

REGULATING GHG EMISSIONS FROM INTERNATIONAL SHIPPING

Peter L'Esperance
with assistance from Dan Vanclieaf

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1. INTRODUCTION

(a) The International Shipping Sector, Sustainable Development & Climate Change

The international shipping industry has been described as the “lifeblood” of the global economy, responsible for connecting distant markets, creating linkages in international supply chains, facilitating the exploitation of economies of scale and comparative advantages in production, and ultimately moving a wide range of goods between countries, both developing and developed.¹

International shipping is the most cost efficient mode for transporting goods with estimates suggesting that international shipping carries as much as 90% of the volume of world trade.² Further, international shipping is the most energy efficient and least emissions-intensive methods of transporting goods between countries, generating an estimated 3–8 grams of GHGs per tonne–kilometre; significantly less than ground and air transportation, which respectively generate 80 and 435 grams of GHGs per tonne–kilometre.³

The international shipping industry’s superior cost and energy efficiencies coupled with its integral role in facilitating trade and economic development more broadly suggest the industry’s continuing importance in facilitating sustainable development into the future, defined as "development which meets the needs of current generations without compromising the ability of future generations to meet their own needs" having regard to social, economic and environmental criteria.⁴

Yet, the international shipping industry does not operate without environmental impacts. The industry generates a wide variety of pollutants: marine and atmospheric; operational and accidental. With regard to climate change, combustion of the heavy fuel oil, marine diesel oil, and liquefied natural gas relied on by the international shipping sector for propulsion generates significant quantities of potent greenhouse gases (GHG), including carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O).⁵ These emissions join those from other anthropogenic

¹ International Chamber of Shipping (ICS), “ICS Film – International Shipping: Lifeblood of World Trade”, online: <http://www.ics-shipping.org/ics-film---international-shipping-lifeblood-of-world-trade>.

² ICS website, “Home, Shipping and World Trade”, online: <http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade>.

³ ICS, “Shipping, World Trade and the Reduction of CO₂ emissions: United Nations Framework Convention on Climate Change” (London: ICS, 2014).

⁴ World Commission on Environment and Development, *Our Common Future – Brundtland Report* (Oxford; New York: Oxford University Press, 1987), online: <http://www.un-documents.net/our-common-future.pdf>.

⁵ In 2012, the majority of the international shipping fleet relied on heavy fuel oil – or marine bunkers – to power ship propulsion systems. More specifically, in 2012 international shipping consumed an estimated 667.9 million tonnes of heavy fuel oil, 105.2 million tonnes of marine diesel oil, and 22.6 million tonnes of liquefied natural gas: International Maritime Organization (IMO), *Third IMO GHG Study 2014: Executive Summary and Final Report* (London: IMO, 2015) at 10, online: <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Greenhouse-Gas-Studies-2014.aspx> [*Third IMO GHG Study 2014*].

sources to increase overall concentrations in the atmosphere, contributing directly to climate change.

Accordingly, despite international shipping's characterization as an industry playing an integral role in facilitating global trade and economic growth, it is also an industry that contributes directly to climate change. This contribution has the very real potential to compromise sustainable global development.

(b) Overview

To deconstruct this tension, this paper explores the topic of regulating GHGs generated by the international shipping industry through:

- (a) quantifying GHG emissions generated by the international shipping sector;
- (b) exploring the history of and challenges encountered in regulating GHG emissions from international shipping under the *UNFCCC*, the *Kyoto Protocol*, and the *Paris Agreement*;
- (c) exploring the history and evolution of IMO efforts to regulate GHG emissions from international shipping;
- (d) constructing a framework to compare the relative effectiveness of current and proposed IMO policies to regulate GHGs from international shipping; and
- (e) applying the comparative framework to proposed IMO market-based measures regulating emissions from international shipping with a view to identifying which IMO policy is best positioned to reduce emissions from international shipping to levels consistent with international targets.

2. QUANTIFYING EMISSIONS GENERATED BY THE INTERNATIONAL SHIPPING SECTOR

(a) Aggregate Emissions from the International Shipping Sector as a share of Global Anthropogenic GHG Emissions

International shipping is the least emissions intensive method of transporting goods internationally. Yet, in absolute terms and as a percentage of global emissions, emissions from international shipping remain significant. The *Third International Maritime Organization GHG Emissions Study*, completed in 2014, estimated multi-year average emissions for international shipping between 2007–2012 to equal 846 million tonnes CO₂ and 866 million tonnes CO₂ equivalent (CO₂e) for GHGs combining CO₂, CH₄ and nitrous oxide N₂O.⁶ As a proportion of global anthropogenic emissions, shipping represented 3.1% of CO₂ emissions and 2.8% of GHGs combining CO₂, CH₄ and N₂O.⁷ To provide some context on the international shipping industry's absolute contributions to anthropogenic GHG emissions with reference to those of

⁶ *Ibid.*

⁷ *Ibid.*

other States, Canada generated approximately 726 million tonnes of CO₂e in 2013; Germany generated approximately 950 million tonnes of CO₂e in 2013; France generated approximately 496 million tonnes of CO₂e in 2013; the Russian Federation generated approximately 2,799 million tonnes of CO₂e in 2013.⁸ Note that among Annex I State parties to the *UNFCCC*, only Russia and Germany generate a higher volume of CO₂e emissions than the international shipping industry.

(b) Projected Increases in Emissions from the International Shipping Sector from 2012–2050

The *Third IMO GHG Emissions Study* projected pathways for shipping emissions from 2012–2050. The IMO based the future pathways on projected increases in demand for maritime transport services, projected improvements in fleet fuel consumption and projected improvements in operational efficiency. The pathways predict emissions from international shipping to increase between 50% and 250% in the period up to 2050.⁹ The range in the projected increases flows from different assumptions regarding improvements in operational efficiency, market- or regulatory-driven improvements in efficiency, and projections regarding fuel type.¹⁰

The *Third IMO GHG Emissions Study* reveals that as an emissions source, the international shipping industry is a significant contributor in absolute terms, with absolute emissions that are higher than most *UNFCCC* Annex I countries.¹¹ Projected increases in shipping emissions from 2012–2050 suggest that the industry’s contribution to anthropogenic GHG emissions – and climate change – will continue to increase. These points provide important perspective in contextualizing later discussion on the effectiveness of regulatory responses to GHG emissions generated by the international shipping sector.

3. HISTORY OF REGULATING INTERNATIONAL SHIPPING EMISSIONS

In 1992, the United Nations adopted the *United Nations Framework Convention on Climate Change* (“*UNFCCC*”) to provide the architecture in which subsequent international negotiations would take place to achieve the *UNFCCC*’s ultimate objective: the “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”.¹² Although the *UNFCCC* did not directly address shipping emissions, it established the “Subsidiary body for scientific and technological advice” (SBSTA) tasked with conducting preliminary investigations into regulating GHG emissions from international shipping in concert with the IMO.¹³ The SBSTA and the IMO identified five primary options for addressing emissions from international shipping, specifically:

- (a) No allocation;

⁸ *UNFCCC*, “National greenhouse gas inventory data for the period 1990–2013”, FCCC/SBI/2015/21 (18 November 2015) [*UNFCCC, National greenhouse gas inventory data*].

⁹ *Third IMO GHG Study 2014*, *supra* note 5 at 20.

¹⁰ *Ibid.*

¹¹ *UNFCCC, National greenhouse gas inventory data*, *supra* note 8 at 10.

¹² UN, *United Nations Framework Convention on Climate Change*, 9 May 1992, 1771 UNTS 107 art 16 (entered into force 21 March 1994) [*UNFCCC*].

¹³ *Ibid* at art. 9.

- (b) Allocation to the country where the bunker fuel is sold;
- (c) Allocation to the nationality of the transporting company, or to the country where the vessel is registered, or to the country of the operator;
- (d) Allocation to the country of departure or destination of a vessel. Alternatively, the emissions could be shared between the country of departure and country of arrival; or
- (e) Allocation to the country of departure or destination of passenger or cargo. Alternatively, the emissions related to the journey of a passenger or cargo could be shared by the country of departure and the country of arrival.¹⁴

The 5 proposed options generated debate, but did not produce any agreement on a preferred allocation option. This early failure to adopt a method for allocating GHG emissions from international shipping among UNFCCC Parties foreshadowed the exclusion of GHG emissions from international shipping from later Protocols developed under the UNFCCC, including the *Kyoto Protocol* and the more recent *Paris Agreement*.

In 1997, UNFCCC parties established legally binding GHG emission reduction targets through the adoption of the *Kyoto Protocol*.¹⁵ The *Kyoto Protocol* reflected the ‘common but differentiated responsibilities’ (“**CBDR**”) principle animating the UNFCCC: the concept that all countries have an obligation to undertake action to address climate change but that developed countries should assume greater obligations given their historic responsibility for the bulk of anthropogenic GHG emissions currently effecting climate change.¹⁶ Consistent with the CBDR principle, developed countries committed to reduce GHG emissions to an average of 5 per cent relative to 1990 levels over the five-year period between 2008 and 2012.¹⁷ Although international shipping was not included in these targets, Article 2.2 of the *Kyoto Protocol* expresses that the task of regulating emissions and developing emissions reductions targets would fall to the parties working through the IMO.¹⁸

In 2015, 195 members of the UNFCCC adopted the *Paris Climate Agreement*: a global, legally binding agreement designed to stabilize increases in global average temperature below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.¹⁹ The *Paris Agreement*, like the *Kyoto Protocol*, reflects the CBDR in article 2(2), which provides that, “[t]his Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light

¹⁴ Iulian Florin Vladu & Barnd Hackmann, “International maritime transport under the UNFCCC process” in *Maritime Transport and the Climate Change Challenge*, *supra* note 2 at 67 [Vladu & Hackmann]

¹⁵ UN, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 11 December 1997, 2303 UNTS 148 (entered into force 16 February 2005) [*Kyoto Protocol*].

¹⁶ *Ibid.*

¹⁷ Vladu & Hackmann, *supra* note 14 at 67.

¹⁸ *Kyoto Protocol*, *supra* note 15, art 2(2).

¹⁹ UN, *Adoption of the Paris Agreement*, FCCC/CP/2015/L.9/Rev.1 art 2(1)(a) (12 December 2015) [*Paris Agreement*].

of different national circumstances”.²⁰ However, unlike the *Kyoto Protocol*, the *Paris Agreement* makes no explicit reference to emissions from marine bunker fuels or from international shipping.²¹ Accordingly, the IMO continues to serve as the primary forum through which UNFCCC Parties and non-Parties negotiate emissions reductions targets for the international shipping sector.

4. IMO REGULATION OF GHG EMISSIONS FROM SHIPPING

(a) Introduction to the IMO

The IMO is the UN body responsible for the safety and security of shipping and the prevention of marine pollution by ships.²² The IMO’s membership structure is unique, and accommodates flag States, coastal States, intergovernmental organizations and non-governmental organizations representing industry and environmental interests.²³ Since its establishment in 1958, the IMO has facilitated the development, adoption and implementation of an impressive constellation of international instruments regulating all facets of shipping, international and domestic. As the international community began to appreciate the relationship between emissions from international shipping and climate change, its focus shifted to regulating GHG emissions generated by the industry. The decision to exempt emissions from international shipping from the *UNFCCC* meant that the IMO would be responsible for fulfilling this task.

In September 1997, Parties to the *1973 International Convention for the Prevention of Pollution by Ships* as amended by the *1978 Protocol* (“*MARPOL 73/78*”) – the primary treaty addressing operational and accidental marine environmental pollution from shipping – adopted the *1997 Protocol to MARPOL 73/78*.²⁴ The *1997 Protocol* added Annex VI to *MARPOL 73/78: Regulations for the Prevention of Air Pollution from Ships*.²⁵ Annex IV did not address GHG emissions from shipping. Specifically, during negotiations preceding the instrument’s adoption, Parties agreed that CO₂ was not an air pollutant as such and therefore would not be covered by the regulations.²⁶ However, the Parties did agree on the separate resolution to address “CO₂ emissions from ships”. The resolution invited the IMO to:

- (a) collaborate with the Executive Secretary of the *UNFCCC* in exchanging information on the issue;

²⁰ *1978 Protocol Relating to the 1973 International Convention for the Prevention of Pollution from Ships*, 17 February 1978, 1340 UNTS 61 (entered into force 2 October 1983); *1997 Protocol to amend the 1973 International Convention for the Prevention of Pollution from Ships, as modified by the 1978 Protocol*, 26 September 1997, [2007] ATS 37 (entered into force 19 May 2005) [*MARPOL 73/78*].

²¹ See World Maritime News, “COP21: Paris Remains Silent on Shipping and Aviation”, online: <http://worldmaritimeneews.com/archives/178732/cop21-paris-remains-silent-on-shipping-and-aviation/>; and World Maritime News, “Shipping Dropped from Paris Climate Deal”, online: <http://worldmaritimeneews.com/archives/178438/shipping-dropped-from-paris-climate-deal/>.

²² IMO website, “Introduction to IMO”, online: <http://www.imo.org/en/About/Pages/Default.aspx>.

²³ IMO website, “Membership”, online: <http://www.imo.org/en/About/Membership/Pages/Default.aspx>.

²⁴ *1997 Protocol to amend the International Convention for the Prevention of Pollution by Ships, as modified by the 1978 Protocol*, 26 September 1997, [2007] ATS 37 (entered into force 19 May 2005) [*1997 Protocol to MARPOL 73/78*].

²⁵ *Ibid.*

²⁶ *Maritime Transport and the Climate Change Challenge*, *supra* note 2 at 78.

- (b) commission a study of GHG emissions from ships to establish the amounts and percentage share of GHG emissions from shipping as part of a global inventory of GHG emissions; and
- (c) consider through its Marine Environmental Protection Committee potential emissions reductions measures.²⁷

This resolution formally initiated the IMO's work in developing a regulatory strategy to reduce GHG emissions from ships. Following the resolution, the IMO commissioned its first *IMO Study on GHG Emissions From Ships* in June 2000 to evaluate the shipping sector's absolute and relative contributions to global anthropogenic GHG emissions.²⁸ Since that time, the IMO has commissioned two additional GHG studies in 2009 and more recently in 2014.²⁹ The studies measure the shipping sector's absolute and relative contributions to global GHG emissions, project future increases in the shipping sector's emissions through to 2050, evaluate technical and operational measures' potential to reduce emissions, evaluate proposed market based measures' potential to reduce emissions, and, more generally, inform the IMO and its members in the task of developing a GHG reduction regime for the international shipping sector.

Significantly, the CBDR Principle, which animates the *UNFCCC* and the *Paris Agreement*, is in tension with foundational principles which have traditionally informed IMO regulatory approaches. Specifically, the CBDR Principle conflicts with the IMO principle of equal treatment of ships.³⁰ The ostensible conflict between the two principles is especially evident when one considers that three quarters of all merchant vessels by deadweight tonnage engaged in international trade are registered in countries traditionally categorized as 'developing'; countries that are not subject to binding emissions reduction targets under the earlier *Kyoto Protocol* adopted under the *UNFCCC*.³¹ This pattern of ship registration automatically makes the traditional approach to IMO regulation via the flag State unsuitable for regulating GHG emissions in a manner sensitive to the CBDR principle.

²⁷ Conference of Parties to *MARPOL 73/78*, "Resolution to Address CO₂ Emissions from Ships", 22 October 1997, MP/CONF.3/35, 1997; IMO, *Second IMO GHG Study 2009* (London: IMO, 2009) at 1.2 [*Second IMO GHG Study 2009*]; *Chrysostomou & Vågslid*, *supra* note 47 at 78.

²⁸ IMO, *Study of Greenhouse Gas Emissions from Ships: Final Report of the International Maritime Organization* (London: IMO, 2000).

²⁹ Conference of Parties to *MARPOL 73/78*, "Resolution to Address CO₂ Emissions from Ships", 22 October 1997, MP/CONF.3/35, 1997; IMO, *Second IMO GHG Study 2009* (London: IMO, 2009) at 1.2 [*Second IMO GHG Study 2009*]; *Third IMO GHG Study 2014*, *supra* note 5.

³⁰ Nadine Heitmann & Seterah Khalilian, "Accounting for carbon dioxide emissions from international shipping: Burden sharing under different UNFCCC allocation options and regime scenarios" (2011) 35 *Marine Policy* 682, at 684 [*Heitmann & Khalilian*]. See also Article 1(b) of the *International Convention on the International Maritime Organization*, adopted 6 March 1948, 289 UNTS 48 which articulates the Organization's purpose as "[t]o encourage the removal of discriminatory action and unnecessary restrictions by Governments affecting shipping engaged in international trade so as to promote the availability of shipping services to the commerce of the world without discrimination".

³¹ For information on global fleet ownership and registration, see *UNCTAD, Review of Maritime Transport 2015*, *supra* note 2 at 36 and 42; *Heitmann & Khalilian*, *supra* note 30 at 684.

(b) Current IMO Measures to Regulate Emissions from International Shipping

The tables below introduce the GHG reductions options currently developed and proposed by the IMO. The succeeding sections will critically evaluate each option in its ability to achieve the purpose underlying the *Paris Agreement*: regulating emission reductions to stabilize temperature increases below 2° C by the end of this century. The sections will employ a structured analysis to evaluate the effectiveness of proposed regulatory options based on criteria developed in the Second *IMO GHG Study* and informed by legal regulatory theory. The objective of this analysis will be to attempt to identify the option or collection of options offering the most promise in achieving the stated objective of reducing GHG emissions from the international shipping sector, and anticipating those issues which the IMO must address in implementing the particular options identified.

GHG control or reduction measures developed or proposed by the IMO fall into two distinct categories, each of which will be examined in turn:

- (a) Energy Efficiency Measures (Efficiency-based measures); and,
- (b) Market Based Measures (MBMs).

Due to space constraints, this paper applies the comparative analysis focuses on those measures which IMO GHG studies have identified as the most effective in reducing sector-wide emissions.³²

(i) *Efficiency Based Measures*

Measure	Description	Status	Base Documents
Energy Efficiency Design Index (EEDI)	Mandatory regulatory mechanism requiring all new ships of prescribed classes of ships to meet a minimum threshold for energy efficient design.	Entered into force 1 January 2013;	MEPC.203(62), <i>Amendments To The Annex Of The Protocol Of 1997 To Amend The International Convention For The Prevention Of Pollution From Ships, 1973, As Modified By The Protocol Of 1978 Relating Thereto</i> , adopted 17 July 2011 (entered into force 1 January 2013);

³² The author has also prepared a fuller paper which evaluates these measures that is available on the Canadian Maritime Law Website, online: <<http://www.cmla.org/papers/Regulating%20GHG%20emissions%20from%20international%20shipping.pdf>>.

Measure	Description	Status	Base Documents
Ship's Efficiency Management Plan (SEEMP)	Mandatory regulatory mechanism applicable to all ships within prescribed classes designed to improve the operational energy efficiency of a ship in a cost-effective manner. The SEEMP includes a mechanism to enable ship owners and operators to track ship or fleet efficiency performance over time.	Entered into force 1 January 2013;	MEPC.203(62), <i>Amendments To The Annex Of The Protocol Of 1997 To Amend The International Convention For The Prevention Of Pollution From Ships, 1973, As Modified By The Protocol Of 1978 Relating Thereto</i> , adopted 17 July 2011 (entered into force 1 January 2013);

(ii) *Market Based Measures*

Measure	Description	Proponents	Base Documents
Global Emissions Trading System for International Shipping	Establish a sector-wide cap on emissions from international shipping. Auction a number of emission allowances to the international shipping sector annually sufficient to meet the pre-set cap. Shipowners/ operators can trade emissions allowances to the extent their emissions fall above or below sector cap.	Norway	MEPC 60/4/22; MEPC 60/4/26; MEPC 60/4/41; MEPC 60/4/54; GHG-WG 3/3/5; GHG-WG 3/3/6; GHG-WG 3/3/8
International Fund for GHG Emissions from Ships	Establish a system requiring shipowners/ operators to pay a fee per unit of bunker fuel purchased. Fees collected would be allocated to a separate		MEPC 60/4/8

Measure	Description	Proponents	Base Documents
	International Fund for GHG Emissions from Ships, which would further allocate funds to GHG mitigation and adaptation projects in developing countries, and R&D into technical measures for more energy efficient ship design and propulsion methods.		

5. EVALUATIVE FRAMEWORK

To measure the comparative effectiveness of current and proposed IMO efficiency and market-based policies to reduce GHG emissions from international shipping, this paper will apply the below framework to each of the policy options identified earlier in the paper.³³

Evaluative Framework	
1.	Environmental effectiveness
	<ul style="list-style-type: none"> i. Total amount of emissions under the policy's scope ii. Impacts on shipping in other sectors iii. Range of and depth of emissions reductions measures rewarded iv. Policy applicability
2.	Cost effectiveness
	<ul style="list-style-type: none"> i. Cost effectiveness of emission reduction measures ii. Administrative costs to implement scheme
3.	Incentives for positive technological change
	<ul style="list-style-type: none"> i. Goal-based and non-prescriptive ii. Conducive to technological innovation and improvements in energy efficiency
4.	Practical feasibility/ implementation
	<ul style="list-style-type: none"> i. Administrative complexity and ease of implementation

³³ The authors selected the evaluative criteria based on the work of the IMO, *Report Of The Marine Environment Protection Committee On Its Fifty-Seventh Session*, 7 April 2008, MEPC 57/21 at 4.107.

Evaluative Framework

- ii. Transparent and Fraud Free

5. Legal enforcement

- i. Legal enforceability of policy measures;
- ii. Practical effectiveness of enforcement mechanisms;
- iii. Availability and effectiveness of the legal penalties for non-compliance;

6. Developing country impacts

6. APPLYING THE EVALUATIVE FRAMEWORK TO EFFICIENCY AND MARKET BASED MEASURES

The tables below apply these factors to the two primary efficiency based measures and the two primary market based measures identified above.

(a) Efficiency Based Measures

Criteria	EEDI	SEEMP/ EEOI
1. Environmental Effectiveness	<p>Strengths</p> <ul style="list-style-type: none"> • Ensures <u>new ships</u> meet efficiency performance targets and defined emissions intensity reduction targets • Significant long term emissions reductions potential – <u>regulates incremental improvements in energy efficiency performance</u> • Low predicted impacts on other sectors • Low risks of policy evasion <p>Weaknesses</p> <ul style="list-style-type: none"> • Only applies to <u>new ships of prescribed types 400 GT and above</u> • <u>Limited ability to impose an absolute cap on</u> 	<p>Strengths</p> <ul style="list-style-type: none"> • <u>Mandatory obligation to possess a valid SEEMP applies to new and old ships of prescribed types 400 GT and above</u> • <u>increased short term emissions reduction potential</u> relative to the EEDI • Obligation to prepare a SEEMP makes it more likely for ship owners/operators to adopt the measures articulated in the management plans • Low predicted impacts on other sectors <p>Weaknesses</p> <ul style="list-style-type: none"> • <u>No obligation to implement SEEMP measures nor to use EEOI to track energy efficiency performance</u> • <u>Substantive implementation</u>

Criteria	EEDI	SEEMP/ EEOI
	<p><u>emissions</u></p> <ul style="list-style-type: none"> Potential rebound effects 	<p><u>of the policy entirely dependent on ship owner/operator uptake, something which in turn depends on multiple market factors</u></p> <ul style="list-style-type: none"> Cost effectiveness appears to be the limit on adoption <u>Limited ability to impose an absolute cap on emissions</u>
<p>2. Cost effectiveness</p>	<p>Strengths</p> <ul style="list-style-type: none"> <i>Straightforward/ lowest cost to implement and enforce</i> <i>Many measures feature negative emissions abatement costs</i> <p>Weaknesses</p> <ul style="list-style-type: none"> Limits ship owners/operators to adopting prescribed technical measures 	<p>Strengths</p> <ul style="list-style-type: none"> <i>Cost effective with potential for negative emissions abatement costs – many operational measures have low/ non-existent capital costs</i> <i>Straightforward/ low cost to implement and enforce</i> <p>Weaknesses</p> <ul style="list-style-type: none"> Limits ship owners/operators to adopting prescribed operational measures
<p>3. Incentives for positive technological change</p>	<p>Strengths</p> <ul style="list-style-type: none"> Goal-based/ non-prescriptive within the range of prescribed technologies Ensures international shipping fleet adopts and implements leading technology over time <p>Weaknesses</p> <ul style="list-style-type: none"> <i>Does not appear to reward compliance over and above prescribed</i> 	<p>Strengths</p> <ul style="list-style-type: none"> Goal based and non-prescriptive Rewards a broader set of measures than does the EEDI Although conditional on ship owner/ operator uptake, potential to reward an increased range of measures and volume of emissions reductions on an ongoing basis <p>Weaknesses</p> <ul style="list-style-type: none"> No incentive on ship owners/operators to implement measures contained in the

Criteria	EEDI	SEEMP/ EEOI
	<p><i>threshold</i></p> <ul style="list-style-type: none"> Effectiveness will depend on the degree to which EEDI targets fall below EEDI reference level 	SEEMP
4. Practical feasibility of implementation	<p><i>Strengths</i></p> <ul style="list-style-type: none"> Most straight forward and low cost to implement 	<p><i>Strengths</i></p> <ul style="list-style-type: none"> Straight forward and low cost for ship owners/operators to develop and implement;
5. Legal enforcement	<p><i>Strengths</i></p> <ul style="list-style-type: none"> Mandatory Monitoring compliance and enforcement straightforward and low cost Compliance and enforcement provisions dovetail with those already required under MARPOL 	<p><i>Strengths</i></p> <ul style="list-style-type: none"> straightforward and low-cost for both flag and port States to enforce possession of a valid SEEMP through registration and inspection
6. Impacts on developing countries	<p><i>Strengths</i></p> <ul style="list-style-type: none"> 4 year waiver provision for states seeking to delay implementation <p><i>Weaknesses</i></p> <ul style="list-style-type: none"> No explicit provision for CBDR 	<p><i>Strengths</i></p> <ul style="list-style-type: none"> 4 year waiver provision for states seeking to delay implementation <p><i>Weaknesses</i></p> <ul style="list-style-type: none"> No explicit provision for CBDR No penalties for non-compliance appear to be developed

The efficiency based EEDI and SEEMP/EEOI measures perform complementary roles in regulating the technical and operational aspects of ship design, construction and operations with a view to maximizing energy efficiency and minimizing emissions.

The EEDI's application to *new* ships means that it will target a small albeit increasing share of emissions generated by the global fleet. This means that the measure's potential to achieve emissions reductions through regulation in the short term is low while its potential to do so in the long term is high. Moreover, the EEDI's administrative simplicity suggests it is a cost effective measure well-suited to ensuring fleet wide improvements in energy efficiency and

corresponding reductions in emissions intensities. The critical ingredients to the measure’s success will be the degree to which the EEDI reference level mandates improvements in energy efficiency over and above those which would apply at business as usual levels of investment.

The mandatory requirement to prepare and SEEMP for both *old* and *new* ships suggests that the policy's potential to achieve emissions reductions across the global fleet is high. However, the fact that implementing the measures contained in a ship’s SEEMP or implementing the EEOI is purely *voluntary* significantly diminishes the policy’s effectiveness in regulating emissions reductions. Moreover, cost effectiveness appears to impose a ceiling on ship owner/operator investment in operational measures to improve energy efficiency.

As efficiency based measures, the policy’s ability to impose a cap or restrict industry emissions is limited. For this reasons, IMO members recognize that reliance on efficiency based measures alone will not be adequate to restrict emissions from international shipping to a level consistent with that required under the *UNFCCC*.³⁴

(b) Market Based Measures

Criteria	GHG Fund	ETS
1. Environmental Effectiveness	<p><i>Strengths</i></p> <ul style="list-style-type: none"> • Potential to reduce emissions by 13–40% by 2030 relative to business as usual emissions measured in 2007 – <i>highest estimated emissions reductions potential</i> • Potential to impose an <i>industry cap</i> on emissions through reliance on external emissions reductions credits • Potential to apply to <i>all ships</i>, regardless of size, type, function or build date • <i>Potential to reward all emissions reductions measures</i> – both operational and technical on an <i>ongoing</i> basis • <i>Dual effect of incentivizing decreased fuel consumption and</i> 	<p><i>Strengths</i></p> <ul style="list-style-type: none"> • Potential to reduce emissions by 13–40% by 2030 relative to business as usual emissions measured in 2007 – <i>highest estimated emissions reductions potential</i> • Potential to impose an <i>industry cap</i> on emissions through reliance on external emission • Potential to apply to <i>all ships</i>, regardless of size, type, function or build date • <i>Potential to reward all emissions reductions measures</i> – both operational and technical on an <i>ongoing</i> basis • <i>Dual effect of incentivizing decreased fuel consumption and mobilizing funding for mitigation and adaptation</i>

³⁴ IMO, “Report of the Marine Environment Protection Committee on its Fifty Ninth Session”, 27 July 2009, MEPC 59/24, para 4.106 [MEPC, 59/24].

Criteria	GHG Fund	ETS
	<p><i>mobilizing funding for mitigation and adaptation activities, including in- and out-of-sector mitigation and adaptation activities, R&D for in-sector energy efficiency improvements</i></p> <ul style="list-style-type: none"> • Policy may be applied to non-party states purchasing at Bunker fuel suppliers located in the territories of State parties <p>Weaknesses</p> <ul style="list-style-type: none"> • Potential to cause a price increase, modal shift and carbon leakage for short sea marine shipping services provided that prices for air- and land-based modes of transportation do not increase simultaneously • Risks of evasion medium unless policy universally adopted 	<p><i>activities, including in- and out-of-sector mitigation and adaptation activities, R&D for in-sector energy efficiency improvements</i></p> <p>Weaknesses</p> <ul style="list-style-type: none"> • Potential to cause a price increase, modal shift and carbon leakage for short sea marine shipping services provided that prices for air- and land- based modes of transportation do not increase simultaneously • Risks of evasion high unless policy universally adopted
<p>2. Cost effectiveness</p>	<p>Strengths</p> <ul style="list-style-type: none"> • Provides ship owners/operators with maximum latitude to develop and implement <i>all</i> technical and operational measures to reduce fuel consumption and GHG emissions for ships of varying size, type, function and operational route • Enables the industry to access external emissions reduction and mitigation opportunities which may have smaller or negative emissions abatement costs 	<p>Strengths</p> <ul style="list-style-type: none"> • Provides shipowners/operators with maximum latitude to develop and implement <i>all</i> technical and operational measures to reduce fuel consumption and GHG emissions for ships of varying size, type, function and operational route • Enables the industry to access external emissions reduction and mitigation opportunities which may have smaller or negative emissions abatement costs • Many ship owner/operator

Criteria	GHG Fund	ETS
	<ul style="list-style-type: none"> • Many ship owner/operator obligations dovetail with those already required under <i>MARPOL 73/78</i>, Annex VI • Administrative costs low relative to other MBMs <p><i>Weaknesses</i></p> <ul style="list-style-type: none"> • Administrative costs higher than under EEDI/SEEMP 	<p>obligations dovetail with those already required under <i>MARPOL 73/78</i>, Annex VI</p> <p><i>Weaknesses</i></p> <ul style="list-style-type: none"> • <i>Administrative costs significantly higher than GHG Fund and EEDI/SEEMP</i>
<p>3. Incentives for positive technological change</p>	<p><i>Strengths</i></p> <ul style="list-style-type: none"> • <i>Goal-based non prescriptive</i> – significant and ongoing incentive for technological change <p><i>Weaknesses</i></p> <ul style="list-style-type: none"> • Access to out-of-sector emissions mitigation/adaptation activities may limit in-sector investment 	<p><i>Strengths</i></p> <ul style="list-style-type: none"> • <i>Goal-based non prescriptive</i> – significant and ongoing incentive for technological change <p><i>Weaknesses</i></p> <ul style="list-style-type: none"> • Access to out-of-sector emissions mitigation/adaptation activities may limit in-sector investment • <i>Volatility in emissions allowance/ carbon price may impede investment in efficiency improvement/ emissions reductions technology</i>
<p>4. Practical feasibility of implementation</p>	<p><i>Strengths</i></p> <ul style="list-style-type: none"> • Relatively low-cost/straightforward compared with other MBMs • Precedent in IOPF Administrator <p><i>Weaknesses</i></p> <ul style="list-style-type: none"> • Relatively more administratively complex than EEDI/ SEEMP 	<p><i>Strengths</i></p> <ul style="list-style-type: none"> • Precedent in EU ETS <p><i>Weaknesses</i></p> <ul style="list-style-type: none"> • Administratively complex • <i>Estimated to be significantly more expensive to establish and maintain than GHG</i>

Criteria	GHG Fund	ETS
		<p><i>Fund</i></p> <ul style="list-style-type: none"> • <i>Industry opposition</i>
5. Legal enforcement	<p>Strengths</p> <ul style="list-style-type: none"> • Flag/ coastal State compliance & enforcement obligations dovetail with those already applicable under <i>MARPOL 73/78</i> <p>Weaknesses</p> <ul style="list-style-type: none"> • Requirement to develop a legal structure to establish and govern International GHG Fund Administrator operations 	<p>Strengths</p> <ul style="list-style-type: none"> • Flag/ coastal State compliance & enforcement obligations dovetail with those already applicable under <i>MARPOL 73/78</i> <p>Weaknesses</p> <ul style="list-style-type: none"> • Requirement to develop a legal structure to establish and govern ETS System
6. Impacts on developing countries	<p>Strengths</p> <ul style="list-style-type: none"> • GHG Fund may direct funding to mitigation/ adaptation activities/ R&D in least developed countries (LDCs), land locked developing (LLDCs) countries and small island developing states (SIDs) • Provision for involvement of LDCs, LLDCs, and SIDs in fund allocation process <p>Weaknesses</p> <ul style="list-style-type: none"> • Increased cost of shipping may negatively impact developing countries export capacity – may be mitigated through inclusion of rebate mechanism 	<p>Strengths</p> <ul style="list-style-type: none"> • Proceeds of potential auction of emissions allowances may be directed to mitigation/ adaptation activities/ R&D in least developed countries (LDCs), land locked developing (LLDCs) countries and small island developing states (SIDs) • Exemptions for approved voyages to developing countries <p>Weaknesses</p> <ul style="list-style-type: none"> • Increased cost of shipping may negatively impact developing countries export capacity – may be mitigated through inclusion of rebate mechanism

On the basis of the comparative evaluations above, the GHG Fund appears to be better positioned to regulate emissions generated by international shipping to levels consistent with the *UNFCCC* objective to stabilize global increases in temperature below 2°C relative to pre-industrial levels.

The IMO estimates both the GHG Fund and ETS policies to have an equal ability to reduce sector wide emissions by between 13% and 40% by 2030 relative to business as usual emissions measured from a 2008 base year.³⁵ Both policies have the practical effect of incentivizing decreased fuel consumption and decreased emissions, while simultaneously mobilizing funding for mitigation and adaptation activities. However, the GHG Fund appears to be positioned to achieve these emissions reductions through a simpler mechanism at a reduced cost. With regards to administrative costs borne by ship owners/ operators, the IMO estimates potential additional on board workload costs for the GHG Fund policy to be \$0.1 billion compared with \$0.7 billion for the maritime ETS policy. Regarding gross administrative costs, the IMO estimates gross costs for the GHG Fund policy to range from US \$ 8 – 11 billion in 2020 to US \$ 15 – 25 billion in 2030.³⁶ Contrast with gross administrative costs for the ETS estimated to range from US \$ 24 – 27 billion in 2020 to US \$ 40 – 49 billion in 2030.³⁷ These estimates suggest that the GHG Fund is positioned to deliver equal emissions reductions potential for approximately half the costs of a maritime ETS – supporting the measure’s superior cost effectiveness.

Admittedly, the ETS is better positioned to impose a cap on absolute levels of GHG emissions from the international shipping industry. However, in theory, the GHG Fund also has the ability to control absolute levels of emissions through a combination of adjusting the contribution price or relying on approved out-of-sector emissions reductions credits.

Under both the GHG Fund and the ETS policies, linkages to external carbon markets and the relationship between the contribution or allowance price and external carbon prices will play an important role in determining the level of investment in in-sector efficiency improvement and emissions reductions technologies. Access to external emissions reductions opportunities is positive in the sense that it may enable industry to access a broader, more cost effective range of emissions reductions opportunities. Further, purchasing out-of-sector emission reduction credits may enable the industry to meet a sector wide cap on emissions without compromising growth after the potential for reasonably cost effective in-sector emissions reductions measures has been exhausted. Arguably, however, financing in-sector energy efficiency improvements is the most effective way of reducing the international shipping industry’s actual and ongoing contributions to reductions in anthropogenic GHG emissions.

Both policies provide ship owners/ operators with maximum latitude to develop and implement *all* technical and operational measures to reduce fuel consumption and GHG emissions for ships of varying size, type, function and operational route. Both policies are positioned to incentivize ship owners/ operators to develop and implement ongoing emissions reductions measures. However, the fixed levy price under the GHG Fund proposal is positioned to provide ship owners/ operators with greater certainty surrounding returns to investment in efficiency improvement and emissions reductions measures. Uncertainty or volatility in the emissions allowance or emissions reductions prices within the ETS may impede investment in efficiency improvement/ emissions reductions technology.

³⁵ IMO, “Reduction of GHG Emissions from Ships: Full report of the work undertaken by the Expert Group on Feasibility Study and Impact Assessment of possible Market Based Measures”, 13 August 2010, MEPC 61/INF.2,]. at para 14.37 [IMO, *MBM Feasibility Study and Impact Assessment*].

³⁶ *Ibid* at table 9-3.

³⁷ *Ibid* at table 14-3.

Both policies are of some administrative complexity. However, the GHG Fund’s significantly lower administrative costs relative to the ETS suggest it will face fewer barriers to practical implementation. Moreover, the international shipping industry’s expressed preference for a levy-based rather than a cap and trade based GHG regulation policy suggests the GHG Fund will face fewer *political* barriers to implementation.

Both policies appear positioned to reconcile both the *UNFCCC* CBDR principle as well as the IMO NMFT principle. However, the ETS policy’s ability to do so will be contingent on emissions allowances being allocated by means of auctioning, a policy feature which remains uncertain.

7. RECENT DEVELOPMENTS

In October 2016, MEPC 70 approved a Roadmap for development of a “*comprehensive IMO Strategy on the reduction of GHG emissions from ships*” for application within the international shipping industry.³⁸ The Roadmap adopted a three-step approach to ship energy efficiency towards the development of a Revised IMO GHG Strategy for implementation in 2023. The key stages for the adoption of the revised strategy are set out as follows:³⁹

Spring 2018 (MEPC 72)	Adoption of the Initial Strategy, including, inter alia, a list of candidate short-, mid- and long-term further measures with possible timelines, to be revised as appropriate as additional information becomes available
January 2019	Start of Phase 1: Data collection (Ships to collect data)
Spring 2019 (MEPC 74)	Initiation of Fourth IMO GHG Study using data from 2012-2018
Summer 2020	Data from 2019 to be reported to IMO
Autumn 2020 (MEPC 76)	Start of Phase 2: data analysis (no later than autumn 2020) Publication of Fourth IMO GHG Study for consideration by MEPC 76
Spring 2021 (MEPC 77)	Secretariat report summarizing the 2019 data pursuant to regulation 22A.10 Initiation of work on adjustments on Initial IMO Strategy, based on Data Collection System (DCS) data
Summer 2021	Data for 2020 to be reported to IMO
Spring 2022 (MEPC 78)	Phase 3: Decision step Secretariat report summarizing the 2020 data pursuant to regulation 22A.10
Summer 2022	Data for 2021 to be reported to IMO

³⁸ IMO, *Initial IMO Strategy on Reduction of GHG Emissions from Ships*, Resolution MEPC.304(72), 13 April 2018, online: https://unfccc.int/sites/default/files/resource/250_IMO%20submission_Talanoa%20Dialogue-April%202018.pdf, at Annex 2, para 36. Note that the full text of the IMO Initial Strategy was included within the IMO’s submission to the Talanoa Dialogue established by the UN Climate Change secretariat for countries and stakeholders to contribute information contributing to climate action.

³⁹ *Ibid* at art. 6.2.

Spring 2023 (MEPC 80)	Secretariat report summarizing the 2021 data pursuant to regulation 22A.10 Adoption of Revised IMO Strategy, including short-, mid- and long-term further measure(s), as required, with implementation schedules
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Consistent with the Roadmap, the IMO’s Marine Environment Protection Committee (MEPC) adopted an *Initial IMO Strategy on reduction of GHG emissions from ships* (the “**Initial Strategy**”).⁴⁰ The Initial Strategy was aimed at enhancing IMO’s contribution to global emissions reduction measures consistent with the *Paris Agreement* and identifying actions and measures to be implemented by the international shipping sector in achieving these objectives.⁴¹ The strategy prescribes a first time reduction in total GHG emissions by at least 50% by 2050 compared to 2008 levels, while at the same time working to phase out the use of carbon fuel sources in the industry.⁴² In achieving these goals, The Initial Strategy is structured around commitments or “levels of ambition” for the international shipping sector, which, once implemented will allow the IMO to achieve emissions targets consistent with the *Paris Agreement*.⁴³ The levels of ambition are listed as follows:

1. ***Carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships*** – to review with the aim to strengthen the energy efficiency design requirements for ships with the percentage improvement for each phase to be determined for each ship type, as appropriate;
2. ***Carbon intensity of international shipping to decline*** – to reduce CO2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008; and
3. ***GHG emissions from international shipping to peak and decline*** – to peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 whilst pursuing efforts towards phasing them out as called for in the Vision as a point on a pathway of CO2 emissions reduction consistent with the Paris Agreement temperature goals⁴⁴

In achieving these levels of ambition, the Initial Strategy identifies a number of short, medium and long-term candidate measures to be implemented and agreed upon by the member states. The candidate short-term measures focus on improving existing emissions reductions mechanisms, including EEDI and SEEMP, encouraging states to adopt national action plans to address GHG emissions and the development of an “Existing Fleet Improvement Program”.⁴⁵ The medium term measures include measures intended to directly reduce emissions from ships and support action to reduce GHG emissions, including encouraging the use of alternative low-carbon fuels, developing operational energy efficiency measures for new and existing ships and developing market-based measures to incentivize GHG emissions reduction.⁴⁶ In the long-term,

⁴⁰ *Supra* note 38.

⁴¹ *Ibid* at art. 1.7

⁴² *Ibid* at art. 3.3

⁴³ *Ibid* at art. 3.1

⁴⁴ *Ibid*.

⁴⁵ *Ibid* at art. 4.7.

⁴⁶ *Ibid* at art. 4.8.

the Initial Strategy invites IMO members to pursue the development of zero-carbon or fossil-fuel free fuels in order to assist in the decarbonisation of the shipping industry and encourage and facilitate new and innovative reductions measures.⁴⁷

The Initial Strategy identifies that in adopting GHG emissions reduction measures, specific attention should be paid to the needs of developing countries and small island development states. Further, the disproportionality negative impacts of emissions reductions approaches on developing countries should be addressed in considering the implementation of each of these measures. This recognition differs from the measures previously adopted by the IMO, which favoured the equal application of measures over the CBDR principle.⁴⁸

This Initial Strategy was intended as a framework for further action, identifying and envisioning approaches that could be implemented to curb GHG emissions within the industry. The Initial Strategy represents an important step forward in the development of a comprehensive emissions reductions regime within the international shipping industry, but only time will tell as to whether the Initial Strategy will lead to the adoption of meaningful emissions reduction measures in the international shipping sector. This success will be subject to further negotiation and approval.

8. CONCLUSION

For the international community to avoid climate change's most devastating effects, the IPCC predicts that it must reduce anthropogenic CO₂ emissions by 72–41% by 2050 relative to 2010 levels and by 118–78% by 2100 relative to 2010.⁴⁹ Recognizing this, *UNFCCC* parties convened in Paris in December 2015 to negotiate the *Paris Agreement*: a global, legally binding agreement designed to stabilize increases in global average temperature below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.⁵⁰

Yet, the *Paris Agreement* excluded emissions from the international shipping industry, which produces an estimated 866 million tonnes of GHGs annually, accounts for 2.8% of global anthropogenic GHG emissions, and whose GHG emissions are projected to increase by 50%–250% between the present and 2050.⁵¹ Consequently, the IMO remained the international organization responsible for regulating international shipping's significant and growing share of global anthropogenic GHG emissions.

Atmospheric GHG concentrations are cumulative. If the international community aspires to achieve the emissions reductions required to stabilize atmospheric GHG concentrations and global temperatures, the shipping industry must be part of that solution. The IMO must develop and implement emissions reductions measures in coordination with *UNFCCC* parties. To do

⁴⁷ *Ibid* at art. 4.9.

⁴⁸ *Ibid* at art. 4.10-4.12

⁴⁹ International Panel on Climate Change, *Climate Change 2014 Synthesis Report Summary for Policymakers Chapter* (Geneva, Switzerland: IPCC, 2014) at 22, online: http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf [*IPCC Report 2014*].

⁵⁰ *Paris Agreement*, *supra* note 19, art 2(1)(a).

⁵¹ *Third IMO GHG Study 2014*, *supra* note 5.

otherwise risks compromising the achievement of the *UNFCCC*'s ultimate objective: the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."⁵²

This paper employed a structured analysis to evaluate current and proposed IMO measures' comparative effectiveness in reducing emissions in a manner sensitive to the industry's international character and role as an instrument of sustainable global development. The efficiency based EEDI and SEEMP/EEOI measures are a good start in approaching the task of regulating GHG emissions from international shipping. However, reliance on efficiency based measures alone will not be adequate to restrict emissions from international shipping to a level consistent with those required under the *UNFCCC*.⁵³ This paper concludes that the GHG Fund policy is the MBM which is best situated to regulate emissions from the international shipping industry, as determined by the proposed policy's: (1) environmental effectiveness; (2) cost effectiveness; (3) incentives for positive technological change; (4) practical feasibility of implementation; (5) legal enforcement; and (6) developing country impacts. This conclusion is consistent with that of two similar studies,⁵⁴ as well as others comparing the relative effectiveness of a levy rather than a cap-and-trade scheme.⁵⁵

The author suggests that in approaching the task of regulating GHG emissions from international shipping, the IMO should focus its efforts on the GHG Fund policy. Because uncertainty in a policy's application can detract from the consensus required to implement that policy, the IMO should undertake a comprehensive evaluation of the design, implementation and anticipated effects of the GHG Fund policy which makes special consideration of the policy's effects on developing countries. Experience from the *UNFCCC* context suggests that ensuring that the policy is designed and implemented in a manner conforming to the CBDR principle will be critical to the policy's success, both practical and political.

⁵² UN, *United Nations Framework Convention on Climate Change*, 9 May 1992, 1771 UNTS 107, art. 2 (entered into force 21 March 1994) [*UNFCCC*].

⁵³ IMO, "Report of the Marine Environment Protection Committee on its Fifty Ninth Session", 27 July 2009, MEPC 59/24, para 4.106 [*MEPC*, 59/24].

⁵⁴ Yubing Shi, "Reducing greenhouse gas emissions from international shipping: Is it time to consider market-based measures?" (2016) 64 *Marine Policy* 123 at 128 [Shi, *Reducing Greenhouse gas emissions from international shipping*]; Shi, *Reducing Greenhouse gas emissions from international shipping*, *supra* note 59 at 129; See also Harliaos N Psaraftis, "Market-based measures for greenhouse gas emissions from ships: a review" (2012) 11 *World Maritime University Journal of Maritime Affairs* 212 at 222 [Psaraftis, *Market-based measures for greenhouse gas emissions from ships*].

⁵⁵ See Congressional Budget Office, "Policy Options for Reducing CO₂ Emissions", February 2008, online: <https://www.cbo.gov/sites/default/files/110th-congress-2007-2008/reports/02-12-carbon.pdf>; See also Friends of the Earth, "Clearing the Air: Moving on from Carbon Trading to Real Climate Solutions", November 2010, online: www.foe.co.uk/resource/reports/clearing_air.pdf.