REGULATING GREENHOUSE GAS EMISSIONS FROM SHIPS: THE ROLE OF THE INTERNATIONAL MARITIME ORGANIZATION*

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I. INTRODUCTION

The causes and effects of climate change are extremely broad, so climate change, not surprisingly, has many implications for the world's oceans – and, by extension, for oceans law. With respect to the causes of climate change, the oceans play a key role in the carbon cycle, so changes to their chemistry or biota could increase or decrease transfers of carbon to and from the atmosphere, exacerbating or mitigating the climate change problem. Activities on the oceans emit carbon dioxide and thereby contribute to climate change. But if it proves possible to fertilize the ocean to increase its uptake of carbon dioxide from the atmosphere, then the oceans could conceivably play a role in limiting climate change.[1]

Just as the oceans play a major role in the causes of climate change, they will also be affected by climate change through changes in temperature, chemistry, and sea level. The latest report of the IPCC found with "high confidence" that "ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010."[2] Moreover, the absorption of CO_2 by the oceans has increased ocean acidity. These increases in ocean temperature and acidity will have major impacts on the marine environment, including the degradation and destruction of coral reefs, the loss of Arctic sea ice, and the geographical range of marine species.[3] In addition, sea-level rise will change coastlines, submerge low-lying atolls and other land features, and thereby raise issues about maritime baselines and boundaries.[4]

An important paper presented by David Caron at the 2010 Law of the Sea Institute conference in Hamburg surveyed the broad array of issues raised by climate change for oceans law.[5] The present paper will focus on only one of these issues: the regulation of greenhouse emissions from maritime transport.

II. THE CONTRIBUTION OF MARITIME SHIPPING TO GLOBAL WARMING

The International Maritime Organization has completed three studies of greenhouse gas (GHG) emissions from ships, in 2000,[6] 2009,[7] and 2014.[8] The latest of these reports concluded that maritime shipping contributes about one billion metric tons of carbon dioxide per year, about 900 million tons of which comes from international (as opposed to domestic) shipping.[9] Shipping contributes slightly more if we take into account other greenhouse gases (GHGs), but carbon dioxide accounts for the vast majority of shipping emissions – roughly 97%. Most of these emissions come from three types of ships: container ships, bulk carriers, and oil tankers, in descending order.[10]

Initially, three general points are worth noting about maritime emissions. First, emissions from shipping are a relatively small part of the climate change problem, accounting for less than 3% of overall global emissions.[11] Nevertheless, shipping emissions are bigger than the emissions of all but six countries. They are roughly the same as Germany's emissions and higher than those of the United Kingdom.[12] So they are still significant.

Second, shipping emissions have been increasing much faster than emissions from other sources,[13] and will continue to increase substantially in coming decades, despite improvements to efficiency through changes in ship design and operations. The exact level of future emissions depends on many factors, including, in particular, economic and energy developments. IMO scenarios range widely, from 50-250% growth by 2050 relative to 2012 levels.[14] Increasing demand for maritime transport is the key driver, resulting from population growth and economic development. The International Energy Agency projects a doubling of shipping tonne-kilometers between 2005 and 2050 in its baseline scenario, and a tripling in its high scenario.[15]

Third, maritime shipping is quite clean compared to other modes of transport, emitting less than half as much CO_2 per tonne-mile as rail transport, one-third that of road transport, and less than 1% that of air

transport.[16] This has two implications. On the one hand, it would be counter-productive to single out shipping emissions and regulate them more stringently than emissions from other transportation options, since this would simply result in what economists call emissions "leakage." As controls on maritime shipping became more stringent and costs increased as a result, shippers would switch, where possible, to air, rail or road transport, which have much higher emissions per tonne-mile. Conversely, shipping would do quite well in a regulatory system in which all sources of greenhouse gas emissions were controlled similarly.

There are many options, using known technologies, for reducing emissions from shipping, involving changes in ship design or operational practices.[17] The IMO's Second Greenhouse Gas Report report estimated that these design and operational changes might reduce emissions per tonne-mile by 25-75%.[18] Many of these design and operational changes are "no regrets" measures, meaning that they have negative costs,[19] and could be adopted without harming the competitiveness of the shipping industry, even if no one else were doing anything to control their emissions.

III. THE REGIME COMPLEX ADDRESSING EMISSIONS FROM SHIPS

Three international regimes are relevant to the regulation of emissions from ships: (1) the UN climate change regime; (2) the International Maritime Organization; and (3) the United Nations Law of the Sea Convention (UNCLOS). These form what political scientists refer to as a "regime complex"[20] relating to maritime shipping emissions.[21]

A. United Nations Climate Change Regime

The overarching regime addressing climate change is that established by the UN Framework Convention on Climate Change (UNFCCC),[22] which has evolved over the last twenty-five years in three acts.[23]

The first act, running from 1991 to 1994, was the constitutional phase, which involved the negotiation, adoption, and entry into force of the UNFCCC. Much like a domestic constitution, the UNFCCC established the basic governance structure for the climate change regime, including its fundamental objective (i.e., to stabilize greenhouse gas concentrations at levels that would prevent dangerous anthropogenic interference in the

climate system), norms (including the principle of common but differentiated responsibilities and respective capabilities, or CBDR-RC), and institutions (most importantly, the conference of the parties (COP), which meets annually and is the supreme body within the regime).

The second act was a regulatory phase, involving the negotiation of the 1997 Kyoto Protocol[24] and its elaboration in the 2001 Marrakesh Accords.[25] The Kyoto Protocol had four important features. First, in contrast to the UNFCCC, which did not set legally binding limits on countries' greenhouse gas emissions, the Kyoto Protocol prescribed internationally-negotiated, quantitative emissions targets. Second, these emissions targets were legally binding. Third, they applied only to so-called developed countries, listed in Annex I of the Convention. Fourth, the Protocol established several market-based mechanisms for countries to achieve their targets, including emissions trading and the Clean Development Mechanism. Because of the focus on developed country emission targets, the main axis in the negotiations was between the European Union, which wanted strong targets, and the United States, which wanted weaker targets and pushed for a market-oriented approach.

The third act involved an effort to broaden the regime, in order to encompass the emissions of emerging economies such as China, India and Brazil. This act has run from 2007 to the present, and culminated in the adoption in December 2015 of the Paris Agreement,[26] which builds on the 2009 Copenhagen Accord[27] and the 2010 Cancun Agreements.[28] In contrast to the Kyoto Protocol's internationally-negotiated, legally-binding emissions targets, the Paris architecture involves a bottom-up process in which countries make "nationally determined contributions" (NDCs) specifying what they plan to do to limit their emissions.[29] In this third act, the main axis in the negotiations has been between developed and developing countries.

As this brief history suggests, the UN climate change regime has undergone considerable change. But a number of distinctive features have remained relatively constant:

First, the UN regime has focused on greenhouse gas emissions on a national rather than sectoral basis. It has formulated the mitigation *problematique* in terms of the responsibility of each state to reduce its GHG emissions, rather than in terms of technical options to reduce emissions, or specific policies and measures such as efficiency standards or carbon taxes.

Second, national emissions have been calculated based on where greenhouse gases are emitted rather than in terms of where the goods responsible for emissions are used. In other words, the regime calculates national emissions based on the place of production rather than consumption.[30] The result is a picture of the world like that in Figure 1, where the goal is for each country to shrink its respective circle.

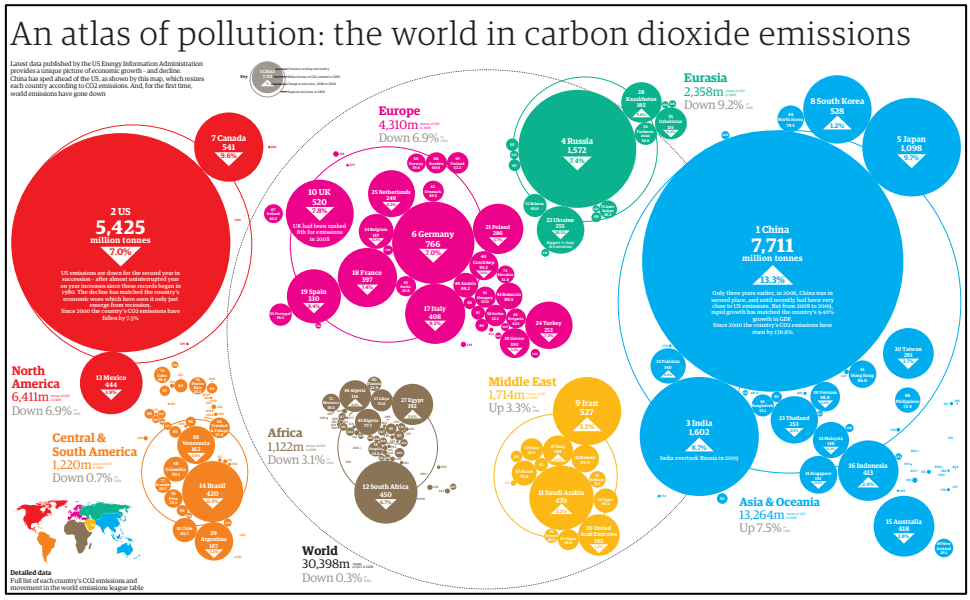

Figure 1: National Emissions of CO_2. Source: *Guardian* (Jan. 31, 2011)

Third, an important element of the UN climate change regime has been the principle of common but differentiated responsibilities and respective capabilities – or CBDR-RC.[31] This principle was reflected in the UNFCCC by the acknowledgment that developed countries should take the lead in combating climate change,[32] and by establishing three categories of parties: (1) Annex II parties, comprising the OECD member states at the time the Convention was adopted, which have obligations relating to finance and technology transfer; (2) Annex I parties, which include Annex II countries as well as the former Soviet bloc; and (3) non-Annex I parties, which include everyone else. Annex I parties are often referred to as "developed" countries and non-Annex I parties as "developing" countries, but the UNFCCC itself does not specify that these categories are co-extensive,[33] and the non-Annex I

category includes many of the richest states in the world, such as Singapore, Qatar, and Saudi Arabia.

The division between Annex I and non-Annex I parties reached its apogee in the Kyoto Protocol, which established legally-binding, quantitative emission reduction targets for Annex I parties, while establishing no new commitments for non-Annex I parties. Since Kyoto, the division between Annex I and non-Annex I countries has eroded, to the point where the Paris Agreement makes no mention of these categories at all. This does not mean that the principle of CBDR-RC is no longer part of the UN climate change regime. It simply means that the Paris Agreement operationalizes the principle in a more flexible manner, by allowing each country to nationally determine its own mitigation contribution, rather than by dividing the world into rigid categories of countries. Although a few provisions of the Paris Agreement apply specifically to "developed" or "developing" countries, most apply to all parties, and the developed/developing categorization is, in any event, more flexible than the Annex I/non-Annex I approach.

A fourth feature worth noting about the UN climate change regime is that it requires consensus or near-consensus decision-making.[34] Exactly what consensus means continues to be debated.[35] But one thing is clear: the consensus/near-consensus requirement within the UNFCCC makes it impossible to adopt decisions if more than a handful of states object.

Because the UNFCCC approach focuses on national emissions based on where emissions occur, it does not translate well to the problem of emissions from international maritime shipping. One reason is that emissions from maritime shipping generally take place outside the territory of any state. Moreover, because shipping is perhaps the most international of all industries, it is not clear which state should be deemed responsible for emissions, even when maritime emissions take place within the territory of a state. Consider, for example, a ship flying the Panamanian flag, owned by a company incorporated in Greece, operated from Singapore, carrying goods from China to Japan and the United States. To which state should the emissions occurring during the ship's voyage be allocated? The flag state? The state where the bunker fuel was sold? The state of the ship owner or operator? The port of origin or destination? The country producing or consuming the cargo?[36] The question has no obvious answer. A study of the various options concluded that "there is no single allocation option that can

be regarded as environmentally effective, legally effective, and allowing for fair burden sharing."[37]

The choice of allocation method has big implications, because the states that have the biggest registries or own the most ships are not necessarily the big economic players, which are responsible for the bulk of international trade. If we look to the state of registry, then Panama would be responsible for the largest share of maritime emissions, followed by Liberia. But if we look to ship ownership, then Greece and Japan would be the biggest players. And if we look to bunker fuel sales, then Singapore and the United States would have the greatest responsibility.[38] Strikingly, the fifteen biggest trading countries account for only about 20% of the world fleet, and for only about half of ship ownership.[39]

According to data submitted by the United Kingdom's Department of Transportation, the UK's share of responsibility for maritime emissions differs by a factor of four, depending on the choice of allocation method used.[40] If shipping emissions are allocated based on bunker fuel sales, then the UK's share of maritime emissions is less than 10 million tons. If shipping emissions are allocated based on the vessel's flag, then the UK is responsible for about 12 million tons, and if they are allocated based on the country of departure/destination, then the figure is almost 24 million tons.[41]

When the parties to the UNFCCC adopted the Kyoto Protocol in 1997, they could not agree on how to allocate emissions from international bunker fuels. So they included a provision in the Protocol that handed the issue off to other international institutions, the International Civil Aviation Organization (ICAO) in the case of emissions from airplanes, and the IMO in the case of emissions from maritime shipping.[42] In part, this was a way of disposing of a contentious issue, by punting it to other organizations. In part it reflected the view that, given the international nature of shipping and civil aviation and the problems with all of the different allocation methods mentioned above, emissions from international transport would be better addressed through an international sectoral approach, rather than through the national target-based approach of the Kyoto Protocol.[43]

B. International Maritime Organization

Let us now turn to the IMO, to whom the Kyoto Protocol gave the issue of maritime emissions. The IMO was created in 1948 and is the UN

specialized agency in the area of international shipping. It has 170 member states, and has adopted 53 conventions, as well as numerous guidelines and codes. Although the IMO's initial mandate was to promote international shipping and ensure maritime safety, it began to focus on marine pollution from vessels in the 1960s and, in 1973, established the Marine Environment Protection Committee (MEPC).[44] Somewhat surprisingly, only a few papers from previous LOSI conferences focus on the IMO, including Bernie Oxman's paper from the 1995 conference at the University of Hawaii[45] and Doris Koenig's paper in 2010 from the Hamburg Conference.[46]

If we compare the IMO with the UNFCCC, a number of differences stand out:

- First, rather than regulate shipping pollution based on national discharge totals (that is, by setting limits on the combined discharges of the ships in a state's registry), the IMO regulates through vessel-based standards, addressing how vessels are designed and constructed, how much each vessel may permissibly discharge, how they are operated, and so forth. Generally, these standards are fairly technical in nature.
- Second, IMO's vessel-based standards apply to vessels on a non-discriminatory basis,[47] and many IMO conventions contain a "no more favorable" treatment principle, which is intended to make its standards applicable to all vessels, of parties and non-parties alike.
- Third, implementation and enforcement of IMO standards is generally the responsibility of the flag state, but many other actors, both public and private, also play important roles, including port states, ship yards, ship owners and operators, insurance companies, banks, and classification societies.
- Finally, although there is a strong culture and tradition within the IMO to adopt decisions by consensus, decisions can be made, as a last resort, by majority or qualified-majority vote – in the case of amendments to the International Convention for the Prevention of Pollution of Ships (MARPOL) annexes, by a 2/3 majority of parties to the relevant annex.[48]

The main instrument regulating ship-based pollution is the International Convention for the Prevention of Pollution of Ships, or MARPOL, which was originally adopted in 1973, but did not come into effect until after the

adoption of a protocol in 1978.[49] Originally, MARPOL had five regulatory annexes, addressing oil pollution, noxious liquid substances carried in bulk, harmful substances in packaged form, sewage, and garbage. In 1997, the parties to MARPOL adopted a sixth annex, addressing air pollution from ships, which took effect in May 2005, and entered into force for the United States in 2009. Although Annex VI still has many fewer parties than MARPOL (72 as of November 2012, compared to 153 for MARPOL), they include most of the big states and account for almost 95% of global tonnage.

When Annex VI was adopted in 1997, climate change was already a major issue. Nevertheless, Annex VI did not originally address it, in part out of deference to the Kyoto Protocol negotiations, which were going on at the same time. Instead, Annex VI focused on the problems of acid rain and ozone depletion, establishing regulatory requirements to limit emissions of the main contributors to acid rain, SO_2 and NO_x, and prohibiting emissions of ozone-depleting substances.[50] It was not until 2011 that the parties extended MARPOL Annex VI to address climate change, as discussed in section IV below.

C. United Nations Convention on the Law of the Sea

The final regime relevant to emissions of GHGs from maritime shipping is UNCLOS, which includes comprehensive provisions relating to the protection of the marine environment. Although the air space above the oceans does not appear to be part of the "marine environment" and thus is not directly protected by UNCLOS, emissions from maritime shipping clearly constitute "pollution of the marine environment," within the meaning of Article 1.1(4) of the Convention, because they introduce energy and carbon dioxide into ocean waters, which results in harm to marine living resources and contributes to sea level rise.[51]

Because GHG emissions from maritime shipping constitute marine pollution, they fall within the ambit of Part XII of UNCLOS, addressing the protection of the marine environment. The question is: Which provisions of Part XII apply to these emissions? Article 212 and 222 address pollution of the marine environment from or through the atmosphere, so they clearly apply.[52] But do Articles 211, 217, 218, and 220, addressing pollution from vessels, also apply? Do greenhouse gas emissions from ships constitute "discharges"?

The question is important because the provisions of UNCLOS addressing vessel-source pollution are considerably stronger than those addressing atmospheric pollution. Article 212 requires flag states to adopt laws and regulations to prevent, reduce and control atmospheric pollution from their vessels, but these laws and regulations merely need to "take into account" internationally agreed rules and standards. Moreover, Articles 212 and 222 on atmospheric pollution do not give any special prescriptive or enforcement powers to coastal states. In contrast, Articles 211 and 217 require flag states to adopt and enforce laws and regulations with respect to vessel-source pollution that "at least have the same effect" as generally accepted international rules and standards; Articles 211 and 218 recognizes that port states can impose and enforce requirements to control marine pollution as a condition of port entry, so long as they give "due publicity" to these requirements (Article 211.3); and articles 211 and 220 gives coastal states jurisdiction (1) to adopt laws and regulations to control marine pollution from vessels in their territorial sea, so long as these laws and regulations do not hamper innocent passage (Article 211.4), and (2) to adopt laws and regulations to control marine pollution from vessels in their EEZ that "conform and give effect" to "generally accepted international rules and standards established through the competent international organization" (Article 211.5). Since one commentator estimates that 70-80% of GHG emissions from ships occur within 250 miles of shore,[53] the extent of port and coastal state jurisdiction over these emissions is potentially crucial.

The parties to MARPOL sought to address these questions, at least as between parties to Annex VI, through the inclusion in Annex VI of Regulation 10.6, which provides that "the international law concerning the prevention, reduction, and control of pollution from ships, … applies *mutatis mutandis*, to the rules and standards set forth in [Annex VI]." This suggests an intent to make Article 211 applicable to air pollution from ships. If so, the remaining question is whether the Annex VI amendments governing CO_2 emissions from vessels represent "generally accepted international rules and standards,"[54] which coastal states can apply to ships in their EEZ, given their rejection by several important states, as discussed below.

D. Regime Interactions and Conflict

As the International Law Commission has observed, regimes typically comes with their own "principles, … form of expertise, and … 'ethos'".[55] So

whenever multiple regimes address the same issue, as is the case with GHG emissions from ships, this raises concerns of fragmentation and conflict.

But regime overlap does not necessarily lead to this result. Regimes can interact in many ways, ranging from conflict at one end of the spectrum to synergistic relationships at the other.[56]

In general, the relationship between the UNFCCC and IMO is more cooperative than conflictive.[57] Each regime has its own treaty basis, and neither is hierarchically superior or subordinate to the other.[58] And each regime could potentially regulate the issue of GHG emissions from ships, the UNFCCC because of its general competence to address climate change, and the IMO because of its competence to address marine pollution from vessels.[59] So this regulatory overlap between the two regimes creates the potential for conflict. Nevertheless, by and large, the UNFCCC and IMO have been able to work constructively with one another. In Article 2.2 of the Kyoto Protocol, the UNFCCC parties agreed that the issue should be addressed in IMO, so there is not a competitive relationship between the two regimes. In a very real sense, the IMO, in addressing maritime emissions, is acting in pursuit of the ultimate objective of UNFCCC, rather than undermining it.[60] This cooperative relationship is perhaps due in part to the fact that the two organizations have essentially the same membership. Indeed, all 170 IMO member states are parties to the UNFCCC. Concerns about regime conflict do not pertain to the regimes as a whole, but rather to one particular issue, namely, the relationship between the UNFCCC's principle of CBDR-RC and the IMO's principle of non-discrimination --- an issue to which we will return shortly.

IV. IMO ACTION RELATING TO CLIMATE CHANGE

Since the IMO began to address climate change in the 1990s, it has basically played three roles: First, as noted earlier, it has undertaken technical studies of the issue. These have drawn on a wide variety of contributors, and have taken advantage of one of the IMO's key comparative advantages over the UNFCCC, namely, its greater technical expertise. Second, the IMO has served as a forum for the negotiation of international technical standards, culminating so far in the adoption in 2011 of amendments to MARPOL Annex VI. Third, the IMO has provided technical assistance – in particular, to developing countries.[61] Importantly, however, the IMO has not played a major role in verification or enforcement of its vessel-source pollution

standards;[62] instead, this has been the responsibility of flag states, supplemented in many cases by regional systems of port state control.

Prior to 1997, the IMO was largely deferential to the UNFCCC – the global body addressing the climate change issue – and took a wait-and-see approach. This deference was reflected in the 1992 decision by MARPOL parties not to address CO_2 emissions from ships in Annex VI, because these emissions were within the province of the UNFCCC.[63]

In 1997, however, this attitude began to change. In anticipation of the Kyoto Protocol's hand-off of the issue to IMO, IMO adopted a resolution calling for the study of emissions from maritime shipping, which led to the first of IMO's three GHG reports. Then, in 2006, MEPC approved a work program with three building blocks, focusing on (1) technical design measures, (2) operational measures, and (3) market-based mechanisms.

The first two parts of this work program provided the basis for the 2011 MARPOL Annex VI amendments, which added a new chapter to Annex VI on energy efficiency. The 2011 amendments entered into force in 2013 and apply to ships above 400 gross tonnage. They have two main components:

- First, a mandatory energy efficiency design index (EEDI), which establishes minimum efficiency levels for new ships, calculated in terms of grams of CO_2 emissions per tonne-mile. The EEDI will gradually escalate and is intended to reduce emissions per tonne-mile by 30% by 2025 through more energy efficient equipment and engines.[64]
- Second, a requirement that all ships maintain a ship-specific energy efficiency management plan (SEEMP), setting forth operational measures to reduce emissions, which address issues such as ship routing, hull maintenance, and ship handling.

Since adopting these amendments, the parties to MARPOL Annex VI have also adopted more detailed guidelines relating to the EEDI and SEEMP, as well as guidelines for voluntary use of the Energy Efficiency Operational Indicator (EEOI), which measures the fuel efficiency of ships and serves as a monitoring tool.

A big question in the development of the Annex VI amendments was whether and how the principle of CBDR-RC should apply?[65] Essentially,

states took three positions. At one end of the spectrum, some states, including the United States, argued that the principle of CBDR-RC does not apply to the IMO's work on greenhouse gas emissions, especially in light of the IMO's non-discrimination and no-more-favorable-treatment principles. At the other extreme, big developing countries such as China argued that CBDR-RC applies, and requires that the obligations of developed and developing countries to limit maritime emissions be differentiated along the lines of the Kyoto Protocol, trumping the IMO's non-discrimination principle.[66] In the middle, the IMO Secretariat argued that even if CBDR-RC is relevant to the IMO's work on GHG emissions, it does not conflict with the IMO's principle of non-discrimination, since non-discrimination applies to ships, whereas CBDR-RC applies to countries.[67]

In my view, the IMO Secretariat is clearly correct that there is no conflict between the UNFCCC's principle of CBDR-RC and the IMO's principle of non-discrimination. One can apply the same standards to all ships, on a non-discriminatory basis, while still differentiating between countries, for example, through the provision of financial and technical assistance to developing countries.[68] This approach to CBDR-RC is reflected in UNCLOS Article 203, which requires that international organizations grant "preference" to developing countries "in the allocation of appropriate funds and technical assistance."

If CBDR-RC required that the Annex VI requirements regarding ship efficiency apply only to vessels flagged or built in developed countries, then these requirements would have quite limited coverage, since most vessels are flagged in countries such as Panama, Liberia, and the Marshall Islands, and built in China and Korea.[69] Consequently, to achieve meaningful levels of emission reductions, limits on vessels flagged in developed states would need to be extremely stringent. To achieve a 10% reduction in overall emissions from international shipping, for example, developed country vessels would have to reduce their emissions by 35%, and to achieve an overall reduction of 20%, developed country vessels would have to reduce their emissions by 70%.[70] Since vessels currently flagged in developed countries could easily evade these requirements by reflagging in a developing country, the requirements would likely prove ineffective in reducing maritime emissions.

The issue of CBDR-RC was first raised in the IMO by China in 2002, but disagreement on the issue did not prevent the MEPC from proceeding with

its technical work program over the next several years to elaborate the EEDI.[71] Ultimately, developed countries were successful in IMO in preserving the "no more favorable treatment" principle. The Annex VI amendments adopted by MEPC in 2011 do not differentiate between vessels flagged, owned, or operated in developed versus developing countries; instead, they apply equally to all vessels. The only concession to developing countries was that the amendments allow countries to waive the new requirements for four years.

How was this result achieved? A key factor was that amendments to MARPOL annexes do not require consensus in order to be approved; they can be adopted by a two-thirds majority vote, representing 50% of the world's gross tonnage. Since only a core group of developing countries, consisting of China, Brazil, and Saudi Arabia, were pushing for differentiated commitments in the Annex VI amendments, the other Annex VI parties were able to outvote them, and the amendments were adopted by a vote of 49 in favor (representing 79% of gross tonnage), 5 against, and 2 abstentions.[72]

Despite the contested vote, the Annex VI amendments are likely to be applied on a very broad basis. The states accepting the amendment represent almost 80% of gross tonnage, and account for a comparable share of maritime emissions. Moreover, although the countries voting against the amendment are not legally bound, their ship owners, operators, and builders will nevertheless have an incentive to meet the new standards if they wish to operate globally.

Ironically, if the dissenting countries had been willing to compromise, they might have been more successful in promoting differentiation. In the Annex VI amendment negotiations, the MEPC chair proposed a compromise that included a resolution on capacity building and technical assistance to balance the undifferentiated commitments in the annex amendments. Developed countries might have been willing to go along with this compromise, but Brazil overplayed its hand and called for a vote on the amendments. When developed countries prevailed in this vote and the amendments were successfully adopted, there was little time left to consider the resolution and developed countries had less incentive to accept it.

The adoption of the Annex VI amendments in 2011 did not put the issue of CBDR-RC to bed, however, and it continued to fester. A solution was

finally reached two years later, in 2013, through the adoption of a resolution with preambular language that recognized in a symmetrical manner both the IMO principles of non-discrimination and no-more-favorable treatment, and the UNFCCC principle of CBDR-RC, without specifying their applicability to MARPOL.[73] Importantly, the resolution stated the expectation that MARPOL parties would give "full and complete effect" to the Annex VI amendments, without any differentiation. The resolution also established an Ad Hoc Expert Working Group on Facilitation of Transfer of Technology for Ships, which is to identify developing country technology needs as well as barriers to technology transfer.

How much difference will the Annex VI amendments make? Because the EEDI applies only to new ships, its coverage will be limited, at least initially.[74] A study commissioned by the IMO estimates that the amendments, if fully implemented, would reduce emissions from business-as-usual levels by only about 13% in 2020 and 39% in 2050.[75] These reductions would not be sufficient to reverse the overall trend of increasing emissions from international shipping. As a result, there is broad agreement that the IMO's actions to date are not enough.

What would be enough? To answer this question, we would first need to decide on an overall global emissions budget compatible with preventing dangerous climate change, and then decide on maritime shipping's share of that global budget. But assuming that we want at least a 50% chance of limiting climate change to less than 2° C and that shipping emissions should be reduced at the same rate as global emissions, this would imply emissions reductions of about 75% by 2050.[76]

Regardless of the exact number, significant emission reductions will clearly be necessary. Of the various policy options for reducing emissions, market-based approaches score best in terms of environmental and cost-effectiveness, although technology standards might bring about technological change more quickly.[77] A market-based mechanism (MBM) could take many forms, including an emissions trading scheme (ETS) for shipping, a trading scheme for energy efficiency credits, or a levy on bunker fuel sales.[78] If emissions allowances were auctioned or a bunker fuel tax adopted, a market-based mechanisms would have the added benefit of providing a potential source of finance for emission reduction or adaptation projects, although this would raise questions about who would administer the funds.

In designing an ETS, many issues would need to be decided, including:

- To which ships the MBM would apply – all vessels or only vessels that do not meet some efficiency standard?
- Who would be responsible for compliance -- the ship owner, ship charterer, ship operator, or some other entity?
- How would allowances be allocated, and who would perform verification and enforcement functions – flag states, port states, or some combination of the two?
- Whether to allow entities to buy and use carbon credits for compliance purposes?[79]
- Whether to cap total shipping emissions, given the relative cleanliness of shipping as compared to other modes of transportation?

Compared to an ETS, a bunker fuel tax would raise fewer issues, since it could be levied directly on ships by the port state where the fuel was sold, although it too would face enforcement issues, since shippers could try to evade the levy through bunkering offshore or in countries with lax controls.[80]

At the moment, it does not appear that the IMO will adopt an MBM anytime soon. Many countries, including the United States, support continuing along the lines of the Annex VI amendments, through the strengthening of technical measures to increase efficiency. So the issues relating to MBMs, for the moment, remain theoretical. Instead, MEPC is focusing on requirements to gather additional data from ships, which could be used to develop stronger GHG requirements in the future.

VI. CONCLUSION

How successful has IMO been in addressing vessel-source emissions? Although progress has been modest, IMO has done reasonably well compared to other forums. Indeed, the Annex VI amendment is the only sectoral agreement adopted to date to limit greenhouse gases. To the extent IMO has been successful, three institutional features have played important roles: first, the technical expertise of the IMO, which has allowed the climate change issue to be addressed in a more technical, less political manner than in the UNFCCC; second, the general institutional culture of IMO, which again has tended to make the issue less political; and, finally, the ability in IMO to make decisions by a qualified majority vote, which allowed the

Annex VI amendments to be adopted over the objections of a small but important group of countries.

Nevertheless, the IMO initiatives to address shipping emissions fall far short of what is needed to combat climate change, and it is unclear whether and when the IMO might adopt additional measures, such as a market-based mechanism. Therefore, it will be important to also explore the potential role of regional and national measures to address shipping emissions, applied for example by port states.[81] But that is a subject for another day.

ENDNOTES

* Many thanks to Oliver Lewis for his many helpful comments.

[1] Karen Scott, "Regulating Ocean Fertilization under International Law: The Risks," *Carbon and Climate Law* 2 (2013): 108.

[2] Intergovernmental Panel on Climate Change (IPCC), "2013: Summary for Policymakers," in T.F. Stocker et al., eds., *Climate Change 2013: The Physical Science Basis: Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2013), 8.

[3] IPCC, "2014: Summary for Policymakers," in C.B. Field et al., eds., *Climate Change 2014: Impacts, Adaptation, and Vulnerability: Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2014), 17.

[4] Davor Vidas, "Sea Level Rise and International Law: At the Convergence of Two Epochs," *Climate Law* 4 (2014): 70-84. Currently, an International Law Association committee, chaired by David Freestone, is studying the implications of sea-level rise for international law. It is expected to complete its report by 2016 or 2017.

[5] David D. Caron, "Climate Change and the Oceans," in Harry N. Scheiber and Jin-Hyun Park, eds., *Regions, Institutions, and the Law of the Sea* (Leiden: Martinus Nijhoff, 2013), chap. 26; see also Randall S. Abate, ed., *Climate Change Impacts on Ocean and Coastal Law* (Oxford: Oxford University Press, 2015).

[6] International Maritime Organization (IMO), *Study of Greenhouse Gas Emissions from Ships* (London: IMO, 2000).

[7] IMO, *Second IMO Greenhouse Gas Study 2009* (London: IMO, 2009).

[8] IMO, *Third IMO Greenhouse Gas Study: Executive Summary and Final Report* (London: IMO, 2015), http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Third%20Greenhouse%20Gas%20Study/GHG3%20Executive%20Summary%20and%20Report.pdf.

[9] Ibid., Table 1. The figures cited are the average annual emissions from 2007-2012, and were calculated using a bottom-up methodology that uses activity data for each ship. Figures calculated using a top-down methodology that multiplies bunker fuel sales by an emissions factor are generally considered less reliable. Ibid., 3.

[10] Ibid., Figures 1-3.

[11] IMO, *Second IMO Greenhouse Gas Study*, Figure 1.1.

[12] House of Commons Environmental Audit Committee, *Reducing CO_2 and Other Emissions from Shipping: Fourth Report of Session 2008-2009* (2009), 5.

[13] Between 1990 and 2010, shipping emissions increased by about 80%, compared to global emissions growth of 40%. Alice Bows-Larkin, "All Adrift: Aviation, Shipping, and Climate Change Policy," *Climate Policy* 15 (2014): 681, 682.

[14] IMO, *Third IMO Greenhouse Gas Study*, 34.

[15] International Energy Agency, *Transport Emissions and CO2: Moving Towards Sustainability* (2009), 339.

[16] Ibid., Figure 1.6; see also IMO, *Second IMO Greenhouse Gas Study*, Figure 1.3.

[17] The IMO's *Second Greenhouse Gas Study* reviewed the various technical options.

[18] Ibid., 54, Table 5.2.

[19] Svere Alvik et al., *Pathways to Low Carbon Shipping: Abatement Potential Towards 2030* (DNV, 2009).

[20] Kal Raustiala and David G. Victor, "The Regime Complex for Plant Genetic Resources," *International Organization* 58 (2004): 277.

[21] Cf. Bernd Hackmann, "Analysis of the Governance Architecture to Regulate GHG Emissions from International Shipping," *International Environmental Agreements* 12 (2012): 85.

[22] UN Framework Convention on Climate Change (UNFCCC), May 9, 1992, 1771 U.N.T.S. 107.

[23] For a history of the UNFCCC regime, see Daniel Bodansky and Lavanya Rajamani, "The Evolution and Governance Architecture of the Climate Change Regime," in Detlef Spring and Urs Luterbacher, eds., *International Relations and Global Climate Change: New Perspectives* (Cambridge, MA: MIT Press, 2nd ed., forthcoming).

[24] Kyoto Protocol, December 10, 1997, 2303 U.N.T.S. 148.

[25] Marrakesh Accords, Dec. 2/CP.7–Dec. 19/CP.7, November 10, 2001, U.N. Doc. FCCC/CP/2001/13/Add.1 and Add.2.

[26] Paris Agreement, December 12, 2015, advance unedited version available at: http://unfccc.int/files/meetings/paris_nov_2015/application/pdf/cop_auv_template_4b_new__1.pdf.

[27] Copenhagen Accord, Dec. 2/CP.15, December 18, 2009, U.N. Doc. FCCC/CP/2009/11/Add.1, 5.

[28] Cancun Agreements: Outcome of the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention, Dec. 1/CP.16, December 11, 2010, U.N. Doc. FCCC/CP/2010/7/Add.1.

[29] Daniel Bodansky, "A Tale of Two Architectures: The Once and Future U.N. Climate Change Regime," *Arizona State Law Journal* 43 (2011): 697.

[30] For a discussion of consumption-based accounting, see Steven J. Davies and Ken Caldeira, "Consumption-Based Accounting of CO2 Emissions," *Proceedings of the National Academy of Sciences*, 107 (2010): 5687.

[31] Lavanya Rajamani, *Differential Treatment in International Environmental Law* (Oxford: Oxford University Press, 2006).

[32] UNFCCC, art. 3.1.

[33] Article 4.2's reference to the "developed country Parties and other Parties included in Annex I" leaves open two questions: first, is every state listed in Annex I "developed," and second, are some states not listed in Annex I "developed"? While the list in Annex I is fixed, unless amended, the categories "developed" and "developing" are more open-ended and could allow for changes in membership, as countries develop (or retrogress) economically, socially, and/or politically. So the countries that, today, are developed or developing may not be the same as those listed or not listed, respectively, in Annex I.

[34] At COP-17 in Cancun, at least two theories were advanced to justify the adoption of decisions over the objections of Bolivia. The Mexican chair suggested that, within the UNFCCC process, the consensus rule does not give individual countries a veto; therefore, decisions can be adopted when only a single country objects. The United States, in contrast, took the view that since the COP has never adopted rules of procedure, the governing voting rule is not consensus; rather, it needs to be determined by looking to past practice, which has allowed decisions to be taken by "general agreement." Lavanya Rajamani, "The Cancun Climate Agreements: Reading the Text, Subtext, and Tea Leaves," *International and Comparative Law Quarterly* 60 (2011): 499, 516.

[35] Dapo Akande, "What Is the Meaning of 'Consensus' in International Decision Making," *EJIL Talk!*, April 8, 2013, http://www.ejiltalk.org/negotiations-on-arms-trade-treaty-fail-to-adopt-treaty-by-consensus-what-is-the-meaning-of-consensus-in-international-decision-making/.

[36] Nadine Heitmann and Setareh Khalilian, "Accounting for Carbon Dioxide Emissions from International Shipping: Burden Sharing under Different UNFCCC Allocation Options and Regime Scenarios," *Marine Policy* 35 (2011): 682.

[37] Ibid., 689.

[38] Ibid., 683.

[39] IMO, *Second Greenhouse Gas Study*, 18, Table 2.5.

[40] House of Commons Environmental Audit Committee, *Reducing CO_2*, 17.

[41] Ibid., EV67-EV68. Another study found a range of 7-42 Mt CO_2 for UK shipping emissions, the low-end representing bunker fuel sales and the high end the value of UK imports. Paul Gilbert, Alice Bows, and Richard Starkey, *Shipping and Climate Change: Scope for Unilateral Action* (Manchester: University of Manchester, 2010).

[42] Kyoto Protocol Article 2.2 provides: "The Parties included in Annex I shall pursue limitation or reduction of emissions … from aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime

Organization, respectively." For a discussion of the Kyoto Protocol decision, see Saiful Karim and Shawkat Alam, "Climate Change and Reduction of Emissions from Ships: An Appraisal," *Asian Journal of International Law* 1 (2011): 131, 134.

[43] Sebastian Oberthür, "Institutional Interaction to Address Greenhouse Gas Emissions from International Transport: ICAO, IMO, and the Kyoto Protocol," *Climate Policy* 3 (2003): 191, 193.

[44] For an excellent history of IMO's work on vessel-source pollution, see R. Michael McGonigle and Mark W. Zacher, *Pollution, Politics, and International Law: Tankers at Sea* (Berkeley: University of California Press, 1981).

[45] Bernard H. Oxman, "The Role of the International Maritime Organization," in Mochtar Kusuma-Atmadja, Thomas A. Mensah and Bernard H. Oxman, eds., *Sustainable Development and the Preservation of the Oceans: The Challenges of UNCLOS and Agenda 21* (Law of the Sea Institute, 1997), 266.

[46] Doris Koenig, "Global and Regional Approaches to Ship Emissions Regulation: The International Maritime Organization and the European Union," in Harry N. Scheiber and Jin-Hyun Park, eds., *Regions, Institutions, and the Law of the Sea* (Leiden: Brill, 2013), chap. 18.

[47] Convention on the International Maritime Organization, March 6, 1948, 289 U.N.T.S. 48, at art. 1(b).

[48] International Convention for the Prevention of Pollution from Ships (MARPOL), Nov. 2, 1973, 34 U.S.T. 3407, at art. 16(2)(f)(ii), amended by Protocol of 1978, 1340 U.N.T.S. 61.

[49] Ibid.

[50] Annex VI included engine-based limits on NO_x emissions and limits on the sulfur content of fuels.

[51] See Meinhard Doelle, "Climate Change and the Use of the Dispute Settlement Regime of the Law of the Sea Convention," *Ocean Development and International Law* 37 (2006): 319, 322. UNCLOS art. 1.1(4) defines "pollution of the marine environment" as "the introduction by man, directly or indirectly, of substances or energy into the marine environment, … which results or is likely to result in such deleterious effect as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use as sea water and reduction of amenities."

[52] Meinhard Doelle argues that Article 212 creates a more general obligation on states to limit GHG emissions from all sources in order to prevent marine pollution through the atmosphere. This is bolstered by the general obligation in Article 194 to protect the marine environment, as well as Article 207 addressing pollution of the marine environment from land-based sources. Doelle, "Climate Change," 323-24.

[53] Richard Hildreth and Alison Torbitt, "International Treaties and U.S. Laws as Tools to Regulate the Greenhouse Gas Emissions from Ships and Ports," *International Journal of Marine and Coastal Law* 25 (2010): 347, 350.

[54] For a discussion of what constitutes a "generally accepted international standard," see Bernard H. Oxman, "The Duty to Respect Generally Accepted International Standards," *N.Y.U. Journal of International Law and Politics* 24 (1991): 109.

[55] Sophia Kopela, "Climate Change, Regime Interaction, and the Principle of Common But Differentiated Responsibility: The Experience of the International Maritime Organization," *Yearbook of International Environmental Law* 24 (2014): 70, 73.

[56] Sebastian Oberthür and Thomas Gehring, *Institutional Interaction in Global Environmental Governance* (Cambridge: MIT Press, 2006); Frank Biermann et al., "The Fragmentation of Global Governance Architectures: A Framework for Analysis," *Global Environmental Politics* 9 (2009): 14, 19.

[57] Oberthür, "Institutional Interaction;" cf. Hackmann, "Analysis of the Governance Architecture," 95-96 (characterizing the relationship of IMO and the UNFCCC as cooperative in terms of their institutional nesting, but conflictive in terms of norms).

[58] Hackmann, "Analysis of the Governance Architecture," 95.

[59] In this regard, the IMO's competence over shipping emissions does not depend on Article 2.2 of the Kyoto Protocol. Rather, it derives from the IMO's own convention, which in 1975 was amended to expressly give the IMO competence over the control of marine pollution from ships, Amendments to the Convention on the International Maritime Organization, Nov. 14, 1975, 1276 UNTS 468, at art. 1(a), 15(j), and from IMO Assembly Resolution A.963(23), adopted in December 2003, which urged the MEPC to "identify and develop the mechanism or mechanisms needed to achieve the limitation or reduction of GHG emissions from international shipping." See Kopela, "Climate Change, Regime Interaction, and the Principle of Common But Differentiated Responsibility," 76-77.

[60] Oberthür, "Institutional Interaction," 200.

[61] Sabine Campe, "The Secretariat of the International Maritime Organization: A Tanker for Tankers," in Frank Biermann and Bernd Siebenhüner, eds., *Managers of Global Change: The Influence of International Environmental Bureaucracies* (Cambridge, MA: MIT Press, 2009).

[62] The IMO does play a modest role in the verification process through its mandatory audit scheme, which provides member states with an assessment of how effectively they are implementing IMO instruments. In 2014, MEPC amended MARPOL to make the audit scheme mandatory for MARPOL parties. For a description of the IMO audit scheme, see "IMO Member State Audit Scheme," IMO, last accessed March 13, 2016, http://www.imo.org/en/OurWork/MSAS/Pages/AuditScheme.aspx.

[63] Aaron Strong, "Tackling Maritime Bunker Fuel Emissions: The Evolution of Global Climate Change Policy at the International Maritime Organization" (unpublished thesis, Tufts, 2011), 36.

[64] The 30% reduction in emissions per tonne-mile is calculated relative to a baseline of the average efficiency of ships constructed between 2000 and 2010.

[65] Kopela, "Climate Change, Regime Interaction, and the Principle of Common But Differentiated Responsibility;" Per Kågeson, "Applying the Principle of Common But Differentiated Responsibility to the Mitigation of Greenhouse Gases from International Shipping," (working paper, Centre for Transport Studies, Swedish National Road and Transport Research Institute, 2011), 5.

[66] Kopela, "Climate Change, Regime Interaction, and the Principle of Common But Differentiated Responsibility," 78-79.

[67] IMO, Marine Environment Protection Committee, *Note by the Secretariat, Prevention of Air Pollution from Ships: Legal Aspects of the Organization's Work on Greenhouse Gas Emissions in the Context of the Kyoto Protocol*, M.E.P.C. doc. 58/4/20 (London, August 1, 2008).

[68] Kopela, "Climate Change, Regime Interaction, and the Principle of Common But Differentiated Responsibility," 92, 98; Kågeson, "Applying the Principle, " 18-23.

[69] According to Lloyd's Register, about two-thirds of vessels are flagged in developing countries, representing about three-quarters of deadweight tonnage.

[70] Elvind S. Vagslid, "IMO Activities on Control of GHG Emissions from Ships," IMO (presentation, COP-16, 2010), http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/COP%2016%20Presentations/IMO%20activities%20on%20control%20of%20GHG%20emissions%20from%20ships.pdf .

[71] Strong, *Tackling Maritime Bunker Fuel Emissions*, 52.

[72] The five states voting no were Brazil, China, Chile, Kuwait, and Saudi Arabia. Ninety-eight MARPOL parties, including India, were ineligible to vote on the amendments, because they are not party to Annex VI.

[73] IMO, Marine Environment Protection Committee *Promotion of Technical Cooperation and Transfer of Technology – Relating to the Improvement of Energy Efficiency of Ships*, Resolution MEPC.229(65), 17 May 2013, M.E.P.C. doc. 65/22, Annex 4. Two preambular paragraphs took "cognizance" of the principles enshrined respectively in the IMO conventions (the principles of non-discrimination and no more favorable treatment) and in the UNFCCC (the principle of CBDR-RC).

[74] Paul Gilbert and Alice Bows, "Exploring the Scope for Complementary Sub-Global Policy to Mitigate CO_2 Emissions from Shipping," *Energy Policy* 50 (2012): 613, 615.

[75] Zabi Bazari and Tore Longva, "Assessment of IMO Mandated Energy Efficiency Measures for International Shipping," MEPC 63/INF.2/Annex (Oct. 31, 2011).

[76] Bows-Larkin, "All Adrift," 687.

[77] IMO, *Second IMO Greenhouse Gas Study*, Table 6.6.

[78] For a survey of the various market-based approaches, see Marine Environment Protection Committee, "Reduction of GHG Emissions from Ships: Full Report of the Work Undertaken by the Expert Group on Feasibility Studies and Impact Assessment of Possible Market-Based Measures," IMO Doc. MEPC 61/INF.2 (Aug. 13, 2010).

[79] Michael Bloor, Susan Baker, Helen Sampson and Katrin Dahlgren, "Enforcement Issues in the Governance of Ships' Carbon Emissions," *Laws* 4 (2015): 335, 340-342.

[80] Ibid., 344-45.

[81] Gilbert and Bows, "Exploring the Scope for Complementary Sub-Global Policy;" Hildreth and Torbitt, "International Treaties and U.S. Law."