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7th session
Agenda item 2

ISWG-GHG 7/2/12
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# FURTHER CONSIDERATION OF CONCRETE PROPOSALS TO IMPROVE THE OPERATIONAL ENERGY EFFICIENCY OF EXISTING SHIPS, WITH A VIEW TO DEVELOPING DRAFT AMENDMENTS TO CHAPTER 4 OF MARPOL ANNEX VI AND ASSOCIATED GUIDELINES, AS APPROPRIATE

## A proposal for and an initial impact assessment of a goal-based approach to realize the substantial speed-related GHG emission reductions that are urgently needed in the short-term and to provide a framework for the full decarbonization of shipping in the longer-term

**Submitted by the Pacific Environment and CSC**


**SUMMARY**

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|---|---|
| *Executive summary:* | In response to discussions at ISWG-GHG 6 and MEPC 74, this document proposes a goal-based approach to achieving the substantial speed-related emissions reductions that are necessary in the short-term if international shipping's GHG emissions are to peak quickly and then decline on a pathway consistent with keeping warming below the Paris Agreement's target of 1.5°C. This document proposes linear carbon intensity improvement per ship of at least 80% by 2030 compared to the 2008 baseline of the Initial IMO GHG Strategy. The 2030 requirement and intermediate annual improvements should be implemented using the Annual Efficiency Ratio (AER) metric ($gCO_2eq$/DWT-nm and $gCO_2eq$/GT-nm). Compliance should be measured in three-year cycles, with annual audits. An impact assessment of this approach is also included. |
| *Strategic direction, if applicable:* | 3 |
| *Output:* | 3.2 |
| *Action to be taken:* | Paragraph 35 |
| *Related documents:* | MEPC 74/7/8 and ISWG-GHG 6/2/13 |

**Introduction**

1 Since the Initial IMO GHG Strategy was adopted at MEPC 72, additional information has clarified the critical importance of keeping global heating below 1.5°C. In the *2018 Special Report on Global Warming of 1.5°C*, the Intergovernmental Panel on Climate Change (IPCC) found considerable differences between global temperature rises of 1.5°C and 2°C[1]. The additional impacts, such as the annihilation of coral reef ecosystems, or the exposure of over 10 million additional people each year to the effects of rising sea levels, could be prevented in the former scenario[2]. In addition, the potential economic benefits of 1.5°C versus 21.5°C could exceed $20 trillion[3].

2 Conversely, a failure to restrict rising temperatures will have profound implications, particularly for small island developing States (SIDS) and least developed countries (LDCs). Under higher temperature scenarios, the impacts of climate change, including rising sea levels, species extinctions and collapsed ecosystems, higher food and water stress, and more extreme weather events including more intense wildfire, are all likely to be worse[4]. The economic impacts on the shipping industry itself could also be substantial. Under a 2.5°C to 3°C warming scenario, researchers project global economic output per capita will decrease by 15% to 25% by 2100[5].

3 In light of the overwhelming need to address the climate emergency, strong immediate actions must be taken to phase out greenhouse gas emissions from shipping "as a matter of urgency". Previously, CSC has proposed to reduce emissions through the direct regulation of ship operational speeds, most recently in document MEPC 74/7/8 and its associated initial impact assessment in document ISWG-GHG 6/2/13. This focus on speed is a result of the urgent need for emission reductions and the now widely acknowledged understanding that the only way ship emissions can be reduced significantly in the short-term is for ships to reduce their speeds.

4 At ISWG-GHG 6, the Working Group agreed, inter alia, that a "goal-based approach is the only one to allow flexibility on routes or ships", and in addition to two coordinated approaches developed by China, Denmark, France and Japan, "Member States and international organizations were invited to submit their own proposals if they wish to do so"[6]. In light of the discussions at ISWG-GHG 6 and other feedback, CSC has developed a goal-based approach to bringing about the significant short-term GHG emission reductions that for most ships can only be realized via speed reduction.

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1 IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

2 *Id.*

3 Burke, M., Davis, W. M., & Diffenbaugh, N. S. (2018). Large potential reduction in economic damages under UN mitigation targets. *Nature*, *557*(7706), 549-553.

4 Diffenbaugh, N. S., Singh, D., & Mankin, J. S. (2018). Unprecedented climate events: Historical changes, aspirational targets, and national commitments. *Science advances*, *4*(2), eaao3354.

5 Burke et al. 2018

6 Report of the sixth meeting of the Intersessional Working Group on Reduction on GHG Emissions from Ships (MEPC 75/7/2).

5 The co-sponsors believe this proposal offers flexibility for stakeholders, while also setting a path to decarbonization that is genuinely in line with the carbon budget remaining to shipping if global heating is to be kept below 1.5°C.

**Summary of the proposal**

6 In this proposal, linear carbon intensity improvements per ship of at least 80% by 2030 compared to the 2008 baseline of the Initial IMO GHG Strategy are required. The 2030 requirement and intermediate annual improvements are described using the following Annual Efficiency Ratio (AER) metrics: $gCO_2eq$/DWT-nm and $gCO_2eq$/GT-nm (variations on this, e.g. $gCO_2eq/m^3$-nm or $gCO_2eq$/TEU-nm, might also be considered). Global AIS data from 2015 is used to calibrate fleetwide 2008 AER baselines into specific "benchmarks" for individual ship type and size categories as a mid-point on a linear trajectory towards achieving the 1.5°C temperature goal (see paragraphs 10 to 12 and figure 6). These reference benchmarks could be cross-checked with the first year of IMO DCS data and 2019 AIS data. Three-year combined compliance cycles with annual audits are proposed, and the carry-over of reduction obligations is allowed between years within the same compliance cycle. Inadvertent non-compliance is handled by limiting the sailing time in the first year of the following compliance cycle, proportionately to the level of cumulative non-compliance at the end of the previous compliance cycle. To address possible disproportionate negative impacts on remote and vulnerable States, a relaxed enforcement regime is proposed for SIDS and LDCs.


**Figure 1: Decarbonization trajectories for shipping**

**Impact assessment**

7 An initial impact assessment (IA) can be found in annex 3 to this document. The assessment was conducted in accordance with the procedure set out in MEPC.1/Circ.885 and concludes that the proposal would have a significant positive impact on both the reduction of GHG emissions and transport costs. Where potential negative impacts have been identified, the assessment concludes that they can be mitigated by careful design of the measure.

**Main elements of the proposal**

8 The proposal has five main elements:

.1 A **metric** to quantify shipping's carbon intensity (CI) as a function of GHG emissions per transport work. For the purpose of policy simplicity, impact measurability and regulatory enforceability, a single metric is desirable. This proposal uses the Annual Efficiency Ratio (AER) as its preferred metric.

.2 A **baseline** or reference year against which to measure the required future CI improvements. In line with the Initial IMO GHG Strategy, this proposal uses 2008 as a baseline year, and calibrates fleetwide carbon intensity performance into specific "benchmarks" for individual ship types and sizes using 2015 AIS data.

.3 A set of **reduction objectives** that describe the annual linear CI improvements per transport work that are required to ensure that total GHG emissions do not exceed the sector's remaining 1.5°C carbon budget. Because ships come in different shapes and sizes and because there are variations in carbon intensity across the fleet, reduction objectives in this proposal take into account ship type and size (using the fleet classification methodology from the *Third IMO GHG Study 2014*).

.4 A method for measuring a ship's **compliance** with its CI requirements:

.1 Annual compliance with the CI requirements is measured through:

$$\text{Attained AER}_{(year\ n)} = CO_{2(year\ N)}/(70\%*DWT*\text{total distance sailed}_{(year\ N)})$$

and

$$\text{Attained AER}_{(year\ n)} = CO_{2(year\ N)}/(100\%*GT*\text{total distance sailed}_{(year\ N)})$$

.2 Compliance over the three-year cycle would be measured like this:

$$\sum_{(year=1,2,3,\ cycle\ n)}(\text{required AERs} - \text{Attained AERs}) = 0$$

.3 While not in this proposal, IMO might also consider translating annual CI requirements into CI requirements per journey; this might be useful for ships that mostly operate in the charter market.

.5 An **enforcement** regime to deter non-compliance and, in the event of non-compliance, to compensate for the associated emissions and related harm to the climate. To this end, the proposal limits sailing time in the first year of the following compliance cycle proportionately to the level of cumulative non-compliance at the end of the previous compliance cycle. This could be done via the ship's International Air Pollution Prevention (IAPP) certificate using the following formula:

$$\text{Sailing time}_{(year\ 1,\ cycle\ n+1)} = 8760 - ((\text{average annual hours underway}_{(cycle\ n)} + \text{average annual service hours}_{(cycle\ n)}) * (\text{average Attained AER}_{(cycle\ n)} / \text{average AER objectives}_{(cycle\ n)} - 1))$$

This formula is only used if non-compliance is detected. To implement this, the service hours of ships would have to be monitored. If a non-compliant ship is scrapped at the end of the compliance cycle, then a system could be developed to transfer the curbing of sailing time to another ship owned by the same company.

9 Absolute annual $CO_2$eq emissions are very sensitive to the choice of targets and baseline. For this reason, special care needs to be taken to ensure that the baseline historical CI and the future CI requirements reflect the real-world performance of ships as closely as possible. Without this, there is a significant risk that ostensible carbon intensity improvements do not actually translate into extra real-world absolute emissions reductions, or that absolute emissions savings exceed shipping's remaining 1.5°C carbon budget.

10 The following sections expand on each of the components introduced here.

**The metric**

11 There does not appear to be a single metric that is perfect for all ship types. But certain metrics, especially AER, can provide a good basis for designing an operational goal-based measure. Data reported under the EU MRV regulation, which covers the operational performance of about twelve thousand ships, indicates a good statistical correlation for AER for major ship types (see figures 2, 3 and 4 below). AER in its classic form, i.e. $gCO_2$/DWT-tonne-nm and $gCO_2$/GT-tonne-nm, will be an available metric via the IMO fuel oil data collection system (DCS). Other variations of the AER, e.g. $gCO_2$eq/$m^3$-nm or $gCO_2$eq/TEU-nm for ship types with volumetric or TEU capacities, could be used, and can be calculated by cross-matching data from the IMO DCS with fleet register databases such as Clarkson's or IHS Fairplay. The IMO DCS could also be revised to ensure that relevant ship types report their volumetric and TEU capacities.

12 As figures 2, 3 and 4 show, AER varies considerably with ship type and size. For this reason, required future AER levels (and baselines) are determined separately for each relevant ship type and size category. These can be found in annex 1 to this document.

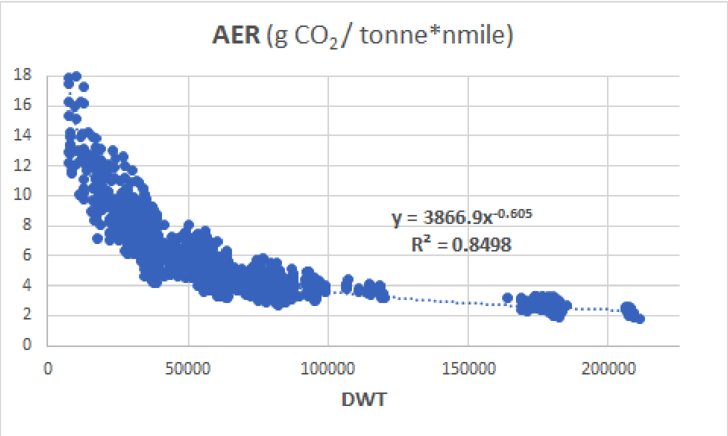


**Figure 2: Bulk Carriers (source: EMSA based on EU MRV data 2018)**

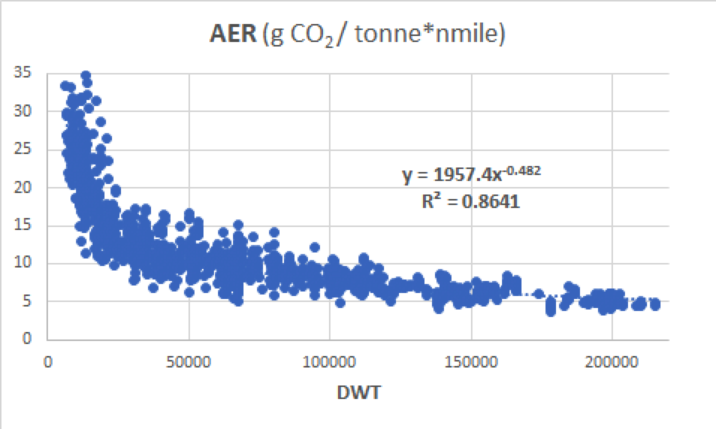


**Figure 3: Containerships (source: EMSA based on EU MRV data 2018)**

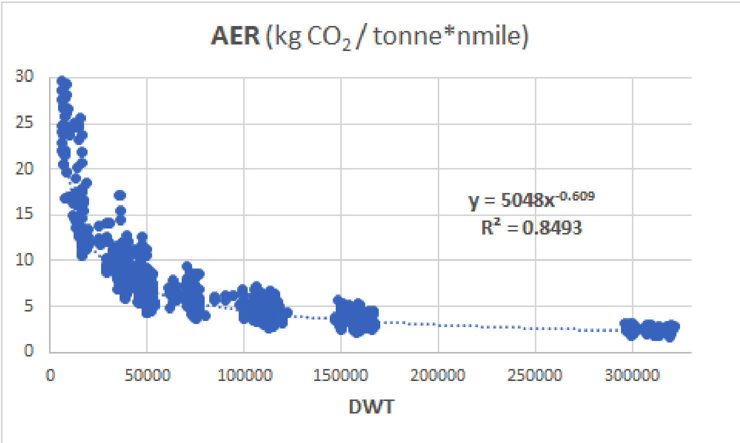


**Figure 4: Oil tankers (source: EMSA based on EU MRV data 2018)**

**The baseline**

13 Baselines, also known as reference lines, are an important element in any regulatory measure and should be constructed respecting certain quality-control principles.

14 In this case the baselines should reflect the real-world historical performance of the fleet using data from a period of time that is relevant to the regulation in question. For measures under the 2018 Initial IMO GHG Strategy, that should have meant a baseline built up from that or the previous year's data. By instead choosing baselines from an earlier period, when ships were significantly less efficient than they are today, a completely false impression will be given of the progress made as a result of measures agreed under the Strategy (see figure 5 below). Improvements that occurred before the Strategy came into existence would nonetheless be "booked" as if they are the result of the Strategy. This is wrong and misleading to any outside observer. The problem has not been eliminated in this proposal but, by strengthening the level of ambition for 2030, its significance has been reduced (see paragraph 20).

15 In addition, data from 2008, the baseline year of the Initial IMO GHG Strategy, is not granular enough to set efficiency reference points and future requirements for individual ship types and sizes. To address this issue, the proposal supplements historical 2008 operational data (from the *Third IMO GHG Study 2014*) with 2015 AIS data, and if appropriate DCS reported information and 2019 AIS data, in order to calibrate the relevant 2008 baselines into specific benchmarks for individual ship type and size categories.

16 Baselines should also accurately reflect the carbon intensity of different ship types and sizes. In this proposal, we suggest the use of GT-nm as a proxy metric for transport work for cruise ships, ferry-ro-pax, ferry-pax only and ro-ro ships, while DWT is used for all other ship types (these values are available from the DCS). Additionally, IMO could in the future consider the use of $m^3$-nm and TEU-nm for LNG carriers and containerships respectively (these figures could come from fleet databases or a future revised DCS). Total annual "distance travelled" is available via the DCS. If new ship types or sizes emerge, new baselines should be established.

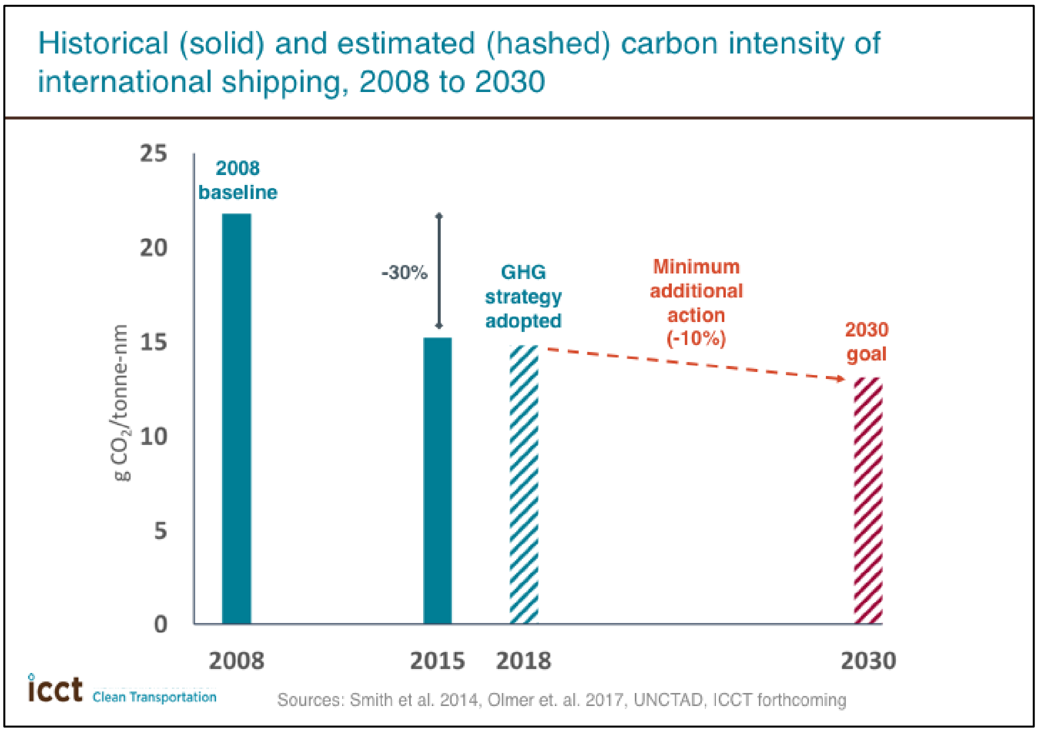


*Figure 5: The impact of a combination of relaxed 2008 baseline and unambitious 2030 target* **on future carbon intensity improvement efforts**

17 To ensure appropriate and transparent baselines, this proposal uses historical 2008 operational data from the *Third IMO GHG Study 2014* to establish a fleet-wide baseline. This is then complemented by 2015 AIS data, to calibrate the fleetwide 2008 AER baseline into specific "benchmarks" for individual ship types and sizes, which reflect real world historical ship carbon intensity. These benchmarks are detailed in annex 1 to this document and could, if thought appropriate, be cross-checked with the 2019 DCS data and future global AIS 2019 analysis.

18 Such calibrated specific AER benchmarks for individual ship types and sizes would be mathematically aligned with the necessary fleet-wide carbon-intensity improvements for 2030 over the 2008 baseline. This is explained in the next section. It is important to stress that the 2019 benchmarking does not replace the 2008 baseline of the Initial IMO GHG Strategy. It only helps to divide the fleet-wide requirements into obligations for individual ship types and sizes using the more granular 2019 data. High quality data of this kind is not available for the year 2008.

**Carbon-intensity objectives**

19 Carbon-intensity objectives for 2030 and intermediate periods leading up to it must be consistent with an overall decarbonization pathway for shipping that is compatible with the

Paris Agreement's objective of keeping warming below 1.5°C (figures 1 and 6). To remain in line with this temperature goal, shipping must be fully decarbonized by 2034. Were this important target to be missed and the 1.5°C threshold breached, full decarbonization by 2052 would keep global warming "well below 2ºC" (WB2C).

20 The cumulative emissions from the 1 January 2018 onwards should not exceed shipping's 1.5°C carbon budget of 9 Gt (2.22% of 420 Gt left to humanity if it is to keep global heating below 1.5°C)[7]. That means that both absolute emissions and the annual carbon intensity of the sector should be reduced linearly between now and 2034 to ensure that there is a smooth transition to carbon-free shipping.

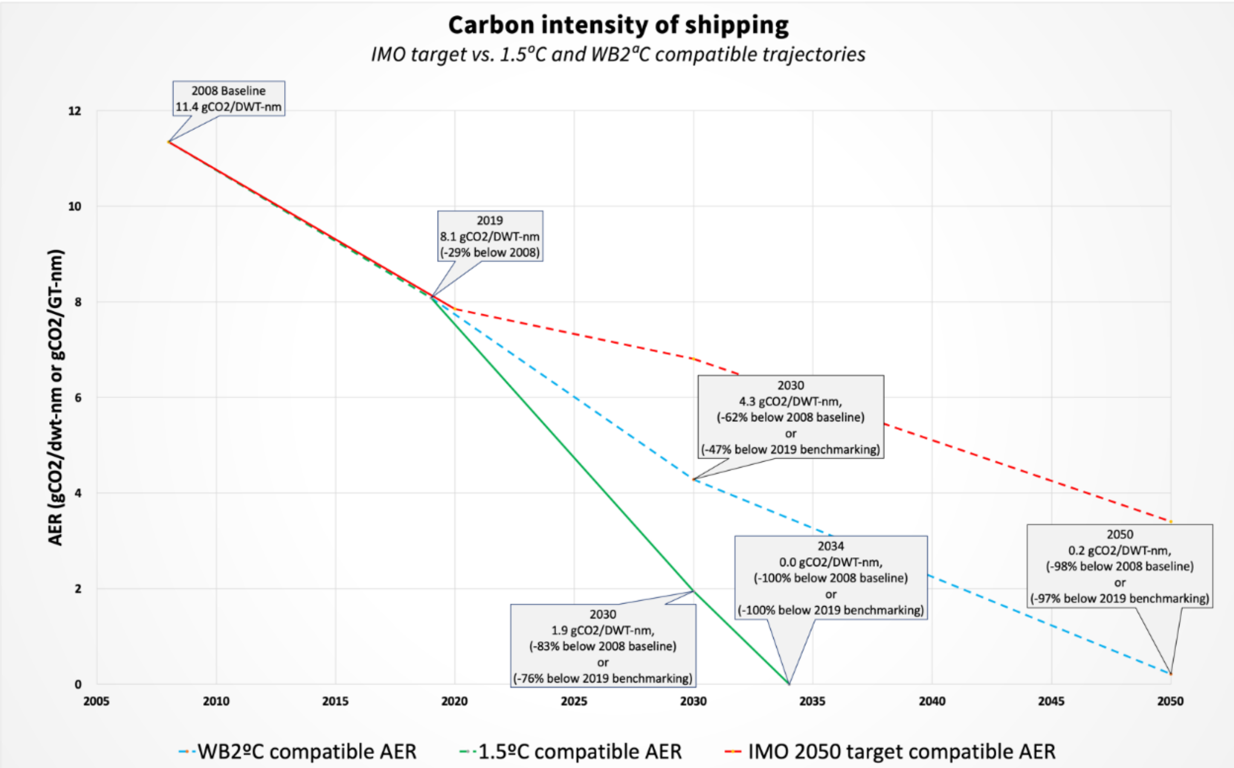


**Figure 6: Carbon intensity trajectories for shipping**

21 Taking these principles into account, an operational goal-based measure should start as soon as possible and the CI be linearly reduced to zero (i.e. 0 $gCO_2eq$/transport-work) by 2034. Anything less than that would mean an unacceptable risk of not keeping global heating below 1.5°C and seriously threaten the survival of some of the most vulnerable nations, including those in the South Pacific.

22 Given that the Initial IMO GHG Strategy chose 2008 as a political baseline, and the end-goal (zero carbon intensity by 2034) is clear, a more ambitious 2030 target can be identified as a point on a linear trajectory between 2008 and 2034 while taking into account future transport work growth. In this way, each ship would be compared to the fleet average (per type/size) in the past, as opposed to its own past performance.

23 With this methodology, the 2030 objective both for the fleet as a whole, as well as for individual ships (using AER as a metric) would be at least 80% below the 2008 Initial GHG Strategy baseline or at least 75% below the 2019 calibrated specific benchmarks (see figure 6). Annex 1 of this document provides annual absolute type/size AER values that

[7] IPCC, 1.5ºC Special Report.

individual ships would be required to meet between 2022 (the first year of implementation) and 2030 (the target year). The latter was determined as a function of linear interpolation between the 2030 objectives and the calibrated specific benchmarking year.

**Compliance**

24 A goal-based approach leaves it to individual ships to choose their method of compliance with the regulation's requirements. To improve their carbon intensity, ships can use the following approaches, individually or in combination:

.1 reduced ship speed;
.2 energy-saving technologies, including but not limited to wind-assistance; and
.3 a switch to zero-carbon fuels.

25 Regardless of the method chosen, ships would be required to demonstrate, via their DCS reporting, that their annual $CO_2$eq emissions per transport work in the reported period is at least equal to the requirement in table 1 of annex 1. In order to demonstrate this, the proposal suggests that ships use the following equations:

$$\textit{Attained AER}_{(year\ n)} = \textit{CO2eq}_{(year\ N)} / (70\%*DWT*\textit{total distance sailed}_{(year\ N)})$$
$$\textit{Attained AER}_{(year\ n)} = \textit{CO2eq}_{(year\ N)} / (100\%*GT*\textit{total distance sailed}_{(year\ N)})$$

26 Analysis of transparent and third-party verified EU MRV data shows that no ship type or size category had above 70% DWT capacity utilisation in 2018 on average. For most ship types and size categories, annual average capacity utilization stood below 60% (see table 3 in annex 1). For that reason, this proposal uses 70% capacity utilisation for all cargo (only) ships when estimating attained AER. For cruise ships, ferry-ro-pax, ferry-pax only and ro-ro ships, 100% of GT capacity could be used for compliance purposes.

27 This proposal uses three-year compliance cycles with annual audits to ensure the regulation's requirements are met. Such a system is aimed at providing flexibility to shipowners. If the regulation's requirement is not met one year, the deficit can be carried over to the next. The total for the three-year cycle must however not exceed the total requirement for that three-year period. No carry-over is allowed between two different compliance cycles. For example, the proposed regulation requires a large containership (more than 14,500 TEU) to achieve an annual average of 7.3 $gCO_2$eq/dwt-nm in 2022 and 6.5 $gCO_2$eq/dwt-nm in 2023 (see table 1 of annex 1). If a ship misses the objective and achieves only 7.5 $gCO_2$eq/dwt-nm carbon intensity in 2022, then it could carry over the 0.2 $gCO_2$eq/dwt-nm exceedance to 2023, and net it from the 2023 objective making the latter 6.3 $gCO_2$eq/dwt-nm.

28 This proposal uses the following formula to measure compliance in the three-year cycle. Zero or negative values denote full or over-compliance with the requirements, while positive values would denote non-compliance:

$$\sum_{(year=1,2,3,\ cycle\ n)}(\textit{required AERs} - \textit{Attained AERs}) = 0$$

29 For certain ships, especially those operating in the charter market, triannual or even annual flexibility may not be desirable given that the commercial decisions affecting the operational efficiency of ships are not always made by the same actor throughout the year. One way to ease implementation for these ships would be to translate the annual CI requirements into CI requirements per journey. CI requirement per journey would provide predictability in relation to commercial charter-party contracts, including in relation to setting the operational speed of the ships and their load-factors. This would bring charterers into the regulatory process.

**Enforcement**

30 While all the usual enforcement tools should be available to ensure consistent compliance with the regulation, additional control mechanisms might also be used to discourage future non-compliance and counterbalance past failures to meet the regulation's requirements. One possibility is to use the annual renewal of the ship's IAPP certificate. If non-compliance is detected at the end of each compliance cycle, the IAPP certificate could be used to curb the sailing time during the first year of the following compliance cycle; any sailing restriction being proportional to the scale of non-compliance in the previous cycle.

31 This can be achieved by using the following equation while taking into account annual average sailing hours and non-sailing time due to maintenance:

$$\text{Sailing time}_{(year\ 1,\ cycle\ n+1)} = 8760 - ((\text{average annual hours underway}_{(cycle\ n)} + \text{average annual service hours}_{(cycle\ n)}) * (\text{average Attained AER}_{(cycle\ n)} / \text{average AER objectives}_{(cycle\ n)} - 1))$$

32 To implement such a system, IMO would need to determine average annual ship service hours. Average annual sailing hours (i.e. hours underway) will already be available via the IMO DCS. This formula would only be used if non-compliance was detected. Given that it is in the interest of the shipowners/operators to continuously utilize their ships, such an operational limitation via the IAPP certificate would help counter-balance past emission exceedances and discourage future non-compliance. If the non-compliant ship is scrapped at the end of the compliance cycle, then a system could be developed to transfer the curbing of sailing time to other ships owned by the same company.

33 To ensure that the curbing of sailing time as a result of non-compliance does not negatively impact important routes in and out of remote SIDS and LDCs, the proposal includes a relaxed enforcement regime for ships trading on these routes. To this end, IMO would need to establish an annual inventory of ships that (largely) service the SIDS/LDCs in each compliance cycle and apply an exemption, if appropriate, only to these ships.

34 Annex 2 to this document provides a draft regulatory text to implement the operational goal-based approach presented above.

**Action requested of the Working Group**

35 The Group is invited to take into account the above proposal, including the draft regulatory text set out in annex 2, when further developing a short-term measure to reduce the climate impact of international shipping.

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## ANNEX 1

### Baselines and reduction objectives for different ship type and sizes

*Table 1: Baselines and carbon intensity reduction objectives compatible with 1.5ºC decarbonization trajectory*

| Ship Type | Capacity Bin | Capacity metric | Carbon intensity objectives (gCO2eq/dwt-nm and gCO2eq/GT-nm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2019 (benchmark) | Cycle 1 | | | Cycle 2 | | | Cycle 3 | | |
| | | | | 2022 (first year of implementation) | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 (-76% below 2019 or -83% below 2008) |
| container | 0–999 | DWT | 22.9 | 20.9 | 18.7 | 16.5 | 14.4 | 12.4 | 10.5 | 8.8 | 7.1 | 5.5 |
| | 1,000–1,999 | DWT | 16.0 | 14.6 | 13.0 | 11.5 | 10.0 | 8.7 | 7.4 | 6.1 | 5.0 | 3.8 |
| | 2,000–2,999 | DWT | 11.4 | 10.5 | 9.3 | 8.2 | 7.2 | 6.2 | 5.3 | 4.4 | 3.5 | 2.8 |
| | 3,000–4,999 | DWT | 10.0 | 9.1 | 8.1 | 7.2 | 6.3 | 5.4 | 4.6 | 3.8 | 3.1 | 2.4 |
| | 5,000–7,999 | DWT | 9.4 | 8.6 | 7.7 | 6.8 | 5.9 | 5.1 | 4.3 | 3.6 | 2.9 | 2.3 |
| | 8,000–11,999 | DWT | 7.7 | 7.0 | 6.2 | 5.5 | 4.8 | 4.2 | 3.5 | 2.9 | 2.4 | 1.8 |
| | 12,000–14,500 | DWT | 6.5 | 5.9 | 5.3 | 4.7 | 4.1 | 3.5 | 3.0 | 2.5 | 2.0 | 1.6 |
| | 14,500–+ | DWT | 7.9 | 7.3 | 6.5 | 5.7 | 5.0 | 4.3 | 3.7 | 3.0 | 2.5 | 1.9 |
| bulk carrier | 0–9,999 | DWT | 22.2 | 20.3 | 18.1 | 16.0 | 13.9 | 12.0 | 10.2 | 8.5 | 6.9 | 5.3 |
| | 10,000–34,999 | DWT | 7.8 | 7.1 | 6.3 | 5.6 | 4.9 | 4.2 | 3.6 | 3.0 | 2.4 | 1.9 |
| | 35,000–59,999 | DWT | 5.3 | 4.9 | 4.3 | 3.8 | 3.3 | 2.9 | 2.5 | 2.0 | 1.7 | 1.3 |
| | 60,000–99,999 | DWT | 4.0 | 3.7 | 3.3 | 2.9 | 2.5 | 2.2 | 1.8 | 1.5 | 1.2 | 1.0 |
| | 100,000–199,999 | DWT | 2.8 | 2.5 | 2.2 | 2.0 | 1.7 | 1.5 | 1.3 | 1.1 | 0.9 | 0.7 |
| | 200,000–+ | DWT | 2.4 | 2.2 | 2.0 | 1.8 | 1.5 | 1.3 | 1.1 | 0.9 | 0.8 | 0.6 |
| oil tanker | 0–4,999 | DWT | 32.8 | 30.0 | 26.7 | 23.6 | 20.6 | 17.8 | 15.1 | 12.6 | 10.2 | 7.9 |
| | 5,000–9,999 | DWT | 22.6 | 20.7 | 18.4 | 16.2 | 14.2 | 12.2 | 10.4 | 8.7 | 7.0 | 5.4 |
| | 10,000–19,999 | DWT | 14.5 | 13.3 | 11.8 | 10.4 | 9.1 | 7.9 | 6.7 | 5.6 | 4.5 | 3.5 |
| | 20,000–59,999 | DWT | 7.3 | 6.7 | 5.9 | 5.3 | 4.6 | 4.0 | 3.4 | 2.8 | 2.3 | 1.8 |
| | 60,000–79,999 | DWT | 5.6 | 5.1 | 4.5 | 4.0 | 3.5 | 3.0 | 2.6 | 2.1 | 1.7 | 1.3 |
| | 80,000–119,999 | DWT | 4.1 | 3.8 | 3.4 | 3.0 | 2.6 | 2.2 | 1.9 | 1.6 | 1.3 | 1.0 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 120,000–199,999 | DWT | 3.6 | 3.2 | 2.9 | 2.6 | 2.2 | 1.9 | 1.6 | 1.4 | 1.1 | 0.9 |
| | 200,000–+ | DWT | 2.7 | 2.4 | 2.2 | 1.9 | 1.7 | 1.4 | 1.2 | 1.0 | 0.8 | 0.6 |
| chemical tanker | 0–4,999 | DWT | 29.3 | 26.8 | 23.9 | 21.1 | 18.4 | 15.9 | 13.5 | 11.2 | 9.1 | 7.1 |
| | 5,000–9,999 | DWT | 20.4 | 18.6 | 16.6 | 14.6 | 12.8 | 11.0 | 9.4 | 7.8 | 6.3 | 4.9 |
| | 10,000–19,999 | DWT | 13.2 | 12.1 | 10.7 | 9.5 | 8.3 | 7.1 | 6.1 | 5.1 | 4.1 | 3.2 |
| | 20,000–+ | DWT | 7.5 | 6.8 | 6.1 | 5.4 | 4.7 | 4.1 | 3.4 | 2.9 | 2.3 | 1.8 |
| general cargo | 0–4,999 | DWT | 24.8 | 22.7 | 20.2 | 17.9 | 15.6 | 13.5 | 11.4 | 9.5 | 7.7 | 6.0 |
| | 5,000–9,999 | DWT | 19.2 | 17.6 | 15.7 | 13.8 | 12.1 | 10.4 | 8.9 | 7.4 | 6.0 | 4.6 |
| | 10,000–+ | DWT | 10.8 | 9.9 | 8.8 | 7.8 | 6.8 | 5.9 | 5.0 | 4.1 | 3.3 | 2.6 |
| liquefied gas tanker | 0–49,999 | DWT | 19.3 | 17.7 | 15.8 | 13.9 | 12.1 | 10.5 | 8.9 | 7.4 | 6.0 | 4.7 |
| | 50,000–199,999 | DWT | 7.7 | 7.0 | 6.2 | 5.5 | 4.8 | 4.2 | 3.5 | 2.9 | 2.4 | 1.8 |
| | 200,000–+ | DWT | 8.4 | 7.7 | 6.8 | 6.0 | 5.3 | 4.5 | 3.9 | 3.2 | 2.6 | 2.0 |
| cruise | 0–1,999 | GT | 101.6 | 93.0 | 82.8 | 73.1 | 63.8 | 55.1 | 46.8 | 38.9 | 31.5 | 24.5 |
| | 2,000–9,999 | GT | 32.9 | 30.1 | 26.8 | 23.7 | 20.7 | 17.8 | 15.2 | 12.6 | 10.2 | 7.9 |
| | 10,000–59,999 | GT | 21.8 | 20.0 | 17.8 | 15.7 | 13.7 | 11.8 | 10.1 | 8.4 | 6.8 | 5.3 |
| | 60,000–99,999 | GT | 23.2 | 21.2 | 18.9 | 16.7 | 14.6 | 12.6 | 10.7 | 8.9 | 7.2 | 5.6 |
| | 100,000–+ | GT | 18.1 | 16.6 | 14.7 | 13.0 | 11.4 | 9.8 | 8.3 | 6.9 | 5.6 | 4.4 |
| ferry-ro-pax | 0–1,999 | GT | 81.1 | 74.2 | 66.1 | 58.3 | 51.0 | 44.0 | 37.4 | 31.1 | 25.2 | 19.5 |
| | 2,000—+ | GT | 25.3 | 23.2 | 20.6 | 18.2 | 15.9 | 13.7 | 11.7 | 9.7 | 7.9 | 6.1 |
| roro | 0–4,999 | GT | 84.8 | 77.6 | 69.1 | 61.0 | 53.3 | 46.0 | 39.1 | 32.5 | 26.3 | 20.4 |
| | 5,000–+ | GT | 18.5 | 16.9 | 15.0 | 13.3 | 11.6 | 10.0 | 8.5 | 7.1 | 5.7 | 4.4 |
| refrigerated bulk | 0–1,999 | DWT | 29.0 | 26.5 | 23.6 | 20.8 | 18.2 | 15.7 | 13.3 | 11.1 | 9.0 | 7.0 |
| ferry-pax only | 0–1,999 | GT | 148.7 | 136.1 | 121.1 | 106.9 | 93.4 | 80.6 | 68.5 | 57.0 | 46.1 | 35.8 |
| | 2,000—+ | GT | 28.5 | 26.1 | 23.2 | 20.5 | 17.9 | 15.5 | 13.1 | 10.9 | 8.8 | 6.9 |
| other liquid tankers | 0–+ | DWT | 26.8 | 24.5 | 21.8 | 19.3 | 16.8 | 14.5 | 12.3 | 10.3 | 8.3 | 6.5 |
| | | | | 20.9 | 18.7 | 16.5 | 14.4 | 12.4 | 10.5 | 8.8 | 7.1 | 5.5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1.5ºC compatible improvement in carbon intensity over 2019** | 0% | -8% | -19% | -28% | -37% | -46% | -54% | -62% | -69% | -76% |
| **1.5ºC compatible improvement in carbon intensity over 2008** | -29% | -35% | -42% | -49% | -55% | -61% | -67% | -73% | -78% | -83% |

*Table 2: Baselines and carbon intensity reduction objectives compatible with well below 2ºC decarbonization trajectory*

| **Ship Type** | **Capacity Bin** | **Capacity metric** | **Carbon intensity objectives (gCO2eq/dwt-nm and gCO2eq/GT-nm)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **2019** (benchmark) | **Cycle 1** | | | **Cycle 2** | | | **Cycle 3** | | |
| | | | | **2022** (first year of implementation) | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** (-76% below 2019 or -83% below 2008) |
| container | 0–999 | DWT | 22.9 | 20.9 | 19.7 | 18.4 | 17.3 | 16.1 | 15.1 | 14.0 | 13.1 | 12.1 |
| | 1,000–1,999 | DWT | 16.0 | 14.6 | 13.7 | 12.9 | 12.1 | 11.3 | 10.5 | 9.8 | 9.1 | 8.5 |
| | 2,000–2,999 | DWT | 11.4 | 10.5 | 9.8 | 9.2 | 8.6 | 8.1 | 7.5 | 7.0 | 6.5 | 6.1 |
| | 3,000–4,999 | DWT | 10.0 | 9.1 | 8.6 | 8.0 | 7.5 | 7.0 | 6.6 | 6.1 | 5.7 | 5.3 |
| | 5,000–7,999 | DWT | 9.4 | 8.6 | 8.1 | 7.6 | 7.1 | 6.6 | 6.2 | 5.8 | 5.4 | 5.0 |
| | 8,000–11,999 | DWT | 7.7 | 7.0 | 6.6 | 6.2 | 5.8 | 5.4 | 5.0 | 4.7 | 4.4 | 4.1 |
| | 12,000–14,500 | DWT | 6.5 | 5.9 | 5.6 | 5.2 | 4.9 | 4.6 | 4.3 | 4.0 | 3.7 | 3.4 |
| | 14,500–+ | DWT | 7.9 | 7.3 | 6.8 | 6.4 | 6.0 | 5.6 | 5.2 | 4.9 | 4.5 | 4.2 |
| bulk carrier | 0–9,999 | DWT | 22.2 | 20.3 | 19.1 | 17.9 | 16.7 | 15.6 | 14.6 | 13.6 | 12.7 | 11.8 |
| | 10,000–34,999 | DWT | 7.8 | 7.1 | 6.7 | 6.2 | 5.8 | 5.5 | 5.1 | 4.8 | 4.4 | 4.1 |
| | 35,000–59,999 | DWT | 5.3 | 4.9 | 4.6 | 4.3 | 4.0 | 3.8 | 3.5 | 3.3 | 3.0 | 2.8 |
| | 60,000–99,999 | DWT | 4.0 | 3.7 | 3.4 | 3.2 | 3.0 | 2.8 | 2.6 | 2.5 | 2.3 | 2.1 |
| | 100,000–199,999 | DWT | 2.8 | 2.5 | 2.4 | 2.2 | 2.1 | 1.9 | 1.8 | 1.7 | 1.6 | 1.5 |
| | 200,000–+ | DWT | 2.4 | 2.2 | 2.1 | 2.0 | 1.8 | 1.7 | 1.6 | 1.5 | 1.4 | 1.3 |
| oil tanker | 0–4,999 | DWT | 32.8 | 30.0 | 28.2 | 26.4 | 24.7 | 23.1 | 21.6 | 20.1 | 18.7 | 17.4 |
| | 5,000–9,999 | DWT | 22.6 | 20.7 | 19.4 | 18.2 | 17.0 | 15.9 | 14.9 | 13.9 | 12.9 | 12.0 |
| | 10,000–19,999 | DWT | 14.5 | 13.3 | 12.5 | 11.7 | 10.9 | 10.2 | 9.5 | 8.9 | 8.3 | 7.7 |
| | 20,000–59,999 | DWT | 7.3 | 6.7 | 6.3 | 5.9 | 5.5 | 5.1 | 4.8 | 4.5 | 4.2 | 3.9 |
| | 60,000–79,999 | DWT | 5.6 | 5.1 | 4.8 | 4.5 | 4.2 | 3.9 | 3.7 | 3.4 | 3.2 | 2.9 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 80,000–119,999 | DWT | 4.1 | 3.8 | 3.5 | 3.3 | 3.1 | 2.9 | 2.7 | 2.5 | 2.4 | 2.2 |
| | 120,000–199,999 | DWT | 3.6 | 3.2 | 3.1 | 2.9 | 2.7 | 2.5 | 2.3 | 2.2 | 2.0 | 1.9 |
| | 200,000–+ | DWT | 2.7 | 2.4 | 2.3 | 2.1 | 2.0 | 1.9 | 1.7 | 1.6 | 1.5 | 1.4 |
| chemical tanker | 0–4,999 | DWT | 29.3 | 26.8 | 25.2 | 23.6 | 22.1 | 20.6 | 19.3 | 18.0 | 16.7 | 15.5 |
| | 5,000–9,999 | DWT | 20.4 | 18.6 | 17.5 | 16.4 | 15.4 | 14.4 | 13.4 | 12.5 | 11.6 | 10.8 |
| | 10,000–19,999 | DWT | 13.2 | 12.1 | 11.3 | 10.6 | 9.9 | 9.3 | 8.7 | 8.1 | 7.5 | 7.0 |
| | 20,000–+ | DWT | 7.5 | 6.8 | 6.4 | 6.0 | 5.6 | 5.3 | 4.9 | 4.6 | 4.3 | 4.0 |
| general cargo | 0–4,999 | DWT | 24.8 | 22.7 | 21.3 | 20.0 | 18.7 | 17.5 | 16.3 | 15.2 | 14.2 | 13.2 |
| | 5,000–9,999 | DWT | 19.2 | 17.6 | 16.5 | 15.5 | 14.5 | 13.6 | 12.6 | 11.8 | 11.0 | 10.2 |
| | 10,000–+ | DWT | 10.8 | 9.9 | 9.3 | 8.7 | 8.1 | 7.6 | 7.1 | 6.6 | 6.2 | 5.7 |
| liquefied gas tanker | 0–49,999 | DWT | 19.3 | 17.7 | 16.6 | 15.6 | 14.6 | 13.6 | 12.7 | 11.9 | 11.0 | 10.2 |
| | 50,000–199,999 | DWT | 7.7 | 7.0 | 6.6 | 6.2 | 5.8 | 5.4 | 5.0 | 4.7 | 4.4 | 4.1 |
| | 200,000–+ | DWT | 8.4 | 7.7 | 7.2 | 6.7 | 6.3 | 5.9 | 5.5 | 5.1 | 4.8 | 4.4 |
| cruise | 0–1,999 | GT | 101.6 | 93.0 | 87.3 | 81.8 | 76.6 | 71.6 | 66.9 | 62.3 | 58.0 | 53.8 |
| | 2,000–9,999 | GT | 32.9 | 30.1 | 28.3 | 26.5 | 24.8 | 23.2 | 21.6 | 20.2 | 18.8 | 17.4 |
| | 10,000–59,999 | GT | 21.8 | 20.0 | 18.8 | 17.6 | 16.5 | 15.4 | 14.4 | 13.4 | 12.5 | 11.6 |
| | 60,000–99,999 | GT | 23.2 | 21.2 | 19.9 | 18.7 | 17.5 | 16.3 | 15.2 | 14.2 | 13.2 | 12.3 |
| | 100,000–+ | GT | 18.1 | 16.6 | 15.5 | 14.6 | 13.6 | 12.8 | 11.9 | 11.1 | 10.3 | 9.6 |
| ferry-ro-pax | 0–1,999 | GT | 81.1 | 74.2 | 69.7 | 65.3 | 61.1 | 57.2 | 53.4 | 49.7 | 46.3 | 43.0 |
| | 2,000—+ | GT | 25.3 | 23.2 | 21.7 | 20.4 | 19.1 | 17.8 | 16.7 | 15.5 | 14.4 | 13.4 |
| roro | 0–4,999 | GT | 84.8 | 77.6 | 72.9 | 68.3 | 64.0 | 59.8 | 55.8 | 52.0 | 48.4 | 45.0 |
| | 5,000–+ | GT | 18.5 | 16.9 | 15.9 | 14.9 | 13.9 | 13.0 | 12.2 | 11.3 | 10.5 | 9.8 |
| refrigerated bulk | 0–1,999 | DWT | 29.0 | 26.5 | 24.9 | 23.3 | 21.8 | 20.4 | 19.1 | 17.8 | 16.5 | 15.3 |
| ferry-pax only | 0–1,999 | GT | 148.7 | 136.1 | 127.8 | 119.8 | 112.1 | 104.8 | 97.9 | 91.2 | 84.9 | 78.8 |
| | 2,000—+ | GT | 28.5 | 26.1 | 24.5 | 23.0 | 21.5 | 20.1 | 18.8 | 17.5 | 16.3 | 15.1 |
| other liquid tankers | 0–+ | DWT | 26.8 | 24.5 | 23.0 | 21.6 | 20.2 | 18.9 | 17.6 | 16.4 | 15.3 | 14.2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1.5ºC compatible improvement in carbon intensity over 2019** | 0% | -8% | -14% | -19% | -25% | -29% | -34% | -39% | -43% | -47% |
| **1.5ºC compatible improvement in carbon intensity over 2008** | -29% | -35% | -39% | -43% | -46% | -50% | -53% | -56% | -59% | -62% |

*Table 3: Real-world cargo load factors for cargo ships in 2018 (source: Transport & Environment based on EU MRV data)*

| EU MRV ship type | Size categories | Size category unit | Total # ships | Total $CO_2$ (Mt) | Average load factor (actual cargo/DWT) |
|---|---|---|---|---|---|
| Ro-ro ship | 0-4999 | dwt | 19 | 0.284 | 32% |
| Ro-ro ship | 5000-+ | dwt | 231 | 5.590 | 37% |
| General cargo ship | 0-4999 | dwt | 7 | 0.040 | 26% |
| General cargo ship | 5000-9999 | dwt | 383 | 1.701 | 60% |
| General cargo ship | 10000-+ | dwt | 614 | 3.767 | 52% |
| Vehicle carrier | 0-+ | vehicle | 410 | 4.581 | 28% |
| Container ship | 0-999 | teU | 150 | 1.871 | 47% |
| Container ship | 1000-1999 | teU | 263 | 3.222 | 48% |
| Container ship | 2000-2999 | teU | 205 | 3.700 | 46% |
| Container ship | 3000-4999 | teU | 257 | 6.530 | 49% |
| Container ship | 5000-7999 | teU | 222 | 6.085 | 56% |
| Container ship | 8000-11999 | teU | 259 | 8.006 | 59% |
| Container ship | 12000-14499 | teU | 133 | 4.634 | 69% |
| Container ship | 14500-+ | teU | 137 | 7.590 | 70% |
| Other ship types | 0-+ | gt | 61 | 0.584 | 34% |
| Gas carrier | 0-+ | dwt | 288 | 2.345 | 33% |
| Bulk carrier | 0-9999 | dwt | 13 | 0.057 | 67% |
| Bulk carrier | 10000-34999 | dwt | 412 | 1.569 | 65% |
| Bulk carrier | 35000-59999 | dwt | 932 | 3.353 | 65% |
| Bulk carrier | 60000-99999 | dwt | 1202 | 6.493 | 57% |
| Bulk carrier | 100000-199999 | dwt | 377 | 3.155 | 57% |
| Bulk carrier | 200000-+ | dwt | 41 | 0.151 | 53% |
| Chemical tanker | 5000-9999 | dwt | 96 | 0.629 | 50% |
| Chemical tanker | 10000-19999 | dwt | 325 | 1.997 | 54% |
| Chemical tanker | 20000-+ | dwt | 672 | 4.990 | 54% |
| Refrigerated cargo carrier | 0-+ | dwt | 135 | 1.712 | 38% |
| Container/ro-ro cargo ship | 0-4999 | dwt | 2 | 0.014 | 47% |
| Container/ro-ro cargo ship | 5000-9999 | dwt | 10 | 0.205 | 34% |
| Container/ro-ro cargo ship | 10000-+ | dwt | 60 | 1.254 | 36% |
| Oil tanker | 5000-9999 | dwt | 39 | 0.181 | 64% |
| Oil tanker | 10000-19999 | dwt | 68 | 0.519 | 50% |
| Oil tanker | 20000-59999 | dwt | 374 | 3.097 | 50% |
| Oil tanker | 60000-79999 | dwt | 195 | 1.242 | 60% |
| Oil tanker | 80000-119999 | dwt | 480 | 5.729 | 52% |

| | | | | | |
|---|---|---|---|---|---|
| Oil tanker | 120000-199999 | dwt | 337 | 4.172 | 56% |
| Oil tanker | 200000-+ | dwt | 109 | 1.290 | 66% |
| Combination carrier | 10000-+ | dwt | 5 | 0.075 | 48% |
| LNG carrier | 50000-199999 | cbm | 155 | 4.219 | 49% |
| LNG carrier | 200000-+ | cbm | 34 | 0.908 | 40% |

***

# ANNEX 2

## DRAFT AMENDMENTS TO MARPOL ANNEX VI FOR THE REGULATION OF SHIP OPERATIONAL CARBON INTENSITY

(shown as additions/~~deletions~~)

**Regulation 22B**
*Required annual carbon intensity improvements*

1 Each ship included in the scope of this regulation pursuant to appendix [X] shall ensure that its annual average carbon intensity (CI) per compliance cycle does not exceed the relevant values stated in table 1 of appendix [X] of the current regulation.

2 Compliance cycle shall be defined as three years in a row starting from the first year of implementation of this regulation. Ships that exceed the required annual CI requirements shall be allowed to reduce the required annual CI requirements in the next year within the same compliance cycle by the difference between the required and attained annual CI reductions in the current year.

3 Carbon intensity for each ship shall be defined as Annual Efficiency Ratio (AER) and measured as total annual $CO_2eq$ emitted per transport work.

4 Transport work for ships other than cruise ships, ferry-ro-pax, ferry-pax only and ro-ro ships shall be measured as 70% of ship deadweight (DWT) multiplied by the total distance sailed per annum. The following equation shall be used to measure compliance with the required CI for ships other than cruise ships, ferry-ro-pax, ferry-pax only and ro-ro vessels:

$$\textit{Attained AER}_{(year\ n)} = CO_2eq_{(year\ N)} / (70\%*DWT*\textit{total distance sailed}_{(year\ N)})$$

5 Transport work for cruise ships, ferry-ro-pax, ferry-pax only and ro-ro ships shall be measured as 100% ship gross tonnage (GT) multiplied by the total distance sailed per annum. The following equation shall be used to measure compliance with the required CI for these ship types:

$$\textit{Attained AER}_{(year\ n)} = CO_2eq_{(year\ N)} / (100\%*GT*\textit{total distance sailed}_{(year\ N)})$$

6 Verification of compliance with required CI per compliance cycle shall be measured using the following equation:

$$\sum_{(year=1,2,3,\ cycle\ n)}(\textit{required AERs} - \textit{Attained AERs}) = 0$$

7 An attained annual average CI within each compliance cycle that is higher than the required annual average CI per compliance cycle reduction shall be deemed a non-conformity with the requirements of the present regulation. This will be revealed if the formula in paragraph 6 returns a value higher than 0.

8 Once non-conformity is established, robust action shall be taken by the flag Administration to prevent non-conformity from being repeated in the future and to remedy as much as possible the past non-compliance. To that end ship International Air Pollution Prevention (IAPP) certificate should be amended to limit its validity for the first year of the following compliance cycle by a percentage commensurate to the level of non-compliance in the previous compliance cycle. Only when a non-conformity is detected, the following equation shall be used to curb the validity of the IAPP:

***Permitted sailing time$_{(year\ 1,\ cycle\ n+1)}$ = 8760 – ((average annual hours underway$_{(cycle\ n)}$ + average annual service hours$_{(cycle\ n)}$) * (average Attained AER$_{(cycle\ n)}$ / average AER objectives$_{(cycle\ n)}$-1))***

9 Remote SIDS and LDCs as defined by the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States, whenever appropriate, can keep an annual inventory of ships visiting their ports. If ships servicing these countries fail to comply with the requirements set in paragraph 1, Administrations can decide not to apply the requirements of paragraph 8 on those ships.

10 On the basis of the reported data submitted to the IMO Ship Fuel Oil Consumption Database, the Secretary-General of the Organization shall produce an annual report to the Marine Environment Protection Committee summarizing the status of compliance with this regulation 22B on achievement of CI requirements for ships, the status of any missing data, and such other relevant information as may be requested by the Committee.

## Appendix […]

## Required Carbon Intensity for ships

### Scope of regulation 22B

1 Regulation 22B applies to the following ship type and size categories listed in table 1 below.

2 Each ship shall not exceed the carbon intensity values in table 1 as appropriate to that ship's type and size category.

*Table 1: Carbon intensity requirements*

| **Ship Type** | **Capacity Bin** | **Capacity metric** | **Carbon intensity objectives (gCO$_2$eq/dwt-nm and gCO$_2$eq/GT-nm)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **2019** (benchmark) | **Cycle 1** | | | **Cycle 2** | | | **Cycle 3** | | |
| | | | | **2022** (first year of implementation) | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** (-76% below 2019 or -83% below 2008) |
| container | 0–999 | DWT | 22.9 | 20.9 | 18.7 | 16.5 | 14.4 | 12.4 | 10.5 | 8.8 | 7.1 | 5.5 |
| | 1,000–1,999 | DWT | 16.0 | 14.6 | 13.0 | 11.5 | 10.0 | 8.7 | 7.4 | 6.1 | 5.0 | 3.8 |
| | 2,000–2,999 | DWT | 11.4 | 10.5 | 9.3 | 8.2 | 7.2 | 6.2 | 5.3 | 4.4 | 3.5 | 2.8 |
| | 3,000–4,999 | DWT | 10.0 | 9.1 | 8.1 | 7.2 | 6.3 | 5.4 | 4.6 | 3.8 | 3.1 | 2.4 |
| | 5,000–7,999 | DWT | 9.4 | 8.6 | 7.7 | 6.8 | 5.9 | 5.1 | 4.3 | 3.6 | 2.9 | 2.3 |
| | 8,000–11,999 | DWT | 7.7 | 7.0 | 6.2 | 5.5 | 4.8 | 4.2 | 3.5 | 2.9 | 2.4 | 1.8 |
| | 12,000–14,500 | DWT | 6.5 | 5.9 | 5.3 | 4.7 | 4.1 | 3.5 | 3.0 | 2.5 | 2.0 | 1.6 |
| | 14,500–+ | DWT | 7.9 | 7.3 | 6.5 | 5.7 | 5.0 | 4.3 | 3.7 | 3.0 | 2.5 | 1.9 |
| bulk carrier | 0–9,999 | DWT | 22.2 | 20.3 | 18.1 | 16.0 | 13.9 | 12.0 | 10.2 | 8.5 | 6.9 | 5.3 |
| | 10,000–34,999 | DWT | 7.8 | 7.1 | 6.3 | 5.6 | 4.9 | 4.2 | 3.6 | 3.0 | 2.4 | 1.9 |
| | 35,000–59,999 | DWT | 5.3 | 4.9 | 4.3 | 3.8 | 3.3 | 2.9 | 2.5 | 2.0 | 1.7 | 1.3 |
| | 60,000–99,999 | DWT | 4.0 | 3.7 | 3.3 | 2.9 | 2.5 | 2.2 | 1.8 | 1.5 | 1.2 | 1.0 |
| | 100,000–199,999 | DWT | 2.8 | 2.5 | 2.2 | 2.0 | 1.7 | 1.5 | 1.3 | 1.1 | 0.9 | 0.7 |
| | 200,000–+ | DWT | 2.4 | 2.2 | 2.0 | 1.8 | 1.5 | 1.3 | 1.1 | 0.9 | 0.8 | 0.6 |
| oil tanker | 0–4,999 | DWT | 32.8 | 30.0 | 26.7 | 23.6 | 20.6 | 17.8 | 15.1 | 12.6 | 10.2 | 7.9 |
| | 5,000–9,999 | DWT | 22.6 | 20.7 | 18.4 | 16.2 | 14.2 | 12.2 | 10.4 | 8.7 | 7.0 | 5.4 |
| | 10,000–19,999 | DWT | 14.5 | 13.3 | 11.8 | 10.4 | 9.1 | 7.9 | 6.7 | 5.6 | 4.5 | 3.5 |
| | 20,000–59,999 | DWT | 7.3 | 6.7 | 5.9 | 5.3 | 4.6 | 4.0 | 3.4 | 2.8 | 2.3 | 1.8 |
| | 60,000–79,999 | DWT | 5.6 | 5.1 | 4.5 | 4.0 | 3.5 | 3.0 | 2.6 | 2.1 | 1.7 | 1.3 |
| | 80,000–119,999 | DWT | 4.1 | 3.8 | 3.4 | 3.0 | 2.6 | 2.2 | 1.9 | 1.6 | 1.3 | 1.0 |
| | 120,000–199,999 | DWT | 3.6 | 3.2 | 2.9 | 2.6 | 2.2 | 1.9 | 1.6 | 1.4 | 1.1 | 0.9 |
| | 200,000–+ | DWT | 2.7 | 2.4 | 2.2 | 1.9 | 1.7 | 1.4 | 1.2 | 1.0 | 0.8 | 0.6 |
| chemical tanker | 0–4,999 | DWT | 29.3 | 26.8 | 23.9 | 21.1 | 18.4 | 15.9 | 13.5 | 11.2 | 9.1 | 7.1 |
| | 5,000–9,999 | DWT | 20.4 | 18.6 | 16.6 | 14.6 | 12.8 | 11.0 | 9.4 | 7.8 | 6.3 | 4.9 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10,000–19,999 | DWT | 13.2 | 12.1 | 10.7 | 9.5 | 8.3 | 7.1 | 6.1 | 5.1 | 4.1 | 3.2 |
| | 20,000–+ | DWT | 7.5 | 6.8 | 6.1 | 5.4 | 4.7 | 4.1 | 3.4 | 2.9 | 2.3 | 1.8 |
| general cargo | 0–4,999 | DWT | 24.8 | 22.7 | 20.2 | 17.9 | 15.6 | 13.5 | 11.4 | 9.5 | 7.7 | 6.0 |
| | 5,000–9,999 | DWT | 19.2 | 17.6 | 15.7 | 13.8 | 12.1 | 10.4 | 8.9 | 7.4 | 6.0 | 4.6 |
| | 10,000–+ | DWT | 10.8 | 9.9 | 8.8 | 7.8 | 6.8 | 5.9 | 5.0 | 4.1 | 3.3 | 2.6 |
| liquefied gas tanker | 0–49,999 | DWT | 19.3 | 17.7 | 15.8 | 13.9 | 12.1 | 10.5 | 8.9 | 7.4 | 6.0 | 4.7 |
| | 50,000–199,999 | DWT | 7.7 | 7.0 | 6.2 | 5.5 | 4.8 | 4.2 | 3.5 | 2.9 | 2.4 | 1.8 |
| | 200,000–+ | DWT | 8.4 | 7.7 | 6.8 | 6.0 | 5.3 | 4.5 | 3.9 | 3.2 | 2.6 | 2.0 |
| cruise | 0–1,999 | GT | 101.6 | 93.0 | 82.8 | 73.1 | 63.8 | 55.1 | 46.8 | 38.9 | 31.5 | 24.5 |
| | 2,000–9,999 | GT | 32.9 | 30.1 | 26.8 | 23.7 | 20.7 | 17.8 | 15.2 | 12.6 | 10.2 | 7.9 |
| | 10,000–59,999 | GT | 21.8 | 20.0 | 17.8 | 15.7 | 13.7 | 11.8 | 10.1 | 8.4 | 6.8 | 5.3 |
| | 60,000–99,999 | GT | 23.2 | 21.2 | 18.9 | 16.7 | 14.6 | 12.6 | 10.7 | 8.9 | 7.2 | 5.6 |
| | 100,000–+ | GT | 18.1 | 16.6 | 14.7 | 13.0 | 11.4 | 9.8 | 8.3 | 6.9 | 5.6 | 4.4 |
| ferry-ro-pax | 0–1,999 | GT | 81.1 | 74.2 | 66.1 | 58.3 | 51.0 | 44.0 | 37.4 | 31.1 | 25.2 | 19.5 |
| | 2,000—+ | GT | 25.3 | 23.2 | 20.6 | 18.2 | 15.9 | 13.7 | 11.7 | 9.7 | 7.9 | 6.1 |
| roro | 0–4,999 | GT | 84.8 | 77.6 | 69.1 | 61.0 | 53.3 | 46.0 | 39.1 | 32.5 | 26.3 | 20.4 |
| | 5,000–+ | GT | 18.5 | 16.9 | 15.0 | 13.3 | 11.6 | 10.0 | 8.5 | 7.1 | 5.7 | 4.4 |
| refrigerated bulk | 0–1,999 | DWT | 29.0 | 26.5 | 23.6 | 20.8 | 18.2 | 15.7 | 13.3 | 11.1 | 9.0 | 7.0 |
| ferry-pax only | 0–1,999 | GT | 148.7 | 136.1 | 121.1 | 106.9 | 93.4 | 80.6 | 68.5 | 57.0 | 46.1 | 35.8 |
| | 2,000—+ | GT | 28.5 | 26.1 | 23.2 | 20.5 | 17.9 | 15.5 | 13.1 | 10.9 | 8.8 | 6.9 |
| other liquid tankers | 0–+ | DWT | 26.8 | 24.5 | 21.8 | 19.3 | 16.8 | 14.5 | 12.3 | 10.3 | 8.3 | 6.5 |
| | | | | 20.9 | 18.7 | 16.5 | 14.4 | 12.4 | 10.5 | 8.8 | 7.1 | 5.5 |
| **1.5ºC compatible improvement in carbon intensity over 2019** | | | 0% | -8% | -19% | -28% | -37% | -46% | -54% | -62% | -69% | -76% |
| **1.5ºC compatible improvement in carbon intensity over 2008** | | | -29% | -35% | -42% | -49% | -55% | -61% | -67% | -73% | -78% | -83% |

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# ANNEX 3

## INITIAL IMPACT ASSESSMENT OF THE PROPOSAL FOR A GOAL-BASED APPROACH TO ACHIEVE SUBSTANTIAL SPEED-RELATED EMISSIONS REDUCTIONS

### 1 Impact on ships and emissions

1.1 In order to meet the Paris Agreement's goal of maintaining global temperature increase below 1.5ºC, the shipping industry must achieve full decarbonization by 2034. Under this scenario, substantial efforts to achieve real world absolute emissions reductions must begin as soon as possible.

1.2 The co-sponsors propose an operational goal-based approach (GBA) to achieve substantial speed-related emissions reductions in the short term. Under this approach, all ships would be required to meet within each compliance cycle an average carbon intensity (CI) which would be linearly reduced over time, categorized by ship type and size. This CI requirement will be based on an Annual Efficiency Ratio (AER) measured as $gCO_2$/DWT-tonne-nm and $gCO_2$/GT-tonne-nm. In keeping with the 2030 target in the Initial IMO GHG Strategy, the co-sponsors identify a short-term objective of reducing fleetwide emissions, as well as for individual ships, by at least 80% below the Initial GHG Strategy's 2008 baseline, or 75% below the 2019 calibrated specific benchmarks identified in this proposal. In this desk-based initial impact assessment, we look at the potential impacts of this measure.

1.3 This goal-based approach would give ships a degree of flexibility in meeting their required CI target. Ships could improve their carbon intensity by:

- reducing speed;
- using energy saving technologies, including but not limited to wind-assistance; and/or by
- switching to zero-carbon fuels.

1.4 Under this approach, individual ships would be competing against their fleet average per type/size, ensuring that ships which have already invested in energy saving technologies or other efficiencies would see a benefit to their investments in the first years of implementation. For older ships, a combination of energy saving technologies and reduced speeds will be needed to meet the necessary CI in a given year. Consequently, shipowners will be able to choose the most cost-effective solutions.

1.5 A goal-based approach could be implemented fairly quickly, but would require several additional elements to be fully developed. While the co-sponsors propose a system of annual audits and improvements on a three-year cycle, it may be necessary to explore a complementary method for assessing CI in a manner that better suits the charter market. At present there is a split incentive between parties in a charter agreement which discourages the uptake of alternative fuels without firm regulatory rules (Sing & Rambarath-Parasm, 2019). IMO could consider developing additional guidelines which translates annual CI objectives into CI objectives per journey in order to provide greater clarity for ships operating in this market.

1.6 In the event of non-compliance the co-sponsors propose a limitation of sailing time for the first year after the compliance cycle, proportionate to the level of cumulative non-compliance in the preceding compliance cycle. IMO would need to develop guidelines to track a ship's annual service hours, which could be easily incorporated into annual DCS reporting, in order to implement this method. This method of enforcement, unlike post-facto methods such as fines, would have an immediate effect on a non-compliant ship's emissions, and would prevent further emissions of GHG.

1.7 By providing a universally applicable and ambitious pathway towards full decarbonization by 2034, this approach will ultimately achieve the vision of the Initial IMO GHG Strategy. Considering the full economic and human costs of climate change, the co-sponsors believe the potential benefits of this approach will far outweigh the potential costs.

## 2 Identification of Impacts to be assessed

### 2.1 Geographic remoteness and connectivity to main markets

2.1.1 This goal-based approach and its associated non-compliance mechanism could theoretically have an adverse effect on geographically remote markets, and the co-sponsors anticipate implementing mitigation measures to address any potentially disproportionate effects on Small Island Developing States (SIDS) and Least Developed Countries (LDCs).

2.1.2 For SIDS/LDCs and other nations away from major trade routes, the freight rates for shipping are typically higher. However, this cost is not strictly connected to distance from major routes. In their analysis of Caribbean freight rates, Willsmeier and Hoffman found that competition between multiple shippers, the level of port infrastructure, low volumes of trade, and the possibility for trans-shipment were just as important in determining freight rates to more geographically remote markets (Willsmeier & Hoffman, 2008)[8]. This suggests that freight rates to these States are determined more by the degree to which the market is controlled by an oligopoly of shippers than the speed at which ships travel or the distance from trading partners. In that sense, these countries might be well advised to look into their national competition laws, international trade agreements, and possibly the WTO for solutions to their relatively higher freight rates. IMO is not necessarily the correct place to solve these problems.

2.1.2 Moreover, as fuel constitutes the largest share of domestic fleet operating costs, potentially 40% to 60% in the case of Pacific Island Countries, reducing dependency on imported fossil fuels could offer a long-term positive benefit (Peter et al., 2014).

2.1.3 However, given the distances involved and the age of the ships often serving these routes, the co-sponsors propose an opt-out clause from enforcement of the curb on sailing time for non-compliant ships on routes that primarily serve SIDS or LDCs. Noting the comments made by the delegation of Tonga at ISWG-GHG 6, the Working Group may wish to discuss the length of this opt-out phase to ensure a level playing field and the consistent development of more efficient ships to serve SIDS and LDCs (MEPC 75/7/2).

2.2 The co-sponsors also concur with the suggestion that, while outside the scope of this proposal, any dedicated international or regional funding to support R&D should invest in international shipping that serves SIDS and LDCs, especially in geographically remote areas.

### 2.2 Cargo value and type

2.2.1 As the goal-based approach applies a CI requirement differentiated by ship type and size, the measure would not disproportionately affect different cargo values or types. Shipowners would have the flexibility to adopt different measures as appropriate for their specific CI requirement. For instance, ships that carry potentially higher value or perishable goods such as electronics, car parts, or refrigerated foods may consider adopting wind or other energy-saving technologies like hull air lubrication (Comer et al., 2019).

[8] See also document ISWG-GHG 1/2/14 (Belgium et al.).

2.2.2 While the relationship between operating costs and the final price of consumer goods requires more study, assuming all costs were passed on to consumers, there would be a slight variation in prices between commodities. However, the effect on consumers would be negligible. In an analysis by Transport & Environment, the introduction of a shipping Emissions Trading Scheme with a €50/tonne-$CO_2$ (€150/tonne-fuel) carbon price would increase prices on a range of consumer goods anywhere between 0.6562% (grain), and 0.0005% (iPads)[9].

**2.3 Transport dependency**

2.3.1 As noted in paragraph 1.3, under a goal-based approach, many ships could opt to reduce speeds, which could potentially decrease operating costs in the short term. Some capital expenditures would be required to adopt energy-saving devices, or alternative fuels.

**2.4 Transport costs**

2.4.1 Under this goal-based approach, ships are likely to reduce speed, and this could have a positive effect on the operating costs during a voyage. Fuel oil is the single most important factor in overall transport costs, and in all but the most exceptional cases of low fuel prices or high daily earnings speed reductions up to around 30% remain below the break-even point (Healey & Graichen, 2019).

2.4.2 However, as ships adopt energy-saving devices, there will likely be additional upfront capital and operational costs associated with this transition. These costs will vary based on the device installed, as well as the potential fuel saved.

2.4.3 However, even under scenarios where transport costs increase dramatically, the difference in total goods transported by sea is comparatively slight. Halim et al. project that in scenarios where full decarbonization is pursued and unit transport costs increases by 100%, the global share of sea transport would decline just by 0.16% (Halim et Al., 2018).

2.4.4 More generally, Öko-Institut e.V. found that shipping also only accounted for a modest fraction of the overall transport costs reflected in a product price, and even in circumstances of low fuel oil or high operator costs, the final impact on most cargo costs is likely to be negligible (Healey & Graichen, 2019).

**2.5 Food security**

2.5.1 The co-sponsors do not believe that this goal-based approach will negatively affect food security. As ships will have the discretion of adopting the most cost-effective tools to meet their required CI, refrigerated ships and others may consider technological energy-savers rather than slow steaming.

2.5.2 As the IPCC's Special Report on the impacts of global warming of 1.5°C above pre-industrial levels makes clear, limiting the overall increase in temperatures is essential to the long-term food security of many communities. To cite just one example, fisheries will likely be affected by shifting temperatures and increasing ocean acidification (IPCC, 2018).

**2.6 Disaster response**

2.6.1 As this goal-based approach does not prescribe alteration of a ship's technical ability, co-sponsors do not anticipate any effect on disaster response. In the event a ship is doing so,

[9] Transport & Environment, EU shipping's €24bn-a-year fossil tax holidays, 2019 accessible at: https://www.transportenvironment.org/publications/eu-shippings-%E2%82%AC24bn-year-fossil-tax-holidays

IMO could consider developing specific guidelines and rules describing the circumstances, e.g. a verifiable disaster response, when ships would be allowed to sail beyond the limits set by the regulation.

**3 Positive and negative potential impacts**

3.1 The co-sponsors anticipate the following positive impacts:

1. the reduction of emissions across the fleet, with the potential to keep global heating below the Paris Agreement's objective of 1.5°C;

2. it provides a consistent incentive for the uptake of technological innovations that reduce carbon intensity. This measure is not only future-proofed for other targets in the Initial IMO GHG Strategy beyond 2030, but it also aligns with the overall vision of fully decarbonizing the fleet "as a matter of urgency";

3. it incentivises uptake of alternative fuels. As estimated by University Maritime Advisory Services (UMAS) and Energy Transitions Commission (ETC), fully decarbonizing the maritime sector will require investments from $1.4 trillion to $1.9 trillion (Global Maritime Forum, 2020). The vast majority (87%) of these investments will be required in onshore development of renewable resources and this proposal provides a strong demand for such investments; and

4. it reduces the overall impact of climate change on many States and the shipping industry itself.

3.2 The co-sponsors anticipate the following negative impacts:

1. capital costs in installing new energy-savers;

2. potential operational costs in new zero-emission ships; and

3. voyage costs in alternative fuels.

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