

# GREENHOUSE GAS EMISSIONS FROM SHIPPING: EXISTING REGULATIONS AND REGULATORY CHALLENGES

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## List of Acronyms

BC	Black Carbon
CAA	Clean Air Act.
CNG	Compressed Natural Gas
EC	European Commission
ECA	Emission Control Area
EEDI	Energy Efficiency Design Index
EPA	Environment Protection Agency
EU	European Union
GHG	Greenhouse Gas
ICCT	International Council on Clean Transport
ISOA	International Shipowners' Association
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
LNG	Liquefied Natural Gas
NOAA	National Oceanic and Atmospheric Administration
NSA	Norwegian Shipowners' Association
OECD	The Organization for Economic Co-operation and Development
PIIE	Peterson Institute for International Economics
PM	Particulate Matters
SEEMP	Ship Energy Efficiency Management Plan

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UNCTAD United Nations Conference on Trade and Development

UNFCCC United Nations Framework Convention on Climate Change

# 1. Introduction

## 1.1 Statement of the problem and purpose of this thesis

The United Nations has proclaimed 2021-2030 as a Decade of Ocean Science for Sustainable Development.<sup>1</sup> Covering more than 70% of the planet's surface, the ocean is central to human well-being, providing valuable and vital ecosystem services such as climate regulation, food, energy, mineral and genetic resources, and cultural and recreational services.<sup>2</sup> The health of ocean has now reached a critical point.<sup>3</sup> Greenhouse gas (GHG) emissions from shipping and the maritime industry has increased drastically in recent times, and is a matter of great concern today.<sup>4</sup> Uncontrolled ship emissions affect the port surroundings and coastal zones significantly.<sup>5</sup> The United Nations Framework **Convention** on Climate Change (UNFCCC)<sup>6</sup> is **concerned** that human activities have been substantially increasing the atmospheric concentrations of greenhouse gases, which will result in an additional warming of the Earth's surface and atmosphere and may adversely affect natural ecosystems and humankind.<sup>7</sup> The UNFCCC is **working** to cut the GHG emissions through the Kyoto Protocol<sup>8</sup> and the Paris Agreement.<sup>9</sup> While the UNFCCC is **working**

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<sup>1</sup> United Nations Education, Science and Cultural Organization, "United Nations Decade of Ocean Science for Sustainable Development (2021-2030)", Accessed: 25.11.2020 <https://en.unesco.org/ocean-decade>

<sup>2</sup> Joachim Claudet, Laurent Bopp, William W.L. Cheung, Rodolphe Devillers, Elva Escobar-Briones et. al, "A Roadmap for Using the UN Decade of Ocean Science for Sustainable Development in Support of Science, Policy, and Action", 2020, One Earth, <https://doi.org/10.1016/j.oneear.2019.10.012>

<sup>3</sup> Above n. 2

<sup>4</sup> Z. H. Munim, R. Saha, Sustainability in the Maritime Domain: Towards Ocean Governance and Beyond, 2020, p. 1

<sup>5</sup> Above n. 1

<sup>6</sup> The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty addressing climate change.

<sup>7</sup> United Nations Framework Convention on Climate Change (UNFCCC), "The Parties to this Convention," Accessed: 24.11.2020 <https://unfccc.int/resource/ccsites/zimbab/conven/text/preamble.htm>

<sup>8</sup> The Kyoto Protocol is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change that commits state parties to reduce greenhouse gas emissions.

<sup>9</sup> At COP 21 in Paris, on 12 December 2015, Parties to the UNFCCC reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement builds upon the Convention and – for the first time – brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so.

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to cut the GHG emissions, GHG emissions from shipping have risen from 977 million tons in 2012 to 1076 million tons in 2018.<sup>10</sup> Because of its dynamic nature and the challenges involved in international shipping, even two decades after adopting MARPOL Annex VI<sup>11</sup>, the International Maritime Organization (IMO)<sup>12</sup> is yet to come up with a concrete proposal to regulate GHG emissions from the sector. The IMO has implemented several energy efficiency measures to reduce GHG emissions from shipping. To see the effects of the implemented strategies, the IMO is conducting GHG studies periodically. The outcome is not that fruitful, as reflected on the 4<sup>th</sup> IMO GHG Study 2020.<sup>13</sup> Perhaps, the study notes that, ship emissions are projected to increase from about 90% of 2008 emissions in 2018 to 90-130% of 2008 emissions by 2050.<sup>14</sup> The good news is, the IMO at last in 2018 has adopted an Initial Strategy for reducing GHG emissions from international shipping.<sup>15</sup> However, a concrete strategy is not expected until 2023.<sup>16</sup> The IMO has adopted a Data Collection System (DCS) for the purpose of collecting ships fuel oil consumption data, which will be used for the proposed Initial Strategy.<sup>17</sup> The IMO strategies are adopted based on the data collected by conducting studies on emission factors of the ships, engines and fuel types.<sup>18</sup> However, quality data across all engines and fuel types are generally lacking.<sup>19</sup>

Apart from the IMO, the European Union as a region, is also trying to reduce GHG emissions from shipping on a regional basis.<sup>20</sup> The EU has adopted European Union Monitoring, Reporting and Verification (EU MRV) system to measure and regulate GHG (carbon) emission.<sup>21</sup> While EU is supporting the IMO, some major developing countries like China, Brazil, Chili, Kuwait, Saudi

<sup>10</sup> International Maritime Authority (IMO), “MEPC 75/7/15: 4<sup>th</sup> IMO GHG Study 2020 – Final Report”, Document can be accessed at: <http://docs.imo.org> (registration required)

<sup>11</sup> In 1997 the IMO adopted International Convention on Prevention of Pollution from Ships (MARPOL) Annex VI for regulating air emissions from shipping.

<sup>12</sup> IMO is the governing body of international shipping was mandated by the Kyoto Protocol solely responsible for GHG emission from international shipping.

<sup>13</sup> Resolution MEPC.75/7/15: 4<sup>th</sup> IMO GHG Study 2020 Final Report.

<sup>14</sup> Above n. 10

<sup>15</sup> IMO resolution MEPC.304(72), “Initial IMO Strategy on reduction of GHG emissions from shipping”,

<sup>16</sup> Resolution MEPC.304(72) can be downloaded from:

[https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20MEPC.304\(72\)\\_E.pdf](https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20MEPC.304(72)_E.pdf)

<sup>17</sup> IMO, “Data Collection System for fuel oil consumption of ships”, Accessed: 25.11.2020

<https://www.imo.org/en/OurWork/Environment/Pages/Data-Collection-System.aspx>

<sup>18</sup> International Council on Clean Transportation (ICCT), “Greenhouse Gas Emission from Global Shipping, 2013-2015” p. 24

<sup>19</sup> Above n. 15

<sup>20</sup> European Commission, “Reducing emissions from the shipping sector”, Accessed: 25.11.2020

[https://ec.europa.eu/clima/policies/transport/shipping\\_en](https://ec.europa.eu/clima/policies/transport/shipping_en)

<sup>21</sup> Above n. 17



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Arabia, India etc. are against the no more favour treatment (NMFT)<sup>22</sup> policy of IMO and yet to ratify MARPOL Annex VI.<sup>23</sup> They demanded for adoption of a resolution on financial, technological and capacity building support from developed countries in order to implement regulations on energy-efficiency for ships by developing countries.<sup>24</sup>

Ship emission reduction is not possible without the participation of all the countries together as international shipping accounts for 90% of the world trade.<sup>25</sup> Thus, without the availability of financial, technological, and capacity building support in the developing countries, a strong emission reduction policy cannot be implemented.

Another key concern is, While CO<sub>2</sub> is not the only pollutant shipping emits, the IMO is only regulating GHG (Carbon).<sup>26</sup> The GHG emissions from shipping - including CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, expressed in CO<sub>2</sub> equivalent (CO<sub>2e</sub>) along with secondary pollutants like black carbon (BC), particulate matter (PM) increased significantly in recent years.<sup>27</sup> The IMO however, is only regulating the GHG (carbon), Ozone Depleting Substances (ODS), while potential emittance like BC, PM are still unregulated.

Considering the aforesaid areas of concern, this thesis will present a critical analysis of the existing regulations in force for the reduction of GHG emissions from international shipping. At the beginning, a short discussion on different international conventions on regulating GHG emissions and to what extent those are relevant to shipping is analyzed. A detailed analysis of MARPOL Annex VI in regulating ships GHG emissions is presented afterwards as the IMO has amended it to include GHG within it. There is further discussion on some regional and countrywide measures adopted for regulating ships emissions. A short summary on the key challenges and possible solutions of regulating GHG emissions from international shipping is presented before concluding.

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<sup>22</sup> No More Favour Treatment: A policy where all the countries are treated equally and are bound to follow the IMO policy.

<sup>23</sup> Transport & Environment, "International Shipping; the first industry with a global climate standard", Accessed: 25.11.2020 [https://www.transportenvironment.org/sites/te/files/media/2011\\_07\\_19\\_EEDI.pdf](https://www.transportenvironment.org/sites/te/files/media/2011_07_19_EEDI.pdf)

<sup>24</sup> MEPC 64/5/9 2012

<sup>25</sup> International Chamber of Shipping, "Explaining Shipping", Accessed: 25.11.2020 <https://www.ics-shipping.org/explaining/>

<sup>26</sup> IMO, "Initial IMO Strategy for reduction of greenhouse gas emission".

<sup>27</sup> (IMO), "MEPC 75/7/15: 4th IMO GHG Study 2020 – Final Report", Document can be accessed at: <http://docs.imo.org>

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In view of these observations, this thesis will be focused on the following:

- What are the current regulations dealing with GHG emissions from shipping?
- How is the European Union regulating GHG emissions with the EU?
- How are different countries dealing with GHG emissions from shipping?
- What are the challenges in regulating GHG emissions from shipping?

In addition to those above, the thesis also aims to offer solutions to the following question:

- How effective are the existing regulations in reducing GHG emissions from international shipping?
- What can possibly be done to control the GHG emissions from shipping in a shorter period?

## 2. Context of GHG Emissions

### 2.1 Background

Climate change has been discussed broadly around the world and recognised as a factor contributing to all global issues.<sup>28</sup> The first evidence of increase of CO<sub>2</sub> in the atmosphere was observed in 1960s and 1970s.<sup>29</sup> The first assessment report in 1990 of the Intergovernmental Panel on Climate Change (IPCC) reflected the concern of 400 scientists about global warming and climate change.<sup>30</sup> This report led to the creation of the UNFCCC in 1992 and later the adoption of the Kyoto Protocol in 1997.<sup>31</sup> One of the main objectives of the Kyoto Protocol is to reduce carbon dioxide (CO<sub>2</sub>) emissions and the presence of GHGs in the atmosphere in order to limit the global temperature rise in this century to 2 degrees Celsius above pre-industrial levels.<sup>32</sup> The Kyoto Protocol implemented the objective of UNFCCC to reduce the onset of global warming by reducing the concentration of six known greenhouse gases : carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF<sub>6</sub>) in the environment.<sup>33</sup> Despite having directives for the limits of GHG emissions, the Protocol had no directives regulating the GHG emissions from shipping. The International Convention for the Prevention of Pollution from Ships (MARPOL)<sup>34</sup> had no directives for the prevention of air pollution from ships until 1997.<sup>35</sup> As 90 percent of the world trade takes place through shipping, and the sector has a potential growth, it is necessary to regulate shipping emissions. The Kyoto Protocol in its Article 2.2 mandated the IMO for the purpose of

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<sup>28</sup> Milke Hulme, “The Idea of Climate Change” 2010. 19(3).

<sup>29</sup> Above n. 28

<sup>30</sup> Roda Verheyen, “Climate change damage and international law” Martinus Nijhoffs publishers 2005, 14

<sup>31</sup> Above n. 30

<sup>32</sup> Earth.org, “What is Kyoto Protocol”.

<sup>33</sup> United Nations, “Kyoto Protocol To The United Nations Framework Convention on Climate Change” 1998 <https://unfccc.int/resource/docs/convkp/kpeng.pdf>

<sup>34</sup> The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.

<sup>35</sup> IMO, “International Convention for the Prevention of Pollution from Ships (MARPOL)”

Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges regulating GHG emissions from international shipping.<sup>36</sup> With the authority vested by the Kyoto Protocol, the IMO adopted MARPOL Annex VI to the Convention for the prevention of air emissions from ships in 1997.<sup>37</sup> Despite the adoption of MARPOL Annex VI, GHG emissions from shipping remained unregulated as MARPOL Annex VI has no provisions regulating GHG emissions.<sup>38</sup> With continuous pressure from the international society, the IMO has adopted mandatory measures to reduce the emissions of greenhouse gases from international shipping in 2008.<sup>39</sup> It was in 2012 when the IMO has implemented the Energy Efficiency Design Index (EEDI) and made it mandatory for new ships to comply with it.<sup>40</sup> While implementing the EEDI, the IMO is conducting GHG studies to determine the progress towards at least by 50 percent GHG emissions reduction target by the year 2050.<sup>41</sup>

## 2.2 Growing international shipping and ship emissions

As mentioned earlier, GHG emissions are one of the main contributors to global warming and shipping is one of the key contributors to global GHG emissions. The state of GHG emissions from different sectors during 1990 - 2016 is shown on the graph below.

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<sup>36</sup> The Kyoto Protocol, Art. 2.2

<sup>37</sup> IMO, "Shipping and Climate change".

<sup>38</sup> Jan Fuglestedt et al. *Environmental Science & Technology*, 1

<sup>39</sup> IMO, "Reducing Greenhouse Gas Emissions from ship"

<sup>40</sup> IMO, "Reducing greenhouse gas emissions from ships", Accessed: 25.11.2020

<https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx>

<sup>41</sup> IMO, "Low carbon shipping and air pollution control"

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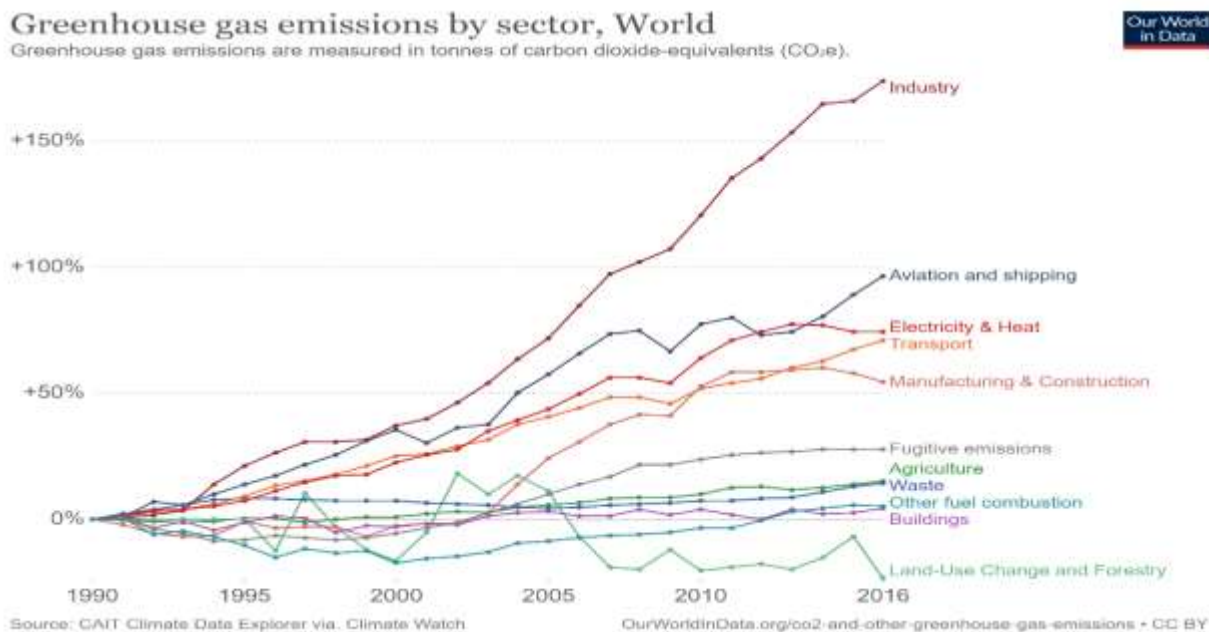


Figure 1.1 Greenhouse Gas Emission by sector from 1990 - 2016<sup>42</sup>

Compared to the other sectors, aviation and shipping stands in the second place with nearly 100% growth over the period. If global shipping were a country, it would be the sixth largest producer of greenhouse gas emissions.<sup>43</sup> Another key concern is the rapid growth of international shipping as predicted by the United Nations Conference on Trade and Development (UNCTAD).

UNCTAD expects international maritime trade to expand at an average annual growth rate of 3.5 percent over 2019–2024<sup>44</sup>.<sup>45</sup> While international maritime trade is growing rapidly, the 4<sup>th</sup> IMO GHG study shows significant growth in shipping emissions as well.<sup>46</sup>

The latest report of the IMO's GHG study shows a 10% increase in GHG emissions from shipping in the time frame of 2012 – 2018.<sup>47</sup> Most strikingly, there has been a substantial increase of short-lived climate pollutants including a 12% increase in black carbon emissions and a 150% increase

<sup>42</sup> Our World in Data, "Emissions by Sector"

<sup>43</sup> Eide et al. 2009, Cost-effectiveness assessment of CO<sub>2</sub>-reducing measures in shipping

<sup>44</sup> In 2017 growth was 4.7 percent and in 2018 it was 2.7 percent. According to the report the reduced growth in 2018 is because of the decision of United Kingdom and Northern Ireland to leave the European Union and the Economic transition of China.

<sup>45</sup> UNCTAD, "Review of Maritime Transport, 2019".

<sup>46</sup> IMO, "Fourth IMO GHG Study 2020". Document can be found here <https://docs.imo.org/Default.aspx> (registration required)

<sup>47</sup> Above n. 46

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in methane.<sup>48</sup> Methane traps 86 times more heat than the same amount of CO<sub>2</sub> in the atmosphere in a 20-year time period.<sup>49</sup> Despite the concerns, IMO is yet to have regulations for the control of harmful pollutants like black carbon and methane, while the regulations relating to PM emissions are not effective enough. With the rapid growth of international shipping and GHG emissions from shipping, the IMO must act faster before the situation gets even worse.

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<sup>48</sup> Above n. 46 page 13

<sup>49</sup> ICCT, “New IMO study highlights sharp rise in short-lived climate pollution”

# 3. Existing Regulations for Controlling GHG Emissions from Shipping

## 3.1 The Kyoto Protocol

The Kyoto Protocol was adopted on 11 December 1997 and entered into force on 16 February 2005.<sup>50</sup> Today, it has near-universal membership with 192 member countries that have ratified the United Nations Framework Convention on Climate Change (UNFCCC)<sup>51</sup> are party to this agreement.<sup>52</sup> The Kyoto Protocol sets binding targets for reducing greenhouse gas emissions on those countries that have ratified the Protocol.<sup>53</sup> For the purpose of this Annex A of the Kyoto Protocol included a list of six greenhouse gases, namely carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF<sub>6</sub>) along with the sectors it will be regulating.<sup>54</sup> Unfortunately the shipping sector was not included in the list.<sup>55</sup> There were expectations that the Kyoto Protocol would be extended to the shipping industry at the UN Climate Change Conference in Copenhagen in December 2009, but the accord reached by the participants at that conference was silent on the reduction of emissions from international shipping.<sup>56</sup> Instead, the Kyoto Protocol mandated IMO as the governing body for the international maritime sector in its Article 2.2 by stating:

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<sup>50</sup> United Nations Climate Change, “What is Kyoto Protocol” Accessed: 29.10.2020

[https://unfccc.int/kyoto\\_protocol](https://unfccc.int/kyoto_protocol)

<sup>51</sup> In 1992, its “Earth Summit” produced the United Nations Framework Convention on Climate Change (UNFCCC) as a first step in addressing the climate change problem

<sup>52</sup> United Nations, “Climate Change” Accessed: 29.10.2020 <https://www.un.org/en/sections/issues-depth/climate-change/>

<sup>53</sup> Gard, “Shipping emissions regulations”, Accessed: 29.10.2020

[http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G\\_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge\\_SDIXI](http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge_SDIXI)

<sup>54</sup> United Nations, “Kyoto Protocol To The United Nations Framework Convention On Climate Change” 1998.

<https://unfccc.int/resource/docs/convkp/kpeng.pdf>

<sup>55</sup> Above n. 53

<sup>56</sup> Above n. 53

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“The Parties included in Annex I 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.”<sup>57</sup>

One of the key reasons for not including sectors like maritime and aviation into the Kyoto Protocol is that the nature of those industries are beyond national boundaries while the Kyoto Protocol addresses global issues within national boundaries.<sup>58</sup> Moreover, bunker fuel is excluded by the IPCC guideline, stating that bunker fuel emissions shall not be reported under the national emissions, but separately.<sup>59</sup> It was further stated that, greenhouse gas emissions from international bunker fuels are not subject to the Kyoto Protocol's emission targets for Annex B countries referring to Art. 2.2 of the Protocol.<sup>60</sup> The article also states that the emissions reduction "shall be pursued" in the shipping sector by the International Maritime Organisation (IMO).<sup>61</sup> Even a discussion on the allocation of bunker fuel in the international climate change negotiation ended with no result,<sup>62</sup> as a result GHG emissions resulting from ships' bunker fuel remained unregulated from the Kyoto Protocol.

Other than regulating the Shipping and Aviation sector, the Kyoto Protocol established GHG emissions reduction targets for Annex B-1997 Parties<sup>63</sup> to the Protocol.<sup>64</sup> The Protocol adopted a common but differentiated responsibility (CBDR) strategy for all the Annex B listed countries, to

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<sup>57</sup> United Nations, “Kyoto Protocol To The United Nations Framework Convention on Climate Change” 1998 <https://unfccc.int/resource/docs/convkp/kpeng.pdf>

<sup>58</sup> The Chamber of Commerce and Industry of WA, “The Kyoto Protocol and Greenhouse Gas Emissions 1999. Can be accessed at:

[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiD44jwNvsAhVE\\_KQKHft8BQ0QFjAMegQIFxAC&url=https%3A%2F%2Fwww.aph.gov.au%2Fparliamentary\\_business%2Fcommittees%2Fhouse\\_of\\_representatives\\_committees%3Furl%3Djsct%2Fkyoto%2Fsub129attach.pdf&usg=AOvVaw0Xodfwy\\_hXaPOz5u1Okolc](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiD44jwNvsAhVE_KQKHft8BQ0QFjAMegQIFxAC&url=https%3A%2F%2Fwww.aph.gov.au%2Fparliamentary_business%2Fcommittees%2Fhouse_of_representatives_committees%3Furl%3Djsct%2Fkyoto%2Fsub129attach.pdf&usg=AOvVaw0Xodfwy_hXaPOz5u1Okolc)

<sup>59</sup> Axel Michaelowa and Karsten Krause, “International Maritime Transport and Climate Policy”, INTERECONOMICS, May/June 2000, Accessed: 31.10.2020 <https://www.intereconomics.eu/pdf-download/year/2000/number/3/article/international-maritime-transport-and-climate-policy.html>

<sup>60</sup> Above n. 59

<sup>61</sup> Above n. 59

<sup>62</sup> Above n. 59

<sup>63</sup> A list of 38 developed countries and economies in transition (EIT) listed by the Kyoto Protocol those were responsible for 39% of global GHG emissions.

<sup>64</sup> Igor Shishlov, Romain Morel & Valentin Bellassen (2016) Compliance of the Parties to the Kyoto Protocol in the first commitment period, *Climate Policy*, 16:6, 768-782, DOI:10.1080/14693062.2016.1164658 <https://doi.org/10.1080/14693062.2016.1164658>



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cut down the national GHG emissions by 5 percent in its commitment period (CP1 2008-2012).<sup>65</sup> At the end of the CP1, despite non-ratification of the Kyoto Protocol by US and withdrawal of Canada from the Protocol in 2011, the remaining 36 countries had a 4% equivalent reduction in their emission.<sup>66</sup> It is to be mentioned that, only 9 out of the 36 countries have failed to achieve their committed target while the data shows that some countries have over achieved the emission reduction target.<sup>67</sup> The collapse of the Soviet Union resulted in the rapid contraction of the economies of the Eastern Block and resulted in a large drop in the GHG emissions of these countries compared to their base-year emission target.<sup>68</sup> After the end of CP1, countries other than Canada, Japan and Russia of CP1, agreed for commitment Period 2 (CP2 2013-2020), through the Doha Amendment in 8 December 2012.<sup>69</sup> The amendment required ratification of 144 countries to come into force.<sup>70</sup> With the last hour ratification of Nigeria and Jamaica the amendment came into force just before its date of expiry.<sup>71</sup> Countries were collectively required to cut emissions by at least 18% below 1990 levels by 2020 under the Doha Amendments where the recent data of UN Climate Change<sup>72</sup> shows that the 37 developed countries had reduced 25.3% emissions by 2018.<sup>73</sup> However, during the commitment period (CP1) all of the EITs except Croatia and Slovenia overreached their respective targets by more than 20% suggests that, most of the emission reduction target of CP2 were already achieved before it came into force.<sup>74</sup> With non-participation of key GHG emitter countries like USA and Canada, and no reduction commitments for developing countries including China, India, Brazil and non-inclusion of data from shipping and aviation sector the Kyoto Protocol cannot be claimed to be successful.

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<sup>65</sup> Above n. 64 on page 16

<sup>66</sup> Above n. 64 on page 16

<sup>67</sup> Igor Shishlov, Romain Morel & Valentin Bellassen (2016) Compliance of the Parties to the Kyoto Protocol in the first commitment period, *Climate Policy*, 16:6, 768-782, DOI:10.1080/14693062.2016.1164658  
<https://doi.org/10.1080/14693062.2016.1164658>

<sup>68</sup> Above n. 67

<sup>69</sup> Doha Amendment to the Kyoto Protocol, 2012 read at:  
<https://treaties.un.org/doc/Publication/CN/2012/CN.718.2012-Eng.pdf>

<sup>70</sup> Above n. 69

<sup>71</sup> Climate Home News, Nigeria, Jamaica bring closure to the Kyoto Protocol era, in last-minute dash. Accessed: 06.11.2020 <https://www.climatechangenews.com/2020/10/02/nigeria-jamaica-bring-closure-kyoto-protocol-era-last-minute-dash/>

<sup>72</sup> UN Climate Change, "Kyoto's Second Phase Emission Reduction Achievable But Greater Ambition Needed", accessed: 06.11.2020 <https://unfccc.int/news/kyoto-s-second-phase-emission-reductions-achievable-but-greater-ambition-needed>

<sup>73</sup> Above n. 69

<sup>74</sup> Above n. 67

### 3.2 The Paris Agreement

The Paris Agreement is the most recent development of United Nations Framework Convention on Climate Change (UNFCCC) in combating the global climate change.<sup>75</sup> In 2015, 196 Parties came together under the Paris Agreement to transform their development trajectories so that they set the world on a course towards sustainable development, aiming at limiting global warming to 1.5 to 2 degrees C above pre-industrial levels.<sup>76</sup> It entered into force on 4 November 2016 and to this date, 189 out of 197 Parties to the Convention have ratified it.<sup>77</sup> The initial plan for the Paris Agreement was to fully replace the Kyoto Protocol by 2020.<sup>78</sup> However, the Paris accord went into effect earlier than expected, in November 2016.<sup>79</sup> For the purpose of limiting the global temperature rise, the Paris Agreement requires all Parties to put forward their best efforts through “nationally determined contributions” (NDCs) and to strengthen these efforts in the years ahead.<sup>80</sup> In pursuance of Art 4 of the Paris Agreement, parties shall communicate their NDCs every 5 years and provide information necessary for clarity and transparency.<sup>81</sup> However, there is no specific directions regarding the regulation of the shipping sector in the Paris Agreement, neither it repeats the call in the Kyoto Protocol for parties to work through the IMO to address GHG emissions from international shipping.<sup>82</sup> In fact, while the Kyoto Protocol has provisions declaring IMO to deal

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<sup>75</sup> United Nations Climate Change, “What is the Paris Agreement?”, Accessed: 03.11.2020

<https://cop23.unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement>

<sup>76</sup> United Nations Climate Change, “Nationally Determined Contributions (NDCs)”, Accessed: 03.11.2020

<https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs>

<sup>77</sup> United Nations Climate Change, “Paris Agreement - Status of Ratification” Accessed: 03.11.2020

<https://unfccc.int/process/the-paris-agreement/status-of-ratification>

<sup>78</sup> NRDC, “Paris Agreement: Everything You Need To Know”, Accessed: 07.11.2020

<https://www.nrdc.org/stories/paris-climate-agreement-everything-you-need-know>

<sup>79</sup> Above n. 78

<sup>80</sup> Above n. 75

<sup>81</sup> United Nations Climate Change, “Nationally Determined Contributions (NDCs)”, Accessed: 04.11. 2020

<https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs#eq-2>

<sup>82</sup> Aldo Chircop, Meinhard Doelle and Ryan Gauvin, “Shipping and Climate Change International Law and Policy Considerations”, Center for International Governance Innovation 2018. Read at:

[https://www.cigionline.org/sites/default/files/documents/Shipping%27s%20contribution%20to%20climate%20change%202018web\\_0.pdf](https://www.cigionline.org/sites/default/files/documents/Shipping%27s%20contribution%20to%20climate%20change%202018web_0.pdf)

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with the shipping emissions, the Paris Agreement has totally ignored the sector. The draft text of the Paris agreement had the following two provisions included:

*23bis. [In meeting the 2 °C objective, Parties agree on the need for global sectoral emission reduction targets for international aviation and maritime transport and on the need for all Parties to work through the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) to develop global policy frameworks to achieve these targets].<sup>83</sup>*

*47.5 Option (a). a. ...*

*b. Encourage the International Civil Aviation Organization and the International Maritime Organization to develop a levy scheme to provide financial support for the Adaptation Fund.*

*c. In establishing the levy scheme, ICAO and IMO are encouraged to take into consideration the needs of developing countries, particularly the LDCs, SIDS and countries in Africa heavily reliant on tourism and international transport of traded goods.<sup>84</sup>*

Neither of these provisions were included in the final Paris Agreement, which is raising question as to the role of emissions reduction commitments in the form of NDCs.<sup>85</sup> Then again, unlike the Kyoto Protocol, the Paris Agreement does not exclude emissions from international shipping, as Article 4.1 of the Paris Agreement refers to all emissions and does not exclude emissions from international shipping.<sup>86</sup>

While the Paris Agreement does not mention emissions from international shipping, and the IMO is continuing its efforts to develop a strategy to address them, the absence of any reference to this mandate in the agreement has the potential to strengthen the hand of the UN climate regime going forward.<sup>87</sup>

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<sup>83</sup> AD HOC WORKING GROUP ON THE DURBAN PLATFORM FOR ENHANCED ACTION Second session, part eight 8–13 February 2015 Geneva, Switzerland, “Negotiation Text” Read at: [https://unfccc.int/sites/default/files/negotiating\\_text\\_12022015%402200.pdf](https://unfccc.int/sites/default/files/negotiating_text_12022015%402200.pdf)

<sup>84</sup> Above n. 83

<sup>85</sup> Above n. 82 on Page 18

<sup>86</sup> Above n. 82 on Page 18

<sup>87</sup> Above n. 81 on Page 18

### 3.3 The Montreal Protocol

The Montreal Protocol on Substances that Deplete the Ozone Layer is the landmark multilateral environmental agreement that regulates the production and use of nearly 100 man-made chemicals referred to as ozone depleting substances (ODS).<sup>88</sup> Ozone-depleting substances are also very potent greenhouse gases, contributing to the phenomenon as other substances widely known to have a greenhouse effect like carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O).<sup>89</sup> The Montreal Protocol sits under the Vienna Convention<sup>90</sup> for the Protection of the Ozone Layer.<sup>91</sup> The Protocol was adopted on 15 September 1987 and to date it is the only UN treaty to have been ratified by every country – all 197 UN Member States.<sup>92</sup> The Montreal Protocol sets binding progressive phase out obligations for developed and developing countries for all the major ozone depleting substances, including chlorofluorocarbons (CFCs), halons and less damaging transitional chemicals such as hydrochlorofluorocarbons (HCFCs) across more than 240 industrial sectors.<sup>93</sup> Refrigeration vessels are used to carry fresh food, vegetables, fruits, fish etc. Such ships are also responsible for ODS in the atmosphere.<sup>94</sup> Unlike other regulations, the Montreal Protocol included the shipping sector within its governance through Decision XXIII/11.<sup>95</sup> Decision

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<sup>88</sup> UN Environment Programme, “About Montreal Protocol”, Accessed: 02.11.2020 <https://www.unenvironment.org/ozonaction/who-we-are/about-montreal-protocol>

<sup>89</sup> European Environment Agency, “Protecting the ozone layer while also preventing climate change”, Accessed: 30.11.2020 <https://www.eea.europa.eu/themes/climate/ozone-depleting-substances-and-climate-change>

<sup>90</sup> The Vienna Convention was adopted in 1985 following international discussion of scientific discoveries in the 1970s and 1980s highlighting the adverse effect of human activity on ozone levels in the stratosphere and the discovery of the ‘ozone hole’. Its objectives are to promote cooperation on the adverse effects of human activities on the ozone layer.

<sup>91</sup> United Nations, “The Vienna Convention”, can be accessed at:

<https://treaties.un.org/doc/publication/unts/volume%201155/volume-1155-i-18232-english.pdf>

<sup>92</sup> Above n. 89 on Page 16

<sup>93</sup> Australian Government, Department of Agriculture, Water and Environment, “Montreal Protocol on Substances that Deplete the Ozone Layer”, Accessed: 02.11.2020 <https://www.environment.gov.au/protection/ozone/montreal-protocol>

<sup>94</sup> Masao Yamasaki, “TRACECA Regional Seminar on MARPOL Awareness and Implementation”, 2015 accessed: 06.11.2020 [http://www.traceca-org.org/fileadmin/fm-dam/TAREP/68ta/1/Session\\_8\\_MY\\_MARPOL\\_Annex\\_VI\\_chapters\\_1\\_to\\_3\\_and\\_Black\\_Carbon\\_Final.pdf](http://www.traceca-org.org/fileadmin/fm-dam/TAREP/68ta/1/Session_8_MY_MARPOL_Annex_VI_chapters_1_to_3_and_Black_Carbon_Final.pdf)

<sup>95</sup> UN Environmental Programme, Treaties, “The Montreal Protocol on Substances that Deplete Ozone Layer”, <https://ozone.unep.org/treaties/montreal-protocol/meetings/twenty-third-meeting-parties/decisions/decision-xxiii11>

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XXIII/11 has done so through the statement *Recognizing that ships use equipment and technologies containing ozone-depleting substances onboard during operations in national and international waterways.*<sup>96</sup>

Paragraph 1 to paragraph 4 of Decision XXIII/11 of the Montreal Protocol contains directions for the Ozone Secretariat regarding the preparation and collection of documents on current information about the sale of ozone-depleting-substances to ships.<sup>97</sup> Paragraph 6 to paragraph 8 contains direction to other relevant authorities to assist the Ozone Secretariat in such preparation.<sup>98</sup> The Montreal Protocol also sets out mandatory timetable for the phase out of ozone-depleting substances and it has been reviewing the time table regularly in accordance with scientific understanding and technological advances.<sup>99</sup> The phase out target of ozone depleting substances (HCFCs) for the marine sector is the following:

Ozone depleting substances	Developed countries	Developing countries
HCFCs	35% reduction by 2004 75% reduction by 2010 90% reduction by 2015 Total phase out by 2020	10% reduction by 2015 35% reduction by 2020 67.5% reduction by 2025 Total phase out by 2030

Also, the direction prohibits any new installations on ships that include HCFCs from 1<sup>st</sup> January 2020.<sup>100</sup> The Montreal Protocol furthermore, has created the Multilateral Fund for the Implementation of the Montreal Protocol (the Multilateral Fund) in 1990 to provide financial assistance to developing countries to help them phase out their use of ozone depleting substances.<sup>101</sup> Overall, the Montreal Protocol sets out a very clear goal in stopping the production of ozone depleting substances, keeping in mind the technological barriers for the developing countries. Thus, the Montreal Protocol is considered as one of the most successful environmental

<sup>96</sup> Above n. 95 on page 20

<sup>97</sup> Above n. 95 on page 20

<sup>98</sup> Above n. 95 on page 20

<sup>99</sup> UN Environment Programme, "About Montreal Protocol", Accessed: 03.11.2020

<https://www.unenvironment.org/ozonaction/who-we-are/about-montreal-protocol>

<sup>100</sup> Safety4sea, "Phasing out ozone depleting substances", Accesses: 03.11.2020 <https://safety4sea.com/phasing-out-ozone-depleting-substances/>

<sup>101</sup> Above n. 99

Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges agreements of all time.<sup>102</sup> MARPOL Annex VI specifically refers to the Montreal Protocol in Article 2.16 in the definition of ODS and making itself committed to comply with the Montreal Protocol.<sup>103</sup>

### 3.4 MARPOL

The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.<sup>104</sup> The MARPOL Convention was adopted by IMO in 1973 but it did not enter into force until 1978 when IMO adopted MARPOL Protocol which absorbed the parent Convention.<sup>105</sup> The IMO's ship pollution regulations are contained in MARPOL 73/78.<sup>106</sup> The Convention includes regulations aimed at different types of pollutions from ships, but air pollution from shipping was not included. In 1997 air pollution from ships was integrated through the adoption of MARPOL Annex VI.<sup>107</sup> MARPOL Annex VI, which came into effect in 2005 and later amended as MARPOL Annex VI (2011 amendments) is the only global regime that clearly addresses the control of air emissions from ship.<sup>108</sup> It should, however, be noted that the 2011 amendments to MARPOL Annex VI were adopted by a majority vote rather than by consensus.<sup>109</sup> Some large developing countries, such as China, Brazil, and Chile, as well as Kuwait and Saudi

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<sup>102</sup> UN Environmental Programme, "About the Montreal Protocol", Accessed: 03.11.2020

<https://www.unenvironment.org/ozonaction/who-we-are/about-montreal-protocol>

<sup>103</sup> GEF-UNDP-IMO GloMEEP Project and IMarEST, 2018: Ship Emissions Toolkit, Guide No.1, Rapid assessment of ship emissions in the national context, [https://gmn.imo.org/wp-content/uploads/2018/10/ship\\_emissions\\_toolkit-g1-online.pdf](https://gmn.imo.org/wp-content/uploads/2018/10/ship_emissions_toolkit-g1-online.pdf)

<sup>104</sup> IMO, "The International Convention for the Prevention of Pollution from Ships (MARPOL)", [https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx)

<sup>105</sup> Above n. 104

<sup>106</sup> Gard, "Shipping Emissions Regulations" Accessed: 01.11.2020

[http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G\\_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge\\_SDIXI](http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge_SDIXI)

<sup>107</sup> Above n. 104

<sup>108</sup> Miluše Tichavska, Beatriz Tovar, "Transportation Research Part A" ELSEVIER 78 (2015) 347–360

<https://doi.org/10.1016/j.tra.2015.05.021>

<sup>109</sup> Yubing Shi & Warwick Gullett (2018) International Regulation on Low-Carbon Shipping for Climate Change Mitigation: Development, Challenges, and Prospects, *Ocean Development & International Law*, 49:2, 134-156, DOI: 10.1080/00908320.2018.1442178 f.59>61

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Arabia, voted against Regulation 21<sup>110</sup>, which questions the global acceptability of the regulation.<sup>111</sup> MARPOL through Annex VI regulates the limits on SO<sub>x</sub>, NO<sub>x</sub> and prohibits deliberate emissions of ozone-depleting substances' from ships.<sup>112</sup> IMO also made the Energy Efficiency Design Index (EEDI) mandatory for all the new ships built from 2015 and Ship Energy Efficiency Management Plan (SEEMP) for all the existing ships.<sup>113</sup> Along with these measures, the IMO has adopted a mandatory data collection system which requires ships above 5000 gross tonnes to report consumption data for fuel oil, hours underway and distance travelled.<sup>114</sup> A detailed discussion on the IMO's data collection system and existing regulations the MARPOL Annex VI regarding the reduction of greenhouse gases emission is presented in the next chapter.

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<sup>110</sup> Regulation 21 sets different reduction targets for different types of ships based on four construction completion phases, namely, Phase 0 (1 January 2013–31 December 2014), Phase 1 (1 January 2015–31 December 2019), Phase 2 (1 January 2020–31 December 2024), and Phase 3 (1 January 2025 and beyond)

<sup>111</sup> Above n. 59 on page 16

<sup>112</sup> Karimalis Nikolaos, "Onboard Energy Management and Marine Environment Protection – Coursework 2", [https://www.academia.edu/26335292/Marine\\_emission\\_control\\_regulations](https://www.academia.edu/26335292/Marine_emission_control_regulations)

<sup>113</sup> Gard, "Shipping emissions regulations", Accessed: 02.11.2020 [http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G\\_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge\\_SDIXI](http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge_SDIXI)

<sup>114</sup> IMO, "New requirements for international shipping as UN body continues to address greenhouse gas emissions." Accessed: 10.11.2020 <https://www.imo.org/en/MediaCentre/PressBriefings/Pages/28-MEPC-data-collection--.aspx>

## 4. Strategies Proposed by the IMO to Reduce GHG Emissions

### 4.1 Energy Efficiency Design Index (EEDI)

The Energy Efficiency Design Index (EEDI) is the most important technical measure adopted by the IMO to reduce greenhouse gas (GHG) emissions from shipping.<sup>115</sup> The EEDI was made mandatory for new ships at MEPC 62 (July 2011) with the adoption of amendments to MARPOL Annex VI.<sup>116</sup> The EEDI came into force in 2013 requiring all the new ships greater than 400 gross ton (GT) build after 1 January 2013 to meet certain level of efficiency in CO<sub>2</sub> emission compared to base level of 2008.<sup>117</sup> Following an initial two year phase zero when new ship design will need to meet the reference level for their ship type.<sup>118</sup> The EEDI requires new ships to enhance efficiency in 3 phases, where new ships has to be 10% more efficient beginning 2015, 20% more efficient by 2020 and 30% more efficient from 2025<sup>119</sup> (The MEPC 74<sup>th</sup> session of March 2019 approved amendments to the early start of phase 3 from 2022, then creating a new, more stringent “Phase 4” EEDI standard for 2025)<sup>120</sup>. Initially the phase out was applicable to new build tankers, bulk carriers, gas carriers, general cargo ships, container ships, refrigerated cargo carriers and combination carriers only.<sup>121</sup> The scope of the EEDI later was extended to LNG carriers, ro-ro cargo ships (vehicle carriers), ro-ro cargo ships; ro-ro passenger ships and cruise passenger ships

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<sup>115</sup> IMO, “Energy efficiency measures”, Accessed: 11.11.2020

<https://www.imo.org/en/OurWork/Environment/Pages/Technical-and-Operational-Measures.aspx>

<sup>116</sup> Above n. 115

<sup>117</sup> IMO Regulation MEPC.203(62), Accessed: 11.11.2020

[https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Technical%20and%20Operational%20Measures/Resolution%20MEPC.203\(62\).pdf](https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Technical%20and%20Operational%20Measures/Resolution%20MEPC.203(62).pdf)

<sup>118</sup> Above n. 117

<sup>119</sup> International Council on Clean Transportation, “The Energy Efficiency Design Index (EEDI) for New Ships”, Accessed: 11.11.2020 [https://theicct.org/sites/default/files/publications/ICCTpolicyupdate15\\_EEDI\\_final.pdf](https://theicct.org/sites/default/files/publications/ICCTpolicyupdate15_EEDI_final.pdf)

<sup>120</sup> IMO, “ Marine Environment Protection Committee (MEPC), 74th session, 13-17 May 2019” accessed: 13.11.2020 <https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-74th-session.aspx>

<sup>121</sup> IMO, “Energy efficiency measures”, Accessed: 11.11.2020

<https://www.imo.org/en/OurWork/Environment/Pages/Technical-and-Operational-Measures.aspx>



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having non-conventional propulsion through an amendment in EEDI regulation in 2014.<sup>122</sup> These exemptions are largely due to the technical difficulty of incorporating those specific types of ships into the EEDI formula set out in Regulation 21 of the Annex VI.<sup>123</sup> However, in the world's shipping fleet today, there are so many different kinds of ships even within the regulated shipping classes, where it is unclear which category a vessel may fall within.<sup>124</sup>

Besides, The EEDI provides a specific figure for an individual ship design, expressed in grams of carbon dioxide (CO<sub>2</sub>) per ship's capacity-mile (the smaller the EEDI the more energy efficient ship design) and is calculated by a formula<sup>125</sup> based on the technical design parameters for a given ship.<sup>126</sup> One of the possible ways to comply with this technical design parameters is by using efficient derating engine with larger diameter propellers operating at a lower RPM.<sup>127</sup> As a result, a number of reports have been received from vessel operators using a Barred Speed Range (BSR) with passage times becoming unacceptably long during sea trials.<sup>128</sup> Derating the engine is not the only way being applied to manipulate EEDI value as we see for the large size vessels.<sup>129</sup> While most of the vessel classes used new design technique, changes in hull design are more prominent in large size bulkers.<sup>130</sup> From these applied techniques it appears that, the EEDI requirement can easily be met by design rather than improvement on engine efficiency.<sup>131</sup> Because of this The EEDI standards have been criticized for being too weak to encourage innovation, as the shipowners can

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<sup>122</sup> Above n. 119 on page 25

<sup>123</sup> Yubing Shi & Warwick Gullett (2018) International Regulation on Low-Carbon Shipping for Climate Change Mitigation: Development, Challenges, and Prospects, *Ocean Development & International Law*, 49:2, 134-156, DOI: 10.1080/00908320.2018.1442178, <https://doi.org/10.1080/00908320.2018.1442178>

<sup>124</sup> James Harrison, "Recent Developments and Continuing Challenges in the Regulation of Greenhouse Gas Emissions from International Shipping," *Ocean Yearbook* 27 (2013):359-384

<sup>125</sup> 2014 Guidelines on the method of calculation of EEDI for new ships, Res. MEPC.245(66) adopted on 4 April 2014, as amended. Document can be accessed at <http://www.imo.org/> registration required)

<sup>126</sup> MARPOL, "Annex VI", <https://www.marpol-annex-vi.com/eedi-seemp/>

<sup>127</sup> International Associations of Classification Societies, "Air Pollution and Energy Efficiency", accessed: 12.11.2020 <http://www.iacs.org.uk/media/5804/mepc-74-5-technical-consequences-of-the-eeedi-on-the-ship-machinery-design-including-performance-of-iacs.pdf>

<sup>128</sup> Above n. 127

<sup>129</sup> The Organization for Economic Co-operation and Development (OECD), "ANALYSIS OF SELECTED MEASURES PROMOTING THE CONSTRUCTION AND OPERATION OF GREENER SHIPS", 2017, Accessed:13.11.2020 <https://www.oecd.org/industry/ind/analysis-of-measures-promoting-greener-ships.pdf>

<sup>130</sup> Above n. 129

<sup>131</sup> Above n. 129

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comply by building larger ships or building ships with smaller engines than the older ships reflected in the EEDI baseline.<sup>132</sup>

When it comes to ship engines, the EEDI can only be applied to ships with ship–engine–propeller design and matching with conventional propulsion.<sup>133</sup> The regulation 21 and 22 of the EEDI shall not apply to ships which have non-conventional propulsion, such as diesel-electric propulsion, turbine propulsion or hybrid propulsion systems, with the exception of cruise passenger ships with diesel-electric propulsion and LNG carriers having diesel-electric or steam turbine propulsion systems.<sup>134</sup> With the increasing use of alternative fuels such as ethane, compressed natural gas (CNG) and bio-fuel that offer a pathway for compliance with the '2020 low sulphur limit requirements', IMO will have to consider developing new property values in the EEDI calculations.<sup>135</sup> With all these limitations, the EEDI leaves too many loopholes for ships to easily comply with the design requirements.

Despite having too many loopholes, the EEDI have managed to cut the carbon intensity of the new ships.<sup>136</sup> Analysis by CE Delft and others has shown that many ships built in 2015 and 2016 already exceed the 2020 requirement.<sup>137</sup> In terms of carbon emission reduction how effective EEDI is still disputed, as almost three-quarters (71%) of all new containerships, which emit around a quarter of global ship CO<sub>2</sub> emissions, already comply with the post-2025 requirements of the IMO's Energy Efficiency Design Index (EEDI), according to a recent study based on the in-house analysis of the IMO's own data.<sup>138</sup>

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<sup>132</sup> ICCT, "Turning the ship, slowly: Progress at IMO on new ship efficiency and black carbon", 2019, accessed: 12.11.2020 <https://theicct.org/blog/staff/mepc74>

<sup>133</sup> Huilin Ren, Yu Ding and Congbiao Sui, "Influence of EEDI (Energy Efficiency Design Index) on Ship–Engine–Propeller Matching", 2019, *Journal of Marine Science and Engineering*. <https://www.mdpi.com/2077-1312/7/12/425/pdf>

<sup>134</sup> ClassNK Technical Informatio, "IACS Procedural Requirement No.38 (Rev.1) in relation to Energy Efficiency Design Index (EEDI)", 2016, Accessed: 13.11.2020 [https://www.classnk.com/hp/pdf/tech\\_info/tech\\_img/T1073e.pdf](https://www.classnk.com/hp/pdf/tech_info/tech_img/T1073e.pdf)

<sup>135</sup> Above n. 127 on page 26

<sup>136</sup> CE Delft, "Readily Achievable EEDI Requirements for 2020", 2016, Accessed: 13.11.2020 [www.cedelft.eu](http://www.cedelft.eu)

<sup>137</sup> Above n. 136

<sup>138</sup> Transport & Environment, "Shipping and Climate Change", Accessed: 14.11.2020 <https://www.transportenvironment.org/what-we-do/shipping-and-environment/shipping-and-climate-change>

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In April 2018, at the 72nd session of IMO's Marine Environment Protection Committee (MEPC) adopted "a pathway consistent with the Paris Agreement temperature goals".<sup>139</sup> On the MEPC 72, the strategies adopted can be summarized as following-

- Reducing ships carbon intensity further through Implementing further phases of the energy efficiency design index (EEDI) for new ships.<sup>140</sup>
- CO<sub>2</sub> emission per transport work should be reduced at least 40% by 2030 and pursue efforts for 70% reduction by 2050 (compared to 2008 level).<sup>141</sup>
- To peak and reduce annual GHG emission from international shipping at least by 50% compared to 2008 level by 2050.<sup>142</sup>

While the above pathway is being applauded, there is also concern that, the relationship between measures to reduce emissions of GHGs and air pollutants should be explored further within the EEDI as it is regulating greenhouse gas (GHG) CO<sub>2</sub> only, where CO<sub>2</sub> is one of the greenhouse gases (GHGs) not the only that shipping emits.<sup>143</sup> Ships along with CO<sub>2</sub>, emit various primary and secondary global warming pollutant such as, volatile organic compounds (VOC), methane (CH<sub>4</sub>), black carbon (BC), organic carbon particles (OC), nitrogen oxides (NO<sub>x</sub>), nitrous oxide (N<sub>2</sub>O), sulfur oxides (SO<sub>x</sub>), and carbon monoxide (CO).<sup>144</sup> These pollutants all contribute to global climate change either directly, by acting as agents that trap heat in the atmosphere, or indirectly by aiding in the creation of additional greenhouse gases.<sup>145</sup>

In principle, the EEDI has the potential to have a significant impact on future CO<sub>2</sub> emissions and would lead to a reduction from bulkers, tankers and containers by around 115 million CO<sub>2</sub> ton by

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<sup>139</sup> IMO, "Marine Environment Protection Committee (MEPC), 72nd session – Media information" Accessed: 14.11.2020 Document can be found here <https://docs.imo.org/Default.aspx> (registration required)

<sup>140</sup> IMO, "IMO adopts an initial strategy on the reduction of greenhouse gas emissions from ships, with a vision which aims to phase them out, as soon as possible in this century", Accessed: 14.11.2020 <https://www.imo.org/en/MediaCentre/PressBriefings/Pages/06GHGinitialstrategy.aspx>

<sup>141</sup> Above n. 139

<sup>142</sup> Above n. 139

<sup>143</sup> Sophia Kopela, "Making ships cleaner: Reducing air pollution from international shipping," *Review of European, Comparative & International Environmental Law* 26, no. 3 (2017): 231-242

<sup>144</sup> James J. Corbett; James J. Winebrake, "The Role of International Policy in Mitigating Global Shipping Emissions," *Brown Journal of World Affairs* 16, no. 2 (Spring/Summer 2010): 143-158

<sup>145</sup> OCEANA, "Shipping Pollution", Accessed: 13.11.2020 <https://europe.oceana.org/en/shipping-pollution-1>

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2035 relative to “business as usual”.<sup>146</sup> However, as EEDI requirements are more effective on vessels having a very low energy efficiency and not promoting very energy efficient vessels, policies and measures encouraging the construction and operation of “over-compliant” vessels (relative to the EEDI) are necessary in order to seek further reduction in CO<sub>2</sub> emissions from ships.<sup>147</sup>

From the above discussion, it is evident that the EEDI of the IMO has vision set, and the result of the EEDI might be visible in the longer run since it only applies to new ships coming into operation after 2015 January 1. Considering the average ship age of 30.4 when scrapped,<sup>148</sup> most of the existing ships will still be operating in the next two decades and thus until then the actual outcome of EEDI will not be visible. However, if IMO must meet the target set by Paris Agreement, immediate cut in GHGs emission from shipping is needed. There is still much work to be done regarding the accuracy of the EEDI measurement. Additional parameters required for the accuracy of the new build ships coming into operation with newer types of engines. Implementation of new strategy for monitoring the energy efficiency of ships during their operational life is further needed to justify the EEDI targets. Also, the other greenhouse gases must be included within the EEDI requirements so that the actual Paris Agreement target of net zero emission can be achieved.

## 4.2 Ship Energy Efficiency Management Plan (SEEMP)

The Ship Energy Efficiency Management Plan (SEEMP) established by the 2011 amendments to MARPOL Annex VI, is an operational measure that establishes a mechanism to improve the energy efficiency of a ship in a cost-effective manner.<sup>149</sup> It seeks to provide 'a possible approach for monitoring ship and fleet efficiency performance over time and some options to be considered

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<sup>146</sup> OECD, “ANALYSIS OF SELECTED MEASURES PROMOTING THE CONSTRUCTION AND OPERATION OF GREENER SHIPS”, Accessed: 14.11.2020 <https://www.oecd.org/industry/ind/analysis-of-measures-promoting-greener-ships.pdf>

<sup>147</sup> Above n. 146 on page 27

<sup>148</sup> United Nations Convention on Trade and Development (UNCTAD), “Decarbonizing maritime transport: Estimating fleet renewal trends based on ship scrapping patterns”, accessed: 14.11.2020 <https://unctad.org/news/decarbonizing-maritime-transport-estimating-fleet-renewal-trends-based-ship-scrapping-patterns>

<sup>149</sup> IMO, “Energy Efficiency Measures”, Accessed: 13.11.2020 <https://www.imo.org/en/OurWork/Environment/Pages/Technical-and-Operational-Measures.aspx>

Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges when seeking to optimize the performance of the ship'.<sup>150</sup> For this purpose, Guidelines for the Development of the Ship Energy Efficiency Management Plan (SEEMP) was adopted in March 2012, which later was superseded by the 2016 Guidelines for the development of Ship Energy Efficiency Management Plan (SEEMP).<sup>151</sup> The SEEMP 2016 Guideline is consist of 2 parts- PART I for energy efficiency compliance and PART II for compliance with IMO DCS requirements<sup>152</sup> (SEEMP Part II was included for the purpose IMO's Data Collection System (DTS) discussed in the later part of this chapter). The SEEMP is regulated by Regulation 22 and 22A of the MARPOL Annex VI which provides that-

*Each ship shall keep on board a ship specific Ship Energy Efficiency Management Plan (SEEMP). this may form project the ship's Safety Management System (SMS).*<sup>153</sup>

However, the normative effect of the SEEMP is rather limited because it lacks regulatory requirements for target setting as well as standards for the content of the plan.<sup>154</sup> In fact, the Guidelines for the Development of the Ship Energy Efficiency Management Plan (SEEMP), emphasize that 'the goal setting is voluntary' and that 'there is no need to announce the goal or the result to the public, and that neither a company nor a ship are subject to external inspection.<sup>155</sup> Though the goal setting is voluntary, a vessel-specific SEEMP must be on board at the time of survey.<sup>156</sup>

The RESOLUTION MEPC.282(70) describes four key processes that the SEEMP must address and describe; and together they form a continuous improvement process.<sup>157</sup>

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<sup>150</sup> Above n. 149

<sup>151</sup> IMO, RESOLUTION MEPC.282(70) 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP).

<sup>152</sup> Varifavia Shipping, "The IMO Data Collection System (DCS)", Accessed: 15.11.2020 <https://www.verifavia-shipping.com/shipping-carbon-emissions-verification/shipping-mrv-regulation-the-imo-data-collection-system-dcs-106.php>

<sup>153</sup> MARPOL 73/78 Annex VI (2011 amendments) reg 22.1

<sup>154</sup> Yoshifumi Tanaka, "Regulation of Greenhouse Gas Emissions from International Shipping and Jurisdiction of States," Review of European, Comparative & International Environmental Law 25, no. 3 (2016): 333-346

<sup>155</sup> IMO, Resolution MEPC.282(70), 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP), Annex, at paragraph 4.1.7

<sup>156</sup> DNVGL, "Monitoring Ship Fleet Efficiency Performance With An SEEMP", Accessed: 14.11.2020 <https://www.dnvgl.com/maritime/energy-efficiency/monitoring-ship-and-fleet-efficiency-performance-with-an-SEEMP.html>

<sup>157</sup> Lloyd's Register, "Implementing a Ship Energy Efficiency Management Plan", Accessed: 14.11.2020 [http://www.superyachtnews.com/articles/18431/seemp\\_client\\_guidance.pdf](http://www.superyachtnews.com/articles/18431/seemp_client_guidance.pdf)

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- *Planning*: As part of each SEEMP, the ship owner is required to review current practices and energy usage onboard each ship with a view to determining any shortfalls or areas for improvement of energy efficiency.<sup>158</sup> Regulation 4.1.1 of RESOLUTION MEPC.282(70) specified planning as the most crucial part of the SEEMP and encouraged to devote sufficient time to planning so that the most appropriate, effective and implementable plan can be developed.<sup>159</sup> Various aspects relating to ship-specific measures, company-specific measures, human resource development and goal setting should be identified at this stage.<sup>160</sup>
- *Implementation*: includes attention to establishing an appropriate system that allows for each selected measure to be rolled out according to the plan.<sup>161</sup>
- *Monitoring*: The SEEMP guidance (MEPC.282(70)) recommends one internationally established tool, that can be used for monitoring; the Energy Efficiency Operational Indicator (EEOI)<sup>162</sup>.<sup>163</sup>
- *SELF-EVALUATION, IMPROVEMENT AND REVIEW*: Regulation 4.4.1 of RESOLUTION MEPC.282(70) Self-evaluation and improvement is the final phase of the management cycle. This phase should produce meaningful feedback for the coming first stage, i.e. planning stage of the next improvement cycle.<sup>164</sup>

The SEEMP puts emphasis on the reduction of greenhouse gas emissions from ships by providing methods for reducing the fuel consumption and using alternative fuel which causes less GHG emissions.<sup>165</sup> It provides guidance on best practices for fuel-efficient operation of ships through

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<sup>158</sup> Above n. 157

<sup>159</sup> IMO, RESOLUTION MEPC.282(70) 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP), Annex, at paragraph 4.1.1

<sup>160</sup> Above n. 157 on page 29

<sup>161</sup> Above n. 156 on page 29

<sup>162</sup> Energy Efficiency Operational Index (EEOI) developed by the IMO to quantify the energy efficiency of a ship in terms of CO<sub>2</sub> production per cargo tonne-nautical mile (g CO<sub>2</sub>/t.nm) and its use and calculation is given in MEPC.1/Circ.68

<sup>163</sup> Above n. 157 on page 29

<sup>164</sup> IMO, RESOLUTION MEPC.282(70) 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP), Annex, at paragraph 4.4.1

<sup>165</sup> Marine Insight, "What is Ship Energy Efficiency Management Plan?", 2019, Accessed: 14.11.2020 <https://www.marineinsight.com/maritime-law/what-is-ship-energy-efficiency-management-plan/>

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 Resolution MEPC.282(70) Paragraph 5.<sup>166</sup> The SEEMP focused on reducing GHG emissions through increasing operational efficiency of the ship, resulting in less fuel consumption.<sup>167</sup>

The SEEMP is not a set rule of operations but a roadmap to try to achieve better fuel efficiency through its guidance regulations. The implementation of the SEEMP highly depends on the different parties involved in the shipping operation such as Port operator, Ship owners, shipyard, ship managers, seafarers etc.<sup>168</sup>

### 4.3 Data Collection System (DCS)

The Data Collection System (DCS) is intended to equip IMO with concrete data on fuel oil consumption, which should assist Member States in making decisions about any further measures needed to enhance energy efficiency and address greenhouse gas emissions from international shipping.<sup>169</sup> Under the new Regulation 22A of MARPOL Annex VI, DCS is a mandatory requirement for the ships with 5000 Gross Tonnage (GT) and above, and the regulation requires ship operators to record and report their fuel oil consumption data, as well as other, additional specific data including proxies to transport work.<sup>170</sup> The DCS was adopted through resolution MEPC.278(70) on Amendments to MARPOL Annex VI on Data collection system for fuel oil consumption of ships and entered into force on 1 March 2018.<sup>171</sup> For the purpose of effective development and management of the data provided, the IMO adopted “The 2017 Database Guideline” by resolution MEPC.293(71).<sup>172</sup> The IMO DCS, through the 2017 Database Guideline, requires the following details to be included-

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<sup>166</sup> Above n. 164, at paragraph 5

<sup>167</sup> Above n. 165

<sup>168</sup> Above n. 165 on page 30

<sup>169</sup> IMO, “MARPOL amendments enter into force - ship fuel oil reporting requirements, garbage classification and IOPP certificate”, Accessed: 15.11.2020

<https://www.imo.org/en/MediaCentre/PressBriefings/Pages/04MARPOLamendments.aspx>

<sup>170</sup> IMO, “Energy Efficiency Measures”, accessed: 15.11.2020,

<https://www.imo.org/en/OurWork/Environment/Pages/Technical-and-Operational-Measures.aspx>

<sup>171</sup> IMO, “Data Collection System for Fuel Oil Consumption of Ships”, Accessed: 14.11.2020

<https://www.imo.org/en/OurWork/Environment/Pages/Data-Collection-System.aspx>

<sup>172</sup> IMO, RESOLUTION MEPC.293(71) the 2017 Guidelines for the development and management of the IMO Ship Fuel Oil Consumption Database (hereafter "the 2017 Database Guidelines")

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1. Ship particulars
2. Record of Revision of Fuel Oil Data Collection Plan
3. Ship engines and other fuel oil consumers and fuel oil types used
4. Emission factor
5. Method to measure fuel oil consumption
6. Method to measure distance travelled
7. Method to use hours underway
8. Process that will be used to report the data to the administration
9. Data quality

Full text of IMO Data Collection System (DCS) as provided by SEEMP can be read [here](#).

The IMO DCS will work through 3 stages- reporting, verification, publication and disclosure.<sup>173</sup> where the ship at the end of each calendar year, by not later than 31 March of the subsequent year, must submit to flag State or Reporting Organization (RO) reports on fuel oil consumption data for the previous calendar year.<sup>174</sup> The flag state or RO then, will issue a Certificate of Compliance for the ship with two months of receiving the report and forward the report to the IMO.<sup>175</sup> Administrations are then required to submit aggregated data to the IMO which aggregates all data submitted by the flag states/recognised organisation and publishes in anonymised form on the IMO's ship fuel oil consumption database in GISIS<sup>176</sup> by 31 May at the latest.<sup>177</sup>

Regulation 8 of RESOLUTION MEPC.282(70) specifies that the Direct CO<sub>2</sub> emission measurement is not required by regulation 22A of MARPOL Annex VI.<sup>178</sup> Thus, IMO DCS is not dealing with methods for monitoring CO<sub>2</sub> which is the principal GHG. Inclusion of direct CO<sub>2</sub> measurement term could have availed further result on IMO DCS's approach for the reduction of GHG emissions.

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<sup>173</sup> Lexology, "Part one: The IMO fuel consumption data collection system (IMO DCS)", Accessed: 15.11.2020 <https://www.lexology.com/library/detail.aspx?g=95c2b3e7-1980-4217-8ee5-df8713c4eb84>

<sup>174</sup> IMO, RESOLUTION MEPC.282(70) 2016 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP) Paragraph 7.1

<sup>175</sup> Above n. 174

<sup>176</sup> Global Integrated Shipping Information System (GISIS) –IMO Ship Fuel Oil Consumption Database Module

<sup>177</sup> IMO, "Data collection system for fuel oil consumption of ships", Accessed: 15.11.2020

<https://www.imo.org/en/OurWork/Environment/Pages/Data-Collection-System.aspx>

<sup>178</sup> IMO, RESOLUTION MEPC.282(70) 2016 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP) Paragraph 8



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However, the IMO is taking one further step through the newly amended Ship Energy Efficiency Management Plan, or SEEMP pursuant to DCS, as it now demands ship operators not only to show the current emissions data, but also to provide ways in which ship operators plan to improve.<sup>179</sup> Unlike other existing methods of the Energy Efficiency Measures the DCS is progressing with more realistic approach and the biggest benefit of the DCS regulations is that, they are forcing shipping companies to be more introspective.<sup>180</sup>

#### 4.4 IMO's initial strategy on reduction of greenhouse gas emissions from ships

In 2018, IMO adopted an initial strategy on the reduction of GHG emissions from ships, setting out a vision which confirms IMO's commitment to reducing GHG emissions from international shipping and to phasing them out as soon as possible<sup>181</sup> Initial GHG strategy of the IMO includes a target *“to reduce the carbon intensity of international shipping (to reduce CO<sub>2</sub> emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008); and that total annual GHG emissions from international shipping should be reduced by at least 50% by 2050 compared to 2008”*<sup>182</sup>. To meet this target the Strategy suggests an indicative framework of measures to be implemented in the short- (2018–2023), medium- (2023–2030) and long-term (after2030).<sup>183</sup> The strategy envisages that a revised strategy will be adopted in 2023 based on the received information from DCS on

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<sup>179</sup> StormGeo, “Sustainability in Shipping: How the IMO DCS is Encouraging Companies to Go Greener”, Accessed: 15.11.2020 <https://www.stormgeo.com/solutions/shipping/articles/sustainability-in-shipping-how-the-imo-dcs-is-encouraging-companies-to-go-greener/>

<sup>180</sup> Above n. 179 on page 32

<sup>181</sup> IMO, “Reducing Greenhouse Gas Emission from Shipping”, Accessed: 15.11.2020 <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx>

<sup>182</sup> IMO, “Reducing greenhouse gas emission from shipping”, Accessed: 15.11.2020 <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx>

<sup>183</sup> Sustainability, “Towards the IMO's GHG Goals: A Critical Overview of the Perspectives and Challenges of the Main Options for Decarbonizing International Shipping”, Accessed: 15.11.2020 <https://www.mdpi.com/2071-1050/12/8/3220>

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 fuel oil consumption of ships over 5,000 gross tons, which began on 1 January 2019 along with the reports from the IMO GHG Studies.<sup>184</sup>

The IMO initial strategy on reduction of greenhouse gas emissions from ships as of RESOLUTION MEPC.304(72) includes the following:

- Vision
- Level of ambition and guiding principles
- List of candidates short-, mid- and long-term further measures with possible timelines and their impacts on states
- Barriers and supportive measures capacity building and technical cooperation R&D
- Follow-up actions towards the development of the revised strategy
- Periodic review of the strategy

#### 4.4.1 Vision

The initial strategy has the vision set to reduce the GHG emissions from international shipping as soon as possible.<sup>185</sup> The vision is set in alignment with UN SDG 13<sup>186</sup> and for the purpose seven newly identified strategic direction was set.<sup>187</sup> The strategic directions includes improving implementation, integrating new and advanced technologies in regulatory framework, responding to climate change, engaging in ocean governance, enhancing global facilitation and security of international trade, ensuring regulatory effectiveness and Ensuring organizational effectiveness.<sup>188</sup>

#### 4.4.2 Levels of ambitions

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<sup>184</sup> IMO, RESOLUTION MEPC.304(72) INITIAL IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS Paragraph 3, p. 5

<sup>185</sup> Initial IMO Strategy, Paragraph 2, p.5

<sup>186</sup> United Nations Sustainable Goal 13 Take urgent action to combat climate change and its impacts

<sup>187</sup> IMO, “IMO assembly adopts vision and strategic direction”, Accessed: 16.11.2020

<https://www.imo.org/en/MediaCentre/PressBriefings/Pages/37-A30.aspx>

<sup>188</sup> Above n. 187

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The Strategy sets out three levels of ambition.<sup>189</sup> First, the carbon intensity of ships should decline through the implementation of further phases of the EEDI.<sup>190</sup> Second, to reduce CO<sub>2</sub> emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008.<sup>191</sup> However, the IMO is yet to come out with a concrete method to achieve this reduction target as the final revised initial strategy will be adopted in 2023.<sup>192</sup> In the meantime, as seen in the Fourth IMO GHG Study, CO<sub>2</sub> emissions have increased over the period from 962 million tons in 2012 to 1056 million tons in 2018 (9.3% increase).<sup>193</sup> Without any concrete plan for the reduction CO<sub>2</sub> and with high rate of increase in its emissions and international trade it will be hard for the IMO to meet the 40% reduction target of CO<sub>2</sub>. Third, GHG emissions from international shipping should peak and decline as soon as possible and total annual emissions should be reduced by at least 50% by 2050 compared to 2008.<sup>194</sup>

### 4.4.3 List of candidates short-, mid- and long-term further measures with possible timelines and their impacts on states

The current initial strategy is focused on short-, mid- and long-term measures but the short-term measures are not expected until the end of 2023.<sup>195</sup> With this approach, emission will not start peaking until 2034.<sup>196</sup> Besides, with the current initial strategy IMO is committed to follow the Paris Agreement's goal for decarbonization.<sup>197</sup> According to the International Energy Association (IEA), in order for international shipping to contribute equally to the Paris Agreement goal of limiting anthropogenic warming to well below 2°C, shipping must emit no more than 17 Gt CO<sub>2</sub>

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<sup>189</sup> Initial IMO Strategy, paragraph 3, p.5

<sup>190</sup> Initial IMO Strategy, paragraph 3.1.1, p.6

<sup>191</sup> IMO, RESOLUTION MEPC.304(72) INITIAL IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS Paragraph 3.1.2, p.6

<sup>192</sup> Above n. 189

<sup>193</sup> IMO, "Fourth IMO GHG Study 2020". Document can be found here <https://docs.imo.org/Default.aspx> (registration required)

<sup>194</sup> Initial IMO Strategy, paragraph 3.1.3, p.6

<sup>195</sup> Initial IMO Strategy, Paragraph 4, p.7

<sup>196</sup> TheICCT, "International Maritime organization's initial greenhouse gas strategy", accessed: 16.11.2020 [https://theicct.org/sites/default/files/publications/IMO\\_GHG\\_StrategyFinalPolicyUpdate042318.pdf](https://theicct.org/sites/default/files/publications/IMO_GHG_StrategyFinalPolicyUpdate042318.pdf)

<sup>197</sup> Initial IMO Strategy, paragraph 4, p.7

Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges in total from 2015 onward.<sup>198</sup> The IMO targets allow a total emission between 28 and 43 Gt CO<sub>2</sub> by international shipping through 2100.<sup>199</sup>

#### 4.4.4 Concerned pollutants

The IMO initial strategy explicitly concerns CO<sub>2</sub> and calls for considering measures to address emissions of methane (CH<sub>4</sub>) and volatile organic compound (VOC)<sup>200</sup>, but not other climate pollutants such as nitrous oxide (NO<sub>x</sub>) or black carbon (BC).<sup>201</sup> Black carbon, in particular, is estimated to account for 7% to 21% of the overall climate impact of international shipping.<sup>202</sup> Separate action on black carbon is being considered in IMO's Pollution Prevention and Response (PPR) Subcommittee.<sup>203</sup>

#### 4.4.5 Follow up approach for the implementation

'Candidate measures' proposed by The Initial Strategy emission reduction target to be implemented over three stages.<sup>204</sup>

Short-term measures will be finalized and agreed through improvements to the existing energy efficiency frameworks (EEDI and SEEDI) and future review of the regulations in between 2018 and 2023.<sup>205</sup> The use of operation measures such as speed optimization, speed reduction etc. are proposed for analysis and consideration.<sup>206</sup> Countries are also encouraged to develop National Action Plans (NAPs), which will be the basis for future national emissions reduction policies.<sup>207</sup>

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<sup>198</sup> International Energy Agency, "Energy Technology Perspectives 2017" (2017). Accessed: 16.11.2020 Retrieved from <https://www.iea.org/etp2017/>

<sup>199</sup> Above n. 196

<sup>200</sup> Initial IMO Strategy, Paragraph 4.7.5, p.8

<sup>201</sup> TheICCT, "International Maritime organization's initial greenhouse gas strategy", accessed: 16.11.2020 [https://theicct.org/sites/default/files/publications/IMO\\_GHG\\_StrategyFinalPolicyUpdate042318.pdf](https://theicct.org/sites/default/files/publications/IMO_GHG_StrategyFinalPolicyUpdate042318.pdf)

<sup>202</sup> Bryan Comer, Naya Olmer, Xiaoli Mao, Biswajoy Roy, and Dan Rutherford, Black carbon emissions and fuel use in global shipping, 2015 (ICCT: Washington DC, 2017). Accessed: 16.11.2020 <https://www.theicct.org/publications/black-carbon-emissions-global-shipping-2015>

<sup>203</sup> Above n. 201

<sup>204</sup> Initial IMO Strategy, paragraph 4.7, p.7

<sup>205</sup> Initial IMO Strategy, paragraph 4.7.1, p.7

<sup>206</sup> Initial IMO Strategy, Paragraph 4.7.4, p.8

<sup>207</sup> Initial IMO Strategy, Paragraph 4.7.6, p.8

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Mid-term measures are to be agreed and finalized in between 2023 and 2030 which include the adoption of strategy for implementing low carbon and zero carbon fuels, including update of national actions plans to specifically consider such fuels.<sup>208</sup>

While the adoption of long-term measures which are yet to be finalized, go beyond 2030.<sup>209</sup> The measures to be related to the development and provision of zero-carbon or fossil-free fuels to enable the shipping sector to assess and consider decarbonization in the second half of the century<sup>210</sup> and to encourage and facilitate the general adoption of other possible new/innovative emission reduction mechanism(s).<sup>211</sup>

On its way towards the reduction on greenhouse gas emissions from shipping, until the initial strategy, the IMO has never implemented sector wide emission reduction target. The IMO initial strategy is an exception to this regard and sets out an ambitious and realistic pathway towards decarbonizing of shipping.<sup>212</sup> However, the initial strategy is being criticized for uncertainty on the decarbonization pathways and non-availability of clear picture of all energy options.<sup>213</sup> The set target requires the development, availability and affordability of zero-carbon fuels to meet the goal.

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<sup>208</sup> Initial IMO Strategy, Paragraph 4.8, p.9

<sup>209</sup> Initial IMO Strategy, Paragraph 4.9, p. 9

<sup>210</sup> Initial IMO Strategy, Paragraph 4.9.1, p. 9

<sup>211</sup> Initial IMO Strategy, Paragraph 4.9.2, p.9

<sup>212</sup> Roel Hoenders, “Achieving the goals of the Initial IMO Strategy on reduction of GHG emissions from ships”, (World Maritime University 2020) Accessed: 17.11.2020 <https://www.nordicenergy.org/wp-content/uploads/2020/03/Roel-Hoenders.pdf>

<sup>213</sup> Above n. 212

# 5. EU strategies in emission control from shipping

## 5.1 EU Strategy

The European Union EU supports ambitious international action to address climate change.<sup>214</sup> Multilateralism and broad-based cooperation continue to be central for EU's climate policy.<sup>215</sup> Despite its strong stand against GHG emissions, international maritime transport was the only transport mode not included in the EU's GHG emissions reduction commitment until 2013.<sup>216</sup> The EU's support on IMO as the most appropriate international forum to regulate emissions from international shipping was the reason for not regulating the shipping sector in a regional basis.<sup>217</sup> It has also exerted pressure on the IMO to progress with its deliberations on GHG reduction in the sector.<sup>218</sup> However, the progress in the IMO has been perceived as being too slow, as a result the European Parliament had suggested for shipping to be incorporated into the European Union's existing land-based emissions trading scheme (ETS)<sup>219</sup>. After some debate with the IMO and International Ship Owners Association (ISOA), regarding inclusion of shipping into the ETS, the European Commission

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<sup>214</sup> European Commission, “Integrating maritime transport emissions in the EU's greenhouse gas reduction policies”, Accessed: 18.11.2020  
[https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/com\\_2013\\_479\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/com_2013_479_en.pdf)

<sup>215</sup> Above n. 214

<sup>216</sup> European Commission, “Time for international action on CO<sub>2</sub> emissions from shipping”, accessed: 18.11.2020  
[https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/marine\\_transport\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/marine_transport_en.pdf)

<sup>217</sup> European Commission, “Time for international action on CO<sub>2</sub> emissions from shipping”, Accessed: 18.11.2020  
[https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/marine\\_transport\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/marine_transport_en.pdf)

<sup>218</sup> Aldo Chircop, Meinhard Doelle and Ryan Gauvin, “Shipping and Climate Change International Law and Policy Considerations”, Accessed: 18.11.2020  
[https://www.cigionline.org/sites/default/files/documents/Shipping%27s%20contribution%20to%20climate%20change%202018web\\_0.pdf](https://www.cigionline.org/sites/default/files/documents/Shipping%27s%20contribution%20to%20climate%20change%202018web_0.pdf)

<sup>219</sup> Above n. 218

Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges did not proceed with the proposal<sup>220</sup>, but in 2013, the Commission set out a strategy which consists of 3 consecutive steps towards reducing GHG emissions from the shipping industry.<sup>221</sup>

The strategy consists of 3 consecutive steps-

- **Monitoring, Reporting and verification** of CO<sub>2</sub> emissions from large ships using EU ports (Regulation 2015/757, adopted in April 2015)
- **Greenhouse gas reduction targets** for the maritime transport sector
- **Further measures** including market-based measures, in the medium to long term

### 5.1.1 EU-MRV (Monitor, Report and Verification)

From 1 January 2018, ships over 5000 gross tonnage loading or unloading cargo or passengers at ports in the European Economic Area (EEA) are to monitor and report their related CO<sub>2</sub> emissions and other relevant information. Regulation (EU) 2015/757 on Monitoring, Reporting and Verification of CO<sub>2</sub> emissions from maritime transport was adopted in April 2015.<sup>222</sup>

The subject matter of the Regulation is in its Article 1:

*“This Regulation lays down rules for the accurate monitoring, reporting and verification of carbon dioxide (CO<sub>2</sub>) emissions and of other relevant information from ships arriving at, within or departing from ports under the jurisdiction of a Member State, in order to promote the reduction of CO<sub>2</sub> emissions from maritime transport in a cost effective manner.”<sup>223</sup>*

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<sup>220</sup> Above n. 218

<sup>221</sup> Above n. 214

<sup>222</sup> REGULATION (EU) 2015/757 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. Regulation can be accessed on: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02015R0757-20161216>

<sup>223</sup> Regulation 2015/757, Article 1

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This limits the focus of the MRV system only on CO<sub>2</sub>, not other air pollutants like SO<sub>x</sub>, NO<sub>x</sub>, or PM.<sup>224</sup> The MRV has been criticized for **non-inclusion** of all ships' GHGs and not covering the main atmospheric pollutants.<sup>225</sup>

The scope of the MRV is also limited to ships above 5000 gross tonnage (GT), while fish-catching or fish-processing ships, wooden ships of a primitive build, ships not propelled by mechanical means, or government ships used for non-commercial purposes are beyond the scope.<sup>226</sup>

The monitoring is conducted on a per-voyage basis.<sup>227</sup> As suggested in *Article 9(1)*, the monitoring is conducted on the following parameters:

- (a) Port of departure and port of arrival including the date and hour of departure and arrival,
- (b) Amount and emission factor for each type of fuel consumed in total,
- (c) CO<sub>2</sub> emitted,
- (d) Distance travelled,
- (e) Time spent at sea,
- (f) Cargo carried,
- (g) Transport work.

The MRV establishes a systematic and innovative approach for larger ships in terms of CO<sub>2</sub> reduction.<sup>228</sup> The proposed system is very broad as it covers annual CO<sub>2</sub> port-to-port emissions, distance and time of travel, along with fuel data and cargo carried.<sup>229</sup> **For the calculation of fuel consumption of CO<sub>2</sub>** operators are free to choose one or more methods from the following-

- a. Bunker delivery notes and periodic stockades of fuel tanks
- b. Bunker fuel tank monitoring
- c. Flow meters for applicable combustion process

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<sup>224</sup> P. Gilbert, "From reductionism to systems thinking: How the shipping sector can address sulphur regulation and tackle climate change," *Marine Policy*, vol. 43 (2014): 376–378

<sup>225</sup> Above n. 224

<sup>226</sup> Regulation 2015/757, Article 2

<sup>227</sup> Regulation 2015/757, Article 9

<sup>228</sup> Laurent Fedi, "The Monitoring, Reporting and Verification", January 2017, *Ocean Yearbook* 31(1):381-417, DOI: 10.1163/22116001-03101015

<sup>229</sup> Above n. 228 on page 33



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### d. Direct CO<sub>2</sub> emission measurements<sup>230</sup>

The emission report concerning the CO<sub>2</sub> emissions and other relevant information as required by *Article ((1))* must be forwarded to the Commission and to the authorities of the flag states concerned, by 30 April of every year pursuant to Article 11.<sup>231</sup> Upon the correct reporting of the information required, the verification authority will issue a ‘Document of Compliance’ pursuant to Article 17.<sup>232</sup> Reported data will be publicly available pursuant to Article 21,<sup>233</sup> while these data could include confidential information would undermine commercial interests of the company.<sup>234</sup>

While the EU-MRV provides for good initiatives for CO<sub>2</sub> measurement, the lack of precise carbon inventories is a major drawback for setting up tighter CO<sub>2</sub> reduction policy.<sup>235</sup>

## 5.1.2 Greenhouse Gas Reduction Target

EU has a strong commitment in terms of environmental policy complying with a high level of protection.<sup>236</sup> Pursuant to Article 191 of the Treaty on the Functioning of the European Union (TFEU)<sup>237</sup>, the EU has established an ambitious policy dealing with decarbonization of all sectors of its member States and shipping was also included later on.<sup>238</sup> In taking measures for GHG reduction, EU as a region has to follow the rules set by the IMO as it is the international governing body.<sup>239</sup> The GHG reduction target for the shipping is set by the European Commission is based on emissions recorded in 1990, though the intra-EU shipping emission is doubled between 1990 and 2008.<sup>240</sup> While the IMO has set its baseline for carbon reduction target to 2008, EU has set the baseline for the same to 1990 and did not give the IMO targets maximum value.<sup>241</sup>

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<sup>230</sup> Laurent Fedi, “The Monitoring, Reporting and Verification”, January 2017, *Ocean Yearbook* 31(1):381-417, DOI: 10.1163/22116001-03101015

<sup>231</sup> Regulation 2015/757, Article 11

<sup>232</sup> Regulation 2015/757, Article 17

<sup>233</sup> Regulation 2015/757, Article 21

<sup>234</sup> Id., Art. 21.3, “Publication of information and Commission report.”

<sup>235</sup> Fedi, “The Monitoring, Reporting and Verification”, 2017.

<sup>236</sup> Above n. 235

<sup>237</sup> Consolidated Version of the Treaty on the Functioning of the European Union, 2008 O.J.C 115/47 (TFEU)

<sup>238</sup> “European Strategy for Low-Emission Mobility,” Final communication from the Commission to the European Parliament, the Council [...], SWD (2016) 244 final, Brussels, 20 July 2016, COM (2016) 501 final

<sup>239</sup> Fedi, “The Monitoring, Reporting and Verification”, January 2017.

<sup>240</sup> Communication from the Commission to the European Parliament, the Council, [...]: “Integrating maritime transport emissions in the EU’s greenhouse gas reduction policies,” European Commission, Brussels, 28 June 2013, COM (2013) 479 final.

<sup>241</sup> Above n. 239

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The main role of IMO as the governing body of international shipping is to create a regulatory framework for the shipping industry that is fair and effective, universally adopted and universally implemented.<sup>242</sup> While EU being a region representing 28 States is also bound to follow the IMO regulation, the MRV system related to CO<sub>2</sub> is indeed a European legal initiative not based on existing IMO regulations.<sup>243</sup> Thus, the European Community Shipowners' Associations, and the International Chamber of Shipping (ICS), expressed concern over the EU MRV on the ground that it calls into question of the IMO's role and suggested for EU MRV Regulation to align with IMO's DCS.<sup>244</sup> At last, in October 2019, the ambassadors of EU member states agreed on their position on a proposal which updates existing EU rules, and partially aligns them with the global data collection system for ship fuel oil consumption of the IMO.<sup>245</sup>

### 5.1.3 Further Measures

Even though the EU MRV Regulation does not oblige shipowners directly to reduce their fuel consumption, the publication of an emission report should rapidly lead them to improve their ships' fuel efficiency, or to stop less efficient vessels.<sup>246</sup> Among the further measures, the EU is considering the following approaches:

- The inclusion of shipping in the EU ETS
- Market-Based Measures

## 5.2 A comparison between EU MRV and IMO DCS

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<sup>242</sup> IMO, "Introduction to IMO", Accessed: 21.11.2020 <https://www.imo.org/en/About/Pages/Default.aspx>

<sup>243</sup> Fedi, "The Monitoring, Reporting and Verification", January 2017.

<sup>244</sup> Above n. 243

<sup>245</sup> European Council, "CO<sub>2</sub> emissions from ships: Council agrees its position on a revision of EU rules", Accessed: 30.11.2020 <https://www.consilium.europa.eu/en/press/press-releases/2019/10/25/co2-emissions-from-ships-council-agrees-its-position-on-a-revision-of-eu-rules/#>

<sup>246</sup> Above n. 243

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The European Union rushed to adopt its own MRV regulation to push the IMO to move faster with its GHG reduction target, while some saying it has been done primarily to “patronize” IMO so its future MRV regulation mirrors that of EU.<sup>247</sup> Despite immense pressure from the EU, IMO followed their own way for the adoption of IMO DCS.<sup>248</sup> While there are similarities between EU MRV and IMO DCS, there are differences between them as well. Both EU’s MRV and IMO’s DCS requirements are mandatory and intend to be the first step in a process to collect and analyse emission data related to the shipping industry.<sup>249</sup> Based on the comparison conducted by Verifavia Shipping<sup>250</sup>, the key differences are following:

- The EU MRV is applicable for all the ships calling at any EU ports, whereas the IMO DCS applies to all the ships worldwide.
- The EU MRV is applicable to ships above 5000 gross tonnage (GT), whereas the IMO DCS is applicable to ships with gross tonnage of 5000 and above.
- The EU MRV relies on a distinct monitoring plan, while the IMO DCS requires the monitoring to be conducted as required by the SEEMP Part II.
- EU MRV collects data only relevant to CO<sub>2</sub>, whereas the IMO DCS collects data relevant to the ships fuel consumption.
- The EU MRV requires the reporting based on the actual cargo carried on ship, while the IMO DCS requires the reporting of DWT (as cargo proxy).
- The EU MRV’s collected data are reported through the Thetis system of EMSA, while the IMO DCS collected data are reported to the relevant Flag Administration.
- Reporting to the verifier should be done by the end of January for EU MRV, whereas the IMO DCS requires the reporting to the verifier by the end of March.

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<sup>247</sup> Panos Zachariadis, “MRV: Another unnecessary regulation”, 2016, [naftikachronika.gr](http://naftikachronika.gr), Accessed: 22/11/2020 [https://www.academia.edu/34965943/MRV\\_Another\\_unnecessary\\_regulation](https://www.academia.edu/34965943/MRV_Another_unnecessary_regulation)

<sup>248</sup> Above n. 247

<sup>249</sup> Dimitrios Dalaklis, “Exploring the New Policy Framework of Environmental Performance Management for Shipping”, 2018, Harbours Review Spotlight: Greenhouse Gas Emissions in Shipping Conference. Accessed: 22.11.2020 [https://www.academia.edu/38243256/Exploring\\_the\\_New\\_Policy\\_Framework\\_of\\_Environmental\\_Performance\\_Management\\_for\\_Shipping](https://www.academia.edu/38243256/Exploring_the_New_Policy_Framework_of_Environmental_Performance_Management_for_Shipping)

<sup>250</sup> Verifavia Shipping, “Verify, Comply, Navigate”, Accessed: 30.11.2020 <https://www.verifavia-shipping.com/shipping-carbon-emissions-verification/shipping-mrv-regulation-the-imo-data-collection-system-dcs-106.php>

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- The EC will make the reported data publicly available, whereas the IMO will keep individual ship data confidential.

Other than those mentioned above, the following are the differences of the two systems regarding Monitoring plan and reporting details-

Comparison	EU MRV (Monitoring, Reporting and Verification)	IMO DCS (Data Collection System)
Monitoring Plan	<ul style="list-style-type: none"> <li>• Separate document explaining the data collection methodology and reporting.</li> <li>• Subject to verification by an independent accredited verifier.</li> <li>• First monitoring period 2018.</li> </ul>	<ul style="list-style-type: none"> <li>• SEEMP Part II describes the data collection and reporting methodology.</li> <li>• Verification by Flag States or Recognized Organization (RO).</li> <li>• First monitoring period 2019.</li> </ul>
Reporting Details	<ul style="list-style-type: none"> <li>• Amount and emission factor for each type of fuel consumed.</li> <li>• Total CO<sub>2</sub> emitted for the voyages to and from EU ports and at berth.</li> <li>• Total Transport work including time at sea and in port, and cargo carried.</li> <li>• Average energy efficiency.</li> </ul>	<ul style="list-style-type: none"> <li>• Amount of each type of fuel consumed in total.</li> <li>• Period of calendar year the data is submitted for.</li> <li>• Hours underway using own propulsion.</li> <li>• DWT to be used as cargo proxy.</li> <li>• Distance travelled.</li> </ul>
Reporting to	<ul style="list-style-type: none"> <li>• European Commission</li> <li>- Annual emissions data reported to the EMSA data base.</li> </ul>	<ul style="list-style-type: none"> <li>• Flag state</li> <li>- Annual emission report to be verified by Flag State/ RO.</li> <li>- Flag state/ RO reports to IMO data base.</li> </ul>

	- Report is verified by an accredited verifier.	
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The above differentiation is based on the EU MRV<sup>251</sup> and the IMO DCS<sup>252</sup>

### 5.3 Limitations of EU MRV

Based on the above discussion the EU MRV has the following limitations:

1. Since the EU MRV is not a flag State obligation, the EU legislation will be enforced through port State control (PSC) within EU seaports.<sup>253</sup>
2. Where an agreement on a global MRV system is reached, the EU Commission should review its own regulation with the view to aligning it in accordance with the global system considered “as more effective due to its broader scope.”<sup>254</sup>
3. EU MRV is only focused on CO<sub>2</sub> while the other GHGs are totally ignored by the regulation.<sup>255</sup>
4. It is not applicable for ship movements and activities not serving the purpose of transporting cargo or passengers for commercial purposes, such as dredging, ice breaking, pipe laying or offshore installation activities.<sup>256</sup>

With these limitations and IMO DCS in force, the EU MRV must come out with proper policy to implement the EU MRV with the requirement of IMO DCS.

### 5.4 European Union Emission Trading System (EU ETS)

<sup>251</sup> Regulation 2015/757

<sup>252</sup> IMO, “Data collection system for fuel oil consumption of ships”, Accessed: 15.11.2020

<https://www.imo.org/en/OurWork/Environment/Pages/Data-Collection-System.aspx>

<sup>253</sup> Directive 2009/16/EC of the European Parliament and of the Council of 23 April 2009 on Port state control, Official Journal L 131 of 28 May 2009, p. 57 accessed: 22.11.2020 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0016&rid=5>

<sup>254</sup> Fedi, “The Monitoring, Reporting and Verification”, January 2017.

<sup>255</sup> Above n. 225 on page 34

<sup>256</sup> DNV GL, “EU MRV and DCS”, Accessed: 22.11.2020 <https://www.dnvgl.com/maritime/insights/topics/EU-MRV-and-IMO-DCS/FAQs-EU-MRV.html>

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The EU Emissions Trading System (ETS) is the world's biggest greenhouse gas trading programme and key pillar of the EU's fight against global warming and CO<sub>2</sub> emissions.<sup>257</sup> EU ETS was implemented in 2005, is the world's first international emission trading scheme.<sup>258</sup> The EU ETS which operates in all EU countries along with Iceland, Liechtenstein and Norway, covers around 40% of the EU's greenhouse gas emissions.<sup>259</sup>

The EU ETS works on the 'cap and trade' principle.<sup>260</sup> The overall volume of greenhouse gases that can be emitted by power plants, factories and other fixed installations covered by the EU emissions trading system (EU ETS) is limited by a 'cap' on the number of emission allowances.<sup>261</sup> Within the overall EU-wide cap, companies receive or buy emission allowances, which they can trade as needed.<sup>262</sup> Each allowance gives the holder the right to emit –

- one ton of carbon dioxide (CO<sub>2</sub>), the most common greenhouse gas, or
- the equivalent amount of two more powerful greenhouse gases, nitrous oxide (N<sub>2</sub>O) and perfluorocarbons (PFCs).<sup>263</sup>

While all other sectors, including the complex aviation sector is included within the EU ETS, the maritime sector is not subject to European emission commitments yet.<sup>264</sup> A voting was conducted on 15 Sep 2020 session of the European Parliament where, the MEPs voted in favour of including greenhouse gas emissions, if there is no comparable system operating in the International Maritime Organisation (IMO) in 2021.<sup>265</sup> However, the European Community Shipowners' Association (ECSA) Secretary General Patrick Verhoeven is against such inclusion within a short time and

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<sup>257</sup> Investigate-Europe, "EU Emission Trading Scheme Explained", Accessed: 23.11.2020 [https://www.investigate-europe.eu/en/2020/eu-emissions-trading-scheme-explained/?ie\\_s=ga&pk\\_campaign=en\\_dsa&pk\\_source=google&pk\\_medium=cpc](https://www.investigate-europe.eu/en/2020/eu-emissions-trading-scheme-explained/?ie_s=ga&pk_campaign=en_dsa&pk_source=google&pk_medium=cpc)

<sup>258</sup> European Commission, "EU Emission Trading System (EUETS)", Accessed: 23.11.2020 [https://ec.europa.eu/clima/policies/ets\\_en](https://ec.europa.eu/clima/policies/ets_en)

<sup>259</sup> Above n. 258

<sup>260</sup> Above n. 258

<sup>261</sup> European Commission, "Emissions cap and allowances", accessed: 23.11.2020 [https://ec.europa.eu/clima/policies/ets/cap\\_en](https://ec.europa.eu/clima/policies/ets/cap_en)

<sup>262</sup> European Commission, "Emissions cap and allowances", accessed: 23.11.2020 [https://ec.europa.eu/clima/policies/ets/cap\\_en](https://ec.europa.eu/clima/policies/ets/cap_en)

<sup>263</sup> Above n. 262

<sup>264</sup> Hellenic Shipping News, "The implementation of EU ETS system in International Maritime Transport Challenges & Prospects", Accessed: 23.11.2020 <https://www.hellenicshippingnews.com/the-implementation-of-eu-ets-system-in-international-maritime-transport-challenges-prospects/>

<sup>265</sup> European Community Shipowners' Association (ECSA), "Shipping does not belong in EU Emission Trading Scheme", Accessed: 23.11.2020 <https://www.ecsa.eu/news/shipping-does-not-belong-eu-emission-trading-scheme>

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said, *“Putting unrealistic pressure on IMO with regional measures that will gravely hurt a global sector and do very little for climate is not the way to proceed. It will unduly complicate the achievement of an effective and timely global agreement in IMO that everyone in the end wants. We thank those MEPs that voted against the inclusion of shipping and hope this spirit will prevail in the upcoming triologue negotiations.”*<sup>266</sup>

Inclusion of shipping would not alone solve all the problems associated with the shipping as the EU ETS itself is being criticized for being vulnerable to lobby influence and meddling by national governments.<sup>267</sup> As the main beneficiaries of the ETS regime are the energy-intensive companies operating across Europe.<sup>268</sup> Many companies are allocated allowances for free who are estimated to be making up 43 percent of all circulating allowances.<sup>269</sup> Thus, inclusion of shipping would allow the major shipping companies to buy carbon credit and impact the progress at IMO with respect to achieving further reductions of the total greenhouse gas (GHG) emissions by the international shipping sector as a whole.<sup>270</sup>

In contrast to the success potential of the EU ETS, the internal features of the maritime transport sectors are not favourable to a regional trading policy.<sup>271</sup> Ships vary considerably in size, type, and usage.<sup>272</sup> When deciding on the specific policy design, mainly with respect to the distribution of allowances, it will be a challenge to agree with all stakeholders and still end up with an ambitious policy.<sup>273</sup> The European Parliament needs to reconsider their position regarding the inclusion of the shipping into EU ETS.

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<sup>266</sup> Above n. 265 on page 46

<sup>267</sup> Investigate Europe, “EU Emissions Trading Scheme Explained”, Accessed: 23.11.2020 [https://www.investigate-europe.eu/en/2020/eu-emissions-trading-scheme-explained/?ie\\_s=ga&pk\\_campaign=en\\_dsa&pk\\_source=google&pk\\_medium=cpc](https://www.investigate-europe.eu/en/2020/eu-emissions-trading-scheme-explained/?ie_s=ga&pk_campaign=en_dsa&pk_source=google&pk_medium=cpc)

<sup>268</sup> Above n. 265 on page 46

<sup>269</sup> Above n. 265 on page 46

<sup>270</sup> Safety4sea, “ICS: Implications of application of the EU ETS to global shipping”, Accessed: 23.11.2020 <https://safety4sea.com/ics-implications-of-application-of-the-eu-ets-to-global-shipping/>

<sup>271</sup> A. Miola, B. Ciuffo, M. Marra, E. Glovine, “Analytical framework to regulate air emissions from maritime transport”, *JRC Scientific and Technical Reports*, Accessed: 23.11.2020 [https://www.academia.edu/22084789/Analytical\\_framework\\_to\\_regulate\\_air\\_emissions\\_from\\_maritime\\_transport?email\\_work\\_card=reading-history](https://www.academia.edu/22084789/Analytical_framework_to_regulate_air_emissions_from_maritime_transport?email_work_card=reading-history)

<sup>272</sup> Above n. 271

<sup>273</sup> Above n.271

## 6. Measures taken by different countries in controlling GHG emissions from shipping

The IMO in its Initial Strategy has encouraged countries to develop National Action Plans (NAPs), which will be the basis for future national emission reduction policy.<sup>274</sup> It is still too soon for all the countries to come up with NAPS since the initial strategy was only introduced in 2018. However, some countries already have a policy designed for ship emission reduction within its jurisdiction.

### 6.1 United States of America (USA)

The Environmental Protection Agency is a United States federal government agency established with the mission to protect human health and the environment.<sup>275</sup> The EPA works to ensure that Americans have clean air, land and water; and for that purpose, it develop and enforce regulations.<sup>276</sup> The EPA is authorized by the Clean Air Act. (CAA)<sup>277</sup> to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate the emissions of hazardous air pollutants.<sup>278</sup>

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<sup>274</sup> Initial IMO Strategy, Paragraph 4.8, p.9

<sup>275</sup> United States Environmental Protection Agency (EPA), “Our Mission and What We Do”, Accessed: 23.11.2020 <https://www.epa.gov/aboutepa/our-mission-and-what-we-do>

<sup>276</sup> Above n. 275

<sup>277</sup> The Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources in US.

<sup>278</sup> EPA, “Summary of the Clean Air Act.”, Accessed: 23.11.2020 <https://www.epa.gov/laws-regulations/summary-clean-air-act>



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Aircraft, ship and non-road vehicles and engines are major contributors to climate change pollution, making up 24% of U.S. mobile source greenhouse gas (GHG) emissions.<sup>279</sup> In early 2008, the Supreme Court affirmed that the U.S. Environmental Protection Agency (EPA) must regulate greenhouse gas (GHG) emissions under the Clean Air Act.<sup>280</sup> However, EPA reportedly exercised its discretion to deny the petitions to regulate GHGs and black carbon emissions from non-road engines and vehicles, including marine vessels and engines in the near or medium term.<sup>281</sup> Pursuant to the petition of Earthjustice to regulate these sources of climate pollution under the Clean Air Act.<sup>282</sup> EPA works closely with partners in government, industry and the public through Voluntary partnership programs<sup>283</sup> under the Clean Air Act.<sup>284</sup> EPA has adopted exhaust emission standards for marine diesel engines installed in a variety of marine vessels ranging in size and application from small recreational vessels to tugboats and large ocean-going vessels.<sup>285</sup> EPA has implemented the national marine diesel engine program to control emissions from U.S ships and international ships within U.S Emission Control Area (ECA)<sup>286, 287</sup> The ECA covers the entire economic exclusive zones (EEZs) of Canada and the U.S., including Hawaii, but excluding U.S. flag Pacific Islands and Arctic areas of Canada and the U.S. north of 60ON latitude.<sup>288</sup>

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<sup>279</sup> Earthjustice, “Curbing Greenhouse Gas Pollution From Ships, Aircraft, And Non-Road Vehicles & Engines”, Accessed: 23.11.2020 [https://earthjustice.org/our\\_work/cases/2010/global-warming-and-ships-aircraft-and-non-road-vehicles-engines](https://earthjustice.org/our_work/cases/2010/global-warming-and-ships-aircraft-and-non-road-vehicles-engines)

<sup>280</sup> Above n. 279

<sup>281</sup> Tsang, supra Note 27, at p. 11 (citing EPA Memorandum in Response to Petitions Regarding Greenhouse Gas and other Emissions from Marine Vessels and Nonroad Engines and Vehicles (June 18, 2012), [https://www.eenews.net/assets/2012/06/18/document\\_pm\\_06.pdf](https://www.eenews.net/assets/2012/06/18/document_pm_06.pdf))

<sup>282</sup> Above n. 278 on page 40

<sup>283</sup> EPA, “Progress Cleaning the Air: Voluntary Partnership Program Accomplishments”, Accessed: 23.11.2020 <https://www.epa.gov/clean-air-act-overview/progress-cleaning-air-voluntary-partnership-program-accomplishments>

<sup>284</sup> EPA, “Developing Clean Air Programs Through Dialogue”, Accessed: 23.11.2020 <https://www.epa.gov/clean-air-act-overview/developing-clean-air-programs-through-dialogue>

<sup>285</sup> EPA, “Domestic Regulations for Emissions from Marine Compression-ignition (Diesel) Engines”, Accessed: 23.11.2020 <https://www.epa.gov/regulations-emissions-vehicles-and-engines/domestic-regulations-emissions-marine-compression>

<sup>286</sup> Together with Canada and France, the U.S. Government successfully petitioned the International Maritime Organization to designate the North American Emission Control Area for both fuel-sulfur standards and NOx emission standards.

<sup>287</sup> EPA, “Regulations for Emissions from Vehicles and Engines”, Accessed: 23.11.2020 <https://www.epa.gov/regulations-emissions-vehicles-and-engines/amendments-related-marine-diesel-engine-emission-0>

<sup>288</sup> MEPC 59th session, Agenda item 6, Interpretations of and Amendments to, MARPOL and Related Instruments, Proposal to Designate an Emission Control Area for Nitrogen Oxides, Sulphur Oxides and Particulate Matter, Submitted by the United States and Canada, MEPC 59/6/5 (2 April 2009) at Annex 2-3.

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Vessels operating in Emission Control Areas must meet the following requirements:

- Fuel-sulfur concentrations may not exceed 0.10 weight percent, or vessels may use an approved equivalent method (such as SO<sub>x</sub> scrubbers, also known as exhaust gas cleaning systems).
- Engines above 130 kW installed on vessels built (or modified) since 2000 must be certified to meet appropriate emission standards corresponding to the vessel's build date (or modification date). As of January 1, 2016, engines installed on new and modified vessels are subject to the Annex VI Tier III NO<sub>x</sub> standards while those engines are operating in the ECA.<sup>289</sup>

The International Maritime Organization (IMO) promotes cooperation between governments in the regulation of shipping engaged in international trade and encourages the adoption of the highest practicable standards concerning maritime safety, efficiency of navigation, and prevention and control of marine pollution from ships.<sup>290</sup>

EPA also has Greenhouse Gas Reporting Program (GHGRP) in force which requires reporting of greenhouse gas (GHG) data and other relevant information from large GHG emission sources, fuel and industrial gas suppliers, and CO<sub>2</sub> injection sites in the United States.<sup>291</sup> Among other things, EPA's work has led to higher energy efficiency requirements for new ships and the implementation of an Emissions Control Area (ECA) for both North America and the U.S. Caribbean.<sup>292</sup> Through imposing stricter regulations within ECA for North America and the U.S. Caribbean, the EPA along with the IMO working in reduction of GHG emissions within that area.

Other than this, the California Air Resource Board CARB, adopted the regulation, "Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline" on July 24, 2008.<sup>293</sup> This regulation is designed reduce

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<sup>289</sup> EPA, "International Standards to Reduce Emissions from Marine Diesel Engines and Their Fuels", Accessed: 23.11.2020 <https://www.epa.gov/regulations-emissions-vehicles-and-engines/international-standards-reduce-emissions-marine-diesel>

<sup>290</sup> EPA, "EPA's Role in International Maritime Organization," Accessed: 30.11.2020

<https://www.epa.gov/international-cooperation/epas-role-international-maritime-organization-imo>

<sup>291</sup> EPA, "Greenhouse Gas Reduction Program (GHGRP)", Accessed: 23.11.2020 <https://www.epa.gov/ghgreporting>

<sup>292</sup> Above n. 291

<sup>293</sup> California Air Resource Board (CARB), "Ocean-Going Vessel Fuel Regulation", Accessed: 23.11.2020 <https://ww2.arb.ca.gov/our-work/programs/ocean-going-vessel-fuel-regulation>

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particulate matter, oxides of nitrogen, and sulfur oxide emissions from ocean-going vessels; reductions that are necessary to improve air quality and public health in California.

## 6.2 Norway

The International Maritime Organization (IMO) and the Norwegian government have launched GreenVoyage-2050 project on 13 May 2019 and will initiate and promote global efforts to demonstrate and test technical solutions for reducing GHG emissions.<sup>294</sup> The aim of the project is to enhance knowledge and information sharing to support the IMO GHG reduction strategy while working on capacity building in developing countries, including small island developing states (SIDS) and least developed countries (LDCs), to fulfill their commitments to meet climate-change and energy-efficiency goals for international shipping.<sup>295</sup>

### 6.2.1 The Government's action plan for green shipping

Norway also has set the individual goal of becoming carbon neutral and implemented the Government Action Plan for Green Shipping with an ambition to reduce emissions from domestic shipping and fishing vessels by half by 2030 and to promote the development of zero- and low-emission solutions for all vessel categories.<sup>296</sup> With the new plan, the government will work to reduce greenhouse gas emissions from all types of ships from ferries and cruise ships to fishery and offshore vessels by 50 percent already by 2030 – two decades before the IMO's deadline.<sup>297</sup>

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<sup>294</sup> Offshore Energy, “Norway, IMO Join Forces on Reducing Shipping’s GHG Emissions”, Accessed: 23.11.2020  
<https://www.offshore-energy.biz/norway-imo-join-forces-on-reducing-shippings-greenhouse-gas-emissions/>

<sup>295</sup> Above n. 293

<sup>296</sup> Norwegian Government, “Government Action Plan for Green Shipping”, Accessed: 23.11.2020  
<https://www.regjeringen.no/contentassets/2ccd2f4e14d44bc88c93ac4effe78b2f/the-governments-action-plan-for-green-shipping.pdf>

<sup>297</sup> Shipwatch, “Norway’s government wants to halve shipping’s emission already by 2030”, Accessed: 24.11.2020  
<https://shippingwatch.com/regulation/article11459026.ece>

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The plan sets up a series of targets for seven categories of vessels — scheduled passenger boats and ferries, cruise ships and larger passenger ferries, cargo ships, offshore vessels, special vessels and fisheries vessels, fishing vessels, and recreational boats.<sup>298</sup>

The Government's action plan seeks the technology and solutions for green shipping with the following options:

- Battery-electric operation
- Partial electrification (hybrid solutions)
- LNG
- Biogas.

\*Source: The government action plan for green shipping<sup>299</sup>

While the government action plan is ambitious, the plan is criticized for imposing requirements without proper suggestions for improvements.<sup>300</sup>

Sigurd Enge<sup>301</sup>, believes the government of Norway's ambitions are great but the plan has too few concrete requirements and lacks satisfactory answers to several questions:

- Where should the renewable energy come from?
- How should investments in land-based renewable energy infrastructure be carried out and for which energy carriers?
- How should the domestic shipping fleet get financial sustainability to implement the investments that are needed?<sup>302</sup>

While there is uncertainty over the success of the Government's action plan, the positive fact is, that the Norwegian Shipowners' Association (NSA) is also supporting the Government's Action

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<sup>298</sup> CleanTechnica, "Norway Announces Plan To Cut Emissions From Ships 50% By 2030", Accessed: 23.11.2020 <https://cleantechnica.com/2019/06/21/norway-announces-plan-to-cut-emissions-from-ships-50-by-2030/>

<sup>299</sup> Above n. 296

<sup>300</sup> CleanTechnica, "Norway Announces Plan To Cut Emissions From Ships 50% By 2030", Accessed: 23.11.2020 <https://cleantechnica.com/2019/06/21/norway-announces-plan-to-cut-emissions-from-ships-50-by-2030/>

<sup>301</sup> Sigurd Enge is one of the most experienced advisors at the Bellona Foundation (an NGO that aims at fighting climate change) <https://bellona.org/employee/sigurd-enge>

<sup>302</sup> Above n. 300

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Plan for Green Shipping and set their action plan for zero emission in 2050.<sup>303</sup> Norwegian shipping aims to take a leading role in developing new technology and sustainable solutions to drastically reduce emissions in the years ahead.<sup>304</sup> For that purpose, the NSA has set the following goals-

- NSA members will cut their GHG emissions by 50 percent per unit by 2030 compared to 2008
- NSA members will only order vessels with zero emission technology from 2030
- NSA members will have a climate neutral fleet from 2050
- The NSA will strive for an international ban from 2050 on fuel that is not climate neutral

The NSA further set a following roadmap to achieve the goals-

- Upgrade the existing fleet in order to reduce emissions
- Use sustainable low and zero-emission fuels from an early stage, and contribute to the development of infrastructure for these fuels
- Phase in ships with zero-emission technology as quickly as possible, and no later than 2030, to realize zero emissions from 2050
- Operate ships as energy-efficiently as possible using voyage planning, low friction anti-fouling paint, and optimized speed
- Minimize the environmental impact of our entire enterprise by taking a lifecycle perspective, using the best overall solutions
- Measure, analyze and publish environmental and climate accounting in a consistent, relevant and transparent manner.

\*Source: Norwegian Shipowners' Association, "Zero emission 2050"<sup>305</sup>

The NSA emphasizes that the feasibility of such measures by the industry will depend on support, namely funding for research and development of carbon neutral solutions on both a national and international level.<sup>306</sup>

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<sup>303</sup> Norwegian Shipowners' Association, "Zero emission in 2050", Accessed: 24.11.2020  
<https://rederi.no/DownloadFile/?file=396209>

<sup>304</sup> Above n. 303

<sup>305</sup> Norwegian Shipowners' Association, "Zero emission in 2050", Accessed: 30.11.2020  
<https://rederi.no/DownloadFile/?file=396209>

<sup>306</sup> BAHR, "The Norwegian Shipowners Association releases its climate strategy – the Norwegian fleet to be carbon neutral by 2050", Accessed: 24.11.2020 <https://bahr.no/en/newsletter/the-norwegian-shipowners-association-releases-its-climate-strategy-the-norwegian-fleet-to-be-carbon-neutral-by-2050-2-2/>



## 7. Regulatory challenges

### 7.1 Challenges in regulating international shipping

The first and most critical step in regulating GHG emissions from international shipping is to determine how to allocate shipping emissions to contributing states.<sup>307</sup> A single ship can be built by one company, owned by a group of other companies, and operated by a group of yet more companies, making it connected to dozens of companies in different countries.<sup>308</sup> To add to this, a ship can be registered in any country because of the open registry system.<sup>309</sup> Ships also carry goods sourced in multiple places as they traverse the high seas, stopping in many countries.<sup>310</sup> Perhaps no industry is as globalized as maritime shipping.<sup>311</sup> Because of this complex nature of the shipping sector, the Kyoto Protocol has excluded the ships' GHG emissions from caused by bunker fuel from its target<sup>312</sup> and mandated the IMO as the governing body to measure and record international shipping emissions in a separate database.<sup>313</sup> Several options include allocating carbon dioxide emissions to countries: based on where the fuel ships use is sold, where ships are registered, or the origins or destinations of the ships were considered.<sup>314</sup> Each option would lead to radically different emissions responsibilities for individual countries, making it even harder for everyone to reach consensus.<sup>315</sup> As long as no country can be held responsible, no government will try to reduce

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<sup>307</sup> Yubing Shi & Warwick Gullett, "Ocean Development & International Law", 2018, DOI: 10.1080/00908320.2018.1442178, <https://doi.org/10.1080/00908320.2018.1442178>

<sup>308</sup> The Conversation, "Cargo ships are emitting boatloads of carbon, and nobody wants to take the blame", Accessed: 24.11.2020 <https://theconversation.com/cargo-ships-are-emitting-boatloads-of-carbon-and-nobody-wants-to-take-the-blame-108731>

<sup>309</sup> Ship Inspection, "open registry", Accessed: 24.11.2020 <http://shipinspection.eu/open-registry/>

<sup>310</sup> Above n. 309

<sup>311</sup> Above n. 309

<sup>312</sup> The Kyoto Protocol, Art. 2.2

<sup>313</sup> The Kyoto Protocol, Art. 2.2

<sup>314</sup> The Conversation, "Cargo ships are emitting boatloads of carbon, and nobody wants to take the blame", Accessed: 24.11.2020 <https://theconversation.com/cargo-ships-are-emitting-boatloads-of-carbon-and-nobody-wants-to-take-the-blame-108731>

<sup>315</sup> Above n. 314

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GHG emissions from shipping.<sup>316</sup> Thus, the biggest challenge in regulating GHG emissions from shipping is to find a way to allocate the emissions to an ‘actual responsible’ country.

A lack of reliable data on emissions is another drawback in regulating shipping emissions.<sup>317</sup> There are many difficulties associated with capturing, sorting, analysing and managing data.<sup>318</sup> Ship emissions include ozone and aerosol precursors (NO<sub>x</sub>, CO, VOCs, SO<sub>2</sub>, etc.) and greenhouse gases (including CO<sub>2</sub>),<sup>319</sup> varies based on engine power and sea condition, making it even harder to gather reliable data of all the ship emissions. Besides, the amount of gases emitted from marine engines into the atmosphere is directly related to total fuel oil consumption, which depends on different factors, such as the actual hull shape, the loading condition, the hull roughness, the state of the engine, ocean steam etc.<sup>320</sup> Until a reliable data measurement mechanism is adopted, it will not be possible to implement the laws strictly.

Another challenge is regulating GHG emissions from shipping is the jurisdictional issue, since the flag State has the primary responsibility to implement relevant rules concerning the regulation of greenhouse gas emissions from international shipping, which alone is inadequate to secure effective compliance with relevant rules.<sup>321</sup> There is a need to examine the question whether and to what extent coastal and port States can regulate greenhouse gas emissions from vessels in international law,<sup>322</sup> and merging with flag state jurisdiction, it might be possible to regulate GHG emissions from shipping more efficiently.

Accountability is also a challenge in regulating shipping emissions as none of the instruments within the current global regulatory framework describe how large shipping corporations are to be

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<sup>316</sup> Above n. 314 on page 54

<sup>317</sup> C. Trimmer, and J. Godar, “Calculating Maritime Shipping Emissions per Traded Commodity”, 2019, *SEI Brief: Stockholm Environment Institute*. <https://www.sei.org/publications/shipping-emissions-per-commodity/>

<sup>318</sup> M. Bulger, G. Taylor, R. Schroeder, *Data-Driven Business Models: Challenges and Opportunities of Big Data*, University of Oxford (2014)19-50

<sup>319</sup> A. Miola at.all, “Analytical framework to regulate airemissions from maritime transport”, JRC Scientific and Technical Reports, Accessed: 23.11.2020  
[https://www.academia.edu/22084789/Analytical\\_framework\\_to\\_regulate\\_air\\_emissions\\_from\\_maritime\\_transport?e\\_mail\\_work\\_card=reading-history](https://www.academia.edu/22084789/Analytical_framework_to_regulate_air_emissions_from_maritime_transport?e_mail_work_card=reading-history)

<sup>320</sup> Above n. 319

<sup>321</sup> Yoshifumi Tanaka, “Regulation of Greenhouse Gas Emissions from International Shipping and Jurisdiction of States”, 2016, *Review of European* 25(3):333-346, DOI: 10.1111/reel.12181

<sup>322</sup> Above n. 321



Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges accountable for the reduction of their vessels' GHG emissions.<sup>323</sup> This is important because currently shipping corporations, as a whole, do not have well-accepted accountability practices for GHG emissions reduction responsibilities.<sup>324</sup> Global corporations for their performance can be held accountable, as it has been proven to be effective in some industries to enhance the responsible behaviour of large corporations that operate in a highly competitive market with sensitive brand images.<sup>325</sup>

Until the challenges discussed above are dealt with, it will not be possible to cut the total GHG emissions from shipping sector. Most of the adopted measures by the IMO are long-term measures, while meeting the Paris Agreement target demands GHG emissions reduction from shipping in a short time. While waiting for the alternative options, the IMO can enforce the following short-term measures to cut down emission in a shorter period:

### Slow steaming

Slow steaming and route optimization would reduce fuel consumption considerably.<sup>326</sup> A 12% reduction in at-sea average speed leads to an average decrease of 27% in daily fuel consumption and thus fewer greenhouse-gas emissions. Slow steaming practices introduced after a slowdown in global trade in 2008 prompted a number of studies of the economic implications and potential for GHG reductions found that emissions could be reduced by 19% if speeds were reduced to minimize costs and by 28% if speeds were further reduced but with no increase in costs.<sup>327</sup>

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<sup>323</sup> Mia Mahmudur Rahman, Md. Tarikul Islam, Sanjaya Kuruppu, "Regulating global shipping corporations' accountability for reducing greenhouse gas emissions in the seas", 2016, Marine Policy, <https://doi.org/10.1016/j.marpol.2016.04.018>

<sup>324</sup> Above n. 323

<sup>325</sup> Above n. 323

<sup>326</sup> Change, "Shipping emissions and 6 strategies to avoid maritime pollution", Accessed: 26.11.2020 <https://container-xchange.com/blog/shipping-emissions/>

<sup>327</sup> C.-Y. Lee, H. L. Lee, and J. Zhang, The impact of slow ocean steaming on delivery reliability and fuel consumption. (2015). *Transp. Res. Part E Logist. Transp. Rev.* 76, 176–190. doi: 10.1016/j.tre.2015.02.004

## Incremental Measures

Incremental measures include hull design, propeller optimization and waste heat recovery. These are mostly short-term measures but would reduce emissions.<sup>328</sup> While causing less disruption to the sector, incremental measures would reduce emissions per vessel by as much as 5%.<sup>329</sup>

## Fuel Switch

The most-significant GHGs reductions come with a fuel switch to low sulphur content fuel.<sup>330</sup> More than 90,000 ships account for the burning of nearly 2bn barrels of the heaviest fuel oil, made from the dirtiest dregs of the barrel.<sup>331</sup> Lack of availability is a drawback to applying this measure but there are proven alternative fuels like LNG that can help reduce GHG emissions too.<sup>332</sup>

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<sup>328</sup> Change, “Shipping emissions and 6 strategies to avoid maritime pollution”, Accessed: 26.11.2020  
<https://container-xchange.com/blog/shipping-emissions/>

<sup>329</sup> The Conversation, “Five ways the shipping industry can reduce its carbon emissions”, Accessed: 26.11.2020  
<https://theconversation.com/five-ways-the-shipping-industry-can-reduce-its-carbon-emissions-94883>

<sup>330</sup> Above n. 329

<sup>331</sup> Above n. 329

<sup>332</sup> Above n. 329

## 8. Conclusion

The main purpose of this thesis was to present a critical analysis of existing regulations related to GHG emissions from international shipping. MARPOL Annex VI is the only regulation which is particularly regulating air emissions from international shipping. Thus, the primary aim was present a critical analysis of the MARPOL Annex VI and the IMO's approach towards the reduction of GHG emissions from shipping.

The EU as a region, consisting of 27 states (the UK left the EU on 31.01.2020), is responsible for 35% of the international shipping. It has a regional policy along with the IMO's MARPOL Annex VI. While IMO as the global policy maker for international shipping has its policy in place, EU as a region has own policy in place undermining IMO policy to some extent. EU policy was discussed in brief while a differentiation has been made between IMO policy and EU policy.

Although the regulations of a specific country will not have significant importance in international shipping, the IMO has invited to countries to implement local policy for decarbonizing shipping. USA is the top GHG emitter among all the countries of the world while Norway is one of the countries with commitment towards decarbonization of shipping. Thus, what regulations these two countries particularly have, are discussed. China, Canada, Brazil the other significant emitters did not ratify the MARPOL Annex VI thus are not obliged thereby.

Finally, the thesis tried identifying the key challenges involved in regulating GHG emissions from shipping. Further, some areas to focus on to overcome those barriers in regulating ship emissions has been presented.

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However, because of the vast and complex nature of international shipping, a solution cannot be attained with further analysis of other international laws. Nevertheless, the thesis tried to find the gaps and suggests probable areas of future research in regulating GHG emissions from shipping.

## Bibliography

1. Joachim Claudet, Laurent Bopp, William W.L. Cheung, Rodolphe Devillers, Elva Escobar-Briones et. al, "A Roadmap for Using the UN Decade of Ocean Science for Sustainable Development in Support of Science, Policy, and Action", 2020, One Earth, <https://doi.org/10.1016/j.oneear> 2019.10.012
2. Z. H. Munim, R. Saha, *Sustainability in the Maritime Domain: Towards Ocean Governance and Beyond*, 2020, Green ports and sustainable shipping in the European context, edited by Carpenter, A., Johansson, T. M., Skinner, J. Springer Strategies in Sustainability series, (Forthcoming)
3. Milke Hulme, "The Idea of Climate Change" 2010. 19(3)
4. Yubing Shi Climate, Change and International Shipping, Brill Nijhoff 2017, P. 08
5. Roda Verheyen, "Climate change damage and international law" Martinus Nijhoffs publishers 2005, 14.
6. Yubing Shi & Warwick Gullett (2018) International Regulation on Low-Carbon Shipping for Climate Change Mitigation: Development, Challenges, and Prospects, *Ocean Development & International Law*, 49:2, 134-156, DOI: 10.1080/00908320.2018.1442178 f.59>61  
<https://doi.org/10.1080/00908320.2018.1442178>
7. Eide, M., Endresen, Ø., Skjong, R., Longva, T. and Alvik, S. (2009), "Cost-effectiveness assessment of CO<sub>2</sub>-reducing measures in shipping", *Maritime Policy and Management*, Vol. 36 No. 4, pp. 367-84.
8. Fuglestedt, Jan; Berntsen, Terje; Eyring, Veronika; Isaksen, Ivar; Lee, David S; Sausen, Robert, ISSN: 0013-936X, 1520-5851; DOI: 10.1021/es901944r *Environmental science & technology*. 2009, Vol.43(24), p.9057-9062
9. International Council on Clean Transportation (ICCT), "Greenhouse Gas Emission from Global Shipping, 2013-2015" p. 24
10. Sophia Kopela, "Making ships cleaner: Reducing air pollution from international shipping," *Review of European, Comparative & International Environmental Law* 26, no. 3 (2017): 231-242

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

11. Yoshifumi Tanaka, "Regulation of Greenhouse Gas Emissions from International Shipping and Jurisdiction of States," *Review of European, Comparative & International Environmental Law* 25, no. 3 (2016): 333-346
12. IMO, Resolution MEPC.282(70), 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP), Annex, at paragraph 4.1.7
13. James J. Corbett; James J. Winebrake, "The Role of International Policy in Mitigating Global Shipping Emissions," *Brown Journal of World Affairs* 16, no. 2 (Spring/Summer 2010): 143-158
14. C. Andersson, R. Bergström, & C. Johansson, Population exposure and mortality due to regional background PM in Europe—Long-term simulations of source region and shipping contributions. *Atmospheric Environment*, 2020. 43(22-23), 3614-3620.  
<https://doi.org/10.1016/j.atmosenv.2009.03.040>
15. International Council on Clean Transportation (icct), "Greenhouse Gas Emission from Global Shipping, 2013-2015 by Naya Olmer, Bryan Comer, BISWAJOY ROY, XIAOLI MAO, AND DAN RUTHERFORD, p. 24  
[https://theicct.org/sites/default/files/publications/Global-shipping-GHG-emissions-2013-2015\\_ICCT-Report\\_17102017\\_vF.pdf](https://theicct.org/sites/default/files/publications/Global-shipping-GHG-emissions-2013-2015_ICCT-Report_17102017_vF.pdf)
16. UN Environment Programme, "Emission Gap Report 2017"  
<https://www.unenvironment.org/resources/emissions-gap-report-2017>
17. UNCTAD, "Review of Maritime Transport, 2019". Access date: 12.10.2020  
[https://unctad.org/system/files/official-document/rmt2019\\_en.pdf](https://unctad.org/system/files/official-document/rmt2019_en.pdf)
18. European Commission, "Integrating maritime transport emissions in the EU's greenhouse gas reduction policies", Accessed: 18.11.2020  
[https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/com\\_2013\\_479\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/com_2013_479_en.pdf)
19. Transport & Environment, "International Shipping; the first industry with a global climate standard", Accessed: 25.11.2020  
[https://www.transportenvironment.org/sites/te/files/media/2011\\_07\\_19\\_EEDI.pdf](https://www.transportenvironment.org/sites/te/files/media/2011_07_19_EEDI.pdf)
20. European Commission, "Reducing emissions from the shipping sector", Accessed: 25.11.2020  
[https://ec.europa.eu/clima/policies/transport/shipping\\_en](https://ec.europa.eu/clima/policies/transport/shipping_en)

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

21. Conserve Energy Future, “What are Environmental Concerns?” Access date: 14.10.2020  
<https://www.conserve-energy-future.com/top-25-environmental-concerns.php>
22. NOAA, “2019 was 2<sup>nd</sup> hottest year on record for earth”.  
<https://www.noaa.gov/news/2019-was-2nd-hottest-year-on-record-for-earth-say-noaa-nasa>
23. International Chamber of Shipping, “Explaining Shipping”, Accessed: 25.11.2020  
<https://www.ics-shipping.org/explaining/>
24. United Nations Education, Science and Cultural Organization, “United Nations Decade of Ocean Science for Sustainable Development (2021-2030)”, Accessed: 25.11.2020  
<https://en.unesco.org/ocean-decade>
25. United Nations Framework Convention on Climate Change (UNFCCC), “The Parties to this Convention,”, Accessed: 24.11.2020  
<https://unfccc.int/resource/ccsites/zimbab/conven/text/preamble.htm>
26. Our World in Data, “Emissions by Sector”. Access date: 12.10.2020.  
<https://ourworldindata.org/emissions-by-sector>
27. Gard, “Shipping emissions regulations”, Accessed: 29.10.2020  
[http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G\\_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge\\_SDIXI](http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge_SDIXI)
28. United Nations, “Climate Change” Accessed: 29.10.2020  
<https://www.un.org/en/sections/issues-depth/climate-change/>
29. UN Environment Programme, “About Montreal Protocol”, Accessed: 02.11.2020  
<https://www.unenvironment.org/ozonaction/who-we-are/about-montreal-protocol>
30. European Environment Agency, “Protecting the ozone layer while also preventing climate change”, Accessed: 30.11.2020  
<https://www.eea.europa.eu/themes/climate/ozone-depleting-substances-and-climate-change>
31. Australian Government, Department of Agriculture, Water and Environment, “Montreal Protocol on Substances that Deplete the Ozone Layer”, Accessed: 02.11.2020  
<https://www.environment.gov.au/protection/ozone/montreal-protocol>

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

32. Masao Yamasaki, “TRACECA Regional Seminar on MARPOL Awareness and Implementation”, 2015 accessed: 06.11.2020 [http://www.traceca-org.org/fileadmin/fm-dam/TAREP/68ta/1/Session\\_8\\_MY\\_MARPOL\\_Annex\\_VI\\_chapters\\_1\\_to\\_3\\_and\\_Black\\_Carbon\\_Final.pdf](http://www.traceca-org.org/fileadmin/fm-dam/TAREP/68ta/1/Session_8_MY_MARPOL_Annex_VI_chapters_1_to_3_and_Black_Carbon_Final.pdf)
33. GEF-UNDP-IMO GloMEEP Project and IMarEST, 2018: Ship Emissions Toolkit, Guide No.1, Rapid assessment of ship emissions in the national context, [https://gmn.imo.org/wp-content/uploads/2018/10/ship\\_emissions\\_toolkit-g1-online.pdf](https://gmn.imo.org/wp-content/uploads/2018/10/ship_emissions_toolkit-g1-online.pdf)
34. UN Environmental Programme, Treaties, “The Montreal Protocol on Substances that Deplete Ozone Layer”, <https://ozone.unep.org/treaties/montreal-protocol/meetings/twenty-third-meeting-parties/decisions/decision-xxiii11>
35. United Nations, “The Vienna Convention”, can be accessed at: <https://treaties.un.org/doc/publication/unts/volume%201155/volume-1155-i-18232-english.pdf>
36. United Nations Climate Change, “What is the Paris Agreement?”, Accessed: 03.11.2020 <https://cop23.unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement>
37. United Nations Climate Change, “Paris Agreement - Status of Ratification” Accessed: 03.11.2020 <https://unfccc.int/process/the-paris-agreement/status-of-ratification>
38. NRDC, “Paris Agreement: Everything You Need To Know”, Accessed: 07.11.2020 <https://www.nrdc.org/stories/paris-climate-agreement-everything-you-need-know>
39. Aldo Chircop, Meinhard Doelle and Ryan Gauvin, “Shipping and Climate Change International Law and Policy Considerations”, Center for International Governance Innovation 2018. Read at: [https://www.cigionline.org/sites/default/files/documents/Shipping%27s%20contribution%20to%20climate%20change%202018web\\_0.pdf](https://www.cigionline.org/sites/default/files/documents/Shipping%27s%20contribution%20to%20climate%20change%202018web_0.pdf)
40. AD HOC WORKING GROUP ON THE DURBAN PLATFORM FOR ENHANCED ACTION Second session, part eight 8–13 February 2015 Geneva, Switzerland, “Negotiation Text” Read at: [https://unfccc.int/sites/default/files/negotiating\\_text\\_12022015%402200.pdf](https://unfccc.int/sites/default/files/negotiating_text_12022015%402200.pdf)
41. United Nations Climate Change, “Nationally Determined Contributions (NDCs)”, Accessed: 03.11.2020



## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

<https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs>

42. United Nations Climate Change, “Nationally Determined Contributions (NDCs)”,

Accessed: 04.11. 2020

<https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs#eq-2>

43. UN Environmental Programme, Treaties, “The Montreal Protocol on Substances that Deplete Ozone Layer”,

<https://ozone.unep.org/treaties/montreal-protocol/meetings/twenty-third-meeting-parties/decisions/decision-xxiii11-montreal-protocol-treatment-ozone-depleting-substances-used-service-ships-including?q=treati>

44. UNFCCC, “United Nations Climate Change”, What is Paris Agreement? Access date: 17.10.2020.

<https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement>

45. Earth.org, “What is Kyoto Protocol”, Access date: 13.10.2020.

<https://earth.org/the-kyoto-protocol/>

46. The Chamber of Commerce and Industry of WA, “The Kyoto Protocol and Greenhouse Gas Emissions 1999. Can be accessed at:

[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiD44jawNvsAhVE\\_KQKHft8BQ0QFjAMegQIFxAC&url=https%3A%2F%2Fwww.aph.gov.au%2Fparliamentary\\_business%2Fcommittees%2Fhouse\\_of\\_representatives\\_committees%3Furl%3Djsct%2Fkyoto%2Fsub129attach.pdf&usq=AOvVaw0Xodfwy\\_hXaPOz5u1Okolc](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiD44jawNvsAhVE_KQKHft8BQ0QFjAMegQIFxAC&url=https%3A%2F%2Fwww.aph.gov.au%2Fparliamentary_business%2Fcommittees%2Fhouse_of_representatives_committees%3Furl%3Djsct%2Fkyoto%2Fsub129attach.pdf&usq=AOvVaw0Xodfwy_hXaPOz5u1Okolc)

47. Igor Shishlov, Romain Morel & Valentin Bellassen (2016) Compliance of the Parties to the Kyoto Protocol in the first commitment period, *Climate Policy*, 16:6, 768-782,

DOI:10.1080/14693062.2016.1164658

<https://doi.org/10.1080/14693062.2016.1164658>

48. Climate Home News, Nigeria, Jamaica bring closure to the Kyoto Protocol era, in last-minute dash. Accessed: 06.11.2020

<https://www.climatechangenews.com/2020/10/02/nigeria-jamaica-bring-closure-kyoto-protocol-era-last-minute-dash/>

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

49. United Nations, “Kyoto Protocol to The United Nations Framework Convention On Climate Change” 1998. <https://unfccc.int/resource/docs/convkp/kpeng.pdf>
50. United Nations Climate Change, “What is Kyoto Protocol” Accessed: 29.10.2020 [https://unfccc.int/kyoto\\_protocol](https://unfccc.int/kyoto_protocol)
51. Doha Amendment to the Kyoto Protocol, 2012 read at: <https://treaties.un.org/doc/Publication/CN/2012/CN.718.2012-Eng.pdf>
52. UN Climate Change, “Kyoto’s Second Phase Emission Reduction Achievable but Greater Ambition Needed”, accessed: 06.11.2020 <https://unfccc.int/news/kyoto-s-second-phase-emission-reductions-achievable-but-greater-ambition-needed>
53. International Maritime Organization (IMO), “International Convention for the Prevention of Pollution from Ships (MARPOL)” Access date: 14.10.2020 [http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx)
54. IMO, “Marine Environment Protection Committee (MEPC), 72nd session – Media information” Accessed: 14.11.2020 Document can be found here <https://docs.imo.org/Default.aspx> (registration required)
55. IMO, “Third IMO Greenhouse Gas Study 2014.” Access date: 15.10.2020 <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Third%20Greenhouse%20Gas%20Study/GHG3%20Executive%20Summary%20and%20Report.pdf>
56. IMO, “Shipping and Climate change” Access date: 05.10.2020. <http://www.imo.org/en/MediaCentre/HotTopics/GHG/Documents/Shipping%20and%20climate%20change.pdf>
57. IMO, “Greenhouse Gas Emissions” Access date: 05.10.2020. <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/GHG-Emissions.aspx>
58. IMO, “Module 2 – Ship Energy Efficiency Regulations and Related Guidelines” Access date: 15.10.2020 <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Air%20pollution/M2%20EE%20regulations%20and%20guidelines%20final.pdf>

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

59. Icct, “New IMO study highlights sharp rise in short-lived climate pollution”. 2020.08.04.  
<https://theicct.org/news/fourth-imo-ghg-study-finalreport-pr-20200804>
60. IMO, Resolution MEPC.304(72), Annex 11  
[http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Resolution%20MEPC.304%2872%29\\_E.pdf](http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Resolution%20MEPC.304%2872%29_E.pdf)
61. IMO, “Greenhouse Gas Emissions from ships”.  
<http://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx>
62. IMO, “Historic background”  
<http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Historic%20Background%20GHG.aspx>
63. IMO, “Introduction to IMO”.  
<http://www.imo.org/en/About/Pages/Default.aspx>
64. IMO, “Reducing Greenhouse Gas Emissions from ship”. Access date: 12.10.2020  
<http://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx>
65. IMO, “Reducing greenhouse gas emissions from ships”, Accessed: 25.11.2020  
<https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx>
66. IMO, “Fourth IMO GHG Study 2020”. Document can be found here  
<https://docs.imo.org/Default.aspx> (registration required)
67. IMO, “Low carbon shipping and air pollution control”.  
<http://www.imo.org/en/MediaCentre/HotTopics/GHG/Pages/default.aspx>
68. International Maritime Authority (IMO), “MEPC 75/7/15: 4<sup>th</sup> IMO GHG Study 2020 – Final Report”, Document can be accessed at: <http://docs.imo.org> (registration required)
69. IMO, “Initial IMO Strategy for reduction of greenhouse gas emission”.
70. (IMO), “MEPC 75/7/15: 4th IMO GHG Study 2020 – Final Report”, Document can be accessed at: <http://docs.imo.org>
71. IMO resolution MEPC.304(72), “Initial IMO Strategy on reduction of GHG emissions from shipping”, Resolution MEPC.304(72) can be downloaded from:

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

- [https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20MEPC.304\(72\)\\_E.pdf](https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20MEPC.304(72)_E.pdf)
72. IMO, “The International Convention for the Prevention of Pollution from Ships (MARPOL)”, [https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx)
73. IMO, “New requirements for international shipping as UN body continues to address greenhouse gas emissions.” Accessed: 10.11.2020  
<https://www.imo.org/en/MediaCentre/PressBriefings/Pages/28-MEPC-data-collection--.aspx>
74. IMO, “Energy efficiency measures”, Accessed: 11.11.2020  
<https://www.imo.org/en/OurWork/Environment/Pages/Technical-and-Operational-Measures.aspx>
75. IMO Regulation MEPC.203(62), Accessed: 11.11.2020  
[https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Technical%20and%20Operational%20Measures/Resolution%20MEPC.203\(62\).pdf](https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Technical%20and%20Operational%20Measures/Resolution%20MEPC.203(62).pdf)
76. International Council on Clean Transportation, “The Energy Efficiency Design Index (EEDI) for New Ships”, Accessed: 11.11.2020  
[https://theicct.org/sites/default/files/publications/ICCTpolicyupdate15\\_EEDI\\_final.pdf](https://theicct.org/sites/default/files/publications/ICCTpolicyupdate15_EEDI_final.pdf)
77. IMO, “ Marine Environment Protection Committee (MEPC), 74th session, 13-17 May 2019” accessed: 13.11.2020  
<https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-74th-session.aspx>
78. Gard, “Shipping Emissions Regulations” Accessed: 01.11.2020  
[http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G\\_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge\\_SDIXI](http://www.gard.no/web/updates/content/20734079/shipping-emissions-regulations?fbclid=IwAR2E5G_Sog40gn7-v-SwZqiZMt79ZKCZo0cyqhd4P3ReuzYxmBSge_SDIXI)
79. Miluše Tichavska, Beatriz Tovar, “Transportation Research Part A” ELSEVIER 78 (2015) 347–360 <https://doi.org/10.1016/j.tra.2015.05.021>
80. Karimalis Nikolaos, “Onboard Energy Management and Marine Environment Protection – Coursework 2”,  
[https://www.academia.edu/26335292/Marine\\_emission\\_control\\_regulations](https://www.academia.edu/26335292/Marine_emission_control_regulations)

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

81. 2014 Guidelines on the method of calculation of EEDI for new ships, Res. MEPC.245(66) adopted on 4 April 2014, as amended. Document can be accessed at <http://www.imo.org/> registration required)
82. International Associations of Classification Societies, “Air Pollution and Energy Efficiency”, accessed: 12.11.2020 <http://www.iacs.org.uk/media/5804/mepc-74-5-technical-consequences-of-the-eedi-on-the-ship-machinery-design-including-performance-of-iacs.pdf>
83. The Organization for Economic Co-operation and Development (OECD), “ANALYSIS OF SELECTED MEASURES PROMOTING THE CONSTRUCTION AND OPERATION OF GREENER SHIPS”, 2017, Accessed:13.11.2020 <https://www.oecd.org/industry/ind/analysis-of-measures-promoting-greener-ships.pdf>
84. ICCT, “Turning the ship, slowly: Progress at IMO on new ship efficiency and black carbon”, 2019, accessed: 12.11.2020 <https://theicct.org/blog/staff/mepc74>
85. Huilin Ren, Yu Ding and Congbiao Sui, “Influence of EEDI (Energy Efficiency Design Index) on Ship–Engine–Propeller Matching”, 2019, *Journal of Marine Science and Engineering*. <https://www.mdpi.com/2077-1312/7/12/425/pdf>
86. ClassNK Technical Informatio, “IACS Procedural Requirement No.38 (Rev.1) in relation to Energy Efficiency Design Index (EEDI)”, 2016, Accessed: 13.11.2020 [https://www.classnk.com/hp/pdf/tech\\_info/tech\\_img/T1073e.pdf](https://www.classnk.com/hp/pdf/tech_info/tech_img/T1073e.pdf)
87. Transport & Environment, “Shipping and Climate Change”, Accessed: 14.11.2020 <https://www.transportenvironment.org/what-we-do/shipping-and-environment/shipping-and-climate-change>
88. CE Delft, “Readily Achievable EEDI Requirements for 2020”, 2016, Accessed: 13.11.2020 [www.cedelft.eu](http://www.cedelft.eu)
89. OCEANA, “Shipping Pollution”, Accessed: 13.11.2020 <https://europe.oceana.org/en/shipping-pollution-1>
90. OECD, “ANALYSIS OF SELECTED MEASURES PROMOTING THE CONSTRUCTION AND OPERATION OF GREENER SHIPS”, Accessed: 14.11.2020 <https://www.oecd.org/industry/ind/analysis-of-measures-promoting-greener-ships.pdf>
91. United Nations Convention on Trade and Development (UNCTAD), “Decarbonizing maritime transport: Estimating fleet renewal trends based on ship scrapping patterns”,

Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

- accessed: 14.11.2020 <https://unctad.org/news/decarbonizing-maritime-transport-estimating-fleet-renewal-trends-based-ship-scrapping-patterns>
92. IMO, RESOLUTION MEPC.282(70) 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP).
93. Varifavia Shipping, “The IMO Data Collection System (DCS)”, Accessed: 15.11.2020 <https://www.verifavia-shipping.com/shipping-carbon-emissions-verification/shipping-mrv-regulation-the-imo-data-collection-system-dcs-106.php>
94. DNVGL, “Monitoring Ship Fleet Efficiency Performance With An SEEMP”, Accessed: 14.11.2020 <https://www.dnvgl.com/maritime/energy-efficiency/monitoring-ship-and-fleet-efficiency-performance-with-an-SEEMP.html>
95. Lloyd’s Register, “Implementing a Ship Energy Efficiency Management Plan”, Accessed: 14.11.2020 [http://www.superyachtnews.com/articles/18431/seemp\\_client\\_guidance.pdf](http://www.superyachtnews.com/articles/18431/seemp_client_guidance.pdf)
96. Marine Insight, “What is Ship Energy Efficiency Management Plan?”, 2019, Accessed: 14.11.2020 <https://www.marineinsight.com/maritime-law/what-is-ship-energy-efficiency-management-plan/>
97. IMO, RESOLUTION MEPC.282(70) 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP), Annex, at paragraph 4.1.1
98. IMO, “MARPOL amendments enter into force - ship fuel oil reporting requirements, garbage classification and IOPP certificate”, Accessed: 15.11.2020 <https://www.imo.org/en/MediaCentre/PressBriefings/Pages/04MARPOLamendments.aspx>
99. IMO, “Data Collection System for Fuel Oil Consumption of Ships”, Accessed: 14.11.2020 <https://www.imo.org/en/OurWork/Environment/Pages/Data-Collection-System.aspx>
100. IMO, RESOLUTION MEPC.293(71) the 2017 Guidelines for the development and management of the IMO Ship Fuel Oil Consumption Database (hereafter "the 2017 Database Guidelines")
101. Lexology, “Part one: The IMO fuel consumption data collection system (IMO DCS)”, Accessed: 15.11.2020

<https://www.lexology.com/library/detail.aspx?g=95c2b3e7-1980-4217-8ee5-df8713c4eb84>

102. IMO, “Data collection system for fuel oil consumption of ships”, Accessed: 15.11.2020 <https://www.imo.org/en/OurWork/Environment/Pages/Data-Collection-System.aspx>
103. StormGeo, “Sustainability in Shipping: How the IMO DCS is Encouraging Companies to Go Greener”, Accessed: 15.11.2020  
<https://www.stormgeo.com/solutions/shipping/articles/sustainability-in-shipping-how-the-imo-dcs-is-encouraging-companies-to-go-greener/>
104. Sustainability, “Towards the IMO’s GHG Goals: A Critical Overview of the Perspectives and Challenges of the Main Options for Decarbonizing International Shipping”, Accessed: 15.11.2020 <https://www.mdpi.com/2071-1050/12/8/3220>
105. IMO, “IMO assembly adopts vision and strategic direction”, Accessed: 16.11.2020 <https://www.imo.org/en/MediaCentre/PressBriefings/Pages/37-A30.aspx>
106. TheICCT, “International Maritime organization's initial greenhouse gas strategy”, accessed: 16.11.2020  
[https://theicct.org/sites/default/files/publications/IMO\\_GHG\\_StrategyFinalPolicyUpdate042318.pdf](https://theicct.org/sites/default/files/publications/IMO_GHG_StrategyFinalPolicyUpdate042318.pdf)
107. International Energy Agency, “Energy Technology Perspectives 2017” (2017). Accessed: 16.11.2020 Retrieved from <https://www.iea.org/etp2017/>
108. TheICCT, “International Maritime organization's initial greenhouse gas strategy”, accessed: 16.11.2020  
[https://theicct.org/sites/default/files/publications/IMO\\_GHG\\_StrategyFinalPolicyUpdate042318.pdf](https://theicct.org/sites/default/files/publications/IMO_GHG_StrategyFinalPolicyUpdate042318.pdf)
109. Bryan Comer, Naya Olmer, Xiaoli Mao, Biswajoy Roy, and Dan Rutherford, Black carbon emissions and fuel use in global shipping, 2015 (ICCT: Washington DC, 2017). Accessed: 16.11.2020 <https://www.theicct.org/publications/black-carbon-emissions-global-shipping-2015>
110. Roel Hoenders, “Achieving the goals of the Initial IMO Strategy on reduction of GHG emissions from ships”, (World Maritime University 2020) Accessed: 17.11.2020  
<https://www.nordicenergy.org/wp-content/uploads/2020/03/Roel-Hoenders.pdf>

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

111. European Commission, “Integrating maritime transport emissions in the EU's greenhouse gas reduction policies”, Accessed: 18.11.2020  
[https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/com\\_2013\\_479\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/com_2013_479_en.pdf)
112. European Commission, “Time for international action on CO<sub>2</sub> emissions from shipping”, accessed: 18.11.2020  
[https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/marine\\_transport\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/marine_transport_en.pdf)
113. Aldo Chircop, Meinhard Doelle and Ryan Gauvin, “Shipping and Climate Change International Law and Policy Considerations”, Accessed: 18.11.2020  
[https://www.cigionline.org/sites/default/files/documents/Shipping%27s%20contribution%20to%20climate%20change%202018web\\_0.pdf](https://www.cigionline.org/sites/default/files/documents/Shipping%27s%20contribution%20to%20climate%20change%202018web_0.pdf)
114. REGULATION (EU) 2015/757 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. Regulation can be accessed on: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02015R0757-20161216>
115. P. Gilbert, “From reductionism to systems thinking: How the shipping sector can address sulphur regulation and tackle climate change,” *Marine Policy*, vol. 43 (2014): 376–378
116. IMO, “Introduction to IMO”, Accessed: 21.11.2020  
<https://www.imo.org/en/About/Pages/Default.aspx>
117. European Council, “CO<sub>2</sub> emissions from ships: Council agrees its position on a revision of EU rules”, Accessed: 30.11.2020  
<https://www.consilium.europa.eu/en/press/press-releases/2019/10/25/co2-emissions-from-ships-council-agrees-its-position-on-a-revision-of-eu-rules/#>
118. Panos Zachariadis, “MRV: Another unnecessary regulation”, 2016, *naftikachronika.gr*, Accessed: 22/11/2020  
[https://www.academia.edu/34965943/MRV\\_Another\\_unnecessary\\_regulation](https://www.academia.edu/34965943/MRV_Another_unnecessary_regulation)
119. Dimitrios Dalaklis, “Exploring the New Policy Framework of Environmental Performance Management for Shipping”, 2018, *Harbours Review Spotlight: Greenhouse Gas Emissions in Shipping Conference*. Accessed: 22.11.2020



[https://www.academia.edu/38243256/Exploring\\_the\\_New\\_Policy\\_Framework\\_of\\_Environmental\\_Performance\\_Management\\_for\\_Shipping](https://www.academia.edu/38243256/Exploring_the_New_Policy_Framework_of_Environmental_Performance_Management_for_Shipping)

120. Verifavia Shipping, “Verify, Comply, Navigate”, Accessed: 30.11.2020  
<https://www.verifavia-shipping.com/shipping-carbon-emissions-verification/shipping-mrv-regulation-the-imo-data-collection-system-dcs-106.php>
121. IMO, “Data collection system for fuel oil consumption of ships”, Accessed: 15.11.2020 <https://www.imo.org/en/OurWork/Environment/Pages/Data-Collection-System.aspx>
122. Directive 2009/16/EC of the European Parliament and of the Council of 23 April 2009 on Port state control, Official Journal L 131 of 28 May 2009, p. 57 accessed: 22.11.2020 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0016&rid=5>
123. DNV GL, “EU MRV and DCS”, Accessed: 22.11.2020  
<https://www.dnvgl.com/maritime/insights/topics/EU-MRV-and-IMO-DCS/FAQs-EU-MRV.html>
124. Investigate-Europe, “EU Emission Trading Scheme Explained”, Accessed: 23.11.2020 [https://www.investigate-europe.eu/en/2020/eu-emissions-trading-scheme-explained/?ie\\_s=ga&pk\\_campaign=en\\_dsa&pk\\_source=google&pk\\_medium=cpc](https://www.investigate-europe.eu/en/2020/eu-emissions-trading-scheme-explained/?ie_s=ga&pk_campaign=en_dsa&pk_source=google&pk_medium=cpc)
125. European Commission, “EU Emission Trading System (EUETS)”, Accessed: 23.11.2020 [https://ec.europa.eu/clima/policies/ets\\_en](https://ec.europa.eu/clima/policies/ets_en)
126. European Commission, “Emissions cap and allowances”, accessed: 23.11.2020 [https://ec.europa.eu/clima/policies/ets/cap\\_en](https://ec.europa.eu/clima/policies/ets/cap_en)
127. European Commission, “Emissions cap and allowances”, accessed: 23.11.2020 [https://ec.europa.eu/clima/policies/ets/cap\\_en](https://ec.europa.eu/clima/policies/ets/cap_en)
128. Hellenic Shipping News, “The implementation of EU ETS system in International Maritime Transport Challenges & Prospects”, Accessed: 23.11.2020  
<https://www.hellenicshippingnews.com/the-implementation-of-eu-ets-system-in-international-maritime-transport-challenges-prospects/>
129. European Community Shipowners’ Association (ECSA), “Shipping does not belong in EU Emission Trading Scheme”, Accessed: 23.11.2020  
<https://www.ecsa.eu/news/shipping-does-not-belong-eu-emission-trading-scheme>

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

130. Safety4sea, “ICS: Implications of application of the EU ETS to global shipping”, Accessed: 23.11.2020 <https://safety4sea.com/ics-implications-of-application-of-the-eu-ets-to-global-shipping/>
131. A. Miola, B. Ciuffo, M. Marra, E. Glovine, “Analytical framework to regulate airemissions from maritime transport”, *JRC Scientific and Technical Reports*, Accessed: 23.11.2020 [https://www.academia.edu/22084789/Analytical\\_framework\\_to\\_regulate\\_air\\_emissions\\_from\\_maritime\\_transport?email\\_work\\_card=reading-history](https://www.academia.edu/22084789/Analytical_framework_to_regulate_air_emissions_from_maritime_transport?email_work_card=reading-history)
132. United States Environmental Protection Agency (EPA), “Our Mission and What We Do”, Accessed: 23.11.2020 <https://www.epa.gov/aboutepa/our-mission-and-what-we-do>
133. EPA, “Summary of the Clean Air Act.”, Accessed: 23.11.2020 <https://www.epa.gov/laws-regulations/summary-clean-air-act>
134. Earthjustice, “Curbing Greenhouse Gas Pollution From Ships, Aircraft, And Non-Road Vehicles & Engines”, Accessed: 23.11.2020 [https://earthjustice.org/our\\_work/cases/2010/global-warming-and-ships-aircraft-and-non-road-vehicles-engines](https://earthjustice.org/our_work/cases/2010/global-warming-and-ships-aircraft-and-non-road-vehicles-engines)
135. Tsang, supraNote 27, at p. 11 (citing EPA Memorandum in Response to Petitions Regarding Greenhouse Gas and other Emissions from Marine Vessels and Nonroad Engines and Vehicles (June 18, 2012), [https://www.eenews.net/assets/2012/06/18/document\\_pm\\_06.pdf](https://www.eenews.net/assets/2012/06/18/document_pm_06.pdf))
136. EPA, “Progress Cleaning the Air: Voluntary Partnership Program Accomplishments”, Accessed: 23.11.2020 <https://www.epa.gov/clean-air-act-overview/progress-cleaning-air-voluntary-partnership-program-accomplishments>
137. EPA, “Developing Clean Air Programs Through Dialogue”, Accessed: 23.11.2020 <https://www.epa.gov/clean-air-act-overview/developing-clean-air-programs-through-dialogue>
138. EPA, “Regulations for Emissions from Vehicles and Engines”, Accessed: 23.11.2020 <https://www.epa.gov/regulations-emissions-vehicles-and-engines/amendments-related-marine-diesel-engine-emission-0>

## Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

139. EPA, “Regulations for Emissions from Vehicles and Engines”, Accessed: 23.11.2020 <https://www.epa.gov/regulations-emissions-vehicles-and-engines/amendments-related-marine-diesel-engine-emission-0>
140. EPA, “International Standards to Reduce Emissions from Marine Diesel Engines and Their Fuels”, Accessed: 23.11.2020 <https://www.epa.gov/regulations-emissions-vehicles-and-engines/international-standards-reduce-emissions-marine-diesel>
141. EPA, “EPA’s Role in International Maritime Organization,” Accessed: 30.11.2020 <https://www.epa.gov/international-cooperation/epas-role-international-maritime-organization-imo>
142. EPA, “Greenhouse Gas Reduction Program (GHGRP)”, Accessed: 23.11.2020 <https://www.epa.gov/ghgreporting>
143. California Air Resource Board (CARB), “Ocean-Going Vessel Fuel Regulation”, Accessed: 23.11.2020 <https://ww2.arb.ca.gov/our-work/programs/ocean-going-vessel-fuel-regulation>
144. Offshore Energy, “Norway, IMO Join Forces on Reducing Shipping’s GHG Emissions”, Accessed: 23.11.2020 <https://www.offshore-energy.biz/norway-imo-join-forces-on-reducing-shippings-greenhouse-gas-emissions/>
145. Norwegian Government, “Government Action Plan for Green Shipping”, Accessed: 23.11.2020 <https://www.regjeringen.no/contentassets/2ccd2f4e14d44bc88c93ac4effe78b2f/the-governments-action-plan-for-green-shipping.pdf>
146. Shipwatch, “Norway’s government wants to halve shipping’s emission already by 2030”, Accessed: 24.11.2020 <https://shippingwatch.com/regulation/article11459026.ece>
147. CleanTechnica, “Norway Announces Plan To Cut Emissions From Ships 50% By 2030”, Accessed: 23.11.2020 <https://cleantechnica.com/2019/06/21/norway-announces-plan-to-cut-emissions-from-ships-50-by-2030/>
148. Sigurd Enge is one of the most experienced advisors at the Bellona Foundation (an NGO that aims at fighting climate change) <https://bellona.org/employee/sigurd-enge>
149. Norwegian Shipowners’ Association, “Zero emission in 2050”, Accessed: 24.11.2020 <https://rederi.no/DownloadFile/?file=396209>

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150. Bahr, “The Norwegian Shipowners Association releases its climate strategy – the Norwegian fleet to be carbon neutral by 2050”, Accessed: 24.11.2020  
<https://bahr.no/en/newsletter/the-norwegian-shipowners-association-releases-its-climate-strategy-the-norwegian-fleet-to-be-carbon-neutral-by-2050-2-2/>
151. Yubing Shi & Warwick Gullett, “Ocean Development & International Law”, 2018, DOI: 10.1080/00908320.2018.1442178,  
<https://doi.org/10.1080/00908320.2018.1442178>
152. The Conversation, “Cargo ships are emitting boatloads of carbon, and nobody wants to take the blame”, Accessed: 24.11.2020 <https://theconversation.com/cargo-ships-are-emitting-boatloads-of-carbon-and-nobody-wants-to-take-the-blame-108731>
153. Ship Inspection, “open registry”, Accessed: 24.11.2020  
<http://shipinspection.eu/open-registry/>
154. The Conversation, “Cargo ships are emitting boatloads of carbon, and nobody wants to take the blame”, Accessed: 24.11.2020 <https://theconversation.com/cargo-ships-are-emitting-boatloads-of-carbon-and-nobody-wants-to-take-the-blame-108731>
155. C. Trimmer, and J. Godar, “Calculating Maritime Shipping Emissions per Traded Commodity”, 2019, *SEI Brief. Stockholm Environment Institute*.  
<https://www.sei.org/publications/shipping-emissions-per-commodity/>
156. M. Bulger, G. Taylor, R. Schroeder, Data-Driven Business Models: Challenges and Opportunities of Big Data, University of Oxford (2014)19-50
157. A. Miola et al., “Analytical framework to regulate air emissions from maritime transport”, JRC Scientific and Technical Reports, Accessed: 23.11.2020  
[https://www.academia.edu/22084789/Analytical\\_framework\\_to\\_regulate\\_air\\_emissions\\_from\\_maritime\\_transport?email\\_work\\_card=reading-history](https://www.academia.edu/22084789/Analytical_framework_to_regulate_air_emissions_from_maritime_transport?email_work_card=reading-history)
158. Yoshifumi Tanaka, “Regulation of Greenhouse Gas Emissions from International Shipping and Jurisdiction of States”, 2016, *Review of European Law* 25(3):333-346, DOI: 10.1111/reel.12181
159. Mia Mahmudur Rahman, Md. Tarikul Islam, Sanjaya Kuruppu, “Regulating global shipping corporations' accountability for reducing greenhouse gas emissions in the seas”, 2016, *Marine Policy*, <https://doi.org/10.1016/j.marpol.2016.04.018>

Greenhouse Gas Emissions from Shipping: Existing Regulations and Regulatory Challenges

160. Change, “Shipping emissions and 6 strategies to avoid maritime pollution”, Accessed: 26.11.2020 <https://container-xchange.com/blog/shipping-emissions/>
161. The Conversation, “Five ways the shipping industry can reduce its carbon emissions”, Accessed: 26.11.2020 <https://theconversation.com/five-ways-the-shipping-industry-can-reduce-its-carbon-emissions-94883>