves port efficiency, see section 3.2.2). Therefore, avoiding DNI might not always be a suitable option right after the carbon price is implemented. In addition, avoiding DNI may require sporadic large disbursements to finance infrastructure that reduces DNI, but then subsequent disbursements might be lower (for instance, related to the maintenance of the infrastructure). On the other hand, remedying DNI may take the form of a lump-sum payment or a continuous payment (or a combination of the two).[30]

It is likely that a combination of avoidance and remediation interventions is the most practical way forward to address DNI. Certain measures that avoid DNI might cost little compared to the impacts they prevent, but others might be much more expensive.[31] In addition, it is possible that some DNI become apparent only after they have occurred, for instance, if an ex-ante cost-benefit analysis fails to identify some DNI. Thus, a combination of avoidance and remediation interventions is likely to be the most cost-effective and practical way forward.

3.1.3 Other Potentially Relevant Principles

There are further principles that some stakeholders see as being part of the Initial IMO GHG Strategy, despite not being explicitly mentioned. Two of these principles that could be particularly relevant in the context of carbon revenue use are the principle of Highest Possible Ambition and the Polluter Pays principle (Marshall Islands and Solomon Islands 2021a).

Carbon revenue uses that support GHG-emission abatements can align with the principle of Highest Possible Ambition. The principle of Highest Possible Ambition is recognized in the Paris Agreement, and creates the expectation that parties to the agreement will put in place their best efforts to set and achieve climate change mitigation targets (Voigt and Ferreira 2016). While not explicitly mentioned in the Initial IMO GHG Strategy, it has been argued that the principle of Highest Possible Ambition recognized in the Paris Agreement also applies to the decarbonization of international shipping (MCST 2020; Aidun, Metzger, and Gerrard 2021; Marshall Islands and Solomon Islands 2021a). Some analysts see this principle as creating an imperative to reduce GHG emissions from international shipping (Aidun, Metzger, and Gerrard 2021). However, in the context of carbon revenue use, the principle could be seen as having a broader meaning, i.e., calling for carbon revenue uses that reduce GHG emissions, whether in- or out-of-sector (e.g., by financing GHG mitigation projects). The remainder of this technical paper discusses the principle of Highest Possible

30 As noted in chapter 2, there can be a tradeoff between the level of carbon price applied and the revenue raised. Similarly, impacts on states may depend on the level of the carbon price applied. Thus, the level of the carbon price applied can affect both the impacts on states and the amount of revenues available to address these impacts.

31 CE DELFT (2021) offers an estimate of the revenues needed to remedy negative impacts on LDCs and SIDS.

Ambition as if it was accepted that this principle applies to the GHG mitigation outcomes that could be reached through revenue uses. Thus, specific carbon revenue uses that reduce GHG emissions more than an alternative use could be seen as more aligned with this principle.[32]

Using carbon revenues to address climate impacts may align with certain interpretations of the Polluter Pays principle. Analysts debate the meaning of the Polluter Pays principle in climate change law and policy (Heine, Faure, and Dominioni 2020). According to the Organisation for Economic Co-operation and Development (OECD) Recommendations from 1972 and 1974, this principle means that the polluter should bear the "costs of pollution prevention and control measures" (OECD, 1972; OECD, 1974). In the context of shipping's decarbonization, it has been argued that this principle entails that carbon revenues from shipping are directed to "address environmental and societal externalities resulting from the combustion of fossil fuels within the maritime sector" (Marshall Islands and Solomon Islands, 2021a, para 20), and could be operationalized by directing carbon revenues towards mitigation and adaptation measures in vulnerable countries (Marshall Islands and Solomon Islands, 2021a). If this view was accepted, the Polluter Pays principle could provide additional guidance on how to use carbon revenues.[33]

3.2 HOW REVENUES COULD BE USED

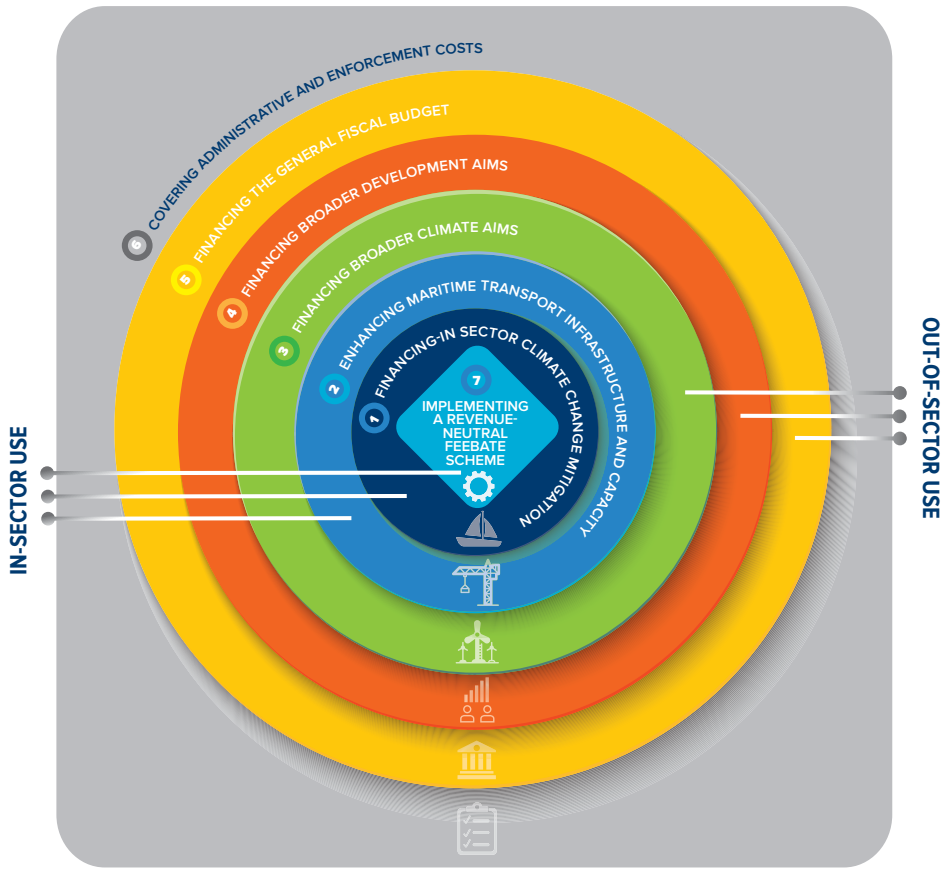
The previous section reviewed some of the guiding principles of the Initial IMO GHG Strategy and discussed how carbon revenue use could help to put them into practice. This section builds on this analytical framework to discuss how specific carbon revenue–use options would align with certain interpretations of guiding principles of the Initial IMO GHG Strategy.

There are several options for using carbon revenues—both in-sector and out-of-sector. The following options are considered in this technical paper (Figure 4): 1) financing in-sector climate change mitigation (e.g., financing zero-carbon bunker fuels production and deployment), 2) enhancing maritime transport infrastructure (e.g., improving ports) and capacity (e.g., strategies), 3) financing broader climate aims, 4) financing broader development aims, 5) financing the general fiscal budget, 6) covering administrative and enforcement costs, and 7) implementing a revenue-neutral feebate scheme. Of these options, financing in-sector climate change mitigation, enhancing maritime transport infrastructure and capacity, or implementing a revenue-neutral feebate scheme, are considered in-sector uses. Financing broader climate aims, financing broader development aims, or financing the general fiscal budget are out-of-sector uses. Covering administrative and enforcement costs is neither related to in-sector or out-of sector use per se.

32 A broader assessment of the alignment of the carbon pricing instrument with the Principle of Highest Possible Ambition would account for the level of carbon price, the GHG emissions covered, and the revenue use. This report focuses exclusively on the latter aspect.

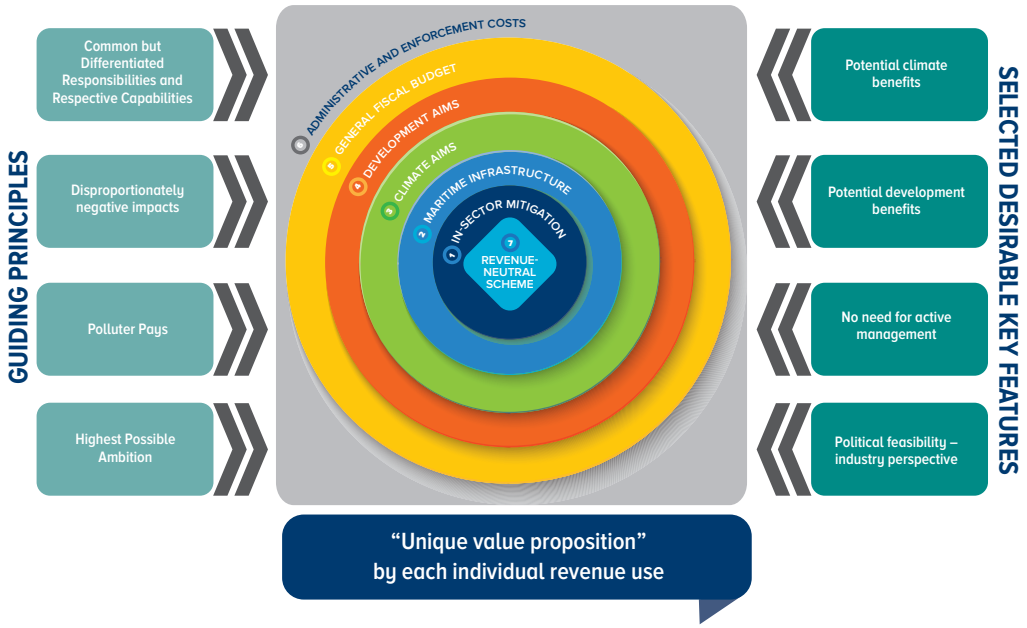
33 This report does not take a position on whether this view of the Polluter Pays principle should be accepted. However, since this view has been upheld in a submission to the MEPC, the report analyzes the alignment of different carbon revenue uses with this interpretation of the Polluter Pays principle.

FIGURE 4: POTENTIAL REVENUE USES FROM CARBON PRICING IN SHIPPING CONSIDERED



This section discusses the advantages and disadvantages of these carbon revenue use options. In particular, it analyzes how carbon revenues from international shipping could be used taking into account their potential climate benefits, non-climate-related development benefits, alignment with the Initial IMO GHG Strategy, political acceptability, and need for active management of revenues. As it will be clear from the analysis below, there are overlaps between these revenue uses. For instance, enhancing maritime transport infrastructure and capacity can deliver climate and development benefits. Nonetheless, it is useful to separate these revenue use options as each of them has different advantages and disadvantages.

FIGURE 5: POTENTIAL REVENUE USES ASSESSED AGAINST GUIDING PRINCIPLES AND SELECTED DESIRABLE KEY FEATURES



3.2.1 Financing in-sector climate change mitigation

Many of the recent proposals on carbon pricing suggest using (at least a share of) carbon revenues for in-sector climate change mitigation (Trafigura 2020; ICS and Intercargo 2021; Marshall Islands and Solomon Islands 2021a; Norway 2021c).

The main rationale for using carbon revenues to finance in-sector climate change mitigation is that this carbon revenue use can contribute to making zero-carbon bunker fuels and technologies more competitive compared to fossil fuel alternatives. In particular, carbon revenues could be used to deploy in-sector policies which can stimulate early adoption of long-run solutions and help to proactively manage the decarbonization of international shipping by facilitating its energy/fuel transition. Crucially, if these additional pull policies were implemented, the carbon price applied to drive shipping's decarbonization could be lower than if revenues were used exclusively out-of-sector (see Box 4 for a discussion of the economic rationale for channeling revenues to in-sector mitigation under a carbon pricing scheme).

BOX 4: FINANCING IN-SECTOR MITIGATION WITH CARBON REVENUES: THE ECONOMIC RATIONALE

Carbon pricing provides economic incentives to reduce GHG emissions, but market failures and market barriers may limit its effectiveness. Economic theory suggests complementing carbon pricing with other policies aimed to address these market failures and barriers and help close the price gap between incumbent and new zero-carbon bunker fuels and technologies through financial support. Such market failures include, for instance (World Bank 2019a):

- **Network effects:** The private sector may invest in network-based technologies suboptimally due to the high costs of creating a sufficiently large network. For instance, the uptake of zero-carbon bunker fuels in shipping will require upfront investments in adequate bunkering infrastructure, and ship owners may refrain from investing in vessels that run on zero-carbon fuels without parallel investments in a corresponding bunkering network. Thus, public sector financing may be needed to support infrastructure investments that increase confidence and facilitate the shift to green technologies.

- **Barriers to financing:** The public sector can support lending for zero-carbon investment projects, thereby reducing banks' perceived risks of such investments. For instance, vessels equipped with zero-carbon technologies are often more expensive. Potential financiers may perceive these investments as being riskier—meaning that shipowners will have to prove that they are able to recover these additional costs (OECD/ITF 2018). These reservations may hinder the industry's ability to decarbonize at a speed consistent with the targets of the Initial IMO GHG Strategy. Until loans for zero-carbon technologies become more accessible, there may be a need for the public sector to facilitate a financial transition to such technologies (OECD/ITF 2018).

- **Knowledge sharing:** Companies that invest in research and development (R&D) for zero-carbon technologies may not internalize all the benefits of their investments despite bearing all the costs. This may induce them to invest suboptimally. For instance, a company that expects its competitors to also benefit from its R&D investments may decide to underinvest in R&D. Public sector subsidies can remedy this market failure by financing zero-carbon technology R&D.

- **Lack of information, split incentives, and systemic behavioral biases:** Sometimes, companies fail to invest in green technologies due to split incentives, or because they lack adequate information, or are subject to systemic behavioral biases (Rehmatulla and Smith 2015; World Bank, Ecofys and Vivid Economics 2016; IMarEST 2021). For instance, companies may underestimate the benefits of investing in certain energy efficiency technologies or zero-carbon bunker fuel production facilities. Public sector funding may remedy these market distortions by, for instance, subsidizing these technologies or by investing in improving information availability.

Addressing market failures and barriers allows for decarbonization at a lower cost, meaning that eventually a lower carbon price is needed to deliver a targeted climate change mitigation outcome in the presence of complementary policies that address these constraints.

Under this carbon revenue-use option, carbon revenues could finance the development and implementation of a supply chain of low- and zero-carbon fuels and the development and uptake of other technical measures. Measures to decarbonize maritime transport usually include: 1) low- and zero-carbon fuels, such as biofuels,[34] hydrogen[35] and ammonia, and synthetic carbon-based fuels;[36] 2) technical efficiency measures applied to the vessels;[37] and 3) operational measures, such as speed optimization. A recent review of this research indicates significant variations in the mitigation potential of each type of technical measure. For instance, reviewed studies indicate that wind assistance technologies and air lubrication technologies could improve the energy efficiency of vessels by 1 to 60 percent and by 1 to 23 percent, respectively (World Bank 2022, forthcoming). If carbon revenue use was restricted to one or more of these technical measures, research on the GHG mitigation potential of each option could provide input for the specific selection.[38]

Significant investments will be needed to deploy zero-carbon bunker fuels and technologies. Carbon revenues from shipping could finance part of it. Recent studies have gauged the investments needed to develop low- and zero-carbon fuels. For example, UMAS and ETC (Krantz, Sogaard, and Smith 2020) estimate the investments needed to develop zero-carbon fuels to meet the IMO target of reducing GHG emissions by at least 50 percent by 2050. The study suggests that these investments are of about $1 trillion to $1.4 trillion between 2030 to 2050. Full decarbonization of the sector by 2050 would require about $1.4 trillion to $1.9 trillion (Baresic et al. 2022). Only 13 percent of these investments are "ship-related"; the remaining are land-based, such as hydrogen production, the synthesis of ammonia, and storage and bunkering infrastructure (Krantz, Sogaard, and Smith 2020). Martin Stopford suggests that shipowners will need to invest about $2.2 trillion to renew their fleets in line with decarbonization targets for the sector (Splash247 2021). Englert et al. (2021a) provide country estimates of investments needed for Brazil, India, Mauritius, and Malaysia. It is yet unclear how much of the investments needed to meet the decarbonization targets of the sector need to be publicly financed to mobilize sufficient private sector investments.[39] In this respect, it is important to avoid crowding out private sector investments. The development of a global international framework to support the production and distribution of zero-carbon bunker fuels may help identify where and how much public sector investment is needed.

Financing shipping's decarbonization can yield development outcomes beyond climate change mitigation. For instance, a recent World Bank report suggests that the development of zero-carbon bunker fuels for international shipping can yield significant economic benefits

34 Biofuels are fuels derived from biomass, such as energy crops and waste.
35 Hydrogen and all hydrogen-derived fuels such as ammonia or synthetic carbon-based fuels require developing renewable power production (e.g., through solar and wind) at large scale.
36 On the role of different zero-carbon fuels in the decarbonization of shipping, see Englert et al. (2021a).
37 This includes, for instance, the design of vessels' hulls (to reduce resistance, improve hydrodynamic performance, or increase vessels' size) or power and propulsion technologies (such as improvements of propulsion efficiency, waste heat recovery technologies, and cold ironing). For more on this see World Bank (2022).
38 Research on the payback period for energy efficiency technologies in international shipping can also guide the disbursement of carbon revenues (European Commission 2015). Technologies with a good return on investment (ROI) may not need to be subsidized because energy efficiency regulations can suffice for their uptake. In addition, for existing and proven technologies, directing support to operational expenditures instead of capital expenditures can help level the playing field between first and late movers.
39 The Organisation for Economic Co-operation and Development (OECD) finds that public climate finance provided by developed countries in 2018 amounted to $64.3 billion (including export credits). In the same year, public climate finance attributed to developed countries mobilized $14.6 billion of private finance (OECD, 2020).

for developing countries (Englert et al. 2021a). These additional benefits are likely to come in the form of, for instance, export opportunities, industrial modernization, and energy security, and should be accounted for in the selection of carbon revenue uses.

Financing in-sector mitigation would be aligned with the principle of Highest Possible Ambition.[40] If it was accepted that the principle of Highest Possible Ambition applies to the decarbonization of international shipping (MCST 2020), it could be argued that using carbon revenues for in-sector mitigation would be aligned with the Highest Possible Ambition principle as it can accelerate the deep decarbonization of international shipping. In return, the existence of alternative carbon revenue uses that are likely to yield higher mitigation outcomes (see below, section 3.2.3) may suggest that financing shipping's decarbonization may not be the carbon revenue use most aligned with the principle of Highest Possible Ambition yet.

Financing in-sector mitigation could help avoid or remedy for DNI, if revenues were distributed based on impacts. This revenue use can potentially address DNI both in the form of avoidance and remediation. On the one hand, as discussed above, this carbon revenue use option would drive shipping's decarbonization at a lower carbon price than if revenues were used exclusively out-of-sector. If DNI increase with the stringency of the carbon price applied, the likelihood of DNI occurring would be lowered with in-sector carbon revenue use. On the other hand, carbon revenues could be distributed to finance in-sector mitigation in disproportionately negatively affected countries based on estimates of impacts to remedy DNI. This carbon revenue use option could thus be aligned with addressing DNI via remediation.

If carbon revenues were used to finance in-sector mitigation, avoiding and remedying DNI may entail a different allocation of carbon revenues across countries. While remedying DNI will require channeling carbon revenues to disproportionately negatively affected countries, avoiding DNI may require distributing a significant share of carbon revenues to countries well positioned to deploy zero-carbon fuels and other zero-carbon technologies but not necessarily disproportionately negatively affected by policies to decarbonize international shipping. These distributional effects would need to be taken into account in defining what it actually means to address DNI (i.e., avoidance or remediation).

Financing shipping's decarbonization could also be compatible with some interpretation of the CBDR-RC principle and the Polluter Pays principle. Distributing carbon revenues to decarbonize shipping in selected countries based on their contribution to climate change and their capacity to address the climate challenge may address the need to be cognizant of CBDR-RC, both under the broad and the narrow approach. If revenues were distributed to climate-vulnerable countries, this revenue use could also be aligned with certain interpretations of the Polluter Pays principle.

40 In addition, this carbon revenue use would be aligned with the Initial GHG Strategy's aim to help "achieve the above objectives [GHG mitigation], including incentives for research and development and monitoring of GHG emissions from international shipping." (IMO 2018 at 1.7.3) [emphasis added]

In-sector carbon revenue use may ultimately facilitate the adoption of a more ambitious carbon price. Considerations of political acceptability may suggest dedicating a share of carbon revenues to in-sector decarbonization if doing so allows the implementation of a more ambitious carbon price which has the potential to yield larger mitigation outcomes.

3.2.2 Enhancing maritime transport infrastructure and capacity

Carbon revenues could also finance enhancements of maritime transport infrastructure. A broad set of interventions could be seen as generally "enhancing" maritime transport infrastructure, including, for instance, investments that improve the logistics infrastructure in ports, the climate-readiness of port infrastructure (including not only climate change mitigation interventions, but adaptation too), safety, and air quality. The enhancement of maritime transport infrastructure is likely to focus primarily on ports, but could include other types of infrastructure, such as hinterland transport infrastructure or artificial sea-level waterways. Similarly, various interventions could be seen as improving capacity, such as the enhancement of the performance of an organization through the development of strategies, partnerships, rules, and plans, or the enhancement of individual skills, through training and experience (UNDAF 2018).

Enhancing maritime infrastructure and capacity has the potential to yield development benefits, including but not limited to climate change mitigation and adaptation. Financing improvements of port infrastructure in developing countries may help to reduce GHG emissions related to port operations (Sifakis and Tsoutsos 2021). For instance, implementing innovative smart energy systems to reduce the consumption of energy from fossil fuels can help to reduce GHG emissions from ports. In addition, investments in maritime transport infrastructure can improve the adaptive capacity of countries to climate change. Being often located on coasts, port facilities are particularly vulnerable to climate-related risks, such as natural disasters (e.g., tropical cyclones) and sea level rise. Infrastructure improvements can help to address these risks (OECD 2016; UNCTAD 2020), thereby reducing the costs of climate change on port-related activities and seaborne transport. The potential adaptation benefit of enhancing maritime transport infrastructure and capacity are an advantage of this revenue use compared to financing in-sector climate change mitigation which focuses (as the name suggests) exclusively on mitigation activities. Enhancing maritime transport infrastructure and capacity can also yield additional development outcomes. For instance, safer and less polluting port infrastructure could improve public health as well as local air and water quality.[41]

Some types of maritime transport infrastructure enhancements could help address the need to be cognizant of CBDR-RC and align with the principle of Highest Possible Ambition. Distributing revenues to countries that have contributed less to global GHG emissions or have less capacity to address climate change could be a way to address the need to consider CBDR-RC. If revenues were used to improve the readiness of maritime infrastructure to climate change, this could fall under the narrow approach to address

41 For a recent review of technologies and tools for sustainable ports see Bjerkan and Seter (2019).

the need to be cognizant of CBDR-RC. Other types of "enhancements" such as improving safety could fall under the broad approach only, unless these interventions produce climate benefits too. To the extent that this revenue use reduces GHG emissions, it could be seen as aligned with the Highest Possible Ambition principle. However, once again, other revenue uses are likely to yield larger GHG abatements, including financing the decarbonization of ships and broader climate action. Thus, it could be argued that this revenue use is not necessarily the most aligned with the Highest Possible Ambition principle.

Enhancing maritime infrastructure and capacity could also align with the Polluter Pays principle. If revenues were distributed to climate-vulnerable countries to support climate change mitigation or adaptation, this revenue use could be aligned with the Polluter Pays principle.

This carbon revenue use can also help to address DNIs. Research suggests that there is a negative correlation between port efficiency and maritime transport costs (Wilmsmeier, Hoffmann, and Sanchez 2006; CE DELFT 2021). Thus, enhancing port efficiency in countries at risk of being disproportionately negatively affected by the implementation of a carbon price may allow for the avoidance of DNI—at least to a certain extent (CE DELFT 2021). The distribution of revenues to enhance maritime infrastructure based on DNI can also help remedy DNI.

Enhancing maritime transport infrastructure and capacity keeps revenue spending relatively close to the sector, potentially allowing the implementation of a more ambitious carbon pricing instrument. Similar to financing in-sector decarbonization, this carbon revenue use could receive support from key stakeholders in the shipping sector, who may tend to favor shipping-related spending.

3.2.3 Financing broader climate aims

Recent proposals suggest allocating a share of carbon revenues to climate change mitigation and adaptation outside the shipping sector—especially to address the needs of countries most vulnerable to climate change. Proposals that put forward this idea have been made, for instance, by the Marshall Islands and Solomon Islands (2021b), Norway (2021c), and Trafigura (2020).[42] In addition, MEPC 59 noted that there was a general preference to use revenues from the implementation of market-based measures in shipping to fund climate action in developing countries (MEPC 2009). This view has also been endorsed by the High-level Advisory Group on Climate Change Financing (High-Level Advisory Group on Climate Change Financing, 2010).

Today, there is still a large gap between international climate-related public finance available and the estimated needs of developing countries. Carbon revenues could help fill this gap. International climate-related public finance has grown considerably in the last few years (World Bank Group 2020), but volumes still fall short of developing

42 The idea of using carbon revenues to finance climate change action has been originally proposed for aviation (Hepburn and Müller 2010).

countries' needs. A recent study reviews estimates of international public finance flows and concludes that in 2017 about $3 billion of financing was provided in the form of dedicated climate finance,[43] while funding provided for development purposes but with attention to climate-related concerns reached $55 billion (World Bank Group 2020). In contrast, existing estimates of annual climate-related needs of developing economies point to figures in the order of trillions of dollars (World Bank Group, 2020). Doumbia and Lauridsen (2019) find that climate change is one of the Sustainable Development Goals (SDG) where the financing gap is the widest. The mismatch between available funds and estimated needs calls for exploring additional opportunities to mobilize financial resources and for using available funds to attract private sector investments.

Using carbon revenues to address broader climate needs has the potential to yield more cost-effective GHG abatements compared to exclusively sector-related carbon revenue uses. A first key advantage of allocating carbon revenues to address climate-related needs of emerging and developing economies more broadly is that it has the potential to yield more cost-effective—and therefore likely larger—GHG abatements compared to channeling them exclusively to in-sector mitigation or enhancing maritime transport infrastructure and capacity more generally. This is because shipping and port activities may not (always) be the areas that offer the largest GHG mitigation potential at the lowest costs. In return, a counterargument is that sector-specific spending may allow achieving tipping points[44] in the deployment of certain shipping-related fuels and technologies (e.g., zero-carbon bunker fuel supply chains) with more certainty or at least more rapidly than if revenues were spent across multiple sectors. One way to ensure that financing climate change activities (broadly) yields greater climate outcomes is to embed criteria in the disbursement of revenues that aim to yield transformative impacts.[45] It is important to stress that even if revenues were used to mitigate GHG emissions from sectors other than international shipping, the aims of the Initial IMO GHG Strategy would remain to reduce GHG emissions by 50 per cent by 2050 (at the latest) over 2008 levels. Any mitigation outcome achieved outside the shipping sector should not be used as an argument for slower in-sector decarbonization.

A second key advantage of allocating some, or all, carbon revenues to support general climate finance—in contrast to shipping's decarbonization only—is that it could also be used to specifically support adaptation activities.[46] In the Paris Agreement, Parties have agreed to aim to reach a balance between mitigation and adaptation finance (Article 9.4).[47] Up to now, most climate finance has supported climate change mitigation activities: according to the Climate Policy Initiative, 93 per cent of climate finance went to mitigation in 2017/2018 (CPI 2020). Allocating a share of carbon revenues to adaptation could help address this imbalance and provide needed support to communities affected by climate change.

43 Dedicated climate finance is finance provided with the explicit aim to mitigate or adapt to climate change.

44 A tipping point in the deployment of a technology is a point where the marginal increase in the adoption of a technology is able to trigger a more significant adoption of this technology.

45 There are different definitions of "transformational impact", but generally it refers to whether financing one activity has the potential to yield large and long-term climate benefits beyond the financed activity (see below, section 6.2).

46 The financing gap discussed above relates both to mitigation and adaptation activities.

47 Article 9.4 of the Paris Agreement, 2015 (UNFCCC). The Green Climate Fund (GCF)—the largest climate facility in operation currently—has the aim to split financing evenly 50:50 among mitigation and adaptation (GCF, 2021a; GCF, 2020). There are a wide variety of mitigation projects financed by the GCF. These include, for instance, providing financial support for the generation of solar power or supporting the adoption of climate-friendly cooking facilities. Adaptation projects also vary. For instance, they include improving water and food security or decreasing deforestation. For a list of projects recently financed by the GCF, see GCF (2021a; 2021b).

Financing climate change action can also deliver development benefits. Many actions that help address climate change can deliver additional development benefits. For instance, the deployment of renewable energy usually increases energy security, increases employment, and reduces local pollution (IPCC 2007).

Addressing the need to be cognizant of CBDR-RC and addressing DNI may justify financing broader climate aims. If carbon revenues were distributed based on countries' contribution to climate change and their capacity to address it, this carbon revenue use could help address the need to be cognizant of CBDR-RC (both applying a narrow and a broad approach). This carbon revenue use could also remedy DNI, if revenues were distributed among countries based on estimated DNI (CE DELFT 2021). For instance, an IMO-commissioned study (Anger et al. 2009) found that if a significant share of carbon revenues was spent on mitigation and adaptation in LDCs, the implementation of carbon pricing in international shipping could have a positive effect on the GDP of these economies. Even so, this carbon revenue use is unlikely to avoid DNI, as the broad range of climate-related activities that could be financed under its umbrella would not necessarily be related to seaborne international trade only.

Financing broader climate aims can be aligned both with the Highest Possible Ambition principle and the Polluter Pays principle. Since this more flexible carbon revenue use is likely to yield the highest climate outcomes, it can be seen as being strongly aligned with the Highest Possible Ambition principle. If revenues were distributed to countries vulnerable to climate change to finance adaptation and mitigation activities, this revenue use could be aligned with the Polluter Pays principle.

3.2.4 Financing broader development aims

As in climate finance, current development finance appears insufficient to meet developing countries' needs—carbon revenues from shipping could help reduce the gap. In 2014, UNCTAD estimated that achieving the Sustainable Development Goals (SDGs) by 2030 would require $3.3 trillion of annual investments in SDG-related sectors in developing countries (UNCTAD 2014). A more recent World Bank study suggests that the investment needs of low- and middle-income countries to meet infrastructure-related SDGs between 2015 and 2030 are between $1.5 and $2.7 trillion per year (Rozenberg and Fay 2019). The IMF estimates that additional yearly spending on infrastructure-related and health/education-related SDGs in the period 2019–2030 alone amount to $2.6 trillion in low-income developing countries and emerging countries (Gaspar et al 2019). These gaps exist partially because many developing countries, especially low-income ones, struggle to raise sufficient revenues through domestic taxation (World Bank 2019a). International public finance can help close this gap, but current flows are far from sufficient to address the needs (Doumbia and Lauridsen 2019).

Allocating carbon revenues from carbon pricing in shipping to SDG-related needs has the potential to deliver the most cost-effective development benefits. This carbon revenue use could yield the most-cost effective development benefits among the potential carbon revenue uses since revenues could be spent where they deliver the highest development outcomes given a certain level of funding available.

There is a partial overlap between this carbon revenue use and using revenues exclusively for climate change mitigation and adaptation. The overlap is due to two main factors. First, climate change—together with power infrastructure and transport—is among the issues where the SDG-related financing gap appears the widest (Doumbia and Lauridsen 2019). Thus, allocating carbon revenues to SDG-related needs would likely channel some development-related funding to climate-specific activities, too. This would be particularly likely if the size of the funding gap was used as a criterion to allocate funding. Second, the SDGs aim to achieve development sustainably. Financing SDGs such as water and ecosystems are often expected to also make an economy more resilient to climate change (International Council for Science 2017). For instance, sustainable water management practices can improve resilience to climate-related risks of droughts. Of course, there can be tradeoffs between the achievement of different SDGs. Thus, this revenue-use option would be unlikely to yield the same climate benefits that might be yielded if revenues were exclusively dedicated to climate finance.

Financing broader development aims could help address DNI but does not appear to be well-aligned with the Polluter Pays principle. If revenues were distributed among developing countries based on estimated DNI, this revenue use could help to remedy DNI (CE DELFT 2021). Avoiding DNI through this revenue use appears more difficult due to the wide variety of activities that would be eligible to be financed—which would not necessarily all be related to seaborne international trade. Under this revenue use, it is likely that only a share of carbon revenues would be directed towards mitigation and adaptation action in climate-vulnerable countries. This carbon revenue use is therefore not necessarily well aligned with the Polluter Pays principle.

This revenue use option is not well-aligned with the Highest Possible Ambition principle. Although allocating carbon revenues to development could deliver some climate change mitigation and adaptation outcomes, the magnitude of these results will depend on the specific activities financed. In general, it can be expected that more specific climate-related spending of revenues will likely lead to larger mitigation and adaptation outcomes. Thus, this revenue use does not seem well aligned with the Highest Possible Ambition principle.

Financing broad development aims could be aligned with the broad approach of addressing the need to be cognizant of CBDR-RC, if revenues were distributed based on countries' contributions to and capacity to address climate change. This revenue-use option appears less suitable to address the need to be cognizant of CBDR-RC under a narrow approach, due to the uncertain climate outcomes it will deliver.

3.2.5 Financing the general fiscal budget

Obviously, carbon revenues could also be distributed to countries without being earmarked for specific purposes, so as to leave full discretion of spending to beneficiaries. The key advantage of this revenue use is that it leaves maximum freedom to beneficiaries to finance activities based on their national priorities and in light of national circumstances. Yet, it could potentially lead to suboptimal spending in relation to broader and longer-term climate and development goals.

Not earmarking revenues may challenge the environmental integrity of the overall carbon pricing scheme. For instance, if carbon revenues were used to finance long-lived high-carbon infrastructure, such as coal-powered energy generation,[48] to improve electricity access as a development goal, the environmental integrity of the overall scheme could be compromised.

Addressing DNI may justify this revenue use. However, this revenue use is not well aligned with the Polluter Pays principle. If revenues were distributed based on expected DNI, this revenue use could align with remedying DNI. However, this revenue use is not well suited to prevent DNI as financed activities are unlikely to relate exclusively to seaborne international trade. Similarly, under this carbon revenue use, it is not guaranteed that revenues will be used to finance mitigation or adaptation action in climate-vulnerable countries and, as explained above, some carbon revenue uses could even result in negative climate outcomes. Thus, this carbon revenue use is not well aligned with the Polluter Pays principle.

Financing the general fiscal budget appears less suitable to address the need to be cognizant of CBDR-RC and to align with the Highest Possible Ambition principle. This revenue-use option does not guarantee that recipient countries' capacity to address climate change is improved. Thus, this carbon revenue-use option can only align with a broad approach to address the need to be cognizant of CBDR-RC. In addition, due to its uncertain climate change mitigation outcomes, this revenue use option does not appear well aligned with the Highest Possible Ambition principle.

3.2.6 Covering administrative and enforcement costs

A share of carbon revenues could cover costs related to the proper implementation and functioning of the revenue-raising mid-term measures. Implementing and guaranteeing the adequate functioning of the carbon pricing instrument and the related management of carbon revenues (e.g., administration and enforcement activities) may burden countries and other entities (e.g., international organizations) involved in these activities. For instance, if carbon pricing was implemented through a cap-and-trade scheme, funding would be needed to establish a regulatory body monitoring the carbon market (Kachi, Mooldijk, and Warnecke, 2019). In this case, part of the carbon revenues raised could cover these costs.

This revenue-use option can be well-aligned with addressing the need to be cognizant of CBDR-RC, the Highest Possible Ambition principle, and the Polluter Pays principle. To the extent that covering administrative and enforcement costs of the revenue-raising carbon pricing instrument is instrumental to ensure the adequate functioning of this measure, this revenue use is also instrumental in all the other revenue uses and to achieve any climate or development benefits. Thus, it could be argued that this revenue use is potentially well-aligned with addressing the need to be cognizant of CBDR-RC, the Highest Possible Ambition principle, and the Polluter Pays principle.

48 Note that global investments in coal supply increased from $80 billion in 2018 to $90 billion in 2019 (IEA 2020).

Addressing DNI by covering administrative and enforcement costs of selected countries can however pose significant risks. In principle, carbon revenues could be used to cover the administrative costs of the carbon pricing instrument in selected countries based on impacts. This could be seen as a way to remedy (at least part of) potential DNI. However, ensuring the integrity of this mid-term measure is crucial to deliver the mitigation outcomes of the Initial IMO GHG Strategy. Covering administrative costs in some selected countries only may undermine the integrity of the measure in countries where these costs are not covered. Therefore, it might be preferable to address DNI through a different form of carbon revenue use.

3.2.7 Implementing a revenue-neutral feebate scheme

A revenue-neutral feebate scheme represents a passive revenue use that can mitigate an increase of maritime transport costs and the related impacts on States.[49] A passive revenue use does not require active management of carbon revenues because revenues are disbursed following predetermined rules that leave no discretion to implementing entities. Under a revenue-neutral feebate scheme, regulated entities (e.g., shipowners or charterers) whose GHG intensity is above a benchmark pay a levy (also called a fee), and those that produce lower GHG emissions per ton-mile than the benchmark receive a subsidy (also called a rebate). A feebate scheme of this type has been proposed by Trafigura (2020), for instance. Parry et al. (2018) find that this type of revenue use allows reducing the impact of a carbon levy on average shipping costs without compromising GHG emissions reductions.

A major downside of the absence of additional carbon revenues in a revenue-neutral feebate scheme is that it does not guarantee the delivery of *additional* climate outcomes. Existing research suggests that a revenue-neutral feebate scheme may not yield additional GHG abatements compared to an equally scaled carbon levy (without accounting for the potential use of revenues from the levy) (Parry et al. 2018). This is because some of the incentives to reduce GHG emissions under a feebate scheme are weakened compared to a carbon levy where carbon revenues are actively managed (Parry, et al. 2018).[50] Furthermore, a revenue-neutral feebate scheme is unlikely to deliver adaptation outcomes either in maritime infrastructure and capacity or out-of-sector. Thus, this type of revenue use does not address the negative climate-related consequences of GHG emissions by the shipping sector. However, a potential climate change mitigation benefit of this carbon revenue use is that returning carbon revenues to energy-efficient vessels may help to address potential resistance from key stakeholders—thereby potentially allowing the implementation of a more ambitious carbon pricing instrument.

More generally, this carbon revenue use does not guarantee any significant development outcomes. Some development benefits may materialize if maritime transport costs do not increase on routes from/to developing countries. However, besides these potential benefits, the absence of any carbon revenues to be used for further action makes *additional*

49 In this report, the term "feebate" is used because this is the term often employed in the debate on the decarbonization of international maritime transport. However, a similar scheme could be applied to pricing mechanisms other than "fees", such as levies.

50 In particular, a revenue-neutral feebate scheme may not induce consumer demand to shift towards lighter and short-distance products (Parry et al. 2018).

climate and development outcomes uncertain. For instance, if energy-efficient shipping companies used revenues to improve the safety of their fleet the instrument may deliver some additional development outcomes. However, these additional benefits remain more uncertain compared to those delivered by carbon revenues discussed above—not least because they purely depend on decisions made by companies on an individual basis.

A revenue-neutral feebate scheme is not necessarily well suited to address DNI. In principle, *if* DNI related to an increase of maritime transport costs grew with an increase of the level of carbon price, this carbon revenue use might help address DNI (by mitigating the increase in shipping costs, it would also mitigate DNI). However, in practice, it is unclear whether reducing *average* shipping costs can address DNI as vessels operating in certain regions (or on certain routes) may emit more GHGs (on average) than vessels operating in other regions (or on other routes).[51] As a result, vessels in some regions may end up subsidizing vessels operating in other regions—with the result that maritime transport costs may increase in some parts of the world, but not in others. Further, a feebate scheme risks supporting the creation of a two-tier market, where vessels that already have a lower GHG intensity reduce emissions even further, while vessels with a higher GHG intensity are denied resources to reduce their GHG emissions per ton-mile. Remedying DNI through this carbon revenue use appears also complicated, because it is challenging to target specific countries based on impacts through such a feebate scheme.

This revenue use is also not well suited to address the need to be cognizant of CBDR-RC. This is because it cannot be guaranteed that ships receiving the rebate are those that can be seen as being connected to countries that have contributed (or are expected to contribute) less to climate change or have less capacity to address climate change.

Lastly, this revenue does not seem well aligned with the Polluter Pays principle nor the principle of Highest Possible Ambition. A revenue-neutral feebate scheme is not aligned with the Polluter Pays principle for two reasons: First, vessels with a GHG intensity below the benchmark level do not pay for their GHG emissions although they still pollute. Second, revenues are not distributed to address mitigation and adaptation activities. In addition, since the mitigation benefits of this carbon revenue use are unlikely to be higher than those of an equally scaled carbon levy, it is difficult to see this carbon revenue use as aligned with the Highest Possible Ambition principle.

3.3 DISCUSSION

This chapter has discussed the pros and cons of key options for carbon revenue use. In particular, the first part of the chapter has focused on assessing how carbon revenue use would align with some interpretations of the guiding principles included in the Initial IMO GHG Strategy or put forward by recent submissions which appear relevant to carbon

51 For instance, this could be due to the characteristics of ports (e.g., larger vessels which are often more energy-efficient may not be able to call at smaller ports) or type of imports/exports.

revenue use. In particular, section 3.1 discussed the need to be cognizant of CBDR-RC, the need to address DNI, the Polluter Pays principle and the Highest Possible Ambition principle. The second part of the chapter has discussed seven options for carbon revenue use and analyzed their alignment with these principles, their potential climate and non-climate development benefits, and political acceptability. Preliminary results from this analysis are presented below.

Some carbon revenue uses may be more aligned with certain interpretations of the Initial IMO GHG Strategy than others. Financing shipping's decarbonization, enhancing maritime transport infrastructure and capacity, financing climate change needs more broadly, and covering administrative and enforcement costs seem to have the potential to be aligned with multiple principles that are included—or at least that stakeholders have recognized as being included—in the Initial IMO GHG Strategy. Other carbon revenue uses seem to be less aligned with the guiding principles of this strategy. Table 2 summarizes the results of the alignment analysis, including the analysis of selected desirable key features, using the RAG method.[52] Uncertainties over the definitions of some of these principles suggest taking these conclusions with some caution.

52 Under RAG, options are marked, with green indicating a more positive evaluation, red a less positive evaluation, and amber an evaluation between green and red.

photo: *iStock Photo / CaraMaria*

TABLE 2: REVENUE USES, THEIR POTENTIAL ALIGNMENT WITH THE INITIAL IMO GHG STRATEGY AND OTHER SELECTED DESIRABLE KEY FEATURES

CRITERIA		1 FINANCING IN-SECTOR CLIMATE CHANGE MITIGATION	2 ENHANCING MARITIME INFRASTRUCTURE AND CAPACITY	3 FINANCING BROADER CLIMATE AIMS	4 FINANCING BROADER DEVELOPMENT AIMS	5 FINANCING THE GENERAL BUDGET	6 COVERING ADMINISTRATIVE AND ENFORCEMENT COSTS	7 IMPLEMENTING A REVENUE-NEUTRAL FEEBATE
Potential Alignment with the Initial IMO GHG Strategy Principles	Narrow CBDR-RC*							
	Broad CBDR-RC*							
	Avoiding DNI							
	Remedying DNI							
	Polluter Pays							
	Highest Possible Ambition							
Selected Desirable Key Features	Potential Climate Benefits**							
	Potential Development Benefits**							
	No Need for Active Management							
	Political Feasibility – Industry Perspective							
	"Unique value proposition"	Opportunity to lower the carbon price level needed to decarbonize shipping	Extension of the options to address DNI through sector-specific but not necessarily climate-related financing	Highest potential climate benefits	Highest potential development benefits	Greatest flexibility for recipient countries to use carbon revenues	Instrumental for proper functioning of carbon pricing instrument	Only option that does not require active management of revenues

* "Broad CBDR-RC" is understood as encompassing "narrow CBDR-RC". Thus, any carbon revenue use that satisfies the latter appears also aligned with the former.

** Note: The results presented in this table describe the potential of each revenue use option to deliver climate and development benefits and align with the Initial IMO GHG Strategy under the assumption that carbon revenues are adequately spent (e.g., corruption and poor governance do not lead to carbon revenue misuse).

Under a Red-Amber-Green (RAG) matrix, options are marked, with green indicating a more positive evaluation, red a less positive evaluation, and amber an evaluation between green and red. Green = highly aligned | Amber = partially aligned | Red = less aligned.

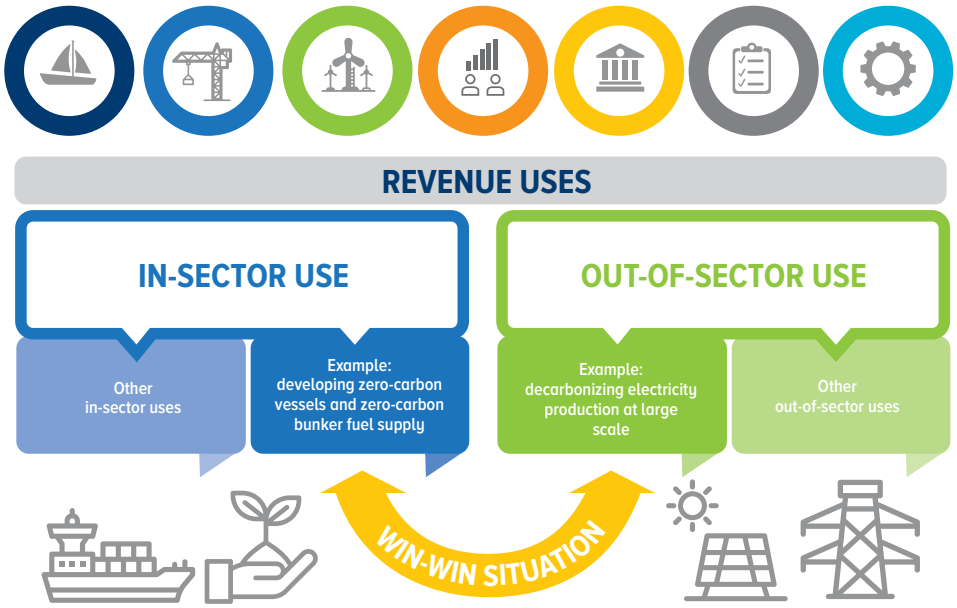
There is a case to use a meaningful share of carbon revenues to finance shipping's decarbonization and enhance maritime transport infrastructure and capacity. Financing in-sector climate change mitigation would speed up the decarbonization of shipping and achieve mitigation targets for the sector with a lower carbon price. Another reason that could speak in favor of spending carbon revenues to decarbonize the sector or to enhance maritime transport infrastructure and capacity is to prevent DNI instead of remedying them. Lastly, shipping-related carbon revenue uses, such as financing shipping's decarbonization, enhancing maritime transport infrastructure and capacity, and rewarding energy efficiency through a feebate scheme may allow implementing a more ambitious carbon pricing instrument that yields higher climate change mitigation outcomes.

However, the case for using *all* carbon revenues to finance shipping's decarbonization appears rather weak. As discussed above, revenue raised through carbon pricing in shipping could be between $1 trillion and $3.7 trillion (Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping 2021; Baresic et al. 2022). Existing research suggests that meeting the temperature target set in the Initial GHG Strategy requires $1 trillion to $1.4 trillion (Krantz, Sogaard. and Smith 2020), and full decarbonization by 2050 requires about $1.4 trillion to $1.9 trillion (Baresic et al. 2022). Since this figure includes private sector investments, the revenues raised by a carbon pricing instrument are likely to exceed the need of the sector to meet the minimum targets of the Initial IMO GHG Strategy and perhaps also the investments needed to fully decarbonize the sector. Financing broader climate and development goals has the potential to yield climate and development benefits more cost-effectively than a narrow revenue use that focuses on shipping-related activities only, such as financing shipping's decarbonization and enhancing maritime transport infrastructure and capacity. The case of the latter as *exclusive* types of carbon revenue uses is therefore not very strong per se.

A viable way forward from a political point of view could be to agree on splitting the carbon revenues between in-sector use, out-of-sector use, and covering administrative and enforcement costs. This would mean: part of the carbon revenues would be allocated to financing in-sector climate change mitigation (e.g., building a zero-carbon bunker fuel supply infrastructure) and enhancing maritime transport infrastructure and capacity. A key advantage of focusing on both types of in-sector uses is that both in-sector mitigation and adaptation activities could be financed. While financial support to adaptation is particularly important for countries disproportionately exposed to climate change, such as many LDCs and SIDS, financing in-sector mitigation can help reduce the burden of the transition on the shipping industry. Another part would be allocated to wider climate and/or development goals not necessarily related to shipping. A share of carbon revenues used in-sector and out-of-sector, respectively, would be allocated to selected countries (e.g., to address DNI and the need to consider CBDR-RC), and another share would be allocated globally to in-sector and out-of-sector climate action.

A win-win situation could be achieved if synergies are created between in-sector and out-of-sector carbon revenue use. Some types of out-of-sector revenue uses, such as financing the development of a zero-carbon power supply, can help the shipping industry decarbonize while delivering mitigation and co-benefits outside of the shipping sector. Investments of this type can therefore be a win-win for both the shipping industry and non-shipping constituencies.

FIGURE 6: WIN-WIN SITUATION FROM SYNERGIES BETWEEN STRATEGIC IN-SECTOR USE AND OUT-OF-SECTOR USE OF REVENUES FROM CARBON PRICING IN INTERNATIONAL SHIPPING



Ultimately, defining DNI can have important implications for the selection of carbon revenue uses. Only a few types of carbon revenue use appear suitable to *prevent* DNI—these are carbon revenue uses that focus on sector-related spending, such as decarbonizing shipping and enhancing maritime transport infrastructure and capacity. Remediation leaves more flexibility in spending (see Table 1), because it could also be achieved through broader carbon revenue uses, such as spending for climate change mitigation and adaptation or development across additional sectors. If IMO Member States decided that potential DNI could be addressed only by avoiding them (ex ante), a fewer number of revenue use options would be able to address DNI than if it was decided that DNI could be remedied, too. The current debate focuses on the definition of "disproportionately negative impacts" (MEPC 76/15). The analysis presented in this technical paper suggests that a discussion on the actual meaning of "addressing" these impacts will also have implications for the strategic use of carbon revenues.

4. WHO COULD RECEIVE CARBON REVENUES?

This chapter discusses who could be the groups of recipients of carbon revenues. This technical paper distinguishes recipients from beneficiaries of carbon revenues. Beneficiaries are individuals or entities that ultimately benefit from the distribution of carbon revenues. The recipient is instead the entity that receives carbon revenues, e.g., from a fund that distributes them. To illustrate, imagine that carbon revenues are distributed to a government to finance the renewal of its national fleet for small-scale fishing. In this context, the recipient is the government, and the beneficiaries could be seen as the fishers. Sometimes there is an overlap between the recipient and the beneficiary. In the case above, if the fund that distributed revenues disbursed them directly to the fishers, the recipient and the beneficiary would be the same.

4.1 MATCHING RECIPIENTS TO AIM PURSUED

This technical paper distinguishes three main groups of recipients of carbon revenues from international shipping. The section builds on existing proposals and related literature to discuss how revenues could be distributed among three potential groups of recipients. The potential groups of recipients considered are:

1. **Governments**[53]
2. **The shipping industry**
3. **The private sector more broadly**

Carbon revenues would be distributed to the three potential groups of recipients through a fund with adequate capacity. The potential governance and management of such fund is discussed below (chapters 5 and 6).

Furthermore, the technical paper distinguishes three main broad aims of carbon revenue use, and discusses who among the three potential groups of recipients may be best positioned to achieve them. The potential aims of carbon revenue use already outlined in section 3.2 can be simplified to three broad categories:[54]

1. **Achieving maximum climate and/or development outcomes:** This broad category includes the delivery of both climate and development outcomes. In addition, achieving climate change mitigation outcomes could also be seen as aligning with the principle of

53 GHG emissions from shipping also negatively affect countries that are not part of the IMO. A political decision will need to be made on whether to also disburse carbon revenues from shipping to countries not part of the IMO.

54 This simplification helps to avoid repetitions and make the text more reader friendly. A similar simplification was less easy to implement in the previous section without losing the needed level of granularity of the analysis.

Highest Possible Ambition and the Polluter Pays principle.

2. **Supporting an equitable transition:** This category includes addressing the need to be cognizant of the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) and addressing disproportionately negative impacts (DNI). Please note that the aggregation of these two principles under the broader category "achieving an equitable transition" should not be interpreted as an endorsement of the view that addressing one principle addresses also the other. Some interpretations of the Polluter Pays principle could also be seen as supporting the achievement of an equitable transition.

3. **Ensuring an adequate functioning:** A third broad aim of carbon revenue use could be to ensure an adequate functioning of the carbon pricing scheme and the distribution of revenues.

Ideally, the decision on who the groups of recipients of carbon revenues will be is based on who is best positioned to achieve the aims of carbon revenue use.

4.1.1 Achieving maximum climate and/or development outcomes

Climate and development finance can target either governments or the private sector: the two types of finance are complementary. Climate and development finance that targets governments of developing countries supports various activities, including the setting up of adequate public institutions, the financing of public sector investments, and the implementation of policies that enable subsequent private sector investments, such as implementing national plans to enhance transport infrastructure (IFC 2011). Climate and development finance that targets the private sector most often complements these efforts by directly supporting companies and related advisory services.[55] The complementarity of climate and development finance that target governments and the private sector may also exist if a share of carbon revenues was allocated to reducing greenhouse gas (GHG) emissions from shipping or enhancing maritime transport infrastructure and capacity. For instance, the adoption by shipowners of a zero-carbon technology may require private-oriented climate finance to de-risk this type of investment. At the same time, public-oriented climate finance could support setting up an enabling regulatory framework for the production of zero-carbon bunker fuels.[56]

The complementarity of climate and development finance that targets governments and the private sector may suggest dedicating a share of carbon revenues from international shipping to both types of finance. The optimal allocation of carbon revenues from international shipping to governments and private actors may depend on the specific revenue use. For instance, de-risking activities needed to mobilize private sector finance can be sector-specific, and therefore vary depending on whether carbon revenues are used, for instance, to support shipping's decarbonization or climate change more broadly.

55 On the complementarity between development finance that targets the public and the private sector, see IFC (2011).
56 Research indicates that an enabling regulatory framework is among the key factors for the production of zero-carbon bunker fuels (Englert et al. 2021a).

4.1.2 Supporting an equitable transition

The strategic use of carbon revenues can help address considerations of an equitable transition implicitly recognized in the Initial IMO GHG Strategy. In particular, as discussed in the previous chapter, the Initial IMO GHG Strategy makes reference to the need to be cognizant of CBDR-RC and calls to address DNI on States. This subsection discusses how equitable transition considerations could affect the distribution of carbon revenues among governments, the shipping industry, and the private sector more broadly.

Pragmatic considerations suggest that addressing the need to be cognizant of CBDR-RC via revenue use would be easier if revenues were distributed to countries instead of the private sector (including the shipping industry). Under the United Nations Framework Convention on Climate Change (UNFCCC) regime, CBDR-RC applies to States as it considers their historical contribution to climate change and their capabilities. Thus, the operationalization of this principle in the International Maritime Organization (IMO) context could call for differentiation among States. *In theory*, this operationalization could also take the form of targeted funding distributed to companies identified as being related to developing countries, for instance, due to their ownership, location of operations, or country of incorporation. However, in many circumstances, the relationship between a company and a particular country is likely to remain blurred. One can imagine, for instance, a company controlled by two main shareholders—a businesswoman from country A and a large multinational investment management company from country B that is incorporated in country C but operates primarily in country D. Then, one may assume that country A *or* D are developing countries. Whether providing targeted funding to this company[57] operationalizes the need to be cognizant of CBDR-RC appears debatable. In international shipping, the relationship between a country and a ship can be particularly blurred due to the ship's registered flag, inter-jurisdictional trading, or the domicile of the individual or company owning and/or operating a vessel, such as the charterer, which may be different from one another. Thus, addressing the need to be cognizant of CBDR-RC through carbon revenue use is likely more easily achieved if beneficiaries are sovereign governments with clear affiliation to a country.

Factors that could be considered to establish a clear link between a company and a country may vary in time, which may add an obstacle to the adequate consideration of CBDR-RC. The practical difficulties in implementing the need to be cognizant of CBDR-RC by providing targeted funding to developing countries through their private sector actors suggest that a larger share of carbon revenues could be allocated to developing countries' governments than if the aim of "maximizing climate and/or development outcomes" alone was pursued.

Addressing DNI on States may require channeling an even greater share of the carbon revenues to governments than considerations of climate and/or development outcomes and CBDR-RC alone would suggest. As discussed in the previous chapter, two broad options are imaginable: avoidance or remediation. Remedying DNI creates issues

57 Compared to what it would have received if D and A were developed countries.

that are similar to those that apply to using carbon revenues to address the need to be cognizant of CBDR-RC: the difficulty of linking many companies to one country militates in favor of distributing carbon revenues to governments. Two arguments would support a similar conclusion if DNI were addressed through avoidance. First, arguably, governments are likely better positioned to protect their own interests (avoiding negative impacts) than individual private companies. Second, this approach would make the government recipient more accountable than if carbon revenues were distributed to private sector actors: Under this approach, a failure to prevent disproportionately negative impacts may less easily be attributed to a private company. Higher accountability of the recipient can lead to a more effective use of carbon revenues.

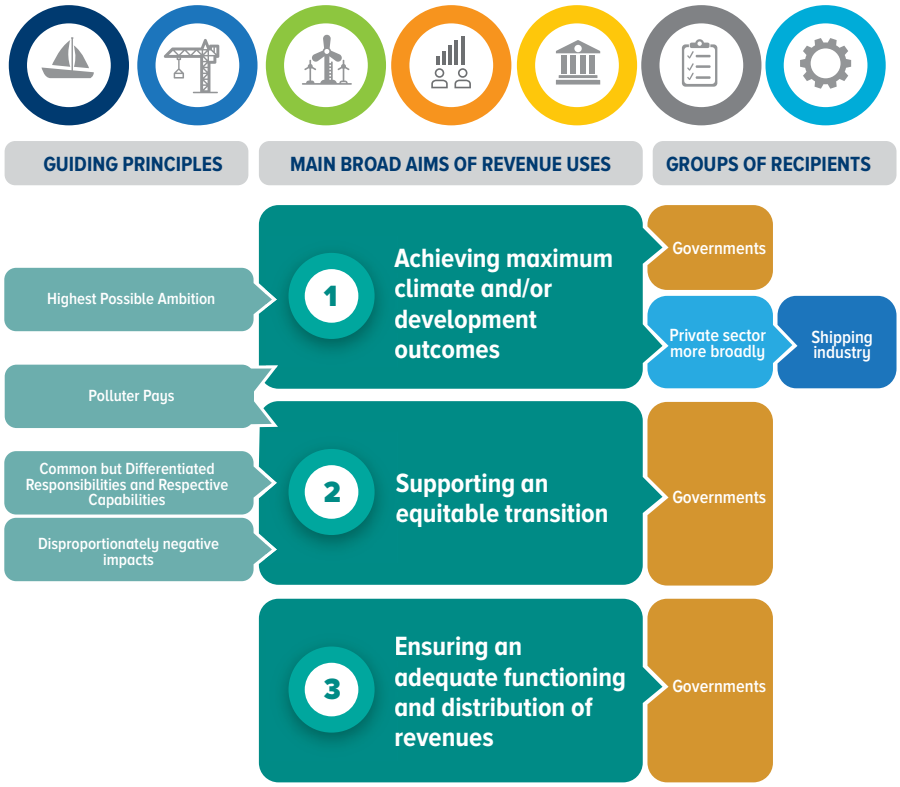
Ultimately, this logic also applies to favoring governments as recipients in the context of the Polluter Pays principle. Taking the possible view that this principle could be operationalized by directing carbon revenues towards mitigation and adaptation measures in vulnerable countries (Marshall Islands and Solomon Islands, 2021a), it could easily be justified that sovereign governments with clear affiliations to a vulnerable country would be in a better position to know their sources of GHG emissions and climate vulnerabilities and to address these effectively.

4.1.3 Ensuring an adequate functioning

Ensuring an adequate functioning of the carbon pricing scheme and the distribution of revenues is also likely going to require dedicating a share of carbon revenues to governments and other public organizations. Guaranteeing the adequate functioning of the mid-term measures (e.g., administration and enforcement activities) will put a transactional burden on governments, the IMO, and any other potential organization involved in these activities. Part of the carbon revenues could cover these costs.

This also suggests that a larger share of carbon revenues could be devoted to governments than considerations of equitable transition and the achievement of development/climate outcomes alone may suggest.

FIGURE 7: GROUPS OF RECIPIENTS BEST POSITIONED TO ACHIEVE MAIN BROAD AIMS OF POTENTIAL REVENUE USES



4.2 DISCUSSION

There appears to be a stronger case for channeling a significant share of carbon revenues—potentially through a third-party fund—to governments of developing countries in order to address equity concerns and support an adequate functioning of the carbon pricing scheme. The need to be cognizant of CBDR-RC and to address DNI and the Polluter Pays principle appear to be taken into account better by distributing carbon revenues to governments—regardless of whether DNI were to be addressed through avoidance or remediation. The channeling of these funds could occur through a third-party fund with the suitable financial management capacity and experience. In addition, it seems helpful that a share of the carbon revenues will go to public entities involved in the administration and enforcement of the carbon pricing instrument.

In principle, the complementarity of private-oriented and public-oriented development/climate finance may suggest dividing revenues between governments and the private sector (including the shipping industry). Thus, while there is a case to distribute a significant part of the revenues to governments of developing countries, a share could also be distributed to the private sector. Carbon revenues could be distributed to the private sector either directly, through a fund, or by first allocating revenues to governments, which then directs funding to private sector actors. The latter approach makes it easier to identify the share of carbon revenues distributed to each country because, as explained above, the affiliation of a private company to a country is often not fully clear.

5. GOVERNING CARBON REVENUES FROM SHIPPING

Currently, one key focus of the debate on the governance of carbon revenues from international shipping refers to the institutional set-up proposed by the International Chamber of Shipping (ICS) and others. Although the proposal MEPC 75/7/4 submitted by ICS et al. (2019) was not meant to be linked to market-based measures, some stakeholders have indicated that this institutional set-up (or a modified version) could serve as a disbursement mechanism for a share of carbon revenues raised through a levy on GHG emissions from international shipping (e.g., Marshall Islands and Solomon Islands, 2021b). The ICS proposal and related discussions are briefly summarized in Box 5.

BOX 5: THE IMRB/IMRF PROPOSAL IN A NUTSHELL

The ICS proposal (ICS et al. 2019) envisions three main components for the collection and disbursement of carbon revenues from international shipping:

- **The International Maritime Research and Development Board (IMRB):** The IMRB would be composed of a Board of Directors and a Secretariat led by an Executive Director. Members of the Board of Directors, the Secretariat, and the Executive Director would be selected based on rules laid out in a IMRB Charter. The IMRB's key function would be to manage research and development (R&D) related to the decarbonization of international shipping. Specific functions would include, for instance: developing, directing, managing, and administering a R&D strategy; developing R&D programs; developing requests for proposals; revising proposals; and approving funding.

- **The International Maritime Research Fund (IMRF):** This fund would provide financing to the IMRB and the related activities to be funded.

- **The IMO Oversight Body:** This oversight body would meet periodically. It would have, amongst others, the following prerogatives: advising the IMRB; approving its budget; and ensuring that the IMRB respects the IMRB Charter. The oversight body would have no power to decide about funding for individual activities. The oversight body would report to the MEPC.

Various aspects of the ICS proposal have been the center of a lively debate that provides a helpful framework for building an adequate governance and management structure of carbon revenue use. These aspects include, inter alia, the representation of International Maritime Organization (IMO) Member States, especially Least Developed Countries (LDCs) and Small Island Developing States (SIDS), in the oversight body (MCST 2020; Argentina et al. 2021); the role of the industry in the oversight body (Turkey 2021); and the relationship between the IMRF,

continues on page 47

IMRB, and IMO Oversight Body (Vanuatu 2020; Denmark et al. 2021). Whether or not the ICS proposal is used as a base to distribute revenues, these debates can represent an important test case for the discussion on the disbursement of carbon revenues from shipping.

The following section analyzes two key topics in the governance of carbon revenues: These are: 1) whether revenues should be disbursed by an existing fund or a new fund; and 2) the role of the International Maritime Organization (IMO) in the governance of carbon revenues from shipping.

5.1 WHO DISBURSES THE REVENUES?

A key issue in the governance of carbon revenues is whether funds are disbursed through an existing or a new fund. Both options have been proposed by stakeholders already.

For the purpose of this technical paper a *fund* is an independent legal entity that disburses revenues to recipients. The key function that distinguishes a fund from other entities involved in the governance of carbon revenues is that the fund decides which activities are to be financed. The decisions of the fund might be guided by an overarching strategy and could be subject to review by an oversight entity (e.g., the IMO or another entity). The fund could also be entrusted with holding, investing, and distributing carbon revenues from shipping. However, these functions could also be outsourced to an external trustee.

The choice between creating a new fund or using an existing one would need to take into account at least the following considerations:

- ***Donor-recipient dynamics:* Carbon revenues from international shipping are not easily attributable to any specific country.** For instance, carbon revenues collected from pricing GHG emissions released in international waters during a voyage between country A and B by a vessel registered in country C and owned by a company incorporated in country D are not easily attributed to the exclusive activity of any of these countries. They, therefore, do not reflect the common donor-recipient dynamics that characterize many climate finance funds today.[58] This special feature of carbon revenues from international shipping may require disbursing them through a fund with a governance structure that does not reflect common donor-recipient dynamics.

- ***Sector specificities:* Some types of investments related to decarbonizing international shipping and enhancing maritime transport infrastructure and capacity may**

58 Note, however, that it would not be the first time that a climate fund is financed through mechanisms other than donations from countries. For instance, the Adaptation Fund has been partially financed through the Clean Development Mechanism (CDM).

pose sector-specific challenges that may call for creating a specialized fund. The specialized fund would have a clear mission, specific expertise, and decision-making processes tailored to the needs of the sector. These specific needs may not be present if carbon revenues were allocated to climate or development finance more generally.

In return, there can be investments related to shipping decarbonization that may benefit from broader expertise in climate and development finance. As mentioned above, existing research indicates that 87 percent of the investments needed to produce zero-carbon bunker fuels and related infrastructure are land-based, and only the remaining 13 percent refer to ship-specific investments (Krantz, Sogaard, and Smith, 2020). Some of the land-based activities may require expertise that goes beyond shipping, such as investing in renewable energy sources to produce zero-carbon hydrogen that could be then used as an input for the production of green ammonia. If carbon revenues were used to finance land-based investments in zero-carbon bunker fuels through a fund specializing in shipping decarbonization, it would be important that the relevant non-shipping-related expertise is included in the governance of the fund.

- ***Redundancy:* A high level of fragmentation characterizes the current landscape of climate and development finance** (Deutscher 2009; OECD 2021). For instance, according to the OECD, 99 public funds (bilateral and multilateral) dedicated to climate finance are currently in operation.[59] The fragmentation of climate and development finance and the lack of strong coordination mechanisms among funds can create risks of redundant investments (Greene 2004; Roberts, and Weikmans 2017). Creating a new fund may further exacerbate this problem. The duplication of efforts tends to be less of an issue when funds have a specific mission (GIZ 2021), as with a fund aimed exclusively at channeling carbon revenues to ship-specific investments. For some types of investments related to the decarbonization of international shipping, such as land-based investments for zero-carbon bunker fuel production and distribution infrastructure, the risk of overlap may be higher.

- ***Fragmentation of finance and reporting:* Experts often identify the fragmentation of climate finance as imposing an undue burden on potential recipient entities.** This can be particularly problematic for countries with severe capacity constraints for drafting funding applications and meeting demands from funding entities (Gomez-Echeverri 2013; Pickering, Betzold, and Skovgaard 2017). Creating a new fund with its own access criteria would further increase the fragmentation of climate and development finance, and would risk exacerbating the burden for potential recipients. Setting up training and support services for potential recipients—especially recipients with restricted capacity—may help address this issue (see below, section 6.3).

- ***Operational costs:* Running a new fund is likely to cause higher operational costs than channeling funding through an existing one**. Using an existing fund would simply entail the duplication of some costs related to the functioning of its secretariat and selected reporting efforts. These costs are not necessarily high, however. For instance,

59 The OECD database does not include "climate-relevant funds", meaning funds that consider climate factors in their investment strategy without explicitly labelling their activities as climate-related (OECD 2015). Thus, the fragmentation of the climate finance landscape would likely be even higher if these funds were also considered.

in 2020, the secretariat of the Green Climate Fund (GCF) cost about $52 million, about 2.5 percent of the funds GCF disbursed in the same year (1 percent if co-financing was included) (GCF, 2020).

- ***Transactional costs:*** **Creating a new fund would require reaching an agreement on its decision-making processes and other governance issues.** Key aspects of creating a new fund would include, for instance, establishing the disbursement criteria (further discussed in section 6.2), the mechanisms of redistribution, the board composition and its powers, and the relation between the new fund and other entities (e.g., the IMO or a trustee) (see section 5.2). Negotiations on these aspects may further delay implementing carbon pricing in international shipping, which entails a risk of not meeting the Initial IMO GHG Strategy's targets.

  The history of climate finance shows variability in the time needed to create a new climate finance fund. For instance, the GCF was first proposed at the 15th Conference of the Parties (COP15) for the United Nations Framework Convention on Climate Change (UNFCCC) (2009), and the fund started operating fully in November 2015. The Global Environmental Facility (GEF) was proposed in 1989, and the pilot phase ended in 1994 (Clémençon 2006). By contrast, the creation of the Climate Investment Funds (CIF) occurred much more quickly: Japan, the United Kingdom, and the United States (USA) announced the intention to create these funds in 2008, and many of the CIF' program areas became operational in 2009 (Lattanzio 2013). Therefore, it is difficult to forecast how much time it would take to create a new fund under the auspices of the IMO. However, at least theoretically, redistributing revenues through an existing fund created with the consensus of many countries already part of the IMO may reduce political frictions and speed up the implementation of carbon pricing in shipping. In practice, whether relying on an existing fund would reduce implementation time will depend ultimately on the priorities of IMO parties and the targeted fund, and should not be taken for granted.

The case to create a new fund appears stronger for carbon revenues dedicated exclusively to sector-specific goals than for revenues used for more general climate or development finance. The discussion above suggests that disbursing carbon revenues from shipping through a new fund can have advantages but also poses risks. Overall, the analysis indicates that the case for a new fund is stronger if revenues were used in-sector than if revenues are used out-of-sector. This is because if revenues were used in-sector, the benefits of disbursing carbon revenues through a new fund would likely be higher (e.g., addressing sector-specific needs and ensuring that adequate expertise is present in the fund), and risks would likely be lower (e.g., duplication of efforts) than if revenues were used for more general climate or development finance. Conversely, the case for using an existing fund is stronger for out-of-sector revenue uses than in-sector ones.

5.2 TAILORING GOVERNANCE ARRANGEMENTS TO REVENUE USES

Governance arrangements of carbon revenues disbursement need to be tailored to the type of revenue use. As discussed in section 3.2, there is a wide range of potential options of how carbon revenues from international shipping could be used. These include, for instance, the financing of zero-carbon bunker fuels and technologies, investments in enhancing port infrastructure and capacity, or broader forms of carbon revenue use, such as financing climate change mitigation and adaptation outside the shipping sector or, even more broadly, supporting development. Implementing each of these revenue use options may require a specific set of competencies. The governance structure of carbon revenue use should be tailored to the specific revenue use options selected.

The IMO may have a strong say in in-sector-related revenue uses but a lesser one in their use for wider climate and/or development aims—this difference should be reflected in governance arrangements. If a share of carbon revenues was meant to support the decarbonization of international shipping or to enhance maritime transport infrastructure and capacity, the IMO's role in the governance of these revenues may be strong due to its special mandate, expertise, and unique position to reconcile the specific interests of the sector. On the other hand, the IMO may be less well positioned to govern broader types of carbon revenue uses, such as financing climate mitigation and adaptation or development more generally. The role of the IMO in the governance of carbon revenues from international shipping should, therefore, reflect these considerations.

6. MANAGING CARBON REVENUES FROM INTERNATIONAL SHIPPING

Various organizations have substantial experience in financing climate-and development-related projects. If deemed beneficial, this existing experience could be harnessed to ensure an adequate and effective use of carbon revenues from international shipping.

This chapter discusses three areas where relying on existing expertise in the management of carbon revenues could be beneficial. In particular, the chapter focuses on three aspects of managing carbon revenues: 1) addressing the challenges of managing carbon revenues actively; 2) establishing revenue distribution criteria, if a new fund was to be created; and 3) ensuring that no one is left behind in the distribution of carbon revenues.

6.1 ADDRESSING CHALLENGES OF MANAGING CARBON REVENUES ACTIVELY

Managing significant amounts of carbon revenues from shipping may pose new challenges for the International Maritime Organization (IMO). Currently, the only fund created under the auspices of the IMO is the International Oil Pollution Compensation Funds (IOPC), which provide financial compensation for oil pollution damage that results from oil spills from tankers. Since 1971, the IOPC and its predecessor fund have disbursed about $1 billion in total (IOPC 2020). Disbursing carbon revenues from international shipping is likely to pose a more diverse set of challenges than those related to the creation of IOPC, at least in terms of the potential size of revenues to be raised and disbursed, the types of activities financed, and the related stakeholders' interests.

Passive forms of carbon revenue use could help to limit the amount of revenues to be managed actively. A revenue-neutral feebate scheme has the key advantage of reducing the need for active management of revenues. However, as discussed above (see sub-section 3.2.7), this type of carbon revenue use does not guarantee that the needs to be cognizant of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) and to address disproportionately negative impacts (DNI) is addressed, nor is it likely to yield higher climate or development outcomes than wider types of revenue use, such as financing climate and development aims more broadly. These characteristics of a revenue-neutral feebate scheme may suggest that (at least a share) of carbon revenues would be used in an alternate manner. However, key alternate carbon revenue uses would then entail more active management of the revenues.

Relying on the services of an organization with substantial experience in managing climate and development finance may reduce the need to rely on passive forms of carbon revenue use. If a new fund was to be established (either for shipping-specific funding or for climate/development finance more generally), relying on the trustee services of an existing organization with substantial experience in climate change and development finance could help ensure its adequate functioning and create trust among stakeholders.

Today, many climate finance funds are managed by multilateral development banks (MDBs). For instance, in 2019 the World Bank managed 92 active climate-related trust funds, the Asian Development Bank 21, the Inter-American Development Bank 14, and the African Development Bank 3 (GIZ 2021). The World Bank also provides trustee services to key financial intermediary funds, such as the Green Climate Fund (GCF 2019), the Global Environmental Facility (GEF 2021) and the Climate Investment Funds (CIF 2021).[60] Such services provided include receiving, holding, and investing donors' contributions and distributing this funding when instructed by the GCF, GEF, or CIF. MDBs often also host the secretariat of major climate funds (GIZ 2021). For instance, the World Bank hosts the secretariats of the GEF and CIF. The benefits of having the secretariat hosted by an MDB include the provision of a legal personality and access to expertise, staffing, and institutional arrangements (World Bank 2019b).

Ideally, trustee services will be provided by a global organization in the case of international shipping. Entrusting the management of carbon revenues from international shipping to a global organization that has links to most, if not all, IMO Member States, may help to ensure that the interests of all the main stakeholders of this sector are represented.

Preventing the misuse of carbon revenues requires that adequate monitoring and accountability mechanisms are in place. Existing climate and development funds have established monitoring and accountability mechanisms to ensure that revenues disbursed are used adequately—for example the GCF (2015). If a new fund is created to disburse carbon revenues from shipping, such a mechanism also will need to be established. Experience from existing funds may provide guidance on how to set up such mechanisms.

6.2 POTENTIAL REVENUE DISTRIBUTION CRITERIA—LEARNING FROM EXPERIENCE

If a new fund was to be created, parties to the IMO would need to agree on the criteria used to distribute revenues among beneficiaries. The previous section has demonstrated that creating a new fund to distribute carbon revenues from international shipping may have some advantages.

60 Financial intermediary funds are a type of trust fund that normally leverage resources from the private and the public sector to support international initiatives, usually with the aim to provide public goods (GIZ 2021).

Distribution criteria used by some of the major climate finance funds in operation today can help inform the selection of distribution criteria for the new fund.[61] The focus of this section is on climate finance funds because, although the Initial IMO GHG Strategy does not explicitly establish that carbon revenues should be used for climate finance, a review of existing IMO submissions and other stakeholders' proposals indicates a preference for using at least a fraction of carbon revenues to support climate-related activities (see above subsection 3.2.3). However, it is not suggested that all or any of these criteria should necessarily guide the use of carbon revenues from international shipping. This review is aimed exclusively to provide ideas and stimulate a debate.

A first criterion to distribute revenues among beneficiaries is linked to *climate impacts*. If carbon revenues were to be used for climate finance, a criterion to guide action could be the climate impact of carbon revenue use in terms of reduced or avoided greenhouse gas (GHG) emissions and—if adaptation was also included in the potential objectives—delivered adaptation outcomes.

These impacts will need to be additional to activities that would have been carried out anyway. For instance, if carbon revenues were used to support building low- or zero-carbon vessels (or retrofitting existing ones), a proof could be required that there is a finance gap that could not be closed by using alternative sources of finance (e.g., private or public loans or grants) (Brown et al. 2018). There is already some evidence of industry investments in developing zero-carbon bunker fuels and related technologies and government support for these investments.[62] For instance, Grieg Edge and Wärtsilä Norway are working on building an ammonia-fueled tanker and received $5.4 million by Polit-E, a Norwegian government funding scheme (Grieg Star 2020). Another example is the ShipFC consortium project that received €10 million from the Fuel Cells and Hydrogen 2 Joint Undertaking to develop a high-power fuel cell vessel powered by green ammonia (FCH Joint Undertaking 2020). Investments of this type will need to be taken into account to make sure that climate outcomes delivered by targeted carbon revenue use go beyond those that may already be achieved by private and public sector actors anyway.

Major climate finance funds operating today give particular consideration to whether climate impacts are transformational (World Bank 2020). Different definitions of "transformational impact" exist, but generally, the term refers to whether financing one activity can catalyze climate change mitigation or adaptation impacts beyond the funded activity, and enable a long-term, significant, and non-linear impact on a system (Westphal and Thwaites 2016). This concept is sometimes also referred to as the activity's "paradigm shift potential" (Westphal and Thwaites 2016). Examples of activities that may have transformational impacts include 1) achieving tipping points in the deployment of green technologies whereby high-carbon intensity technologies become less economically attractive than low-carbon ones—such as when public funding of low-carbon infrastructure overcomes network barriers for the deployment of low-carbon technologies (see Box 4 in

61 The criteria discussed in this section are inspired by those adopted by the Green Climate Fund (GCF), the Global Environmental Facility (GEF), and the Climate Investment Funds (CIF).

62 For a recent review, see Tugçe, Tsang, and Van Vrijaldenhoven (2021).

subsection 3.2.1), or ii) implementing policies that lead to low-carbon investments at large scale (Vivid Economics 2020). The operationalization of mitigation and adaptation impacts will require identifying adequate indicators. Major climate finance funds have created frameworks to evaluate the transformational effects of funded activities (Uitto et al. 2019; World Bank 2020). These frameworks could also inspire and guide the use of carbon revenues from international shipping (Uitto et al. 2019; World Bank 2020).

A potential problem of focusing exclusively on climate impacts is that financing activities based on potential GHG reductions relative to a baseline scenario tends to channel funding primarily to regions where a high GHG abatement potential exists (Mathy and Blanchard 2017). An Overseas Development Institute study indicates that up to 2014, almost three-fourths of public mitigation finance went to 10 countries (Nakhooda et al. 2014). In the context of the decarbonization of international shipping, there are significant disparities in countries' potential to produce zero-carbon bunker fuels (Englert et al. 2021a), which could translate into an unequal disbursement of carbon revenues if building up a zero-carbon bunker fuel supply chain was the sole focus.

Value for money **represents another common criterion to distribute funds for climate activities.** This criterion—often referred to also as "efficiency" or "cost-effectiveness"—aims to allocate funding so that climate outputs (mitigation and adaptation) are maximized given the limited budget available (Muller, Fankhauser, and Forstater 2013). The large funding gap in climate finance clearly calls for this criterion to be incorporated in disbursement decision-making and in establishing disbursement mechanisms.

A type of disbursement mechanism that can help to maximize value for money is results-based climate finance. As against input-based approaches, results-based climate finance delivers funding for activities only after certain verifiable targets have been achieved. Thus, this mechanism shifts the risk of partial or total failure from the funder to the funded entity, thereby helping solve the principal-agent problem that characterizes traditional financing methods.[63] In addition, results-based climate finance tends to leave more ownership to recipients, often resulting in more innovative approaches to overcome obstacles (World Bank Group and Frankfurt School of Finance and Management 2017). The target's achievement could be evaluated using preestablished indicators of qualitative (e.g., completion of a climate-resilient infrastructure) or quantitative (e.g., achievement of a climate change mitigation target) nature (World Bank Group and Frankfurt School of Finance and Management 2017). Substantial knowledge exists on the strengths and weaknesses of results-based finance in the climate and development contexts (World Bank Group and Frankfurt School of Finance and Management 2017). This knowledge could be harnessed to identify whether and when to use this mechanism in the shipping context. Results-based climate finance can be coupled with more traditional upfront financing (in the form of grants or concessional loans) when needed, to strengthen institutions and provide sufficient infrastructure to deliver on the aims of the funded activity.

63 The principal-agent problem arises in this context because the recipient of funding (the agent) has more information than the funder (the principal) on the specific project that needs to be implemented and the recipient can use this information to its advantage. The funder does not have the means to ensure that the recipient always acts in the best interest of the funder (World Bank Group and Frankfurt School of Finance and Management 2017).

***Capacity and policy alignment* are other criteria often used to allocate climate funding**. These terms are used broadly here to encompass what major climate finance funds cover under different headings.[64] The terms usually relate to a range of considerations regarding the capacity of a country to carry out the financed activity and the alignment of the financed activity with a country's nationally determined contributions, development, and climate change plans.

***Equity* considerations related to the need to be cognizant of the CBDR-RC principle and address DNI could be another criterion that guides revenue distribution in shipping.** Parties may need to agree on a metric to operationalize equity considerations. For instance, Parry et al. (2018) discuss two potential distribution keys to target Small Island Developing States (SIDS) and low-income countries: distributing revenues to countries based on the carbon price attributed to their sales of bunker fuels or their share of global import values. They find, however, that neither approach is fully satisfactory because the former would overcompensate large refueling hubs, and the latter does not represent a reliable proxy for GHG emissions (Parry et al. 2018). Further research may be needed to identify adequate distributional keys to operationalize equity considerations in disbursement decisions.

***Needs* could represent another criterion that informs the disbursement of climate finance and refers to potential climate vulnerabilities and the corresponding financial needs of recipients.** For instance, if revenues were used to finance shipping's decarbonization, countries most in need of support for financing the transition to zero-carbon shipping would be favored over others. There could be a partial overlap between this criterion and *equity* as CBDR-RC could also account for countries' capacity to address climate change and DNI could be related to a country's economic situation.

Climate finance is often directed to uses that deliver benefits beyond climate change and help achieve *other sustainable development goals* (SDG). These development benefits include, for instance, public health benefits from improved environmental quality (e.g., reductions in local air pollutants), increased energy security, and economic dividends in terms of growth or jobs creation. For instance, the Global Commission on Adaptation finds that adaptation action can yield a "triple dividend" in terms of avoided climate-related losses, economic benefits (e.g., due to increased productivity), as well as social and environmental benefits (Global Commission on Adaptation 2019).

Developing a resource allocation framework can help to address tradeoffs among allocation criteria. There can obviously be tensions between the criteria for the distribution of carbon revenues discussed in this section. Experience from climate finance suggests that developing a resource allocation framework can help with weighing criteria included in the allocation of funding and increase transparency and predictability of resource use.

64 For instance, a country's capacity and alignment of the funded activity with the policy framework of the country is considered under the heading "country ownership" in the framework of GCF (GCF 2018) and the "GEF Performance Index" for GEF (GEF 2005).

6.3 ENSURING ACCESS TO FINANCE

Climate finance is often allocated through a competitive process that may put some developing countries at a disadvantage in terms of accessing finance. Some developing countries, such as some Least Developed Countries (LDCs) and SIDS, may experience higher barriers to access climate finance due to capacity constraints, preventing them from responding successfully to competitive processes such as calls for proposals. These constraints can put them at a disadvantage compared to other potential beneficiaries and result in a distribution of funding skewed towards countries that have higher capacity. Steps need to be taken to address this issue.

One option to address this issue in the context of carbon revenues from shipping would be to reserve a share of yearly revenues to selected countries that is accessible through non- or less-competitive and/or simplified application processes. Along these lines, the GCF aims to channel 50 percent of its funding for adaptation to SIDS, LDCs and African countries (GCF 2021c). Only if these revenues were not accessed within a predetermined period, would they become accessible to other countries through fully competitive applications.

If a new fund was created, an adequate readiness program would need to be set up. Readiness programs support applicants in becoming more competitive in preparing their proposals to receive funding. These programs can be particularly valuable when countries aim to access funds directly, without the support of multilateral institutions acting as intermediaries. Currently, many climate funds offer readiness programs targeted to accessing their own funding.[65] If a new fund was created, setting up an adequate readiness program could help level the playing field. Building on the experience of other funds could help make the readiness program most effective.

6.4 DISCUSSION

The case to disburse revenues through a new fund appears stronger for carbon revenues dedicated exclusively to sector-specific goals than for revenues used for more general climate or development finance. In principle, carbon revenues could be disbursed through an existing or a new fund—both options have their advantages. This analysis suggests that the benefits of disbursing carbon revenues through a new fund would likely be higher (e.g., addressing sector-specific needs), and risks are lower (e.g., duplication of efforts) if carbon revenues were used for sector-specific uses than for general climate and development finance.

If a new fund was established, relying on trustee services of an organization with substantial experience in managing climate and development finance may reduce the

65 Funds that offer a readiness program include, for instance, the GCF (GCF 2021d) and the Adaptation Fund (AF 2021).

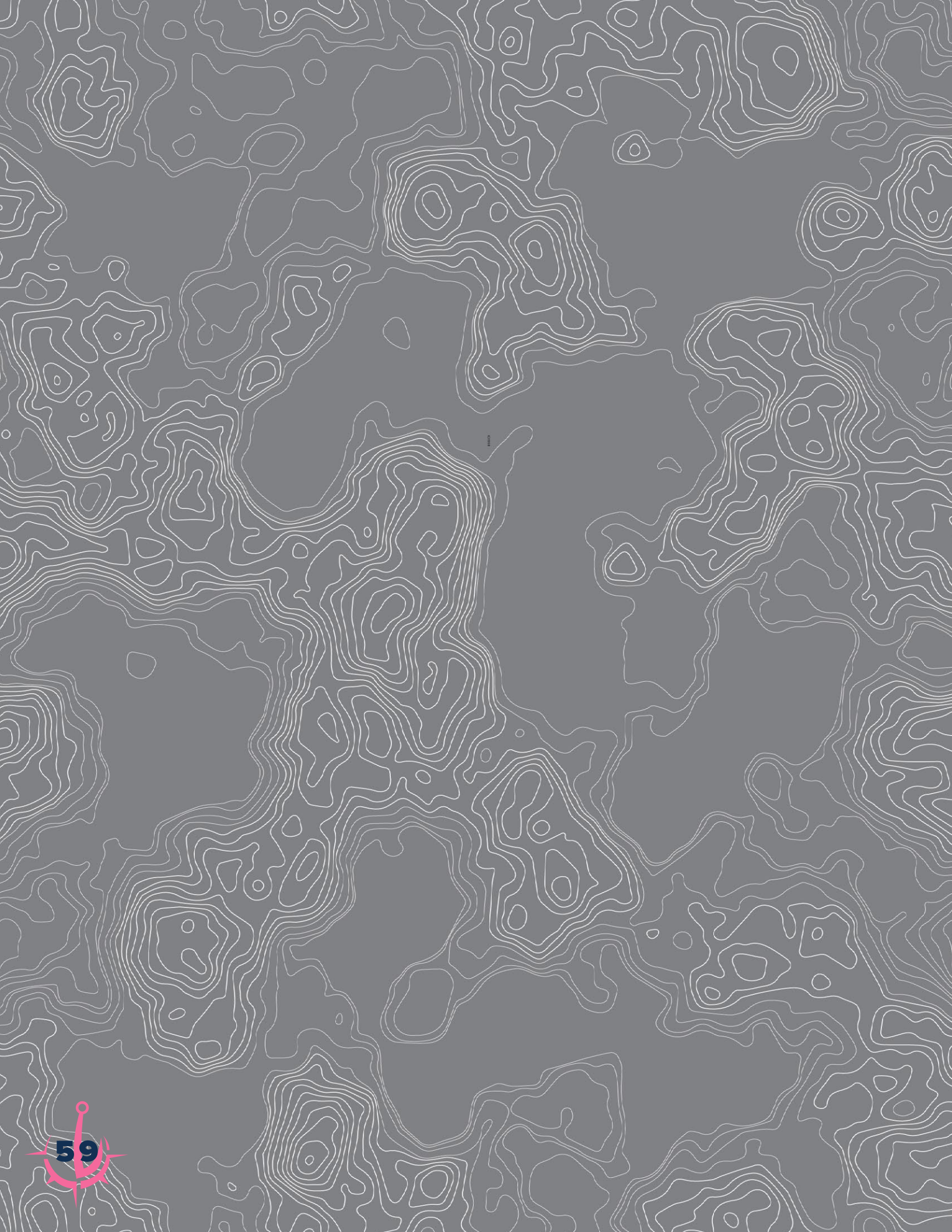
burden of managing carbon revenues actively. If a new fund was established (either for shipping-specific funding or for climate and development finance more generally), relying on the trustee services of an existing organization with substantial experience in climate change finance can support its adequate functioning and create trust among stakeholders. Entrusting the management of carbon revenues from shipping to a global organization would help ensure that the interests of all main stakeholders of international shipping are represented.

If there was a need to curtail the amount of carbon revenues to be managed, introducing some aspects of a feebate scheme could be the policy of choice. Revenues distributed through a feebate scheme do not require active management as funding is allocated through predetermined rules. This is a key advantage of this carbon revenue use compared to the alternative options discussed in this technical paper.

The IMO may want to have a strong say in sector-related revenue uses but a lesser one in the use for wider climate and/or development aims—this difference should be reflected in governance arrangements. If a share of carbon revenues was meant to support financing in-sector climate change mitigation or to enhance maritime transport infrastructure, the IMO's role in the governance of these revenues may be strong due to its special mandate, expertise, and unique position to represent the specific interests of the sector. On the other hand, the IMO may be less well positioned to govern broader types of carbon revenue uses, such as financing climate mitigation and adaptation or development more generally. The role of the IMO in the governance of carbon revenues from international shipping should, therefore, reflect these considerations.

If a new fund was created, common distribution criteria used by some of the major climate finance funds in operation today could inform the future criteria used for distributing carbon revenues from international shipping. Experience from climate finance suggests that developing resource allocation frameworks can help with weighing criteria included in the allocation of funding and increase transparency and predictability of resource use.

Special needs of selected developing countries could be accounted for by putting aside a certain share of the carbon revenues for less competitive and simplified bidding. Climate and development finance is often allocated through a competitive process that can put some developing countries at a disadvantage to access finance. Reserving a share of carbon revenues to these countries could help level the playing field. Only if these revenues were not accessed within a predetermined time period would they become accessible to other countries through fully competitive applications.



7. CONCLUSIONS

There is an ongoing discussion at the Marine Environment Protection Committee (MEPC) on whether to adopt any mid-term measures that raise revenues. Mid-term measures that can raise revenues are carbon levies and cap-and-trade schemes where allowances are sold. While the primary aim of such measures would be to put a price on carbon and thereby incentivize greenhouse gas (GHG) emission reductions in the shipping sector, these measures can also raise significant carbon revenues. Consequently, the debate at the MEPC has also focused on how such carbon revenues from international shipping could be used, managed, and governed. This technical paper has aimed to contribute to this discussion by addressing three broad questions: 1) What could carbon revenues from international shipping be used for?; 2) Who could be the recipients of carbon revenues from international shipping?; and 3) How could adequate governance and management of carbon revenues from international shipping be imagined? The key findings related to these questions are presented below.

A general finding of this technical paper is that those types of mid-term measures that can raise revenues deserve particular attention as these revenues could render an additional set of actions possible. For instance, the collection of revenues could enable the deployment of additional in-sector policies (e.g., subsidies) which can stimulate early adoption of long-run solutions and help to proactively manage the decarbonization of international shipping by facilitating its energy/fuel transition. Such policies could be implemented in a generalized way (i.e., where the early adoption appears least expensive), or with a prioritization of certain countries/routes in order to couple it with other principles/objectives. Further actions could include, for instance, delivering additional climate and development benefits, putting some of the guiding principles of the Initial IMO GHG Strategy into practice, and addressing some of the equity concerns of key stakeholders that may hinder the rapid decarbonization of the sector.

While some of the guiding principles of the Initial IMO GHG Strategy could be operationalized also by implementing exemptions, this approach poses risks of adverse consequences and does not guarantee an equitable transition. Addressing the need to be cognizant of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) and addressing disproportionately negative impacts (DNI) via exemptions may yield a number of adverse consequences. These include, for instance, a situation where shipping companies reassign older vessels which are usually less energy-efficient and less safe to exempted routes to deploy their newest, more energy-efficient vessels on routes covered by a market-based measure. This also reduces the incentive to transition to zero-carbon fuels and technologies on exempted routes (CE DELFT 2021). Further, the benefits of exemptions, in terms of lower transport costs–which can translate into lower costs of transported commodities, would be shared by both the exporting and the importing country. This sharing of benefits could undermine the aim of ensuring an equitable transition if the importing or the exporting country was a developed country not necessarily needing support (Dominioni, Heine and Martinez-Romera, 2018). For these reasons, carbon revenue use is a better option than exemptions to address the principles of the Initial IMO GHG Strategy.

In the case of a revenue-raising mid-term measure, action should be taken to ensure that the potential volatility of carbon revenues does not threaten the financial viability of projects to be funded. Experience shows that unexpected drops in carbon revenue raised can pose risks for the realization of projects to be financed. Two main options to address such risks are to 1) design a carbon pricing instrument that yields predictable revenue flows (e.g., by making the level of the carbon price applied more predictable over a certain timeframe through a price floor), or 2) to create a reserve which can help mitigate financial risks. Establishing an adequate long-term investment plan can help minimize fiscal risks in case revenues decrease over time due to reduced emissions from the sector.

WHAT COULD CARBON REVENUES FROM INTERNATIONAL SHIPPING BE USED FOR?

To answer this question, the technical paper has distinguished seven options for carbon revenue use and assessed their alignment with certain interpretations of the Initial IMO GHG Strategy, their potential to deliver climate and non-climate-related development benefits, their need for active management, and their political acceptability from an industry perspective. There are four main findings derived from this analysis.

First, some carbon revenue uses appear more aligned with certain interpretations of the Initial IMO GHG Strategy than others. In particular, this technical paper has considered the alignment of different options for carbon revenue use with the need to be cognizant of CBDR-RC, the need to address DNI, the Polluter Pays principle, and the principle of Highest Possible Ambition. The analysis indicates that the following carbon revenue uses have the potential to be more aligned with certain interpretations of the Initial IMO GHG Strategy: financing shipping's decarbonization (e.g., building a zero-carbon bunker fuel supply infrastructure), enhancing maritime transport infrastructure and capacity, financing climate change needs more broadly, and covering administrative and enforcement costs. Other revenue use options seem to be less aligned with the Initial IMO GHG Strategy; however, they may have other strengths worthy of consideration. Selected desirable key features and unique value propositions of each carbon revenue use option are summarized in Table 2 (section 3.3).

Second, there is a case to use a meaningful share of carbon revenues to finance shipping's decarbonization and enhancing maritime transport infrastructure and capacity. Financing in-sector climate change mitigation could speed up the decarbonization of shipping and achieve mitigation targets for the sector with a lower carbon price. Another reason that would speak in favor of spending carbon revenues to decarbonize the sector and to enhance maritime transport infrastructure and capacity is to prevent DNI instead of remedying for them. Furthermore, focusing on both types of in-sector carbon revenue uses would allow to cover both in-sector mitigation and adaptation activities. While financial support to adaptation is particularly important for countries disproportionately exposed to climate change, such as many countries disproportionately exposed to climate change, such as many Least Developed Countries (LDCs) and Small Island Developing States (SIDS), financing in-sector mitigation can help reduce the burden of the transition on the shipping industry. Lastly, shipping-related carbon revenue uses, such as financing shipping's decarbonization, enhancing maritime transport infrastructure and capacity, and rewarding energy efficiency through a feebate scheme may allow implementing a more ambitious carbon pricing instrument that ultimately yields higher climate change mitigation outcomes.

Third, the case for using *all* carbon revenues to finance shipping's decarbonization appears rather weak. As discussed above, revenue raised through carbon pricing in shipping could be between $1 trillion and $3.7 trillion (Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping 2021; Baresic et al. 2022). Existing research suggests that meeting the temperature target set in the Initial IMO GHG Strategy requires $1 trillion to $1.4 trillion (Krantz, Sogaard, and Smith 2020), and full decarbonization by 2050 requires about $1.4 trillion to $1.9 trillion (Baresic et al. 2022). Since this figure includes private sector investments, the revenues raised by a carbon pricing instrument are likely to exceed the need of the sector to meet the minimum targets of the Initial IMO GHG Strategy and perhaps also the investments needed to fully decarbonize the sector. Financing broader climate and development goals has the potential to yield climate and development benefits more cost-effectively than a narrow revenue use that focuses on shipping-related activities only, such as financing shipping's decarbonization and enhancing maritime transport infrastructure and capacity. The case of the latter as *exclusive* types of carbon revenue uses is therefore not very strong per se.

Fourth, a viable way forward from a political view would be to agree on splitting the carbon revenues between in-sector use, out-of-sector use, and covering administrative and enforcement costs. This would mean that part of the carbon revenues would be allocated to financing in-sector climate change mitigation and enhancing maritime transport infrastructure and capacity. Another part would be allocated to wider climate and/or development goals not necessarily related to shipping. A share of carbon revenues used in-sector and out-of-sector, respectively, would be allocated to developing countries (e.g., to address the need to consider CBDR-RC and address DNI) and another share would be allocated to global in-sector and out-of-sector climate action.

WHO COULD BE THE RECIPIENTS OF CARBON REVENUES FROM INTERNATIONAL SHIPPING?

This technical paper has discussed who among governments, the shipping sector, and the private sector more broadly should receive carbon revenues if the following broad carbon revenue use aims were pursued: 1) maximize climate and other development benefits, 2) support an equitable transition, and 3) support the adequate functioning of the mid-term measures and the revenue distribution. Revenues would be distributed among these three potential groups of recipients through a—potentially third-party governed—fund.

The analysis has highlighted that a significant share of carbon revenues should go to governments of developing countries. If the need to be cognizant of CBDR-RC, address DNI, and implement the Polluter Pays principle was operationalized through revenue use, a share of the revenues should be disbursed to governments, not the private sector—regardless of whether DNI were addressed through avoidance or remediation. In addition, a share of the carbon revenues could go to public entities (governments and international institutions) involved in the administration and enforcement of the carbon revenues. Achieving climate and development outcomes most effectively may require, however, splitting revenues among governments and private sector actors (potentially including the shipping industry). On this ground, a certain share of carbon revenues could be disbursed to the private sector, too.

HOW COULD ADEQUATE GOVERNANCE AND MANAGEMENT OF CARBON REVENUES FROM INTERNATIONAL SHIPPING BE IMAGINED?

In this respect, this technical paper has discussed five key topics related to the governance and management of carbon revenues from shipping: 1) whether revenues should be disbursed by an existing fund or a new fund; 2) the role of the International Maritime Organization (IMO) in the governance of carbon revenues from shipping; 3) how to address challenges of managing carbon revenues actively; 4) how to select revenue distribution criteria if a new fund was created; and 5) how to ensure that no country is left behind in the distribution of carbon revenues. There are five main findings derived from this analysis.

First, the case to disburse revenues through a new fund seems stronger for carbon revenues dedicated exclusively to sector-specific goals than for revenues used for more general climate or development finance. Carbon revenues could be disbursed through an existing or a new fund—both options have their advantages. Overall, the analysis indicates that the case for a new fund is stronger if revenues are used in-sector than if revenues are used out of sector. This is because if revenues are used in sector the benefits of disbursing carbon revenues through a new fund would likely be higher (e.g., addressing sector-specific needs and ensuring that adequate expertise is present in the fund), and risks would likely be lower (e.g., duplication of efforts) than if revenues are used for more general climate or development finance. Conversely, the case for using an existing fund is stronger for out-of-sector revenue uses than in-sector ones.

Second, governance arrangements may suggest that the IMO should have a strong role in sector-related revenue uses but a potentially lesser one in the use for wider climate and/or development aims. The IMO appears uniquely positioned to have a strong say in the governance of carbon revenues used to finance shipping-related investments. However, the IMO may be less well positioned to govern broader types of carbon revenue uses, such as financing climate mitigation and adaptation or development more generally in other sectors. Governance arrangements of carbon revenues from international shipping should reflect these considerations.

Third, if a new fund was established, relying on the trustee services of an organization with substantial experience in managing climate and development finance may reduce the need to rely on passive forms of carbon revenue use. Relying on passive forms of carbon revenue use, such as a revenue-neutral feebate scheme, would have the key advantage of higher cost-effectiveness of carbon revenue management compared to uses that require active management. However, some carbon revenue use options that require active management might be preferred on other grounds (e.g., potential climate, development, or distributional outcomes). If the active management revenue use option was preferred and a new fund was established (either for shipping-specific funding or for climate finance more generally), relying on the trustee services of an existing organization with substantial experience in climate change finance could facilitate its adequate functioning and create trust among stakeholders. Entrusting the management of carbon revenues from shipping to a global organization would help ensure that the interests of all the main stakeholders of international shipping are represented.

Fourth, lessons learned from managing previous climate finance funds could be harnessed to help establish adequate criteria for distributing carbon revenues from international shipping and ensure that no one is left behind. There is significant expertise in many development organizations on how to set up adequate resource allocation frameworks and ensure that potential recipients with less capacity to access funding are not put at a disadvantage. This experience could be harnessed to ensure that carbon revenues from shipping are adequately disbursed. A key option to make access to funding more inclusive is to reserve a share of carbon revenues for selected countries—e.g., some LDCs, SIDS, and African countries—and organize the access through less competitive and simplified application processes.

FUTURE RESEARCH

The analysis in this technical paper has also highlighted that defining what it means to "address" DNI can have important implications for the strategic choice of carbon revenue uses. If IMO Member States decided that potential DNI can be addressed only by avoiding them (ex ante), a fewer number of revenue use options would be able to address DNI than if it was decided that DNI can be remedied. The analysis presented in this technical paper suggests that a discussion on the actual meaning of "addressing" these impacts will also have implications for the strategic use of carbon revenues. This discussion should complement current efforts to define the meaning of DNI.

Further research can help quantify carbon revenue spending needed to achieve specific outcomes under consideration. Key knowledge gaps include the identification of public sector spending needed to mobilize sufficient private sector resources to decarbonize international shipping and the identification of carbon revenues that should go to governments to maximize climate and development outcomes.

ANNEX 1–BACKGROUND INFORMATION OF CAP-AND-TRADE AND CARBON LEVIES

This annex complements section 2.1 by providing further background information on cap-and-trade and carbon levies and is meant for readers less familiar with the basics of carbon pricing. Section 2.1 has discussed some of the key features of carbon levies and cap-and-trade that influence the amount and volatility of revenues raised. This annex focuses on four other key aspects of these instruments: 1) the importance of covering well-to-wake emissions with the carbon price, 2) the certainty of the GHG emissions reductions, 3) the environmental risks related to unpredictable carbon prices, and 4) the administrative and compliance burden of carbon levies and cap-and-trade.

THE IMPORTANCE OF COVERING WELL-TO-WAKE EMISSIONS WITH THE CARBON PRICE

Covering full well-to-wake greenhouse gas (GHG) emissions reduces the risks of locking in another fossil fuel. Section 2.1 highlighted that the amount of GHG emissions covered by carbon pricing is a key factor that determines the amount of carbon revenue raised. However, there are other, arguably more important, reasons to extend the coverage of a potential carbon pricing instrument to well-to-wake GHG emissions. In particular, if a carbon pricing instrument was applied exclusively to tank-to-propeller GHG emissions, the carbon pricing instrument would risk incentivizing the uptake of fuels that are less carbon-intensive than traditional oil-derived bunker fuels when burned, but whose GHG benefit remain less clear when not only carbon dioxide but also methane and the fuel's full life cycle is considered. A case in point is liquefied natural gas (LNG), which theoretically contains up to 30 percent less carbon per unit of energy produced than traditional oil-derived bunker fuels and can therefore offer a GHG benefit during combustion. However, the GHG benefits of LNG become more uncertain when, compared to pure downstream carbon dioxide, methane emissions—up-, mid-, and downstream—are included in the picture. Such methane leakage[66] can offset, at least partially, the GHG benefit of burning LNG instead of fossil-derived bunker fuels (Englert et al. 2021b). As recently highlighted by Englert et al. (2021b), a large-scale uptake of LNG as a bunker fuel in the long term is incompatible with meeting the mitigation targets of the Initial IMO GHG Strategy. In addition, infrastructure for LNG cannot easily be reused for those zero-carbon bunker fuels that are most likely to become deployed in the shipping industry, i.e., ammonia and hydrogen (Englert et al. 2021b). Thus, implementing a carbon pricing instrument that incentivizes the uptake of LNG as a bunker fuel in the short-term risks locking in international shipping in a pathway inconsistent with the Initial IMO GHG Strategy.

66 LNG is basically liquefied methane.

THE CERTAINTY OF THE GREENHOUSE GAS (GHG) EMISSIONS REDUCTIONS

An essential feature of a carbon pricing instrument is the level of certainty of GHG emission reductions. Under cap-and-trade, GHG emissions are capped, and the cap can be lowered gradually. Thus, this carbon pricing instrument can provide a high level of certainty that GHG emissions will be reduced over time. Carbon levies, while they clearly incentivize abatements, do not guarantee that GHG emissions are reduced over time. It is theoretically possible that overall GHG emissions increase under a carbon levy—for instance, during a period of economic boom where the consumption of fossil fuels increases. One option to increase the degree of certainty that GHG emissions reduction targets are met under a carbon levy is to adjust the carbon price level over time, making it more stringent if needed. The use of carbon price corridors—where regulators commit to keep the level of carbon price within a range—can help maintain a certain level of predictability of the carbon price while allowing for flexibility. A further option to increase the certainty that a mitigation target is reached under a carbon levy is to set up governance arrangements that facilitate the regular or ad hoc adjustment of the level of carbon price applied in case new reliable information reveals that the shipping sector is not on a pathway to meet the GHG emission reduction targets of the Initial IMO GHG Strategy.[67]

THE ENVIRONMENTAL RISKS RELATED TO UNPREDICTABLE CARBON PRICES

Unpredictable carbon prices do not only create fiscal risks, they also reduce the environmental effectiveness of the carbon pricing instrument. Section 2.1 has highlighted that an unpredictable carbon price can create fiscal risks. In addition, a more predictable carbon price can also make the economic case for investments in low-carbon infrastructure more certain compared to a less predictable carbon price (Parry and Pizer 2007). A more predictable carbon price can therefore facilitate this type of investment. In addition, a predictable carbon price can also help regulated entities to better plan their activities. These positive effects of a predictable carbon price need to be balanced against potential needs to adjust the stringency of the carbon price applied over time—for instance, in light of new information available (e.g., new studies showing that a higher carbon price level is needed to achieve a mitigation target) or changing circumstances (e.g., the development of a new technology that helps to decarbonize international shipping by applying a lower rate).

67 For instance, the Swiss government has set mitigation targets that, if not met, mandate the government to increase the tax rate of the Swiss carbon levy without needing the approval of the parliament (Carattini, Carvalho, and Fankhauser 2017).

THE ADMINISTRATIVE AND COMPLIANCE BURDEN OF CARBON LEVIES AND CAP-AND-TRADE

Another key difference is that cap-and-trade schemes tend to impose a higher administrative and compliance burden. Cap-and-trade schemes require establishing a regulatory body to monitor and surveil the carbon market (Kachi, Mooldijk, and Warnecke 2019). This oversight function includes, for instance, preventing market manipulation and fraud and ensures market transparency (Kachi and Frerk 2013). Risks of market manipulation could be high in a carbon market for international shipping where few large shipping companies account for a large share of some of the market segments (for instance, container shipping) and can therefore exercise significant market power (Kachi, Mooldijk, and Warnecke 2019). Cap-and-trade schemes also risk imposing a higher compliance burden than carbon levies, especially on smaller companies (Kachi, Mooldijk, and Warnecke 2019). Larger operators will have an advantage in the trading of allowances because setting up a trading desk or trading via a commercial bank or an exchange allows for economies of scale when larger volumes are being traded. Existing regional disparities in regulated entities' size and familiarity of complying with a cap-and-trade scheme may result in a heterogeneous burden-sharing across companies located in different countries. Currently, cap-and-trade schemes have been implemented so far only in developed and middle-income countries (World Bank 2021). Compliance entities located in jurisdictions that already have a cap-and-trade scheme in place are likely to face lower compliance costs—at least initially—due to the expertise that may already have been built up in-house or that is domestically available. Lastly, the potential trade benefits of cap-and-trade may be limited if abatement costs are fairly homogeneous in the shipping industry.

BIBLIOGRAPHY

AF (Adaptation Fund). 2021. Readiness Programme for Climate Finance. https://www.adaptation-fund.org/readiness/

Aidun, Hillary, Daniel Metzger, and Michael Gerrard. 2021. Principles of International Law and the Adoption of a Market-Based Mechanism for Greenhouse Gas Emissions from Shipping. New York: Sabin Center for Climate Change Law, Columbia Law School. https://scholarship.law.columbia.edu/faculty_scholarship/2749/.

Anger, Annela, Terry Barker, Hector Pollitt, Håkon Lindstad, Veronika Eyring, and David Lee. 2009. International Shipping and Market Based Instruments 2009. London, UK: International Maritime Organization.

Argentina et al. 2021. "Comments on the proposal to establish an International Maritime Research and Development Board (IMRB)." MEPC/76/7/20. London: IMO, April 7.

Austria et al. 2021. "ISWG-GHG 10/5/3." Comments on technical paper MEPC 76/7/15 proposing a Low GHG Fuel Standard for international shipping. London: IMO, September 3.

Azarova, Valeriya, and Mathias Mier. 2021. "Market Stability Reserve under exogenous shock: The case of COVID-19 pandemic." Applied Energy 283: 116351.

Baresic, Domagoj, Isabelle Rojon, Alison Shaw, and Nishatabbas Rehmatulla. 2022. Closing the Gap: An Overview of the Policy Options to Close the Competitiveness Gap and Enable an Equitable Zero-Emission Fuel Transition in Shipping. Prepared by UMAS, London.

Belgium et al. 2019. "The need for new fuels and implications for mid- and long-term measures." ISWG-GHG 5/5. London: IMO, March 22.

Bjerkan, Kristin, and Hanne Seter. 2019. "Reviewing tools and technologies for sustainable ports: Does research enable decision making in ports?" Transportation Research Part D 72:243–260.

Bouman, Evert, Elizabeth Lindstad, Agathe Rialland, and Anders Strimman. 2017. "State of the Art Technologies, Measures, and Potential for Reducing GHG Emissions from Shipping - A Review." Transportation Research Part D: 408–421.

Brown, Jennifer, Aoife O'Leary, Anne-Marie Wallis, and Bryony Worthington. 2018. Lessons from Other Sectors for Enabling the Deployment of New Low Carbon Technologies in Shipping. New York: Environmental Defence Fund.

Carattini, Stefano, Maria Carvalho, and Sam Fankhauser. 2017. How To Make Carbon Taxes More Acceptable. London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science.

CE DELFT. 2021. Study on Assessment of Possible Global Regulatory Measures to Reduce Greenhouse Gas Emissions from International Shipping. Luxembourg: European Commission.

CIF (Climate Investment Funds). 2021. Donors & MDBS. October 11, 2021. https://www.climateinvestmentfunds.org/finances.

Clémençon, Raymond. 2006. "What Future for the Global Environmental Facility?" The Journal of Environment and Development 15(1): 50–74.

CVF (Climate Vulnerable Forum). 2021. Dhaka–Glasgow Declaration of the CVF. November 2, 2021. https://thecvf.org/our-voice/statements/dhaka-glasgow-declaration-of-the-cvf/

CPI (Climate Policy Initiative). 2020. Updated View on the Global Landscape of Climate Finance 2019. London: Climate Policy Initiative.

Denmark et al. 2021. "Proposed draft amendments to MARPOL Annex VI (Establishment of the International Maritime Research and Development Board and the IMO Maritime Research Fund)." MEPC 76/7/7. London: IMO, March 10.

Deutscher, Eckhard. 2009. "How Fragmented is Aid?" OECD DAC Journal on Development 10(1): 35–52.

Dominioni, Goran, Dirk Heine, and Beatriz Martinez Romera. 2018. "Regional carbon pricing for international maritime transport: challenges and opportunities for global geographical coverage." Carbon & Climate Law Review 12(2): 140–158.

Dominioni, Goran and Michael Faure. 2022 "Environmental Policy in Good and Bad Times: The Counter-Cyclical Effects of Carbon Taxes and Cap-and-Trade", Journal of Environmental Law, 34(2).

Doumbia, Djeneba, and Morten Lauridsen. 2019. Closing the SDG Financing Gap—Trends and Data. Washington D.C.: IFC.

DNV. CII – Carbon Intensity Indicator. https://www.dnv.com/maritime/insights/topics/CII-carbon-intensity-indicator/answers-to-frequent-questions.html.

Englert, Dominik, Andrew Losos, Carlo Raucci, and Tristan Smith (Englert et al. 2021a). 2021. Volume 1: The Potential of Zero-Carbon Bunker Fuels in Developing Countries. Washington, DC: World Bank.

Englert, Dominik, Andrew Losos, Carlo Raucci, and Tristan Smith (Englert et al. 2021b). 2021. Volume 2: The Role of LNG in the Transition Toward Low- and Zero-Carbon Shipping. Washington DC: World Bank.

European Commission. 2015. Study on Energy Efficiency Technologies for Ships. Brussels: European Commission.

European Commission. 2021. Emissions Cap and Allowances. https://ec.europa.eu/clima/policies/ets/cap_en.

FCH Joint Undertaking. 2020. “Major Project to Convert Offshore Vessel to Run on Ammonia-Powered Fuel Cell.” https://www.fch.europa.eu/press-releases/major-project-convert-offshore-vessel-run-ammonia-powered-fuel-cell.

Friedrich, Marina, Eva-Maria Mauer, Michael Pahle, and Oliver Tietjen. 2020. From Fundamentals to Financial Assets: the Evolution of Understanding Price Formation in the EU ETS. Hamburg: Leibniz Information Centre for Economics.

Galdi, Giulio, Stefano Verde, Simone Borghesi, Jürg Fussler, Ted Jamieson, Emily Wimberger , and Li Zhou. 2021. Emissions Trading Systems With Different Price Control Mechanisms: Implications For Linking. Florence: EUI Policy Brief.

Gaspar, Vitor, David Amaglobeli, Mercedes Garcia-Escribano, Delphine Prady, and Mauricio Soto. 2019. Fiscal Policy and Development: Human, Social, and Physical Investments for the SDGs. Washington D.C.: International Monetary Fund.

GCF (Green Climate Fund). 2015. Monitoring and Accountability Framework for Accredited Entities. Songdo, Republic of Korea: Green Climate Fund.

GCF (Green Climate Fund). 2018. GCF Handbook. Songdo, Republic of Korea: Green Climate Fund.

GCF (Green Climate Fund). 2019. April 12th. “Amendment to the amended and restated agreement on the terms and conditions for the administration of the Green Climate Fund Trust Fund.”

https://www.greenclimate.fund/technicalpaper/amendment-amended-and-restated-agreement-terms-and-conditions-administration-green-climate.

GCF (Green Climate Fund). 2020. Climate Action During the Pandemic: Annual Results Report 2020. Songdo: Green Climate Fund.

GCF (Green Climate Fund). 2021a. GCF in Brief: Adaptation Planning. Songdo: Green Climate Fund.

GCF (Green Climate Fund). 2021b. Green Climate Fund. October 8. https://www.greenclimate.fund/project/sap021.

GCF (Green Climate Fund). 2021c. Annual Results Report 2020. Songdo: GCF.

GCF (Green Climate Fund). 2021d. Country Readiness. https://www.greenclimate.fund/readiness/process.

GEF (Global Environmental Facility). 2005. The GEF Resource Allocation Framework. Global Environmental Facility

GEF (Global Environmental Facility). 2021. “Funding.” https://www.thegef.org/about/funding.

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit). 2021. Climate Change–related Trust Funds at the Multilateral Development Banks. Berlin: GIZ.

Global Commission on Adaptation. 2019. Adapt Now: A Global Call for Leadership on Climate Resilience. Rotterdam: Global Commission on Adaptation.

GMF (Global Maritime Forum). 2021. Call to Action for Shipping Decarbonization. Copenhagen: Global Maritime Forum.

Gomez-Echeverri, Luis. 2013. "The Changing Geopolitics of Climate Change Finance." Climate policy 13(5): 632–648.

Greene, William. 2004. "Aid Fragmentation and Proliferation: Can Donors Improve the Delivery of Climate Finance?" IDS Bulletin 35(3): 66–75.

Grieg Star. 2020. “Grieg and Wärtsilä to build groundbreaking green ammonia tanker.” https://www.griegstar.com/grieg-and-wartsila-to-build-groundbreaking-green-ammonia-tanker/.

Heine, Dirk, Michael Faure, and Goran Dominioni. 2020. "The Polluter-Pays Principle in Climate Change Law: an Economic Appraisal." Climate Law 10(1): 94–115.

Hepburn, Cameron, and Benito Müller. 2010. "International Air Travel and Greenhouse Gas Emissions: A Proposal for an Adaptation Levy." The World Economy 33(6): 830–849.

High-Level Advisory Group on Climate Change Financing. 2010. Report of the High-level Advisory Group on Climate Change Financing. New York: UN.

Höhne, Niklas, Helcio Blum, Jan Fuglestvedt, Ragnhild Bieltvedt Skeie, Atsushi Kurosawa, Guoquan Hu, Jason Lowe et al. 2011. “Contributions of Individual Countries’ Emissions to Climate Change and their Uncertainty.” Climatic Change 106(3): 359–391.

ICS and Intercargo. 2021. "A Levy-Based MBM, Per Tonne of CO2 Emissions, to Expedite the Uptake and Deployment of Zero-Carbon Fuels." ISWG-GHG 10/5/2. London: IMO, September 3.

ICS, BIMCO, CLIA, INTERCARGO, INTERFERRY, INTERTANKO, IPTA, and WSC. 2019. “Proposal to establish an International Maritime Research and Development Board (IMRB).” MEPC 75/7/4. International Maritime Organization, December 18.

IEA (International Energy Agency). 2020. World Energy Investment 2020. Paris: International Energy Agency.

IFC (International Finance Corporation). 2011. International Finance Institutions and Development Through the Private Sector. Washington DC: IFC.

IMarEST (Institute of Marine Engineering, Science & Technology). 2021. "Considerations on CII Targets." ISWG-GHG 8/3/3. London: IMO, April 9.

IMF (International Monetary Fund). 2019. Fiscal Policies for Paris Climate Strategies—From

Principle to Practice. Washington, DC: IMF.

IMO (International Maritime Organization). 2018. "Adoption of the Initial IMO Strategy on Reduction of GHG Emissions from Ships and Existing IMO Activity Related to Reducing GHG Emissions in the Shipping Sector." London: IMO, April 13.

IMO (International Maritime Organization). 2020. Fourth IMO GHG Study. London: IMO.

International Council for Science. 2017. A Guide to SDG Interactions: From Science to Implementation. Paris: International Council for Science.

IMO Secretariat. 2011. "The Organization's Work on GHG Emissions and the United Nations Framework Convention on Climate Change and its Kyoto Protocol." ISWG-GHG 3/3/9. London: IMO, February 25.

IOPC (International Oil Pollution Compensation Funds). 2020. Annual Report 2020. London: International Oil Pollution Compensation Funds.

IPCC (Intergovernmental Panel on Climate Change). 2007. Fourth Assessment Report. IPCC.

Kachi, Aki, and Michel Frerk. 2013. Carbon Market Oversight Primer. Berlin: International Carbon Action Partnership.

Kachi, Aki, Silke Mooldijk, and Carsten Warnecke. 2019. Carbon Pricing Options for International Maritime Emissions. Berlin: New Climate Institute.

Krantz, Randall, Kasper Sogaard, and Tristan Smith. 2020. "The Scale of Investment Needed to Decarbonize International Shipping." https://www.globalmaritimeforum.org/news/the-scale-of-investment-needed-to-decarbonize-international-shipping.

Lattanzio, Richard. 2013. International Climate Change Financing: The Climate Investment Funds (CIF). Washington DC: Congressional Research Service.

Marshall Islands and Solomon Islands. 2021a. "Proposal for IMO to establish a universal mandatory greenhouse gas levy." MEPC 76/7/12. London: IMO, March 10.

Marshall Islands and Solomon Islands. 2021b. "Comments on submissions concerning an International Maritime Research and Development Fund and Board (IMRB/IMRF)." MEPC 76/7/49. London: IMO, April 21.

Martinez Romera, Beatriz, and Harro van Asselt. 2015. "The International Regulation of Aviation Emissions: Putting Differential Treatment into Practice." Journal of Environmental Law 27: 259–283.

Mathy, Sandrine, and Odile Blanchard. 2017. "Proposal for a poverty-adaptation-mitigation window within the Green Climate Fund." Climate Policy 16(6):752–767.

Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping. 2021. Options Paper on Market-Based Measures. Copenhagen: Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping.

MCST (Micronesian Center for Sustainable Transport). 2020. “IMO carbon tax design.” Background Research Paper. Micronesia: MCST.

MEPC (Marine Environment Protection Committee). 2009. "Report of the Marine Environment Protection Committee on its Fifty-Ninth Session." London: IMO, July 27.

MEPC (Marine Environment Protection Committee. 2021. "Report of the Marine Environment Protection Committee on its Seventy-Sixth Session." MEPC 76/15. London: IMO, July 12.

MPA Singapore/CPLC (The Maritime and Port Authority of Singapore/Carbon Pricing Leadership Coalition). 2019. Shipping Expert Workshop on “Enabling and Managing the Transition Towards Low-Carbon Shipping: the Role of Climate Policy Measures." Singapore: MPA Singapore/CPLC.

Muller, Benito, Samuel Fankhauser, and Maya Forstater. 2013. Quantity Performance Payment by Results–Operationalizing Enhanced Direct Access for Mitigation at the Green Climate Fund. Oxford: Oxford Institute for Energy Studies.

Mundaca, Gabriela, Jon Strand, and Ian Young. 2021. "Carbon Pricing of International Transport Fuels: Impacts on Carbon Emissions and Trade Activity." Journal of Environmental Economics and Management: 102517.

Nakhooda, Smita, Marigold Norman, Sam Barnard, Charlene Watson, Romilly Greenhill, Alice Caravani, Nella Canales Trujillo, Merylyn Hedger, and Shelagh Whitley. 2014. Climate Dinance: Is It Making a Difference? A Review of the Effectiveness of Multilateral Climate Funds. London: ODI.

Nordhaus, William. 2017. "Revisiting the Social Cost of Carbon." Proceedings of the National Academy of Sciences 114(7): 1518–1523.

Norway. 2021a. "Concepts for a Regulatory Mechanism for the Effective Uptake of Alternative Low-Carbon and Zero-Carbon fuels." MEPC 76/7/2. London: IMO, March 9.

Norway. 2021b. "Proposal for Regulatory Mechanisms for the Effective Uptake of Sustainable Low-Carbon and Zero-Carbon fuels." ISWG-GHG 10/5/6. London: IMO, September 3.

Norway. 2021c. “A Discussion of Different Principles Behind Carbon Pricing Models.” ISWG-GHG 10/5/4. London: IMO, September 3.

OECD (Organisation for Economic Co-Operation and Development). 1972. Recommendation on Guiding Principles Concerning International Economic Aspects of Environmental Policies –C(72)128. Paris: OECD.

OECD (Organisation for Economic Co-Operation and Development). 1974. Recommendation on the Implementation of the Polluter-Pays Principle, C(74)223. Paris: OECD

OECD (Organisation for Economic Co-Operation and Development). 2015. Climate Fund Inventory. Paris: OECD.

OECD (Organization for Economic Co-Operation and Development). 2016. Adapting Transport to Climate Change and Extreme Weather: Implications for Infrastructure Owners and Network Managers. Paris: OECD.

OECD (Organisation for Economic Co-Operation and Development). 2020. Climate Finance Provided and Mobilised by Developed Countries in 2013–18. Paris: OECD.

OECD (Organisation for Economic Co-Operation and Development). 2021. Climate Fund Inventory Database. https://qdd.oecd.org/subject.aspx?subject=climatefundinventory.

OECD (Organisation for Economic Co-Operation and Development) / ITF (International Transport Forum). 2018. Decarbonising Maritime Transport: The Case of Sweden. Paris: The International Transport Forum. https://www.itf-oecd.org/sites/default/files/docs/decarbonising-maritime-transport-sweden.pdf.

Parry, Ian, and William Pizer. 2007. Emissions Trading Versus CO2 Taxes Versus Standards. Washington, DC: Resources for the Future.

Parry, Ian, Dirk Heine, Kelley Kizzier, and Tristan Smith. 2018. Carbon Taxation for International Maritime Fuels: Assessing the Pptions. Washington, DC: International Monetary Fund.

Pickering, Jonathan, Carola Betzold, and Jakob Skovgaard. 2017. "Special Issue: Managing Fragmentation and Complexity in the Emerging System of International Climate Finance." International Environmental Agreements: Politics, Law and Economics 17:1–16.

Psaraftis, Harilaos N., and Thalis Zis. 2021. “Impact Assessment of a Mandatory Operational Go*al*-Based Short-Term Measure to Reduce GHG Emissions from Ships: the LDC/SIDS case study.” International Environmental Agreements: Politics, Law and Economics:1–23.

Rajamani, Lavanya. 2016. "Ambition and Differentiation in the 2015 Paris Agreement: Interpretative Possibilities and Underlying Politics." International & Comparative Law Quarterly 65(2): 493–514.

Rehmatulla, Nishatabbas, and Tristan Smith. 2015. "Barriers to Energy Efficient and Low Carbon Shipping." Ocean Engineering 110(2015): 102–112.

Ricke, Katharine, Laurent Drouet, Ken Caldeira, and Massimo Tavoni. 2018. "Country-Level Social Cost of Carbon." Nature Climate Change 8(10): 895–900.

Reuters. “Shell bunkering unit tops Singapore's list of 2020 marine fuel suppliers.” 14 January 2021. https://www.reuters.com/world/china/shell-bunkering-unit-tops-singapores-list-2020-marine-fuel-suppliers-2021-01-14/.

Roberts, Timmons, and Romain Weikmans. 2017. "Postface: Fragmentation, Failing Trust and Enduring Tensions Over What Counts as Climate Finance." International Environmental Agreements: Politics, Law and Economics 17:129–137.

Rojon, Isabelle, Nicholas-Joseph Lazarou, Nishatabbas Rehmatulla, and Tristan Smith. 2021. "The Impacts of Carbon Pricing on Maritime Transport Costs and Their Implications for Developing Economies." Marine Policy 132: 104653.

Rozenberg, Julie, and Marianne Fay. 2019. Beyond The Gap: How Countries Can Afford the Infrastructure They Need While Protecting The Planet. Washington D.C.: The World Bank.

Sands, Philippe, and Jacqueline Peel. 2012. Principles of International Environmental Law. Cambridge: Cambridge University Press.

Sifakis, Nikolaos, and Theocharis Tsoutsos. 2021. "Planning Zero-Emissions Ports Through the Nearly Zero Energy Port Concept." Journal of Cleaner Production 286: 125448.

Splash247. 2021. "$3.4trn: Stopford Puts A Price Tag On The Global Fleet Upgrade Needed Through To Imo 2050." https://splash247.com/3-4trn-stopford-puts-a-price-tag-on-the-global-fleet-upgrade-needed-through-to-imo-2050/.

Sullivan, Katie, Clayton Munnings, Nicolas Girod, and Ben Evans. 2021. Carbon Market Business Brief–California. Montreal: IETA.

Trafigura. 2020. A Proposal for an IMO-Led Global Shipping Industry Decarbonisation Programme. Singapore: Trafigura.

Tugçe, Ayvalı, S.C. Tsang, and Tim Van Vrijaldenhoven. 2021. "The Position Of Ammonia In Decarbonising Maritime Industry." Johnson Matthey Technology Review 65(2): 275–290.

Turkey. 2021. "Comments on the establishment of the International Maritime Research Board (IMRB)." MEPC 76/7/58. London: IMO, April 21.

Uitto, Juha I, Jyotsna Puri, Anna Williams, Joe Dickman, Archi Rastogi, Geeta Batra, and Kseniya Temnenko. 2019. "Evaluating Transformational Change: Lessons from International Environmental Funds." In Evaluation for Transformational Change: Opportunities and Challenges for the Sustainable Development Goals, by Rob D van den Berg, 105–130. Exeter: International Development Evaluation Association (IDEAS).

UNCTAD (United Nations Conference on Trade and Development). 2014. World Investment Report: Investing in the SDGs: An Action Plan. Geneva: UNCTAD.

UNCTAD (United Nations Conference on Trade and Development). 2020. Climate Change Impacts and Adaptation for Coastal Transport Infrastructure: A Compilation of Policies and Practices. TRANSPORT AND TRADE FACILITATION Series No 12., Geneva: UNCTAD.

UNCTAD (United Nations Conference on Trade and Development). 2021. Review of Maritime Transport 2021. https://unctad.org/system/files/offici*al*-technical paper/rmt2021_en_0.pdf.

UNDAF (United Nations Development Assistance Framework Guidance). 2018. UNDAF Companion Guidance: Capacity Development. UNDP.

United Kingdom. 2020. "Economic Incentives to Reduce GHG Emissions from International Shipping." ISWG-GHG 7/8/1. London: IMO, February 7.

Vanuatu. 2020. "Comments on Technical Paper MEPC 75/7/4 Proposing the Establishment of an International Maritime Research and Development Board (IMRB)." MEPC 75/7/12. London: IMO, February 7.

VividEconomics. 2020. Transformative Climate Finance: A Framework to Enhance International Climate Finance Flows for Transformative Climate Action. London: VividEconomics.

Voigt, Christina, and Felipe Ferreira. 2016. "'Dynamic Differentiation': The Principles of CBDR-RC, Progression and Highest Possible Ambition in the Paris Agreement." Transnational Environmental Law 5(2)", 285–303.

Westphal, Michael, and Joe Thwaites. 2016. Transformational Climate Finance: An Exploration of Low-Carbon Energy. Washington, DC: World Resource Institute.

Wilmsmeier, Gordon, Jan Hoffmann, and Ricardo Sanchez. 2006. "The Impact of Port Characteristics on International Maritime Transport Costs." Research in Transport Economics 16:117–140.

World Bank. 2019a. Using Carbon Revenues. Partnership for Market Readiness Technical Note: No. 16. Washington, DC.: World Bank.

World Bank. 2019b. Financial Intermediary Fund Management Framework. Washington, DC: World Bank.

World Bank. 2021. "Carbon Pricing Dashboard." May 17th. https://carbonpricingdashboard.worldbank.org/.

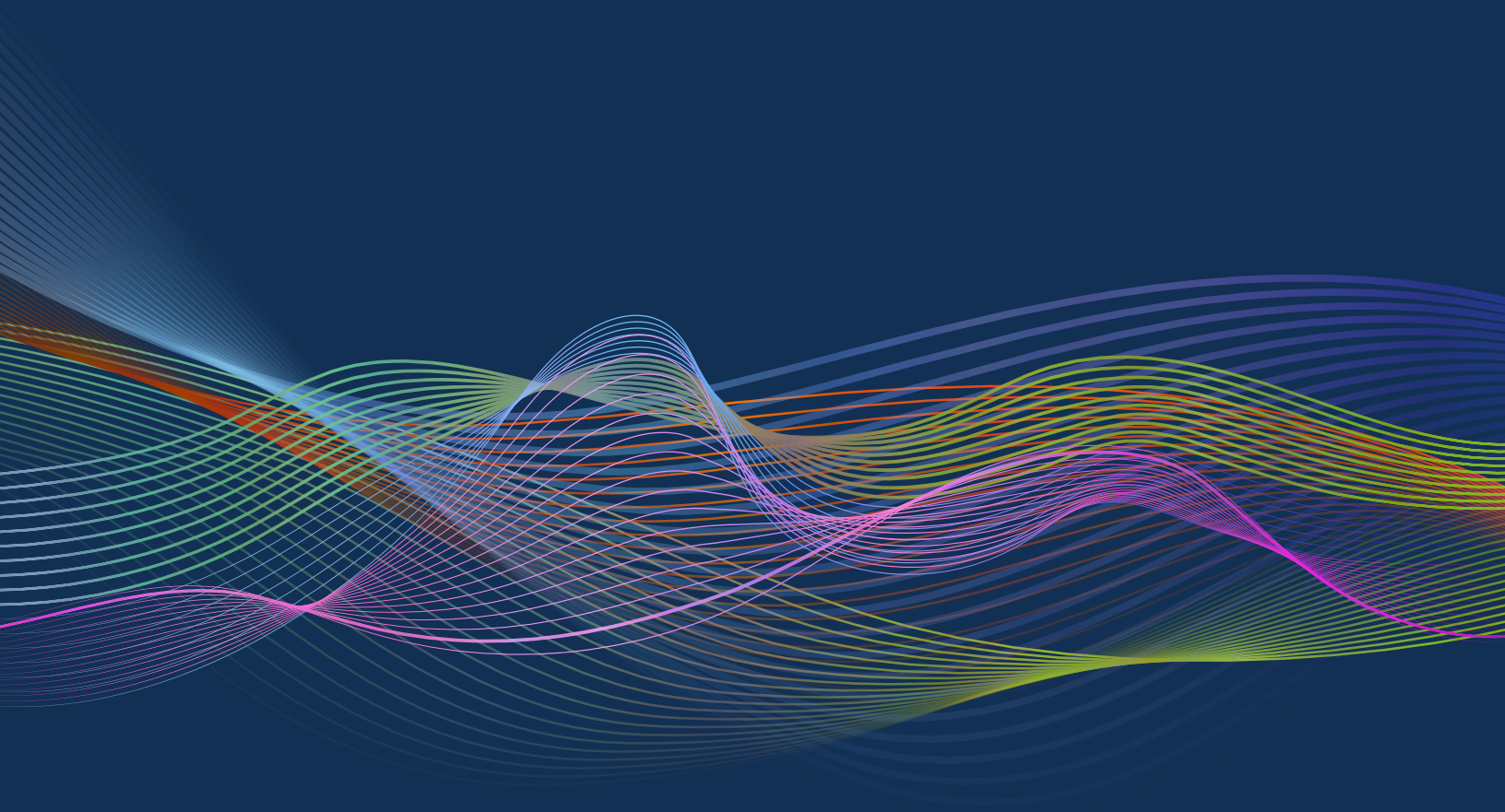
World Bank. 2022 (forthcoming). Energy Efficiency in Shipping. Washington, DC: World Bank.

World Bank Group. 2020. Transformative Climate Finance: A New Approach for Climate Finance to Achieve Low-Carbon Resilient Development in Developing Countries. Washington, DC: World Bank Group.

World Bank, Ecofys, Vivid Economics. 2016. State and Trends of Carbon Pricing 2016. Washington, DC: World Bank.

World Bank Group and Frankfurt School of Finance and Management. 2017. Results-Based Climate Finance in Practice: Delivering Climate Finance For Low-Carbon Development. Washington, DC: World Bank.

Yeh, Sonia, Julie Witcover, Gabriel Lade, and Daniel Sperling. 2016. "A Review of Low Carbon Fuel Policies: Principles, Program Status and Future Directions." Energy Policy 97: 220–234.



THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP