What's Shipping Doing About Climate Change?

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Climate change poses significant threats to the world's countries, and in particular to shipping. So what is shipping doing about climate change? Despite the significance of shipping to the supply chain, few people know much about what the shipping industry is doing to address climate change and greenhouse gases (GHG). This Article seeks to fill that gap.

Over the past fifteen years (and with increased speed since 2018), shipping has made significant progress towards establishing a framework for reducing GHG emissions. In addition to an extensive literature review, this Article details the progress that shipping has made towards decarbonization. It also offers a primer on the maritime industry's current regulatory approach to decarbonization. Leveraging data already collected under this approach, it proposes a low and (mostly) revenue-neutral maritime GHG emissions tax in order to further propel shipping towards net-zero GHG emissions by 2050. While many obstacles remain, with these advances, shipping can lead the fight against climate change.

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I. INTRODUCTION

Climate change poses significant threats to the world's countries and economies, but it also poses a pointed threat to shipping.[1] *Lloyd's List*, the preeminent source for maritime news since 1734,[2] warns that "key global ports in US, Europe and Asia could be unusable by 2050 without urgent action on decarbonisation."[3] So what is shipping doing about climate change? Slowdowns in the supply chain during the COVID-19 pandemic brought significant coverage of and a new appreciation for shipping's role in the global economy. Despite its significance, few people outside of maritime experts and participants in the industry know much about what the shipping industry is doing to address climate change and greenhouse gases (GHG).

When examined more closely, it turns out that shipping has actually made significant progress towards establishing a framework for reducing GHG emissions. The goal of this Article is to place these advances in the full context of addressing climate change, sharing them with the broader audience beyond the shipping and transportation industries so that the lessons derived can be applied both to the future of the maritime industry and more broadly to other sectors.

In the rest of this Article, I review the literature about decarbonization in the maritime industry and then offer an extensive history of the industry's approach to reducing GHG emissions. I then

1. This Article uses "shipping" and "maritime industry" interchangeably.

2. *See Stylish Shipping Chronicle Keeps Finger on the Pulse*, LLOYD'S LIST (Dec. 27, 2007), https://www.lloydslist.com/LL102401/Stylish-shipping-chronicle-keeps-finger-on-the-pulse.

3. James Baker, *Shipping Must Be Better Prepared for Climate Risk, Warns LR Forecast*, LLOYD'S LIST (Sept. 8, 2023), https://lloydslist.com/LL1146519/Shipping-must-be-better-prepared-for-climate-risk-warns-LR-forecast (describing a report from Lloyd's Register and the LR Foundation. Also, note the British spelling of "decarbonisation.").

describe the maritime industry's current regulatory approach to decarbonization and note things to watch for in the near future. I then draw lessons from these experiences for the more distant future of maritime decarbonization and conclude by suggesting how shipping can serve as a broader example in the fight against climate change.

II. LITERATURE REVIEW

Climate change has been a topic of great concern for many decades, and greenhouse gas emissions by the maritime industry play a major role.[4] This Part reviews the academic literature on the reduction of greenhouse gas emissions by the maritime industry, beginning with the coverage in environmental law journals and then turning to other academic sources. It then briefly reviews my own work on emissions trading and climate change from about twenty-five years ago.

A. Coverage in Environmental Law Journals

Given the significance of maritime GHG emissions, one might expect significant examination of maritime emission reduction by environmental law journals. However, this coverage has been relatively sparse. This lack of attention seems to parallel the approach to maritime emissions taken by the Kyoto Protocol and Paris Agreement, discussed in more detail later, which primarily referred GHG emissions to the International Maritime Organization (IMO). This Article seeks to redirect some attention concerning GHG emissions reduction back to the maritime sector.

Most of the interest in maritime GHG emissions in environmental law journals began around 2007 and 2008, ten years after the adoption of the Kyoto Protocol but also just two years after its ratification in 2005, and at the start of its first 2008-2012 commitment period. Many of these articles contained limited references to the maritime sector's role in GHG emissions reductions. For example, in 2008, John Dernbach noted one of the significant limitations of the Kyoto Protocol: "it [the Protocol] does not generally require or authorize international agreement on any specific policies and measures or particular economic sectors, and it does not create any international structure for developed or developing countries

4. Jennifer Brown et al., *Carbon Revenues from Shipping: A Game Changer for the Energy Transition,* WORLD BANK BLOGS (May 12, 2022), https://blogs.worldbank.org/transport/carbon-revenues-shipping-game-changer-energy-transition/ (noting that shipping is responsible for about "three percent of global GHG emissions annually.").

to cooperate on such matters,"[5] and only mentioned maritime emissions as one of the two exceptions to this limitation.[6] Tseming Yang and Robert Percival in 2009 likewise made a brief reference to maritime emissions as being one of the few examples of multilateral environmental agreements: "For example, the International Maritime Organization (IMO) has taken on a significant leadership role in coordinating national marine pollution standards and other marine environmental protection efforts around the world."[7] Another brief mention comes from Richard Stewart, Michael Oppenheimer, and Bryce Rudyk in 2013, noting that for climate change, "the International Maritime Organization (IMO) could serve as the institutional base for global regulatory standards in the international shipping sector, an action it has already taken for sulfur dioxide emissions."[8]

More interest in maritime emissions reduction by environmental law journals appeared with a couple of proposals for alternative approaches to regulations. In 2014, Jon Truby compared using an maritime emissions taxation scheme with inclusion of maritime emissions within the European Union Emissions Trading Scheme (EU ETS).[9] Truby noted that inclusion of maritime emissions in any EU reduction approach would be extremely significant, with "approximately half of the world's ships gross registered at 250 tons or more . . . estimated to operate in European waters."[10] Truby concludes that inclusion within the EU ETS is preferred:

> Consequently, the inclusion of maritime transportation emissions in the EU ETS remains a more attractive option as opposed to a maritime emissions tax. With reduced complexity and fewer potential legal

5. John C. Dernbach, *Achieving Early and Substantial Greenhouse Gas Reductions Under a Post-Kyoto Agreement*, 20 GEO. INT'L ENV'T L. REV. 573, 579 (2008).

6. *Id.* at n.25.

7. Tseming Yang & Robert V. Percival, *The Emergence of Global Environmental Law*, 36 ECOLOGY L. Q. 615, 638. There is another reference in this article to the IMO, as an example of an "International organization[] that ha[s] traditionally had a primarily non-environmental focus, . . . [and that has] increasingly adopted environmental protection as part of their organizational mission," *Id.* at 647-48.

8. Richard B. Stewart et al., *Building Blocks for Global Climate Protection*, 32 STAN. ENV'T L.J. 341, 380 (2013).

9. Jon M. Truby, *Maritime Emissions Taxation: An Alternative to the EU Emissions Trading Scheme?,* 31 PACE ENV'T L. REV. 310 (2014).

10. *Id.* at 311-12 n.10 (citing M.E. Davies et al., *Study on the Economic, Legal, Environmental and Practical Implications of a European Union System to Reduce Ship Emissions of SO_2 and NO_x: Final Report*, BMT MURRAY FENTON EDON LIDDIARD VINCE LTD. 25 (2000).

challenges, the framework for the EU ETS already exists, and the transition to include maritime emissions would thus be relatively straightforward.[11]

A different approach was offered by Joanne Scott, Tristan Smith, Nishatabbas Rehmatulla, and Ben Milligan in 2017.[12] They suggested using "private standards" rather than regulation to reduce maritime emissions.[13] They note that private standards "have emerged against a backdrop of regulatory inertia and the exclusion of international shipping from the Paris Climate Change Agreement."[14] Part of this inertia has been due to "disagreements between countries about the status and implications of the CBDR principle."[15] As a result, they suggest that "conditions may be present for the mitigation of shipping's GHG emissions to become a site of 'hybrid' governance, combining private standards and state/supra-state law in a productive way."[16]

Some of the most in-depth coverage of maritime GHG emissions reduction in an environmental law journal came in a sequence of updates from 2015-2017 on "Arctic Law & Policy Year in Review," published by the *Washington Journal of Environmental Law & Policy*. The 2015 review offered the views of the outgoing Secretary-General of the IMO, Koji Sekimizu, including "his view that [the] IMO is the only place where the debate over shipping and climate change should be taken forward, given the huge impact the industry has on the global economy and its unique international structure."[17] The 2016 review reported that in October of 2016, "the IMO's Marine Environment Protection Committee (MEPC) adopted a requirement that ships of 5,000 gross tonnage and above will have to collect consumption data for each type of fuel oil they use, as well as other, additional, specified data including proxies for transport work."[18] It also noted that the "MEPC also approved a roadmap (2017 through 2023) for developing a 'Comprehensive IMO strategy on

11. *Id.* at 323.

12. Joanne Scott et al., *The Promise and Limits of Private Standards in Reducing Greenhouse Gas Emissions from Shipping*, 29 J. ENV'T L. 231 (2017).

13. *Id.*

14. *Id.*

15. *Id.* at 261. Other barriers are noted in Rafael Leal-Arcas & Antonio Morelli, *The Resilience of the Paris Agreement: Negotiating and Implementing the Climate Regime*, 31 GEO. ENV'T L. REV. 1, 43 (2018) ("Cleaner shipping and aviation technology exists . . . . But it seems that powerful lobbyists are interfering with the process of greening the shipping industry.").

16. Scott, *supra* note 12.

17. Craig H. Allen, *Arctic Law & Policy Year in Review: 2015*, 6 WASH. J. ENV'T L. & POL'Y 71, 141 (2016).

18. Craig H. Allen, *Arctic Law & Policy Year in Review: 2016*, 7 WASH. J. ENV'T L. & POL'Y 115, 187 (2017).

reduction of GHG emissions from ships.'"[19] The 2017 review discussed some of the difficulties in negotiating about maritime GHG emissions reduction. It reported this statement from Danish Maritime Authority's Director General Andreas Nordseth:

> It is decisive that we achieve global solutions to the climate challenge. That will require debate on a wide range of issues some of which are quite challenging, but which the 172 IMO member States must reach an agreement on. As expected, this week's negotiations have indeed been difficult, and will continue to be so during the final phase in April next year. On the other hand, it is very positive to see many member States as well as both industry and NGO's pushing for a high level of ambition. Now, we need to keep the intense efforts up in order to achieve an ambitious strategy which will demonstrate the continued determination of the IMO to reducing greenhouse gas emissions.[20]

Similar to these reviews, Harsha Pisupati and Armin Rosencranz[21] offered updates on the impacts on the Arctic from the MEPC's activities in 2018 and 2019. They noted that in 2018,

> during the 72d Marine Environment Protection Committee (MEPC) conference, the IMO adopted an initial strategy to reduce emissions from ships by at least 50% by 2050 compared to 2008 levels. The strategy includes a framework for Member states to achieve low-carbon-intensity shipping in a phased manner through voluntary cooperation between the port and shipping sectors.[22]

Furthermore, in 2019, the MEPC "discussed ways to implement the initial strategy in line with the Paris Climate Agreement and the United Nations 2030 Agenda for Sustainable Development."[23]

In 2018, an entire issue[24] of the *Ecology Law Quarterly* was devoted to "Oceans & Climate Change." This issue offered articles on "Ocean Acidification, . . . Biodiversity & Climate Change, . . . Fisheries & Climate Change, . . . the Arctic, . . . [and] Dispute Resolution."[25] This issue noted that "[g]lobal ocean governance regimes have been slow to

19. *Id.*

20. Craig H. Allen, *Arctic Law & Policy Year in Review: 2017*, 8 WASH. J. ENV'T L. & POL'Y 106, 188 (2018).

21. Harsha Pisupati & Armin Rosencranz, *The Deteriorating Arctic and the Impact of the Shipping Industry*, 49 ENV'T L. REV. 10837 (2019).

22. *Id.* at 10845.

23. *Id.*

24. This was Volume 45, Issue 1.

25. Jordan Diamond et al., *Oceans & Climate Change: Calling for Holistic Conversation*, 45 ECOLOGY L. Q. 1, 3-6 (2018).

respond to the climate change challenge."[26] To help speed up this process, "[t]he articles in this special issue offer a compelling sample of the critical questions that sit at the intersection of ocean governance and climate change."[27] However, this journal issue left out discussion of "many other issues, including (among others) the role of marine activities in climate change mitigation (e.g., reducing shipping emissions)."[28]

After these articles, in the past five years, there have been no articles published in environmental law journals that have examined maritime GHG emissions reduction.

B. Coverage in Other Journals

While there has been relatively sparse interest in maritime GHG emissions reduction in environmental law journals, there has been some coverage in general interest law reviews and significant interest in international law and energy law journals.

In 2011, Robert Percival published "Global Law and the Environment" in the *Washington Law Review*.[29] This article contained an extensive analysis of maritime GHG emissions. Percival begins by noting how significant maritime emissions are:

> Even though ocean shipping is a very energy-efficient mode of transport, ships are a significant, but as yet largely unregulated, source of GHG emissions. The fuel that ships use is so dirty that it creates enormous pollution; in fact, many ships use bunker fuel with such high sulfur content that it has been estimated that just sixteen of the world's largest ships can produce as much sulfur pollution as all of the world's cars.[30]

He then notes the variety of responses to reducing maritime GHG emissions:

> In the absence of comprehensive environmental regulation for ships, countries and private shipping companies have fashioned various means to address the problem of shipping pollution. Countries have adopted

26. *Id.* at 1.

27. *Id.* at 6.

28. *Id.* In fact, the IMO is only mentioned briefly in the last two articles on the Arctic and on dispute resolution, neither of which address the IMO's role in reducing GHG emissions by shipping. *See* Henri Féron*, A New Ocean: The Legal Challenges of the Arctic Thaw*, 45 ECOLOGY L. Q. 83, 107-110 (2018); *see also* Seokwoo Lee & Lowell Bautista, *Part XII of the United Nations Convention on the Law of the Sea and the Duty to Mitigate Against Climate Change: Making Out a Claim, Causation, and Related Issues*, 45 ECOLOGY L. Q. 129, 142 nn.63 & 65 (2018).

29. Robert V. Percival, *Global Law and the Environment*, 86 WASH. L. REV. 579 (2011).

30. *Id.* at 592-93.

> multilateral agreements, entered into regional agreements, crafted their own regulatory standards, and one country has encouraged cooperation with private shipping companies. In addition, at least one shipping company has voluntarily undertaken measures to reduce its own pollution.[31]

He then turned to the more recent efforts to craft a more "comprehensive" approach under the IMO. In particular, he closely analyzed the meeting of the IMO's MEPC in September 2010, set up "to discuss methods and plans to reduce shipping emissions globally."[32] He began by noting the fundamental conflict between developed and developing countries. Developed countries "stressed the importance of equal treatment of all countries as necessary for the functional economic effect of market-based mechanisms, [while] developing countries argued that the principle of 'common but differentiated responsibility' [CBDR] reflected in the UNFCCC dictates that they should bear less of the burden of reducing emissions."[33] In addition to this fundamental conflict, there were disagreements over "whether mandatory emission reductions should be part of an agreement,"[34] concerns over the "difficulty associated with measuring shipping emissions,"[35] and disagreements over "whether to apply the GHG reduction and efficiency requirements to existing ships."[36] As a result, "the parties [attending the MEPC meeting] were unable to reach an agreement."[37]

That same year, the first in a number of articles about maritime GHG emissions reduction appeared in an international law journal. Md. Saiful Karim and Shawkat Alam wrote an "Appraisal" of "Climate Change and Reduction of Emissions of Greenhouse Gases from Ships."[38] Karim and Alam reviewed the history of the IMO's approach to maritime GHG emissions reductions. They noted how the IMO began its analysis in 2000 with "a comprehensive study of greenhouse gas emissions from ships."[39] They then noted the conflict between developed and developing countries noted above by Percival, expressed this time in March 2008 at the fifty-

31. *Id.* at 593.
32. *Id.* at 597.
33. *Id.*
34. *Id.* at 598.
35. *Id.*
36. *Id.*
37. *Id.* at 597-98.
38. Md. Saiful Karim & Shawkat Alam, *Climate Change and Reduction of Emissions of Greenhouse Gases from Ships: An Appraisal*, 1 ASIAN J. INT'L L. 131 (2011).
39. *Id.* at 141.

seventh MEPC meeting.[40] This debate continued at the fifty-eighth MEPC meeting in October 2008.[41] Unable to reach a consensus, parties at the fifty-ninth MEPC meeting in July 2009 decided to reconsider "voluntary and interim measures"[42] at the next meeting, scheduled for March 2010, after "report[ing] these developments within the IMO to the 15th Conference of the Parties (CoP 15) of the UNFCCC, held in Copenhagen in December 2009."[43] After reviewing these developments, the authors concluded that "the very strict position of some of the leading developing countries is in fact the main obstacle towards the adoption of mandatory . . . measures for the reduction of GHG emissions from marine bunker fuels."[44]

In 2014, Yubing Shi wrote about "[g]igantic shipbuilders under the IMO mandate of GHG emissions" in the *Journal of East Asia & International Law*.[45] Shi offers "a comparative assessment of these three countries' [China, Japan and Korea] positions on regulatory principles of the greenhouse gas issue, and concludes that their differentiated perspectives on this matter reflect their different regulatory interests."[46] Shi notes that despite these differences, the IMO did finally decide in 2011 on rules concerning "technical and operational measures, [which would be incorporated in] amend[ments to] Annex VI to the International Convention for the Prevention of Pollution from Ships (. . . MARPOL 73/78)."[47] These amendments would "add[] a new Chapter 4 to Annex VI on the regulation on energy efficiency for ships, . . . [which would include] mandatory [rules on] the Energy Efficiency Design Index ("EEDI") for new ships, and the Ship Energy Efficiency Management Plan ("SEEMP") for all ships."[48]

Another international law journal article advocated for private governance to reduce maritime GHG emissions. After reviewing the developments with the IMO and the European Union,[49] Daniel Metzger

40. *Id.*
41. *Id.*
42. *Id.* at 142.
43. *Id.*
44. *Id.*
45. Yubing Shi, *Gigantic Shipbuilders Under the IMO Mandate of GHG Emissions: With Special References to China, Japan and Korea*, 7 J. EAST ASIA & INTL. L. 493 (2014).
46. *Id.* at 493.
47. *Id.* at 496.
48. *Id.*
49. For more on the European Union's actions, *see infra* Part 0; *see also* Natalie L. Dobson & Cedric Ryngaert, *Provocative Climate Protection: EU 'Extraterritorial' Regulation of Maritime Emissions*, 66 INT'L & COMPAR. L. Q. 295, 295 (2017) (noting how "frustrated by the slow pace

claimed that "shipping inefficiency can be better addressed through private environmental governance."[50] He noted that "[c]orporations and other transnational organizations have significant power to affect behavior through supply chain contracting,"[51] and therefore that "supply-chain pressure could drive a certification-and-standards system."[52] He gave the example of "[r]ightship [which has] . . . created an emissions rating—on an A-G scale—in order to help customers make informed decisions about which ships to use."[53]

More recently, two articles on maritime GHG emissions reduction have appeared in energy law journals. In 2019, Daniel Bosch, Jr. wrote about the impacts of IMO regulations on reducing maritime GHG emissions on U.S. shipping.[54] He notes that although the "IMO is unable to enforce new regulations unilaterally, relying instead on its member states to enforce the regulation domestically, . . . maritime regulations adopted by the IMO have a unique character in international law because member states have less flexibility in choosing whether to adopt IMO regulations."[55] Bosch concludes that "[t]hough there are ways that the United States could resist compliance, the equitable treatment of vessels and the economic issues with an one-sided system of enforcement will make it untenable to reject the GHG reduction strategy."[56]

In 2022, Stefanos Roulakis and Vanessa DiDomenico provided a short update on maritime decarbonization.[57] They note that the debate over decarbonization needs to address both efficiency and gross emissions.[58] They also review technical, operational, and management measures to reduce emissions. They conclude that "meeting [the IMO's emissions reduction] goals will require significant deviations from the current norm in shipping."[59]

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of negotiations in the International Maritime Organization, the EU issued Regulation 2015/757 on the monitoring, reporting, and verification of carbon dioxide emissions from maritime transport.").

50. Daniel J. Metzger, *Private Governance Can Increase Shipping's Efficiency and Reduce Its Impacts*, 49 VAND. J. TRANSNAT'L L. 1143, 1143 (2016).

51. *Id.* at 1178.

52. *Id.*

53. *Id.* at 1176-77.

54. Daniel W. Bosch Jr., *Rocking the Boat: The Legal Implications of IMO 2020 for Future IMO Greenhouse Gas Reduction Strategies and the Impacts to Louisiana*, 8 LSU J. ENERGY L. & RES. 261 (2019).

55. *Id.* at 263-64.

56. *Id.* at 285.

57. Stefanos N. Roulakis & Vanessa C. DiDomenico, *Maritime Decarbonization*, 22 PRATT'S ENERGY L. REPT. 76 (2022).

58. *Id.* at 76.

59. *Id.* at 78.

Meanwhile, in the past fifteen years, there have been four articles in maritime law journals that have significantly discussed GHG emissions reduction. In 2008, Eric Rothenberg and Robert Nicksin reviewed recent environmental regulations in the shipping industry.[60] They noted how bunker fuel emissions were not included in national emissions targets under the Kyoto Protocol.[61] They then reviewed the different approaches that the IMO was considering to reduce maritime emissions,[62] while suggesting that "progress will likely be slow on determination of baselines or establishment of emissions factors for international maritime activity."[63]

Five years later, Timothy Nast offered a full review of the shipping industry's actions to reduce GHG emissions.[64] Nast began by offering key facts about shipping and shipping emissions as well as an overview of possible technological responses.[65] He then reviewed the IMO plan to reduce maritime emissions through technological proposals including "the implementation of an Energy Efficiency Design Index (EEDI)" and the "Ship Energy Efficiency Management Plan (SEEMP)."[66] He also discussed the possibility of a cap-and-trade system for the maritime industry.[67] He then considered "the possible use of admiralty remedies to enforce emissions regulation."[68] Despite the "widespread consensus that the industry should take decisive action to reduce GHG emissions and do its part to counteract global warming . . . there has been a massive amount of talk, but little decisive action."[69] Without any mandatory regulations, Nast encourages "vessel owners, operators, and holding companies [sic] [to] take voluntary initiative to reduce their GHG emissions."[70]

The IMO's Director of Legal Affairs, Frederick Kenney, gave the 2017 William Tetley Lecture at Tulane University Law School, published later in the *Tulane Maritime Law Journal*.[71] Kenney starts with a review

60. Eric B. Rothenberg & Robert S. Nicksin, *Latest Developments in International Maritime Environmental Regulation*, 33 TUL. MAR. L.J. 137 (2008).

61. *Id.* at 146-47.

62. *Id.* at 147.

63. *Id.* at 148.

64. Timothy Nast, *The Response of the International Shipping Industry to Global Climate Change*, 44 J. MAR. L. & COM. 29 (2013).

65. *Id.* at 30-31.

66. *Id.* at 33-34.

67. *Id.* at 35-37.

68. *Id.* at 40-43.

69. *Id.* at 44.

70. *Id.*

71. Frederick J. Kenney, *Global Regulation of Ships: The Future of Development and Implementation at the International Maritime Organization*, 42 TUL. MAR. L.J. 259 (2018).

of the beginning of the international regulation of shipping, starting roughly 150 years ago.[72] He then reviews the "IMO regime"[73] and its "strategic directions."[74] He then points to the IMO's past and future efforts on climate change.[75] Noting that "shipping remains to this day the only regulated industry that has actually reduced greenhouse gas emissions from 2.8% in 2007 to 2.2% in 2012,"[76] he reviews the IMO's efforts on climate change, including the adoption of Annex VI in 1997, amendments to Annex VI in 2011 to mandate EEDI for new ships, and the "adopt[ion in 2016 of] a roadmap for the IMO to develop a comprehensive plan . . . for short-, mid-, and long-term future measures to reduce greenhouse gases."[77]

In 2020, Tae-Hwan Joung, Seong-Gil Kang, Jong-Kap Lee, and Junkeon Ahn offered a detailed review of the IMO's actions from 2011 through 2019.[78] They described the IMO's "Initial Strategy for reducing GHGs caused by ships," as developed in 2018.[79] They then reviewed how a combination of "five technologies (linear improvement, dynamometer/propulsion system, alternative fuel, renewable energy and ship operation)" is "expected to reduce [emissions by] up to 75% by 2050."[80]

Thus, we see that decarbonization by the maritime industry drew interest from environmental law and general interest journals from around 2007 through 2018. However, environmental law journals have not examined it since then. There has been more recent interest from international, energy, and maritime law journals. However, none of these give the full context nor provide precise details of the maritime industry's specific efforts to reduce GHG emissions. The rest of this Article intends to do so. This next subpart briefly reviews some of my own prior research before proceeding with my analysis.

72. *Id.* at 260.
73. *Id.* at 261.
74. *Id.* at 263.
75. *Id.* at 267-68.
76. *Id.* at 267.
77. *Id.* at 267-68.
78. Tae-Hwan Joung et al., *The IMO Initial Strategy for Reducing Greenhouse Gas (GHG) Emissions, and its Follow-Up Actions Towards 2050*, 4 J. INT'L MAR. SAFETY, ENV'T AFF. & SHIPPING 1 (2020).
79. *Id.* at 4.
80. *Id.* at 5.

C. My Own Prior Work on Emissions Trading and Climate Change

My own research on emissions trading and climate change began more than twenty-five years ago.[81] In 2000, drawing upon this research, I published the article *Political Obstacles to the Implementation of Emissions Markets: Lessons from RECLAIM, in the Natural Resources Journal*.[82] In this article, I examined the development of the RECLAIM emissions market for Los Angeles, noting in particular political obstacles that depend significantly on the existing regulatory scheme and technological uncertainty. Following up on this work, the next year I published a review of *Global Emissions Trading: Key Issues for Industrialized Countries*, edited by Suzi Kerr.[83] In this review, I described how the book offers a guide "toward developing global emissions trading institutions that can successfully combat climate change."[84] I also examined implementation issues and proposed an alternative to the Kyoto Protocol.[85] This prior research informs the lessons drawn from decarbonization by the maritime industry and will influence recommendations for the future.

III. HISTORY OF MARITIME GHG EMISSIONS REDUCTIONS

The first global institutions on climate change were developed over a period of about ten years, beginning thirty-five years ago. In 1988, the first global effort to study the impacts of climate change was initiated when the "Intergovernmental Panel on Climate Change (IPCC) was created by the World Meteorological Organization and the United Nations Environment Programme."[86] Two years later, the IPCC "issued a first assessment report . . . [which] stated that global warming was real and urged that something be done about it."[87] Two years later in 1992, at

81. Dale B. Thompson, An Examination of the Consequences of Political, Administrative, and Legal Institutions on the Implementation and Performance of Environmental Policies (1998) (Ph.D. dissertation, Stanford University), https://searchworks.stanford.edu/view/3934811.

82. Dale B. Thompson, *Political Obstacles to the Implementation of Emissions Markets: Lessons from RECLAIM*, 40 NAT. RES. J. 645 (2000). For current updates on RECLAIM, *see About RECLAIM*, S. COAST AIR QUALITY MGMT. DIST., http://www.aqmd.gov/home/programs/business/about-reclaim (last visited May 14, 2024).

83. Dale B. Thompson, *Global Emissions Trading: Key Issues for Industrialized Countries*, 41 NAT. RES. J. 755 (2001), https://digitalrepository.unm.edu/cgi/viewcontent.cgi?article=1599&context=nrj.

84. *Id.* at 756.

85. *Id.* at 761-65.

86. *Historic Background*, INT'L MAR. ORG., https://www.imo.org/en/OurWork/Environment/Pages/Historic%20Background%20GHG.aspx (last visited Feb. 19, 2024).

87. *Id.*

the United Nations Conference on Environment and Development held in Rio de Janeiro, the United Nations Framework Convention on Climate Change (UNFCCC) was created to develop a global approach to climate change.[88] And then five years later, the Kyoto Protocol was adopted as an addition to the UNFCCC.[89] The Kyoto Protocol includes "binding targets for 37 industrialized countries and the European community [Annex I Parties] for reducing greenhouse gas (GHG) emissions[,]"[90] but these targets did not directly include maritime emissions. Instead, the Kyoto Protocol specified that Annex I Parties "shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime Organization, respectively."[91]

A. Actions by the IMO and the MEPC

Shortly before the adoption of the Kyoto Protocol, the 1997 MARPOL Conference "adopted resolution 8 on 'CO_2 emissions from ships,' [which] invit[ed] . . . the IMO to undertake a study of GHG emissions from ships; and . . . the MEPC [the Marine Environment Protection Committee] to consider feasible GHG emissions reduction strategies."[92] The IMO released its first GHG study three years later, "estimat[ing] that ships engaged in international trade in 1996 contributed about 1.8 per cent of the world total anthropogenic CO_2 emissions."[93] Two more studies were released in 2009 and 2014, finding that ships accounted for 2.8% of CO_2 emissions in 2007 and 2.2% in 2012.[94]

Following up on these studies, the IMO adopted resolution MEPC.203(62) in 2011. This resolution "represent[ed] the first-ever mandatory global energy efficiency standard for an international industry sector, the first legally binding instrument to be adopted since the Kyoto

88. *Id.*

89. *See generally* U.N. Framework Convention on Climate Change, Conference of the Parties, 3d. Sess., *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, U.N. Doc. FCCC/CP/1997/L/7/Add/1 (Dec. 10, 1997), https://unfccc.int/cop4/resource/docs/cop3/l07a01.pdf [hereinafter *Kyoto Protocol*].

90. INT'L MAR. ORG., *supra* note 86.

91. *Kyoto Protocol*, *supra* note 89, at 3.

92. U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, AD HOC WORKING GROUP ON FURTHER COMMITMENTS FOR ANNEX I PARTIES UNDER THE KYOTO PROTOCOL, *Information on the Work on Greenhouse Gas Emissions from Ships Being Carried Out by the International Maritime Organization (IMO)* (2008), https://unfccc.int/files/kyoto_protocol/application/pdf/imo.pdf.

93. INT'L MAR. ORG., *supra* note 86.

94. *Id.*

Protocol that addresses GHG emissions and the first global mandatory GHG-reduction regime for an international industry sector."[95] These measures included both the Energy Efficiency Design Index (EEDI) for new ships and the Ship Energy Efficiency Management Plan (SEEMP) for all ships.[96]

B. The Paris Agreement and the Responses of the MEPC and IMO

In 2015, 195 countries and the European Union negotiated and adopted the Paris Agreement.[97] Under this agreement, countries agreed to the goals of "[h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels . . . ."[98] However, there is no specific reference to "maritime," "shipping," nor the "International Maritime Organization (IMO)" within the text of the agreement.[99]

In April 2016, the MEPC met and "welcomed the Paris Agreement and . . . widely recognized and agreed that further appropriate improvements related to shipping emissions can and should be pursued . . . ."[100] Later that year, the MEPC met again and "approved the Roadmap for developing a comprehensive IMO strategy on reduction of GHG emissions from ships . . . ."[101] This Roadmap offers "a three-step approach consisting in: (1) collecting data on ships' fuel oil consumption, (2) analysing this data and (3) mak[ing] decision[s] on what further measures to enhance the energy efficiency shipping, if any, are required."[102] As a Roadmap though, it failed to offer specific details.

In December 2017, a number of countries jointly issued the "Tony de Brum Declaration."[103] These countries included many European

95. *Id.*

96. *Id.*

97. *See generally* Paris Agreement, Dec. 12, 2015, T.I.A.S. No. 16-1104, https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf.

98. *Id.* art. 2, para. 1(a), at 2.

99. *See id*.

100. INT'L MAR. ORG., *supra* note 86.

101. Int'l Mar. Org. [IMO], *Roadmap for Developing a Comprehensive IMO Strategy on Reduction of GHG Emissions from Ships*, MEPC No. 70/80/Add.1 (2016), https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/MEPC%2070-18-ADD.1%20(E).pdf.

102. INT'L MAR. ORG., *supra* note 86.

103. *Tony de Brum Declaration*, MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE ET DE LA COHÉSION DES TERRITOIRES, (Dec. 12, 2017), https://www.ecologie.gouv.fr/sites/default/files/2017.12.12_tony_brum_declaration.pdf; *see also* Craig Eason, *Shipping Nations Sign "De Brum*

countries (including France, Germany, and the United Kingdom), many North, Central and South American countries (including Canada, Chile, Columbia, and Mexico) and many Asian and Pacific countries (including Australia, Bangladesh, Marshall Islands, New Zealand, and Solomon Islands).[104] Non-signatories included the United States (under the presidency of Donald Trump), China, Brazil, Saudi Arabia, and Panama.[105] These signatory countries pledged to "reaffirm their commitment to contribute to the achievement of the objectives of the Paris Agreement, namely holding the increase in the global average temperature to well below 2°C above pre-industrial levels"[106] and "confirm that international shipping . . . must take urgent action in consideration of these vital objectives for the future of the planet and of humanity . . . ."[107] In April 2018, Hilda Heine, the president of the Marshall Islands, and Christiana Figueres, the former executive secretary of the United Nations Framework Convention on Climate Change, published an op-ed in the *New York Times*, citing the de Brum Declaration and calling on the IMO to "take action quickly" to address climate change.[108]

The next week, the MEPC achieved a major breakthrough when it "adopted resolution MEPC.304(72) on the Initial IMO Strategy on reduction of GHG emissions from ships."[109] This resolution states its vision that the "IMO remains committed to reducing GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible in this century."[110] To achieve this vision, it designates:

> levels of ambition [including] . . . carbon intensity of international shipping to decline . . . by at least 40% by 2030, pursuing efforts towards 70% by

Declaration" on Climate Change Commitment, FATHOM WORLD (Dec. 13, 2017), https://fathom.world/shipping-nations-sign-de-brum-declaration-climate-change-commitment/. Tony de Brum was the Foreign Minister of the Marshall Islands, and had championed the decarbonization of shipping. *See* Lisa Friedman, *Tony de Brum, Voice of Pacific Islands on Climate Change, Dies at 72*, N.Y. TIMES (Aug. 22, 2017), https://www.nytimes.com/2017/08/22/world/tony-de-brum-dead-climate-change-advocate.html. He passed away in August of 2017. *Id.*

104. *See* Eason, *supra* note 103.

105. *See id.*

106. *Id.*

107. *Id.*

108. Hilda Heine & Christiana Figueres, *Polluters on the High Seas*, N.Y. TIMES (Apr. 7, 2018), https://www.nytimes.com/2018/04/06/opinion/greenhouse-gases-international-shipping.html.

109. INT'L MAR. ORG., *supra* note 86.

110. Int'l Mar. Org. [IMO], *Initial IMO Strategy on Reduction of GHG Emissions from Ships*, MEPC Res. 304(72), at 4 (Apr. 13, 2018) [hereinafter *Initial IMO Strategy*].

> 2050, compared to 2008; and [sic] GHG emissions from international shipping to peak and decline . . . as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 . . . .[111]

To do this, the resolution provides a "list of candidate short-, mid- and long-term further measures with possible timelines and their impacts on states."[112] The resolution also notes certain "guiding principles," including "the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances . . . ."[113]

Resolution MEPC.304(72) was truly a breakthrough as it went far beyond 2011's Resolution MEPC.203(62). It not only called for specific reductions in the carbon intensity of shipping (i.e. reductions in the *rate* of emissions) but also for specific reductions in total emissions by the entire industry.

C. Reactions to the 2018 Breakthrough

Many different parties announced reactions to this resolution. A number of groups noted the significance of the resolution as a crucial first step in developing a long-term approach to decarbonization by the shipping industry. The Secretary General of the International Chamber of Shipping, Peter Hinchliffe, stated that the resolution was "a groundbreaking agreement—a Paris Agreement for shipping—that sets a very high level of ambition for the future reduction of CO_2 emissions."[114] The world's largest shipping association (with over half of worldwide tonnage) BIMCO stated that it was "very satisfied" with the resolution,[115] "call[ing] the [resolution's] target ambitious, but not impossible . . . ."[116] The CEO of the UK Chamber of Shipping, Guy Platten, proclaimed that this resolution "should be seen as a stepping stone towards decarbonisation in the long term . . . ."[117] John Kornerup Bang of Maersk, the world's largest container shipping company, "welcome[d] the new ambitious results [of the MEPC meeting that announced this resolution],

111. *Id.* at 5.
112. *Id.* at 6.
113. *Id.* at 5.
114. *Reactions to the IMO's Initial Strategy to Reduce Greenhouse Gas Emissions from Ships*, GCAPTAIN (Apr. 13, 2018), https://gcaptain.com/reactions-to-the-imos-initial-strategy-to-reduce-greenhouse-gas-emissions-from-ships/.
115. *Id.*
116. *Id.*
117. *Id.*

which provide a much needed policy signal that will help accelerate investments into low carbon solutions in shipping."[118]

On the other hand, some parties from the environmental community were more critical of this resolution, though they too noted that it did represent progress. The Clean Shipping Coalition "welcomed" the resolution, but found that "the lack of any clear plan of action to deliver the emissions reductions, including urgently needed short-term measures, [was] a major concern."[119] In particular, shipping director for Transport & Environment, Bill Hemmings, stated, "[t]he IMO should and could have gone a lot further but for the dogmatic opposition of some countries led by Brazil, Panama, Saudi Arabia. . . . [But] this decision puts shipping on a promising track."[120] Likewise, maritime finance lead to the Rocky Mountain Institute—Carbon War Room James Mitchell noted, "[a] 50 percent reduction in total GHG emissions was not the truly ambitious, Paris-aligned target we had hoped for, but it is a truly significant first step on the path to decarbonization and there is much to congratulate."[121]

Professor Jessica Green provided a broad perspective on this agreement in an editorial opinion article for the *Washington Post*.[122] She started by noting that while the agreement to reduce shipping emissions by fifty percent by 2050 "sounds impressive," it would not be enough to be "Paris compliant."[123] A group of some countries, "led by small island states in the Pacific, pushed for deeper cuts,"[124] but the group was opposed by Brazil and Panama, with their large shipping registries, and the United States and China. Green notes that, "In the end, 50 percent was the compromise target."[125]

While these reductions would not be enough to achieve the targets of the Paris Agreement, they would be quite significant. Green notes that, "[i]n the absence of regulations, the IMO estimates that, at a minimum, shipping emissions will increase 50 percent by 2050, but that increase

118. *Id.*

119. *Id.*

120. *Id.*

121. *IMO Agrees to CO_2 Emissions Target*, MAR. EXEC. (Apr. 13, 2018, 7:23 PM), https://maritime-executive.com/article/imo-agrees-to-co2-emissions-target.

122. Jessica F. Green, *Why Do We Need New Rules on Shipping Emissions? Well, 90 Percent of Global Trade Depends on Ships*, WASH. POST (April 17, 2018), https://www.washingtonpost.com/news/monkey-cage/wp/2018/04/17/why-do-we-need-new-rules-on-shipping-emissions-well-90-of-global-trade-depends-on-ships/.

123. *Id.*

124. *Id.*

125. *Id.*

could be as high at 250 percent."[126] Green also reminds us that "the IMO decision is a first step, as policies to date have failed to tackle the fundamental problem of decarbonizing."[127] She concludes that "[t]he current IMO decision is a sign that the world's shipping companies have to begin to implement changes—and that more countries are slowly coming around to this realization."[128]

1. Activities Since Breakthrough

While significant progress was made by agreeing on these targets, as noted above, much work remained. In subsequent years, the MEPC built on this progress, establishing some key specific regulations on shipping to achieve these targets. In its biannual meetings, the MEPC continued to press forward.[129]

In May of 2019, MEPC 74[130] heightened the mandatory requirements on the efficiency of new ships. In particular, the MEPC approved "amendments to MARPOL Annex VI to significantly strengthen the Energy Efficiency Design Index (EEDI) 'phase 3' requirements."[131] In November of 2019, MEPC 75 turned its attention to existing ships, "approv[ing] draft new mandatory regulations . . . [that] would require ships to combine a technical and an operational approach to reduce their carbon intensity."[132]

Due to COVID-19, the next meeting (the seventy-sixth) of the MEPC took place in June of 2021. Major developments took place at this meeting. In essence, this meeting was the implementation counterpart of the 2018 "major breakthrough" meeting of the MEPC. In order to achieve the targets that were set in the 2018 "Initial IMO Strategy for Reducing

126. *Id.*

127. *Id.*

128. *Id.*

129. For a summary of these regulations, *see* Int'l Maritime Org., *2023 IMO Strategy on Reduction of GHG Emissions from Ships*, MEPC Res. No. 377(80) (July 7, 2023), https://www.cdn.imo.org/localresources/en/MediaCentre/PressBriefings/Documents/Resolution%20MEPC.377(80).pdf [hereinafter *2023 IMO Strategy*].

130. Here, "MEPC 74" signifies the seventy-fourth meeting of the MEPC.

131. *UN Agency Pushes Forward on Shipping Emissions Reduction*, INT'L MAR. ORG. (May 20, 2019), https://www.imo.org/en/MediaCentre/PressBriefings/Pages/11-MEPC-74-GHG.aspx (specifying energy efficiency reduction rates for new ships based on their deadweight tonnage (DWT)).

132. *Meeting Summary: Marine Environment Protection Committee (MEPC) 75, 16-20*, INT'L MAR. ORG. (Nov. 2020), https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-75th-session.aspx.

GHG Emissions from Ships,"[133] the MEPC amended the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI.[134] The amendments included both "technical and operational approaches to improve the energy efficiency of ships."[135] In particular, ships above certain gross tonnage would be required to "calculate their Energy Efficiency Existing Ship Index (EEXI) following technical means to improve their energy efficiency and to establish their annual operational carbon intensity indicator (CII) and CII rating."[136] A ship's Statement of Compliance would include "a rating of their energy efficiency (A, B, C, D, E - where A is the best)."[137] These amendments took effect in November of 2022, with the Certification requirements for EEXI and CII taking effect on January 1, 2023.[138]

The next meeting of the MEPC (the seventy-seventh) was held shortly after the twenty-sixth United Nations Climate Change Conference (COP 26), both in November of 2021. COP 26 emphasized the "urgen[t need] for all sectors to accelerate their efforts to reduce GHG emissions."[139] Consequently, MEPC 77 began discussions aimed at "strengthen[ing] the ambition"[140] of emissions reductions beyond those targeted in the 2018 IMO GHG Strategy, with a "final draft Revised IMO GHG Strategy [to] be considered by MEPC 80."[141] The MEPC also proposed mid-term measures for GHG reduction.[142] Mid-term measures are actions needed to make additional reductions beyond ship design, operational measures, and voyage management, and will be needed to achieve reduction targets over a ten-to-fifteen year horizon.[143]

133. *Initial IMO Strategy*, *supra* note 110.

134. *Meeting Summary: Marine Environment Protection Committee (MEPC 76)*, INT'L MAR. ORG. (June 10-17, 2021), https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC76meetingsummary.aspx.

135. *Id.*

136. *Id.* Ships over 400 GT would have to calculate EEXI, and those over 5000 GT would also have to calculate CII. *Id.*

137. *Id.*

138. *Id.*

139. *Meeting Summary: Marine Environment Protection Committee (MEPC) 77, 22-26*, INT'L MAR. ORG. (Nov. 2021), https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC77.aspx.

140. *Id.*

141. *Id.*

142. *Id.*

143. *See* Dan Rutherford & Bryan Comer, *The International Maritime Organization's Initial Greenhouse Gas Strategy*, INT'L COUNCIL ON CLEAN TRANSP. 1, 4 (Apr. 23, 2018), https://theicct.org/sites/default/files/publications/IMO_GHG_StrategyFInalPolicyUpdate042318.pdf.

MEPC 78 in June 2022 continued working on mid-term measures, including "a GHG fuel standard . . . and carbon pricing."[144] The MEPC also passed "guidelines to support the implementation of the short-term measure to reduce ships' carbon intensity."[145] MEPC 79 in December 2022 continued work along these axes and also revised the "Fuel Consumption Monitoring Data System" used for implementing EEXI and CII.[146]

D. MEPC 80: Revised IMO GHG Strategy Collection

The eightieth meeting of the MEPC took place in July 2023.[147] This meeting had been targeted as the time the IMO would adopt a revised GHG Strategy.[148] While the meeting was contentious,[149] a revised GHG Strategy was indeed adopted.[150] Compared with the 2018 IMO GHG Strategy, the primary changes from this revised GHG Strategy were to (a) increase the "levels of ambition" related to the "uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources," and to the timing of "reach[ing] net-zero GHG emissions" near 2050;[151] (b) establish "checkpoints" to indicate progress towards achieving net-zero GHG

144. *Meeting Summary: Marine Environment Protection Committee (MEPC)-78th Session, 6-10*, INT'L MAR. ORG. (June 2022), https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-78th-session.aspx [hereinafter *(MEPC)-78th Session, 6-10*]. For more on the development of mid-term measures, *see also ABS News Brief: MEPC 78*, AM. BUREAU OF SHIPPING 1, 2 (June 10, 2022), https://ww2.eagle.org/content/dam/eagle/regulatory-news/2022/ABS%20MEPC%2078%20Brief.pdf.

145. *(MEPC)-78th Session, 6-10*, *supra* note 144 ("The guidelines include those relating to method of calculation of the EEXI, the revised SEEMP and possible correction factors for CII.").

146. *Meeting Summary: Marine Environment Protection Committee (MEPC) 79th Session*, INT'L MAR. ORG. (Dec. 12-16, 2022), https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-79th-session.aspx.

147. *See Marine Environment Protection Committee (MEPC 80), 3-7 July 2023*, INT'L MAR. ORG., https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-80.aspx (last visited May 14, 2024).

148. *See Meeting Summary: Marine Environment Protection Committee (MEPC) 79th Session, supra* note 146.

149. *See* Michelle Wiese Bockmann, *China and India Among Developing Countries Seeking Delay in Revision of Shipping's Emission Strategy*, LLOYD'S LIST (Feb. 15, 2023), https://lloydslist.com/LL1143989/China-and-India-among-developing-countries-seeking-delay-in-revision-of-shippings-emission-strategy (noting that the negotiation "position taken by countries including Brazil, India and China underscores the divisions over shipping decarbonisation targets that remain between western countries and oil producing and developing nations.").

150. *2023 IMO Strategy*, *supra* note 129, at 1-2.

151. *Id.* at 6.

emissions;[152] and (c) create a specific target to develop a "basket of candidate mid-term GHG reduction measures . . . comprised of both [] a technical element . . . and [] an economic element."[153]

Specifically, the revised GHG Strategy offers "levels of ambition," which are specific targets for the reduction of GHG emissions by shipping. Two levels of ambition remained the same: (1) reduction of carbon intensity of an individual ship due to EEDI for new ships; and (2) reduction of "CO_2 emissions per transport work" across all shipping (not just new ships), "by at least 40% [versus 2008 emissions] by 2030."[154] The revised GHG Strategy added these levels of ambition: (3) a minimum of 5% (while "striving" for 10%) in "uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources" across the shipping industry; and (4) reaching "peak GHG emissions . . . as soon as possible and to reach net-zero GHG emissions by or around, i.e. close to, 2050."[155]

The revised GHG Strategy also establishes intermediate checkpoints to gauge progress towards net-zero. The first is to "reduce the total annual GHG emissions from international shipping by at least 20%, striving for 30%, by 2030."[156] And the second is to reduce emissions "by at least 70%, striving for 80%, by 2040."[157]

The revised GHG Strategy also says that "basket of mid-term GHG reduction measures should be finalized and agreed [upon] by the [MEPC] by 2025."[158] The Strategy says that these mid-term measures should include both "a goal-based marine fuel standard regulating the phased reduction of the marine fuel's GHG intensity" (the "technical element") and "a maritime GHG emissions pricing mechanism" (the "economic element").[159]

152. *Id.* at 6.

153. *Id.* at 7-8; *see also* BUREAU VERITAS, *Summary Report*, at 8 (July 2023), https://marine-offshore.bureauveritas.com/sites/g/files/zypfnx136/files/media/document/BV%20Summary%20MEPC%2080_6.pdf.

154. *Id.* at 6 (noting that all reductions in this revised GHG Strategy use 2008 as a reference point).

155. *Id.*

156. *Id.*

157. *Id.*

158. *Id.* at 7.

159. *Id.* at 7-8.

The changes included in the Revised IMO GHG Strategy mark "big improvement[s] on the IMO's initial GHG strategy"[160] in the battle against climate change. Increasing the level of ambition from the 2018 IMO Strategy—from fifty percent by 2050 to net zero by 2050—is both a major change and a needed one in order for the IMO Strategy to be "compatible with the Paris Agreement."[161]

E. Reactions to MEPC 80

There was a wide variance in the reactions to MEPC 80, with some praising its advances and others calling it a "wishy washy compromise."[162] The IMO itself hailed the agreement, with IMO Secretary-General Kitack Lim stating,

> [t]he adoption of the 2023 IMO Greenhouse Gas Strategy is a monumental development for IMO and opens a new chapter towards maritime decarbonization. At the same time, it is not the end goal, it is in many ways a starting point for the work that needs to intensify even more over the years and decades ahead of us. However, with the Revised Strategy that you have now agreed on, we have a clear direction, a common vision, and ambitious targets to guide us to deliver what the world expects from us.[163]

To reflect this "monumental development," the IMO hosted a special side event at the twenty-eighth United Nations Climate Change Conference (COP 28) (held in December 2023) entitled "[t]he 2023 IMO GHG Strategy: defining the global level-playing-field for shipping decarbonization."[164] This event shared the news about the advances in decarbonization by the maritime industry.

Likewise, industry leaders, Johanna Christensen, the chief executive of the Global Maritime Forum, and Katharine Palmer, the maritime lead for the Climate Champions Team "argue[d] [that] the [maritime] industry

160. Bryan Comer & Francielle Carvalho, *IMO's Newly Revised GHG Strategy: What it Means for Shipping and the Paris Agreement*, INT'L COUNCIL ON CLEAN TRANSP. (July 7, 2023), https://theicct.org/marine-imo-updated-ghg-strategy-jul23/.

161. *Id.*

162. Laura Paddison, *Global Shipping Industry Climate Pledge Slammed as a 'Wishy Washy' Compromise*, CNN (July 7, 2023), https://www.cnn.com/2023/07/07/world/shipping-imo-climate-pledge-intl/index.html (statement by Faïg Abbasov).

163. *Revised GHG Reduction Strategy for Global Shipping Adopted*, INT'L MAR. ORG. (July 7, 2023), https://www.imo.org/en/MediaCentre/PressBriefings/pages/Revised-GHG-reduction-strategy-for-global-shipping-adopted-.aspx.

164. *The 2023 IMO GHG Strategy: Defining the Global Level-Playing-Field for Shipping Decarbonization*, INT'L MAR. ORG., https://www.imo.org/en/About/Events/Pages/IMO-UNCTAD-event-COP-28.aspx (last visited May 14, 2024).

showed itself a frontrunner" in climate change as it "asserted its leading role in decarbonisation at COP28."[165] Simon Bennett, deputy secretary general of the International Chamber of Shipping, called the progress of MEPC "historic for our industry."[166] Pacific island nations that play critical roles in the maritime industry also "celebrated the adoption of new targets"[167] at MEPC 80.

On the other hand, many groups had harsh criticisms of the results from MEPC 80. A number of environmental groups "were highly critical of what they see as a toothless plan and a missed opportunity."[168] Faïg Abbasov of Transport & Environment called it, as noted above, a "'wishy washy compromise,'"[169] and John Maggs of the Clean Shipping Coalition similarly called it a "wish and a prayer agreement."[170]

Much of this criticism related to the "'vague and non-committal language'"[171] of the 2023 IMO GHG Strategy. These concerns were echoed by others in the maritime industry. Peter Jameson, Managing Director and Partner at the Boston Consulting Group (BCG), was concerned that "the imprecise wording and lack of detail on the measures increases uncertainty."[172] Laurids Schack, Project Leader at BCG, similarly noted that the "'vagueness maintains ambiguity and will undoubtedly cause delays in action.'"[173]

Richard Meade, Editor-in-Chief of *Lloyd's List*, and Alisdair Pettigrew, BLUE Communications managing director and co-founder, decried the "dangerous credibility gap between the shipping industry's rhetoric and reality when it comes to decarbonization."[174] They declared that "on paper," the maritime industry is "awash with zero-carbon commitments, coalitions, pilot projects, green corridors and studies."[175] However, "in reality, [there is] . . . widespread inaction—or worse,

165. Johanna Christensen & Katharine Palmer, *Shipping Asserted Its Leading Role in Decarbonisation at COP28,* LLOYD'S LIST (Dec. 14, 2023), https://www.lloydslist.com/LL1147610/Shipping-asserted-its-leading-role-in-decarbonisation-at-COP28.

166. Paddison, *supra* note 162.

167. *Id.*

168. *Id.*

169. *Id.*

170. *Id.*

171. *Id.*

172. *Shipping Emissions Deal Maintains Industry Uncertainty*, BCG (July 11, 2023), https://www.bcg.com/publications/2023/shipping-emissions-deal-creates-industry-uncertainty.

173. *Id.*

174. Richard Meade & Alisdair Pettigrew, *Shipping and Decarbonisation: an Inconvenient Truth?*, LLOYD'S LIST (Sept. 7, 2023), https://lloydslist.com/LL1146506/Shipping-and-decarbonisation-An-inconvenient-truth.

175. *Id.*

outright greenwashing—as companies attempt to keep up the pretence of progress amid growing uncertainty."[176] The next month, Meade called for "a little less conversation, [and] a little more action please, "[177] and said that progress on decarbonization was "shipping's existential crisis."[178]

In a similar manner, during COP 28, the chief executive officers of global shipping lines CMA CGM, Hapag-Lloyd, Maersk, MSC, and Wallenius Wilhemsen, issued a joint declaration calling on the IMO and other maritime industry stakeholders to accelerate the path towards decarbonization.[179] In particular, they called for an "effective GHG pricing mechanism" and an "end date for fossil fuel-only vessels."[180]

Despite these concerns, many in the industry still believe that "shipping will 'get there by 2050.'"[181] This was the message from "industry heavyweights" at the *Lloyd's List* Intelligence's Shipping Outlook Forum: 2024 and Beyond, held right after COP 28 on December 13, 2023.[182] Michael Parker, chair of the Poseidon Principles and Citi's shipping and logistic chair, told the audience, "[i]t's pragmatism that will drive us; idealism won't get there . . . I remain optimistic that shipping will get there by 2050."[183] Nikolaus Schües, president of BIMCO and CEO of Reederei F Laeisz, stated that "emissions already are falling, . . . and, by 2050, 'we'll be fine.'"[184] Furthermore, at this forum, *Lloyd's List* released its Shipping Outlook Survey of industry executives. While a majority of respondents was skeptical about meeting the IMO's targets for 2030 and 2040, a majority of respondents (fifty-six percent) did think that the shipping industry would meet the 2050 target for net-zero.[185]

176. *Id.*

177. Richard Meade, *A Little Less Conversation, a Little More Action Please*, LLOYD'S LIST (Oct. 20, 2023), https://www.lloydslist.com/LL1146966/A-little-less-conversation-a-little-more-action-please (article title from comment made by US energy executive, quoting Elvis Presley).

178. *Id.*

179. Press Release, *Shipping CEOs Outline Key Policy Pillars for Decarbonization at Pace*, CMA GGM ET AL. (Dec. 1, 2023), https://www.maersk.com/~/media_sc9/maersk/news/press-releases/files/2023/11/cop28-joint-declaration.pdf.

180. *Id.*

181. David Osler, *Shipping Will 'Get There By 2050', Industry Heavyweights Tell Lloyd's List Outlook Forum*, LLOYD'S LIST (Dec. 13, 2023), https://www.lloydslist.com/LL1147596/Shipping-will-get-there-by-2050-industry-heavyweights-tell-Lloyds-List-Outlook-Forum.

182. *Id.*

183. *Id.*

184. *Id.*

185. *Shipping Outlook Forum: Key Takeaways*, LLOYD'S LIST INTEL., at 15-17 (Dec. 13, 2023), https://www.lloydslist.com/-/media/lloyds-list/images/forums-and-events/2023-new-pictures/lloyds-list-intelligence-outlook-forum-key-takeaways_pdf.

So where does that leave us? In the following Part, I describe the current regulatory approach of decarbonization in the shipping industry and discuss important things to watch in the near future.

IV. CURRENT REGULATORY APPROACH FOR DECARBONIZATION IN THE MARITIME INDUSTRY

Pollution from ships is regulated under the "International Convention for the Prevention of Pollution from Ships," known as MARPOL.[186] With respect to climate change and decarbonization, regulations under MARPOL are part of Annex VI (Prevention of Air Pollution from Ships). As noted above, since 2011, the IMO has progressively increased the regulation of ships to reduce the maritime emissions of GHG. This Part explains the key components of the current regulatory framework.

A. EEDI and EEXI

Shipping regulations are differentiated depending on whether they apply to new ships or existing ones. New ships have been regulated using the Energy Efficiency Design Index (EEDI) since 2013.[187] The counterpart of EEDI for existing ships is the Energy Efficiency Existing Ship Index (EEXI), and EEXI has applied beginning in 2023. Both of these indexes are technical design calculations, not operational ones.[188] They are in terms of carbon dioxide emissions per transport work. They are calculated in an almost identical manner by dividing the product of fuel consumption, times a conversion factor of carbon dioxide emissions for that type of fuel, and times the level of engine power, by the product of the capacity of a ship times its speed:[189]

186. *See International Convention for the Prevention of Pollution from Ships (MARPOL)*, INT'L MAR. ORG. (2019), https://www.imo.org/en/about/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx.

187. *See Improving the Energy Efficiency of Ships*, INT'L MAR. ORG., https://www.imo.org/en/OurWork/Environment/Pages/Improving%20the%20energy%20efficiency%20of%20ships.aspx (last visited Feb. 19, 2024).

188. *See Short-term GHG Reduction Measure*, INT'L MAR. ORG., https://www.imo.org/en/OurWork/Environment/Pages/Short-term-GHG-reduction-measure.aspx (last visited Feb. 19, 2024).

189. *See Outlines of EEXI Regulation*, CLASSNK (Dec. 2021), https://www.classnk.or.jp/hp/pdf/activities/statutory/eexi/eexi_rev3e.pdf (providing detailed explanations of the individual components and differences between EEDI and EEXI).

EEDI / EEXI = (Fuel Consumption x CO_2 Conversion Factor x Engine Power) / (Capacity x Speed).[190]

Regulation via EEDI and EEXI is likewise differentiated by ship types and size categories. Both of these apply only to vessels at or above 400 GT. Both of these indexes "promot[e] the use of more energy efficient (less polluting) equipment and engines."[191] For a given ship type and size and year, "required" EEDI and EEXI are calculated, with a "reduction factor" representing a certain percentage of reductions of emissions compared to 2008 emissions.[192] These reduction factors increase over time, forcing new ships to have increasingly more efficient designs. New and existing ships then calculate their own "attained" EEDI or EEXI. This attained index must be less than or equal to the respective required index, in essence a minimum efficiency level.[193] Once the attained index is less than or equal to the required index, the index has been satisfied for the life of the ship (unless the ship undergoes "extensive retrofitting, modifications, or conversion").[194]

If a ship's attained index is greater than the respective required index, then the ship must take some steps to move into compliance. New ships could revise their hull design, recover waste heat, or reduce consumption of electricity, while existing ships could limit power, add wind assistance, or optimize their propellers.[195] As one maritime consultant notes, "[t]he easiest way to get the energy efficiency index down is to reduce engine power, as vessels' fuel consumption and emissions, respectively, increase as speed increases. The propulsion power, thus CO_2 emissions, is approximately proportional to the cube of the speed."[196]

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190. *Id.*

191. *EEDI & SEEMP*, SIGMA HELLAS, https://www.marpol-annex-vi.com/eedi-seemp/ (last visited Feb. 19, 2024).

192. *See EEXI and CII—Ship Carbon Intensity and Rating System*, INT'L MAR. ORG., https://www.imo.org/en/MediaCentre/HotTopics/Pages/EEXI-CII-FAQ.aspx (last visited May 14, 2024).

193. *Id.*

194. *EEXI*, BUREAU VERITAS, https://marine-offshore.bureauveritas.com/shipping-decarbonization/carbon-index/eexi (last visited Feb. 19, 2024).

195. *See Short-term GHG Reduction Measure*, *supra* note 188; for more detailed examples of modifications to achieve compliance, *see EEXI: Achieving Vessel Compliance*, HELLENIC SHIPPING NEWS (July 21, 2022), https://www.hellenicshippingnews.com/eexi-achieving-vessel-compliance/.

196. Ossi Mett. . .l. . . , *The Basics of EEXI – From 2023, All Existing Ships Must Meet New Energy Efficiency Standards*, NAPA (Sept. 15, 2021), https://www.napa.fi/the-basics-of-eexi-from-2023-all-existing-ships-must-meet-new-energy-efficiency-standards/.

B. SEEMP and CII

Operational regulation of both new and existing ships is done by requirements for Ship Energy Efficiency Management Plan (SEEMP) documentation. There are three parts of an SEEMP: (1) "a ship management plan to improve energy efficiency;" (2) a "ship fuel oil consumption data collection plan;" and (3) the "ship operational carbon intensity plan."[197] Measurement of the ship's annual Carbon Intensity Indicator (CII) is part of the carbon intensity plan.[198] Ships at-or-above 400 gross tonnage (GT) must have a valid SEEMP, although the CII certification component is only required for ships at 5,000 GT and above.[199] The ship will be issued an environmental rating (between A and E, with A representing "major superior" and E representing inferior), based on its calculated annual CII.[200] Ships receiving a D rating for three straight years or a single E rating are required to update their SEEMP with a "corrective action plan."[201] This corrective plan could include changing fuels to a lower-carbon one; "hull cleaning to reduce drag; speed and route[] optimization; installation of low energy light bulbs; and installation of solar/wind auxiliary power for accommodation services."[202]

The CII plays a key role in a ship's SEEMP and overall in the IMO's approach to decarbonization. One maritime consultant calls CII "a lighthouse guiding the maritime industry towards carbon efficiency."[203] Unlike EEDI and EEXI, CII is an operational measurement based on data from the ship's use of fuel.[204] It is not based on a reading of actual CO_2 emissions, but rather upon the quantity and type of fuel used by a ship over a year.[205] Ships report their fuel consumption under the IMO DCS

197. Int'l Mar. Org. [IMO], *2022 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP)* MEPC Res. No. 346(78), at 3 (June 10, 2022), https://www.cdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/MEPC.346%2878%29.pdf.

198. *See id*. at 20-21.

199. *Meeting Summary: Marine Environment Protection Committee (MEPC 76)*, *supra* note 134.

200. *CII—Carbon Intensity Indicator*, DNV, https://www.dnv.com/maritime/insights/topics/CII-carbon-intensity-indicator/index.html (last visited Feb. 19, 2024).

201. *Id.*

202. *EEXI and CII—Ship Carbon Intensity and Rating System*, *supra* note 192.

203. Arjun Shivach, *How Do You Calculate Your CII Score?*, NAUTILUS LABS (Aug. 17, 2023), https://nautiluslabs.com/resources/how-do-you-calculate-your-cii-score/.

204. *See Short-term GHG Reduction Measure*, *supra* note 188.

205. Shivach, *supra* note 203.

(Data Collection System) protocol.[206] This data is then combined with CO_2 emissions factors (how much CO_2 is emitted per unit of fuel), distance sailed, and design deadweight, to calculate CII thus:

> CII = ("Annual Fuel Consumption x CO_2 Emission Factor" {for the relevant fuel}) / ("Annual Distance Sailed x Design Tonnage of the Vessel").[207]

CII thus represents "the ratio of the total mass of CO_2 . . . emitted to the total transport work . . . undertaken in a given calendar year."[208]

C. Enforcement (Or Lack Thereof)

These different instruments have different enforcement mechanisms. EEDI and EEXI are enforced only a single time,[209] while CII and the CII rating are calculated annually, and an up-to-date SEEMP is an ongoing requirement. EEDI is enforced by a ship's flag state,[210] and is done by a two-step verification process with the first step based on the design of the ship and the second "done during a sea trial."[211] Completion of this process is signified "by the issuance of an International Energy Efficiency Certificate (IEEC) by a verifier (Maritime Administration or Classification Society)."[212] EEXI is "a one-off certification taking place at the first annual, intermediate or renewal survey of IAPP [International Air Pollution Prevention] Certificate on or after 1st January 2023."[213]

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206. *Id.*

207. *Id.* There are certain correction factors and voyage adjustments applied to this calculation, depending upon the specific ship and its voyages. CII is closely related to the Annual Efficiency Ratio (AER), which has a similar formula but does not apply correction factors or adjustments.

208. *CII Calculation: Carbon Intensity Indicator Guide*, SHIP NERD (June 28, 2022), https://shipnerdnews.com/cii-calculation-carbon-intensity-indicator/.

209. Unless a vessel undergoes a "major conversion." *See* Int'l Mar. Org., *Amendments to the Annex of the Protocol of 1997 to Amend the International Convention for the Prevention Oof Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto,* MEPC Res. No. 328(76), Regulation 5, § 4.2, at 12 (2021), https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.328(76).pdf [hereinafter MEPC Resolution 328(76)].

210. *The Energy Efficiency Design Index (EEDI) for New Ships*, INT'L COUNCIL ON CLEAN TRANSP. (Oct. 3, 2011), https://theicct.org/sites/default/files/publications/ICCTpolicyupdate15_EEDI_final.pdf.

211. *Id.*

212. *Id.*

213. *EEXI and CII Enter into Force*, BRS SHIPBROKERS (Jan. 20, 2023), https://brsshipbrokers.com/news/eexi-and-cii-enter-into-force*; see also* MEPC Resolution 328(76), *supra* note 209, Regulation 5, § 4.7, at 13.

The CII, CII Rating, and SEEMP are all enforced like other regulations under MARPOL, not by the IMO but by the domestic maritime and port agencies of countries that are a party to MARPOL. As Daniel Bosch explains,

> [u]nder MARPOL, concurrent jurisdictions [for MARPOL member states] are established that allow for inspection and enforcement of not only a nation's own flag vessels, or those which are registered with the respective state's governing authority for maritime regulations and enforcement, but also over vessels under other flags that visit a nation's territorial waters.[214]

By comparing the attained CII with the required CII for a ship, the CII Rating is established (from A to E). As noted above,[215] ships that have ratings of D for three years or E for one year are supposed to develop a corrective action plan to improve the rating to at least C.[216] This corrective action plan should be part of the SEEMP.[217] The domestic enforcing agency will then examine the SEEMP to identify a ship's CII Rating, and if required, whether the SEEMP contains the corrective action plan. Additional enforcement steps are at the discretion of the domestic country examining the ship's SEEMP and its enforcement agency. Moreover, the IMO regulation "*encourage*[*s*]" (but does not require) "administrations, port authorities and other stakeholders . . . to provide incentives to ships rated as A or B."[218]

Many have criticized this enforcement regime as essentially "having no teeth."[219] With respect to the CII Rating regulation, the Alfa Laval blog notes,

> ship[s are] given no direct incentive to be in A or B, and the current level of enforcement creates almost no incentive to leave D and E. . . . This has perhaps been the plan all along on the part of some member states, which would explain the lack of robust enforcement.[220]

A similar view is expressed by Bryan Comer and Francielle Carvalho of the International Council on Clean Transportation: "there are no requirements for what must be included in these [corrective action] plans,

214. Bosch, *supra* note 54, at 263.

215. *See supra* Subpart 0.0.

216. Resolution MEPC 328(76), *supra* note 209, Regulation 28, § 7, at 48.

217. *Id.* Regulation 26 § 3 at 42.

218. *Id.* Regulation 28 § 10 at 45 (emphasis added).

219. *See, e.g.,* Paddison, *supra* note 162.

220. *EEXI and CII—What You Need to Know*, ALFA LAVAL BLOG, https://www.alfalaval.com/microsites/puresox/compliance-blog/eexi-and-cii-what-you-need-to-know/ (last visited Feb. 19, 2024).

and there is never a time when a ship's environmental certificates are revoked, no matter how many times the ship fails."[221]

The problem is that without a more robust enforcement apparatus, there is no way to ensure that these regulatory instruments are having their desired effect. Thus, although we have many components, we lack a complete regulatory system to deliver progress on decarbonization.

V. WHAT TO WATCH FOR IN THE NEAR FUTURE OF THE MARITIME INDUSTRY

While the maritime industry has made considerable progress in establishing a regulatory framework for decarbonization, many other significant changes need to occur in order for the industry to meet its net-zero emissions goal by 2050. So what are some of the key things to be watching?

One set of things to watch for is adaptations by industry players and institutions. A number of adaptations have already begun. The IMO already has committed to review its GHG Strategy further, with the next revision coming in 2028.[222] The IMO has already begun revising the carbon rating scheme, including how it calculates CII. Roel Hoenders, Head of Air Pollution and Energy Efficiency for IMO, stated: "It's a completely new mechanism for the IMO, so I don't think it's unusual that there are elements in the CII that require fixing, and we will look into that."[223]

Meanwhile, BIMCO, the industry organization responsible for creating standardized terms for shipping contracts,[224] has recently "adopt[ed a] new CII clause for voyage charter parties."[225] What is important about this CII clause is that it works to "facilitate collaboration and provide certainty between shipowners and charterers as new

221. Comer & Carvalho, *supra* note 160.

222. *See* Rutherford & Comer, *supra* note 143; *IMO's Work to Cut GHG Emissions from Ships*, INT'L MAR. ORG., https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx (last visited Feb. 19, 2024) (noting that "a review of the 2023 IMO GHG Strategy will be finalized when the Marine Environment Committee meets in autumn 2028, with a view to adoption of the 2028 IMO Strategy on reduction of GHG emissions from ships").

223. Harry Papachristou, *IMO Works on 'Fixing' Faults with Carbon Rating Scheme, Says Senior Official*, TRADEWINDS (Oct. 11, 2023), https://www.tradewindsnews.com/esg/imo-works-on-fixing-faults-with-carbon-rating-scheme-says-senior-official/2-1-1532355.

224. *See About Us and Our Members*, BIMCO, https://www.bimco.org/about-us-and-our-members (last visited Feb. 19, 2024).

225. Mette Kronholm Fraende, *BIMCO Adopts New CII Clause for Voyage Charter Parties*, BIMCO (Oct. 13, 2023), https://www.bimco.org/News/Priority-news/20231013-new-CII-clause-for-voyage-charter-parties.

regulations come into force, changing the way the industry operates to assist compliance and cut emissions."[226] It does this by "focus[ing] on course adjustment and speed reduction and [by] includ[ing] commercial elements such as data sharing."[227] Thus, this new CII clause allows the sharing of the risks of decarbonization between ship owners and charterers.

Another thing to watch for is whether a significant carbon tax program is developed. Aaron Poon, Senior Sustainability Advisor for RightShip, suggests that we should "keep []our eye on the links to carbon tax and carbon pricing connected to European Emissions Trading System. This will have a big impact on vessels traveling through European waters."[228]

In addition to these adaptations and the possible development of a carbon tax, perhaps the most important thing to watch for decarbonization in the maritime industry is alternative fuels. Jon Lane, Environmental Manager for RightShip, states, "[w]ith a target of 5% zero carbon future fuels by 2030 to allow decarbonization by 2050, the race is on. There are lots of exciting partnerships in this space and the development of Green Corridors can help solve the chicken-and-egg question of infrastructure, supply and demand of alternative fuels."[229] In a similar manner, in its 2023 (H2) "Maritime Decarbonisation Technology Outlook," the maritime research firm, Thetius, notes:

> while there is good progression in shipping's decarbonisation, many challenges remain. Largely, these are to do with the current supply and infrastructure of future fuels. Alternative fuels such as methanol and hydrogen hold promise in reducing emissions. However, securing an adequate quantity and quality of these fuels remains a significant challenge and requires concerted efforts in production and distribution. Moreover, while seafarers are expected to handle fuels of the future, at the current time there is a clear lack of focus on training and preparing them for this. Adopting alternative fuels introduces safety concerns and necessitates specialised personnel training, adding complexity to shipping's fuel transition.[230]

226. *Id.* A "charterer" is someone or some business that is hiring a cargo ship for a voyage.

227. *Id.*

228. *Rightship's Maritime Environmental Predictions for 2023*, SHIP NERD (Jan. 19, 2023), https://shipnerdnews.com/rightships-maritime-environmental-predictions-for-2023/.

229. *Id.*

230. *Maritime Decarbonisation Technology Outlook (H2 2023)*, THETIUS 1, 3 (2023).

Likewise, Juan Garcia Valencia and Amy Swift of the World Resources Institute declare:

> Today, almost all lower-carbon fuel sources for shipping are nascent and expensive, and some could even increase emissions if not done right. No clean and commercially viable solution has yet become available at scale. Given these challenges, reaching net-zero shipping emissions by 2050 will require not just stronger commitments but a revolution in clean fuel technologies, efficient ship design and supportive infrastructure—coupled with extensive funding to enable this transition.[231]

However, many in the industry point out that there will be extreme competition for alternative fuels, as all industries make efforts to decarbonize. Noted maritime economist Martin Stopford[232] has said that "shipping won't get 'a sniff' of green fuel, . . . as industries compete for scarce supplies."[233] Likewise, Shell says that "shipping won't get to choose its alternative fuel, . . . [leading it] to question ammonia and methanol bunkering."[234]

VI. LESSONS FOR THE FUTURE OF DECARBONIZATION IN SHIPPING

Since the adoption of the Paris Agreement almost ten years ago, the maritime industry has worked steadily on advancing its efforts to reduce GHG emissions. Some have celebrated its accomplishments.[235] Others have criticized the industry for not going far enough and for being "wishy-washy."[236] Both views are correct, to an extent. There are lessons to be drawn from both perspectives, and both optimism and criticism will be needed for future progress.

231. Juan Garcia Valencia & Amy Swift, *The Shipping Industry Won't Meet its Decarbonization Goals Without Investing More in Low-Carbon Fuels*, WORLD RES. INST. (Oct. 25, 2023), https://www.wri.org/insights/how-to-decarbonize-international-shipping.

232. Among other things, Stopford is author of MARITIME ECONOMICS (3d ed. 2009).

233. Declan Bush, *Stopford: Shipping Won't Get 'a Sniff' of Green Fuel*, LLOYD'S LIST (Sept. 13, 2023), https://lloydslist.com/LL1146577/Stopford-Shipping-wont-get-a-sniff-of-green-fuel.

234. Enes Tunagur, *Shipping Won't Get to Choose its Alternative Fuel, Shell Says*, LLOYD'S LIST (Sept. 13, 2023), https://www.lloydslist.com/LL1146585/Shipping-wont-get-to-choose-its-alternative-fuel-Shell-says. "Bunkering" means to supply ships with fuel.

235. *See* Paddison, *supra* note 162.

236. *Id.*

A. Lessons About What Has and Has Not Been Done

Over a long sequence of meetings of the MEPC and its Intersessional Working Group on Reduction of GHG Emissions from Ships,[237] the industry has tackled the difficult tasks of setting and updating "levels of ambition;" creating a data collection system for fuel; developing the technical standards of the EEDI, EEXI, SEEMP, and CII, and updating those standards; and determining intermediate targets and checkpoints. This difficult work has payoffs beyond its final outputs.

Setting lofty ambitions and then further raising them has provided those involved in this process with an optimism and commitment to continue their difficult work. A large number of industry experts from across the world have been involved with developing and advancing the technical instruments of EEDI, EEXI, and CII, and through their participation with these technical details, the latest developments in GHG reduction technologies have been disseminated further. This sharing of information, knowledge, and skills is essential for reduction of GHG emissions to be a global activity. Also, the adoption of the BIMCO CII clause shows how the maritime industry is interested in sharing the risks of GHG emission reductions.

Furthermore, the development of the Data Collection System for fuel, and its use in calculating CII and ensuring SEEMP compliance, will enable us to create a much more detailed inventory of fuel usage and estimated emissions by the industry. This detailed inventory will provide a foundation for further progress in reducing GHG emissions.

On the other hand, there remain proper concerns about alternative fuels, including both the safety of using those fuels and their availability. But transitions in power-generating engines and motors—whether you are talking about factories, trains, aircraft, automobiles, or even shipping—has always been a lengthy process, requiring sequences of recursive innovations and adaptations. When the proper incentives are there, human creativity and entrepreneurship have delivered the necessary improvements.

Likewise, the current regulatory framework does lack an effective enforcement mechanism. However, as we are still in the early stages of learning more about alternative fuels and other GHG emission reduction

237. The Intersessional Working Group on Reduction of GHG Emissions from Ships (ISWG-GHG) is the working group that develops specific proposals that will be discussed at upcoming Marine Environment Protection Committee meetings. *IMO Working Group Makes Progress on GHG Emissions from Ships*, INT'L INST. FOR SUSTAINABLE DEV. (July 9, 2008), https://sdg.iisd.org/news/imo-working-group-makes-progress-on-ghg-emissions-from-ships/.

actions, it is likely that even with a more complete enforcement apparatus, enforcement actions would take the character of remedial instruction and persuasion rather than rigorous penalties.[238] What is more critical is not whether we have effective enforcement now, but rather in the near future. So the question is, how do we get there?

B. Proposal for a Low and (Mostly) Revenue-Neutral[239] Maritime GHG Emissions Tax

The 2023 IMO GHG Strategy calls for mid-term measures, including some with an "economic element."[240] To be able to achieve its net-zero ambition by 2050, the IMO should adopt a low and (mostly) revenue-neutral emissions tax. As an economist, it is natural for me to recommend an incentive-based instrument to address further GHG emissions by shipping. However, there are important reasons for using this type of tax in order to reduce GHG emissions by shipping.[241]

Technology-based standards, such as EEDI and EEXI, are useful starting points, but they can become barriers to technological innovation. This is because an individual firm that may want to experiment with a new technology in order to get a competitive advantage may lose that advantage if that technology is shown as effective and then becomes the baseline requirement for all.

Emissions trading also has significant issues. An emissions trading system can produce more benefits when a broader scope of participants, with widely varying emission-reduction costs, is included. However, this broader scope of participants is likely to have significant differences in not just emission-reduction costs, but also in monitoring and enforcement costs along with the availability of data on emissions.[242] These differences will present barriers to participation by this wide range of emitters and will also cause great difficulties in determining the initial allocation of emission rights necessary to create an emissions market.[243]

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238. *See* Dale B. Thompson, *Beyond Benefit-Cost Analysis: Institutional Transaction Costs and Regulation of Water Quality*, 39 NAT. RES. J. 517, 519 (1999), https://digitalrepository.unm.edu/cgi/viewcontent.cgi?article=1649&context=nrj.

239. The use of some tax revenues to fund emission-reduction investments is why this would be labeled a mostly-revenue-neutral scheme, rather than a revenue-neutral one.

240. *See supra* Subpart 0.0.

241. Others have also recommended the use of a carbon tax for shipping. *See, e.g.*, Brown et al., *supra* note 4.

242. For discussion of the proposed RECLAIM market for volatile organic compounds (VOC), *see* Thompson, *supra* note 82, at 676-85.

243. *See id*.

A low and (mostly) revenue-neutral GHG emissions tax for shipping can present a number of advantages. One thing to note is that what is important in order to achieve the long-term goal of net-zero emissions is not setting the emissions tax exactly right at the beginning. Instead, what is important is to create the incentives and the institutions needed for progress and innovation in the future. Consequently, it is not necessary to establish a high tax at the beginning: a low one will create some marginal incentives to explore emission reduction activities. Meanwhile, a low tax rate will also improve the political feasibility of the creation of a tax system with a lower expected financial impact on shippers.[244] With many member states already supporting a maritime global GHG tax,[245] a low rate may lead to acquiescence by countries such as China.

Furthermore, a (mostly) revenue-neutral tax system can also provide incentives to include a broader set of participants. With a revenue-neutral tax system, tax revenues from those emitting above a baseline can be allocated as tax-rebates for those participants that emit below that baseline. Furthermore, a portion of those revenues could also be utilized for funding trial participation by others who have not formally joined the tax system. While the emissions tax directly creates incentives for technological innovation, these uses of tax revenues would expand the scope of participation[246] while also providing incentives to create and expand enforcement mechanisms.

Additionally, a portion of the revenues could also be allocated towards investing in and supporting GHG-reduction activities by shipping firms in developing countries. This feature would be consistent with the IMO's "guiding principle" of "common but differentiated responsibilities and respective capabilities."[247] This consistency between an emissions tax and the IMO's guiding principles is also noted by Jennifer Brown, Dominik Englert, Yoomin Lee, and Rico Salgmann of the World Bank, who point to the "advantages of addressing equity considerations through the strategic use of revenues."[248]

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244. *See* Thompson, *supra* note 83, at 764. This is consistent with the recommendation for more feasible emission permit targets as a component to my proposed alternative to the Kyoto Protocol. *Id.*

245. *See* Enes Tunagur, *Support Grows for IMO Greenhouse Gas Levy Despite China Opposition*, LLOYD'S LIST (Feb. 14, 2024), https://www.lloydslist.com/LL1148259/Support-grows-for-IMO-greenhouse-gas-levy-despite-China-opposition.

246. Again, this evolving expansion of the scope of participants was part of my proposed alternative to the Kyoto Protocol. *See id*.

247. *Initial IMO Strategy*, *supra* note 110.

248. Brown et al., *supra* note 4.

In contrast to the EEDI/EEXI/SEEMP/CII apparatus, enforcement of a Maritime GHG Emissions Tax could be more centralized. This is because this system would operate, at least initially, by focusing on the quantity and type of a ship's bunkered fuel, which is data that is easier to collect and enforce than the data needed to monitor and enforce the EEDI/EEXI/SEEMP/CII apparatus. A Maritime GHG Emissions Tax system could leverage the existing inventory of emissions already collected under the Data Collection System for fuel. Differential enforcement by the maritime and port agencies of different countries means that the reliability of this data would be inconsistent across all parties. But this Maritime GHG Emissions Tax system could start by using the most reliable data sources.

VII. CONCLUSION

Despite being ignored by environmental law journals (and most other law journals) over the past five years, the maritime industry has made significant progress towards reducing GHG emissions. The 2018 Initial IMO Strategy represented a major breakthrough, calling for a reduction of maritime GHG emissions of at least fifty percent by 2050. Since then, while there was still significant criticism of the 2018 IMO Strategy, the IMO—through the MEPC and the Intersessional Working Group—continued to revise its regulatory framework, including the regulatory instruments of EEDI, EEXI, SEEMP, and CII.[249] This work culminated most recently in the 2023 Revised IMO GHG Strategy, which set a net-zero emissions ambition for 2050.

Despite this progress, significant obstacles to maritime GHG emission reductions remain. The availability and safety of alternative fuels for the maritime industry remain in doubt, and the maritime decarbonization regulatory system lacks a fully functioning enforcement mechanism. To address these obstacles, this Article recommends the development of a low and (mostly) revenue-neutral maritime GHG emissions tax. A maritime GHG emissions tax system would provide incentives not only to improve GHG reducing technologies, but also incentives to build an institutional structure for implementation and enforcement. If shipping can succeed in improving decarbonization technologies and also in creating institutions for itself, then others may start seeing shipping as a beacon in the struggle against climate change.

249. For more on EEDI, EEXI, SEEMP and CII, *see supra* Part 0.