INTERNATIONAL MARITIME ORGANIZATION

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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

Proposal for an operational carbon intensity rating mechanism as a mandatory goal-based measure to reduce the carbon intensity of international shipping

Submitted by Brazil and China

SUMMARY

Executive summary:	The document proposes an operational carbon intensity rating mechanism as a mandatory goal-based measure to reduce the carbon intensity of international shipping, including the proposed draft amendments to MARPOL Annex VI and the sketches of four supporting guidelines
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 35
Related documents:	ISWG-GHG 7/2; MEPC 74/7/4, MEPC 74/18; ISWG-GHG 6/2/9 and ISWG-GHG 6/2/10

Introduction

1 This document is submitted in accordance with the framework prepared by the Chair in document ISWG-GHG 7/2 and proposes an operational carbon intensity rating mechanism as a mandatory goal-based measure to reduce the carbon intensity of international shipping.

2 China welcomes the efforts led by the Chair to assist Member States in making progress on agenda item 2, including the submission of a regulatory framework on a mandatory goal-based measure to reduce carbon intensity of international shipping. The Chair's document seeks to offer an accommodative framework that does not pre-empt any decision by the Group. We accept document ISWG-GHG 7/2 as the basis for further development of

draft amendments to MARPOL Annex VI and propose to incorporate an operational carbon intensity rating mechanism into the possible regulatory framework on a mandatory goal-based measure to reduce the carbon intensity of international shipping.

Framework of the proposed operational carbon intensity rating mechanism

3 As specified in the Initial IMO GHG Strategy, the carbon intensity of international shipping should be reduced as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008. This implies that the attained operational carbon intensity of individual ships may be either higher or lower than the levels of ambition due to the highly volatile nature of operational performance, but the international shipping as a whole should achieve the targets. This can be additionally justified by the reference performance of the year 2008. When the reference performance is referred to, it always means the average operational carbon intensity of international shipping in year 2008, rather than the various performances of individual ships. In this regard, to give certain tolerance to some under-performance ships does not mean to compromise the levels of ambition. Rather, it is our way of paying due respect to the nature of international shipping.

4 Unlike the constant design efficiency, a ship's operational energy efficiency cannot be appropriately represented by an indicator of a random nature. A performance rating, which is based on the attained operational performance indicator value but has been rounded into a rough performance level, can provide a rational solution in this case. Through comparing the attained indicator value with the required one, a rating label, from among A, B, C, D or E, can be assigned to a ship, indicating a major superior, minor superior, moderate, minor inferior, or inferior performance level respectively. As explained above, the existence of a certain percentage of ships rated as D or E does not necessarily imply the failure of the international shipping in achieving its annual target, as in the meanwhile, there are ships rated as A or B. A well-designed rating system can ensure the fulfillment of the target while allowing for certain deviations of some individual ships.

5 To guide ships to pursue superior performance, the required operational carbon intensity indicator (referred to as required CII), in conjunction with the boundaries for dividing the rating bands, should be clearly defined well before the compliance period in the legal instruments or in the supporting guidelines to be developed by the Committee. Before the compliance period, a ship should update the SEEMP to incorporate the required CIIs of the following three years, as well as the strategy and/or methods to achieve these targets to the satisfaction of the Administration. Then, a Confirmation of Compliance (CoC) will be issued to the ship. After one compliance period (one calendar year), the attained CII of the ship and the updated SEEMP will be verified, and a Statement of Compliance (SoC) will be issued by the Administration, with the assigned rating level. For a ship rated as D or E, corrective strategy and/or methods should be undertaken before the SoC can be issued. For a ship rated as D for three consecutive years or rated as E, other means for remedy shall be additionally undertaken, in accordance with the provision on corrective actions and other means of compliance stipulated in the guidelines to be developed by the Organization.

6 To avoid the delay of being issued a valid SoC, ships shall continuously self-monitor their operational performance and calculate the annual attained CII as soon as the data are available. In the case where a ship is rated as D or E based on self-evaluation, corrective actions should be taken and be included in the updated SEEMP well before the verification of the Administration. Similarly, in the case where a ship is rated as D for three consecutive years or rated as E, other means for remedy should be undertaken well before the verification of the Administration.

7 The framework of the rating mechanism is illustrated in Figure 1 below. Besides, to facilitate smooth implementation of the rating mechanism, a trial period, certain exemptions, as well as the review process are also taken into account.

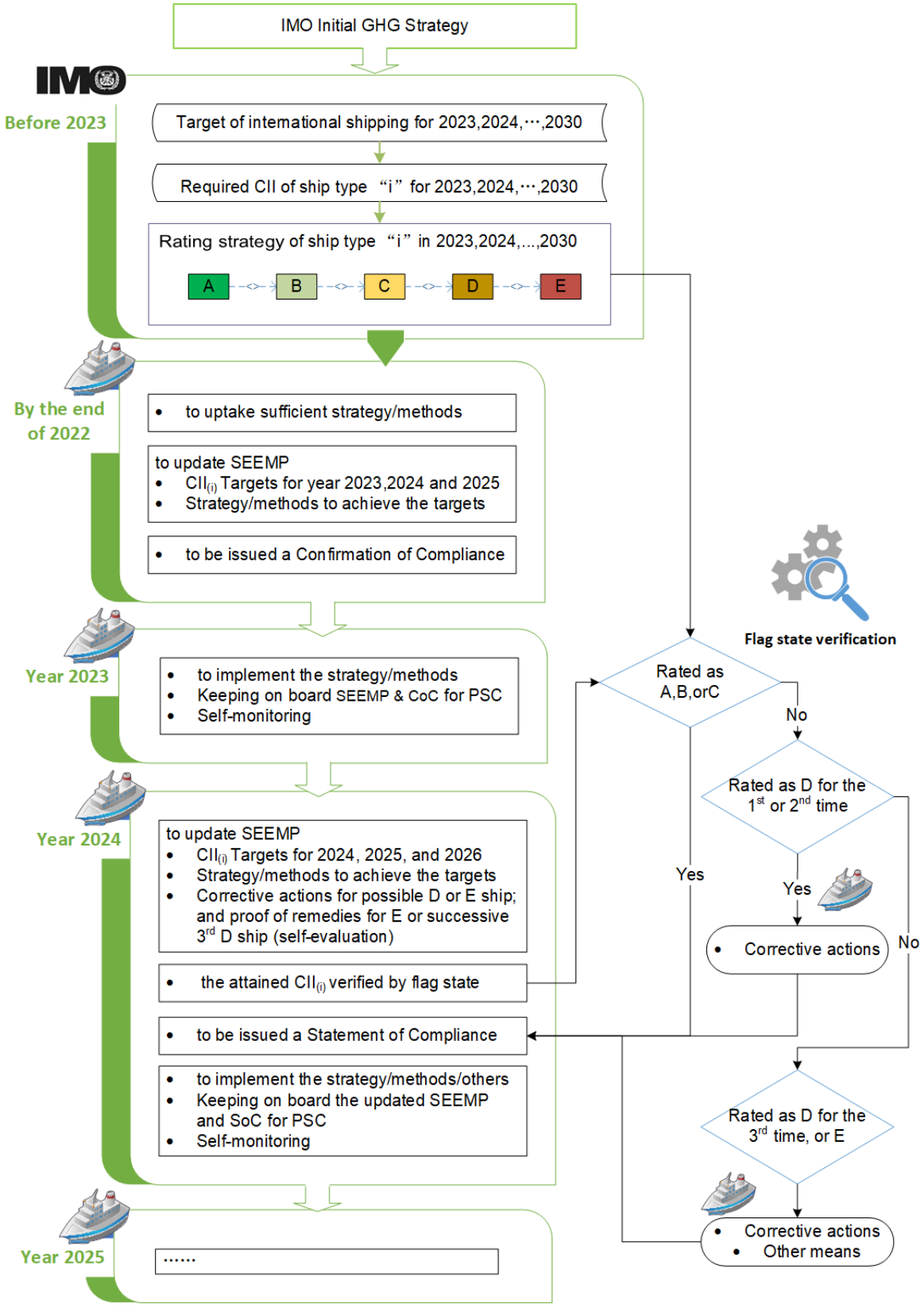

Figure 1: Framework of the operational carbon intensity rating mechanism

Features of the rating mechanism

8 The proposed operational carbon intensity rating mechanism has the following features:

.1 ensuring systematic approaches;

.2 recognizing volatility of operational efficiency;

.3 data and evidence-based; and

.4 contributing to the levels of ambition of the Initial Strategy.

Ensuring systematic approaches

9 An energy efficient ship needs to be energy efficient both in building and in operation, i.e. "better ships + better operation". This is to combine technical measures and operational measures, ensuring systematic approaches in achieving the energy efficiency of a ship.

10 Technical measures serve as a vital starting point in achieving the levels of ambition specified in the Initial IMO GHG Strategy. These measures, indicated by EEDI or EEXI, will ensure ships are well designed, built or refitted. However, technical measures alone are not enough. EEDI and EEXI only indicate these ships are energy efficient when they are delivered or after retrofit, but they are unable to identify whether these ships are efficiently operated. Therefore, the technical measures need to be complemented by a goal-based operational measure. The proposed rating mechanism comes in as an operational measure that guides the ships to improve their operational energy efficiency.

11 The rating mechanism is compatible with the technical measures, including EEDI and the potential EEXI requirements. Nevertheless, the application of EEXI should follow two principles: first, to maintain the authority of IMO regulations, ships having already complied with EEDI regulations will not be required to conform to EEXI ones; second, it should not lead to a situation where large numbers of ships, even after EPL or other measures taken, are forced to face elimination for non-conformity.

Recognizing the volatility of operational efficiency

12 We acknowledge that the operational energy efficiency of a ship depends on various factors including: i) technical factors; ii) business-related factors; and iii) external and uncontrollable factors (ISWG-GHG 6/2/3, paragraph 12). Unlike technical factors, which are relatively stable, business-related, external and uncontrollable factors are variable, mostly beyond the control of the shipowners and operators.

13 The proposed rating mechanism acknowledges the volatility of operational efficiency. Based on this, China considers it more appropriate to assign a rating level to a ship, rather than using a rigorous indicator value, to evaluate the operational efficiency performance. For ships holding a superior rating level, incentives will be provided; for ships holding an inferior rating level, corrective actions should be taken.

Data and evidence-based

14 The main elements of the rating mechanism, namely the specific carbon intensity indicator suitable for each ship type, the ship type specific reference lines and reduction factors, as well as the strategy for rating assignment, will be developed based on concrete data and evidence while in line with the Initial Strategy.

15 The results of the third and fourth IMO GHG studies and the data collected through the IMO Data Collection System in 2019 and 2020 will provide sufficient data for use in the development of the rating mechanism. To ensure a timely enforcement of the mandatory measure, the data and evidence-based technical elements are proposed to be addressed in the supporting guidelines.

16 Stocktaking will be undertaken after each calendar year based on the reported data submitted to the IMO Ship Fuel Oil Consumption Database, to evaluate the progress made by international shipping on carbon intensity reduction. A trial period of three years is proposed to be introduced. By taking these actions, sufficient experience will be gained to build a rational and robust mandatory goal-based mechanism and contribute to the reduction of carbon intensity of international shipping.

Contributing to achieve the levels of ambition of the Initial Strategy

17 The proposed rating mechanism aims to achieve the levels of ambition of the Initial Strategy. By setting ship-type specific reference lines and reduction factors, the levels of ambition are transformed into the specific targets for different ship types, therefore contributing to the achievement of levels of ambition of the Initial Strategy, especially the 2030 target.

18 By the end of 2026, the Organization should review the status of implementation and effect of this regulation and, if proven necessary, amend relevant regulations and guidelines as appropriate.

Legal framework

19 The operational carbon intensity rating mechanism is to be developed under the existing framework of MARPOL Annex VI. Draft amendments related to the scope of application, overall goals, CII targets, ratings, survey and certification are set out in annexes 1 and 2 to this document.

20 To facilitate the implementation of this mandatory short-term measure, it is proposed to develop a package of supporting guidelines, including but not limited to:

.1 G1, Guidelines on Carbon Intensity Indicators and the Calculation Methods (CII guidelines). These guidelines will cover the definition, the applicability, and the calculation method of each specific carbon intensity indicator for ships.

.2 G2, Guidelines on the Reference Lines for Use with Carbon Intensity Indicators (Reference line Guidelines). These guidelines will cover: 1) the methods to calculate the reference lines for use with carbon intensity indicators, and 2) the ship-type specific carbon intensity reference lines as required by regulation 22B of MARPOL Annex VI.

.3 G3, Guidelines on the Carbon Intensity Reduction Factors for Specific Ship Types (Reduction factor Guidelines). These guidelines will cover: 1) the methods to estimate the achieved carbon intensity reduction by specific ship types as well as by international shipping as a whole; and 2) the ship-type [and size group] specific annual carbon intensity reduction factors, as from 2023 to 2030, as required by regulation 22B of MARPOL Annex VI.

.4 G4, Guidelines for Rating the Operational Energy Efficiency Performance of Ships (Rating Guidelines). These guidelines will cover the methods to assign an operational energy efficiency performance rating to a ship, as required by regulation 22B of MARPOL Annex VI, based on the deviation of the attained CII from the target value.

21 A package of the sketches of the above four guidelines is provided in annex 3 to this document.

22 The framework of the proposed amendments to MARPOL Annex VI related to operational carbon intensity and the supporting guidelines is illustrated in Figure 2 below.

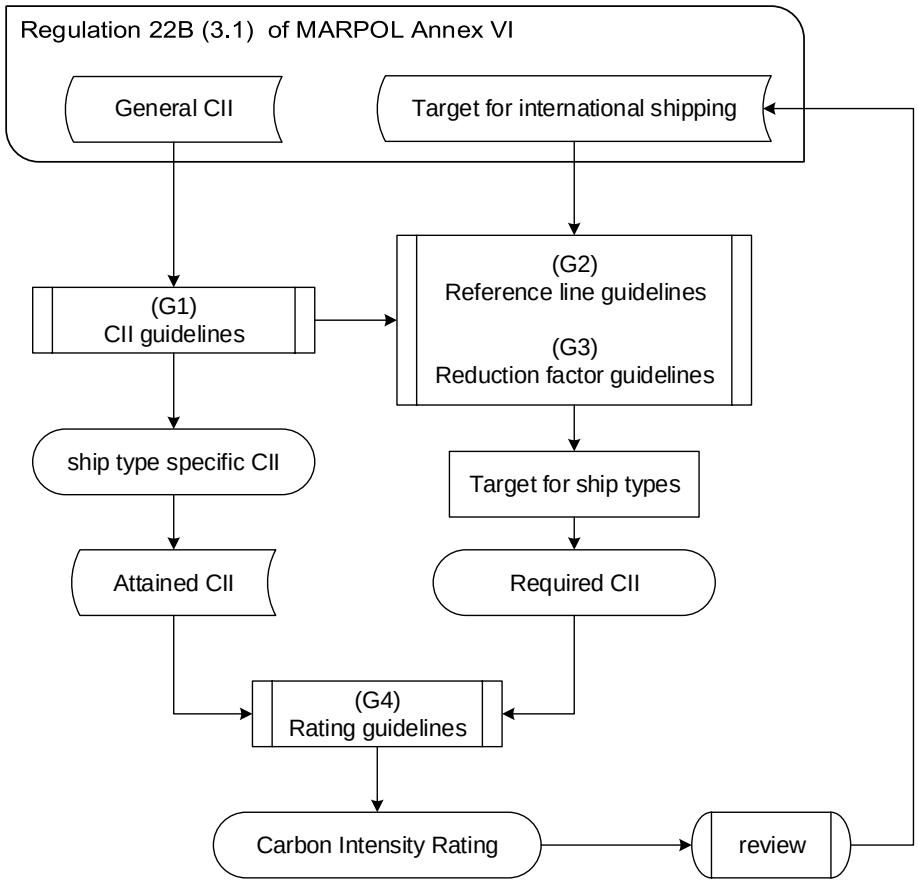

Figure 2: Framework of the proposed amendments to MARPOL Annex VI and its supporting guidelines

Main elements of the rating mechanism

Scope of application

23 The general application scope for MARPOL Annex VI is 400 GT and above. Nevertheless, it should be borne in mind that the Data Collection System (DCS) has a 5,000 GT application threshold. It is recognized that the 400 GT application scope will have the widest coverage; in the meantime, it is also noted the 5,000 GT threshold will make full use of the existing DCS as a basis, which will provide necessary data for calculating the attained CII as well as facilitating early implementation without imposing too much administrative burden. Therefore, China suggests taking 5,000 GT as the application threshold.

24 It is also noted that exemptions may be needed for certain ship types or ships sailing in certain routes or special circumstances. For example, there are situations that make ships unable to meet the targets, including outside factors that cannot be controlled by the shipowner; ships serving Member States subject to particularly challenging operational conditions, such as geographical remoteness, particularly least developed countries (LDCs) and small island developing States (SIDS); or special circumstances, such as prevalence of adverse weather including sailing in ice-infested waters, piracy, seasonal changes in different conditions, etc. China supports the development of exemption provisions to address such cases and is willing to further discuss it with members.

Carbon intensity indicators

25 Regarding the carbon intensity indicator (CII) of ships, it is rather difficult to apply a unified CII to all ships due to the complexity of shipping. The Organization should develop guidelines to help set suitable indicators applicable to specific ship types, taking into account the existing experience, the third and fourth IMO GHG studies and the statistical data collected through IMO DCS. The related proposals or comments submitted to previous sessions, including those from the Russian Federation and IMCA (MEPC 74/6), CLIA (MEPC 74/6/1), China (ISWG-GHG 6/2/10) and some others should all be taken into account.

26 To assist the Group in developing the guidelines, China developed a sketch of Guidelines on Carbon Intensity Indicators and the Calculation Methods (G1). Based on this, an attained CII of a particular ship can be calculated and submitted to the Administration for verification according to its performance data from the DCS in the last calendar year.

Reference lines and reduction factors

27 The operational measures are designed to help ships meet the levels of ambition set by the Initial Strategy. In our view, this target (for the international shipping as a whole) should be assigned to each ship type, as appropriate, through the development of required CIIs, and taking into account their respective reduction potentials and operational characteristics. The required CIIs should be determined as follows:

.1 a reference line is developed for each ship type, based on the specific carbon intensity indicator, and using the Fourth IMO GHG Study as input;

.2 the reduction factor for each calendar year as from 2023 should be determined for each ship type; and

.3 based on the CII reference lines and a given reduction rate, the required CIIs can be calculated and the carbon intensity reduction target for ship types can be clearly set.

28 The detailed methods are provided in the sketches of Guidelines on the Reference Lines for Use with Carbon Intensity Indicators (G2) and Guidelines on the Carbon Intensity Reduction Factors for Specific Ship Types (G3).

Methods for performance rating

29 The key for developing a rating strategy is to determine the rating boundaries, which depend on which direction and distance the boundaries deviate from the given required CII value. These boundaries are suggested to be developed through empirical analyses based on the results of the third and fourth IMO GHG studies, as well as data collected through IMO DCS in the year 2019. Detailed methods are provided in the sketch of the Guidelines for Rating the Operational Energy Efficiency Performance of Ships (G4).

Enforcement and responsibilities

30 Responsibilities of ships, Administrations and other relevant stakeholders in implementing the rating mechanism are summarized in table 1 below.

Table 1: Responsibilities in implementing the rating mechanism

Roles	Before compliance period	Compliance period	
		Year 1	Year 2
Ship	1. to uptake strategy and/or methods to reduce carbon intensity as appropriate; 2. to update SEEMP* (CII targets and the strategy & methods).	1. to implement the strategy & methods specified in SEEMP; 2. self-monitoring.	1. and 2. same with year 1; and Before [31st March] of year 2: 3. to calculate the attained CII for verification; 4. to take corrective strategy and/or methods if would be rated as D; 5. to take corrective strategy and/or methods and other means for remedy if would be rated as D for three consecutive years or E.
Flag state	1. to evaluate the potential of compliance; 2. to issue a Confirmation of Compliance if satisfied.		Before [31st May] of year 2: 1. to verify the attained CII and assign a rating accordingly; 2. to issue SoC to ships rated as A, B or C; 3. to evaluate the corrective strategy and/or methods of ships rated as D, and to issue SoC if satisfied; 4. to evaluate the corrective strategy and/or methods and other means for remedy of ships rated as D for three consecutive years, or ships rated as E, and to issue SoC if satisfied.
Port state	1. to prepare PSC procedure.	1. to verity the validation of Confirmation of Compliance.	1. to verity the validation of Confirmation of Compliance From [1st June] of year 2: 2. to verity the validation of SoC; 3. to inspect ships of rating D, additionally, for corrective strategy and/or methods; 4. to inspect ships rated as D for three consecutive years, or ships rated as E, additionally, for corrective strategy and/or methods and proof of other means for remedy.
Port & others	1. to prepare incentive measures.	1. to prepare incentive measures.	1. to provide incentives to ships rated as A or B.

Impacts assessment

31 The proposed mandatory goal-based rating mechanism would provide impetus for ships to improve their operational performances through the most cost-effective approach. The merits of the mechanism lie in the flexibility in choosing suitable methods to achieve targets and the potential incentive strategies implemented by ports and other stakeholders for ships with superior performance. For ships with inferior performance, necessary corrective actions will be undertaken, thus ensuring the achievement of the levels of ambition of the Initial Strategy.

* Further modification of the SEEMP Guidelines is needed.

32 The rating mechanism, with an application threshold set at 5,000 GT, a three-year trial period, and exemption provisions in place for certain ship types, trading routes as well as some special circumstances, will not bring negative impacts to states, particularly least developed countries (LDCs) and small island developing States (SIDS), and those located in geographical remote areas.

Timelines for development

33 Table 2 below presents a draft work plan for developing amendments to MARPOL Annex VI and the supporting guidelines. In this timeline, the amendments related to the operational carbon intensity of international shipping will come into force in 2023. All the supporting guidelines are expected to be finalized by the first half of 2022 at the latest. Therefore, Administrations, shipowners and other relevant stakeholders can get prepared for implementation in the second half of 2022 and implement the amendments once they become effective.

Table 2: Timelines for developing amendments to MARPOL Annex VI and the supporting guidelines

Documents / Data	2020			2021	2022		2023
	April		October	[May]	[April]	October	1st January
	ISWG-GHG 7	MEPC 75	MEPC 76	MEPC 77	MEPC 78	MEPC 79	MEPC 80
MARPOL Annex VI amendments	Development		Approval	Adoption	Preparation and (early) implementation		
The 4th IMO GHG study and DCS (2019)		Data available					
G1: CII Guidelines	Development		Finalization				
G2: Reference line Guidelines	Initiate		Development	Finalization			
DCS (2020)				Data available			
G3: Reduction factor Guidelines	Initiate		Development	Finalization			
G4: Rating Guidelines	Initiate		Development		Finalization		

Proposal

34 China proposes the Working Group to:

.1 consider the proposed rating mechanism and acknowledge that, as a goal-based operational measure, such a mechanism could (and needs to) be compatible with potential technical approaches, such as EEXI, provided that the latter does not apply to ships that are already compliant with EEDI regulation;

.2 consider the proposed regulation 22B of the draft amendments to MARPOL Annex VI as set out in annex 1 to this document, in line with the Chair's inductive regulatory framework;

.3 consider the rest of proposed draft amendments on other existing regulations and appendices of MARPOL Annex VI that may need to be amended, as set out in annex 2;

.4 consider the package of the sketches of the supporting guidelines to the proposed draft amendments as set out in annex 3; and

.5 recognize the timelines set out in table 2 above for the development of the amendments to MARPOL Annex VI and the supporting guidelines.

Actions requested of the Working Group

35 The Group is invited to consider the proposals set out in paragraph 34 and take action as appropriate.

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ANNEX 1

PROPOSED AMENDMENTS TO BE INCORPORATED INTO THE DRAFT REGULATORY FRAMEWORK FOR A MANDATORY GOAL-BASED MEASURE TO REDUCE THE CARBON INTENSITY OF INTERNATIONAL SHIPPING

(modifications to the text prepared by the Chair are shown as additions/~~deletions~~)

Regulation 22B

Reducing the carbon intensity of international shipping

1 Goal

The goal of this regulation is to reduce the carbon intensity of international shipping, working towards the levels of ambition set out in the Initial IMO Strategy on reduction of GHG emissions from ships.

2 Functional requirements

2.1 In order to achieve the goal set out in paragraph 1, the following functional requirements are embodied in the provisions of this regulation to reduce the carbon intensity of the ship, which can be expressed both in terms of operational and technical carbon intensity.

2.2 A ship to which this chapter applies shall comply with the operational carbon intensity requirements as set out in paragraph 3.1.

2.3 A ship, falling into one or more of the categories set out in regulations 2.25 to 2.35, 2.38 and 2.39 within the ship sizes listed in table 1 of regulation 21, shall comply with the technical carbon intensity requirements as set out in paragraph 3.2.

2.4 Notwithstanding the provisions in paragraphs 2.2 and 2.3, a ship shall at least attain the operational carbon intensity targets set out in paragraph 3.1.2 or/and the required EEXI set out in paragraph 3.2.2.[1]

2.5 Other methods to meet the functional requirements may also be accepted as alternatives to the requirements prescribed in paragraphs 2.2 to 2.4, provided that such methods ensure at least the same level of reduction in carbon intensity of ships and are approved by the Marine Environment Protection Committee based on guidelines to be developed by the Organization.

3 Regulations

3.1 Operational carbon intensity

The operational carbon intensity of the ship shall be calculated and verified by the Administration, or any organization duly authorized by it, for the calendar year starting [date of entry into force], in accordance with paragraphs 3.1.1 to ~~3.1.3~~ 3.1.5, and taking into account guidelines to be developed by the Organization[2].

[1] Application to ships already compliant with EEDI regulation to be determined.

[2] Guidelines on calculation of operational carbon intensity of a ship (to be developed and adopted prior to entry into force).

3.1.1 Operational carbon intensity indicator(s) (CII)

.1 The operational Carbon Intensity Indicator (CII) generally refers to any indicator which is applicable to a specific ship type to indicate the operational carbon intensity performance of a ship. The specific carbon intensity indicator applicable to each ship type shall be determined taking into account guidelines developed by the Organization[3].

.2 The attained CII is the carbon intensity indicator value achieved by an individual ship in accordance with this regulation.

.3 The required CII is the target value of attained CII in accordance with this regulation for the specific ship type and size.

3.1.2 Operational carbon intensity targets

[Note: Ships to which the requirements set out in paragraph 2.3 apply may choose to use the attained EEXI in lieu of operational carbon intensity targets.]

.1 The annual carbon intensity reduction rate, as specified in table 22B.1, shall be achieved by international shipping as a whole.

Table 22B.1. Annual carbon intensity reduction rate for international shipping

Year	2023	2024	2025	2026	2027	2028	2029	2030
Reduction rate	[X_1%]	[X_2%]	[X_3%]	[X_4%]	[X_5%]	[X_6%]	[X_7%]	[40%]

.2 The annual carbon intensity reduction factor for each ship type shall be a positive value in percentage, determined in accordance with guidelines developed by the Organization[4], ensuring the achievement of the annual carbon intensity reduction rate of international shipping stipulated in table 22B.1.

[In case the annual carbon intensity reduction factor (R_y) for each ship type can be decided based on data in a timely manner, the concrete values can be specified in this regulation as follows:

Table 22B.2. Annual carbon intensity reduction factor for each ship type

Ship type	*Reduction factor (R_y)*			
	2023	*…*	*2029*	*2030*
Bulk carrier	*[X_1%]*	*…*	*…*	*…*
Cruise passenger ship	*…*	*…*	*…*	*…*
…	*…*	*…*	*…*	*[X_n%]*

]

.3 For each ship to which this regulation applies, the required CII in a specific calendar year y shall be determined by the CII reference line value (CII_{ref}) and the given reduction factor (R_y), as follows:

$$Required\ CII_y = (1 - R_y) \times CII_{ref}$$

[3] Referring to the CII Guidelines (G1, to be developed and adopted prior to entry into force).

[4] Referring to the Reduction factor Guidelines (G3, to be developed and adopted prior to entry into force).

.4 The CII reference line values (CII_{ref}) shall be ship type specific, and be calculated as follows:

$$CII_{ref} = a_0 Capacity^{-c}$$

where the definition of $Capacity$ is identical with the one used in the applicable ship type specific carbon intensity indicator, a_0 and c are parameters specified in guidelines developed by the Organization[5].

[In case the parameters a_0 and c for each ship type can be decided based on data in a timely manner, the concrete values can be specified in this regulation as follows:

Table 22B.3. Parameters for determining the ship type specific reference lines

Ship type	*Capacity*	a_0	c
Bulk carrier	*DWT*	*[X]*	*[0.477]*
Cruise passenger ship	*GT*	*[X]*	*[0.214]*
…	*…*	*…*	*…*

]

3.1.3 Survey and verification

.1 The attained CII shall be verified for each ship of [5,000] gross tonnage and above, based on the reported data [in accordance with regulation 22A of this Annex], either by the Administration or by any organization duly authorized by it no later than [three] [five] months after the end of the previous calendar year.

.2 An operational carbon intensity rating A, B, C, D or E shall be assigned to each ship based on the attained CII relative to the required CII, indicating a major superior, minor superior, moderate, minor inferior, or inferior performance level. The boundaries used for dividing the rating bands shall be ship type specific and shall be determined in accordance with guidelines developed by the Organization[6].

3.1.4 Corrective actions

.1 Corrective strategy and/or methods shall be undertaken by a ship rated as D or E before the Statement of Compliance related to operational carbon intensity is issued, to the satisfaction of the Administration.

.2 Notwithstanding the requirements of paragraph .1 of this regulation, other means for remedy shall be additionally undertaken by a ship rated as D for three consecutively years or a ship rated as E, in accordance with guidelines developed by the Organization[7].

5 Referring to the Reference line Guidelines (G2, to be developed and adopted prior to entry into force).

6 Referring to the Rating Guidelines (G4, to be developed and adopted prior to entry into force).

7 Referring to the Remedy Guidelines (to be developed and adopted prior to entry into force).

3.1.5 Incentives and the trial period

.1 The Administrations, ports authorities and other stakeholders as relevant are encouraged to provide incentives to the ships which hold a rating of A or B.

.2 A trial period shall be given to ships to which Regulation 22B applies, which shall not be longer than [three] years from the date of entry into force of this regulation.

3.2 Technical carbon intensity

[……]

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ANNEX 2

DRAFT AMENDMENTS TO MARPOL ANNEX VI (except for Regulation 22B) (*Reducing the carbon intensity of international shipping – Operational carbon intensity)*

(shown as additions/~~deletions~~)

Regulation 1

Application

1 The reference to "regulations 3, 5, 6, 13, 15, 16, 18, 19, 20, 21, 22 and 22A" is replaced with "regulations 3, 5, 6, 13, 15, 16, 18, 19, 20, 21, 22, 22A and 22B".

Regulation 3

Exceptions and exemptions

2 After existing paragraph 3, new paragraph 4 and paragraph 5 are added as follows:

"**Greenhouse gas emissions**

4 The Administration may grant exemptions to any voyage of a ship from the requirements of Regulation 22B, if they are necessary for the purpose of:

.1 ensuring the food security and livelihood of geographical remote areas, particularly small island developing States (SIDS) and least developed countries (LDCs); or

.2 securing the safety of a ship operates in regions with high prevalence of adverse weather.

5 The Administration which allows any such exemptions shall, as soon as possible, but not more than 90 days thereafter, communicate to the Organization, which the Organization shall circulate to the Parties to the present Protocol for their information and appropriate action, if any."

Regulation 5

Surveys

3 After existing paragraph 4.5, new paragraphs 4.6, 4.7, 4.8 and 4.9 are added as follows:

4.6 The Administration shall ensure that for each ship to which regulation 22B applies, the SEEMP complies with regulation [22.2 *bis and 22.2 ter*] of this Annex. This shall be done prior to the ship's first compliance period of regulation 22B. Confirmation of Compliance shall be provided to and retained on board the ship, which shall be drawn up in a form corresponding to the model given in appendix XI;

4.7 The Administration shall verify that for each ship to which regulation 22B applies, the ship has been duly operated in line with the SEEMP and assign an operational carbon intensity rating to the ship based on the attained CII. This shall be done no later than [three] [five] months after the end of the previous calendar year;

4.8 Notwithstanding the requirements of paragraph 4.7, the Administration shall verify that corrective strategy and/or methods have been duly undertaken and recorded in the SEEMP by a ship rated as D or E; and

4.9 Notwithstanding the requirements of paragraph 4.7 and 4.8, the Administration shall verify that other means for remedy have been duly undertaken and the proof has been attached to the SEEMP by a ship rated as D for three consecutive years or by a ship rated as E.

Regulation 6

Issue or endorsement of Certificates and Statements of Compliance ~~related to fuel oil consumption reporting~~

4 After existing paragraph 7, new paragraphs 8, 9, 10 and 11 are added as follows:

Statement of Compliance related to Operational Carbon Intensity

8 A Statement of Compliance related to operational carbon intensity shall be issued to a ship after verification in accordance with the provisions of regulation 22B.

9 The Statement of Compliance shall be issued or endorsed either by the Administration or any organization duly authorized by it. In every case, the Administration assumes full responsibility.

10 Notwithstanding the requirements of paragraphs 8 and 9, a ship rated as D shall not be issued a Statement of Compliance unless corrective strategy and/or methods have been duly undertaken to the satisfaction of the Administration.

11 Notwithstanding the requirements of paragraph 8 ,9 and 10, a ship rated as D for three consecutive years or a ship rated as E shall not be issued a Statement of Compliance unless corrective strategy and/or methods and other means for remedy have been duly undertaken to the satisfaction of the Administration.

Regulation 8

Form of Certificates and Statements of Compliance related to fuel oil consumption reporting and Operational Carbon Intensity

5 After existing paragraph 3, a new paragraph 4 is added as follows:

"**Statement of Compliance – Operational Carbon Intensity**

4 The Statement of Compliance related to operational carbon intensity shall be drawn up in a form corresponding to the model given in appendix XII to this Annex and shall be at least in English, French or Spanish. If an official language of the issuing Party is also used, this shall prevail in case of a dispute or discrepancy."

Regulation 9

Duration and Validity of Certificates and Statements of Compliance ~~related to fuel oil consumption reporting~~

6 After existing paragraph 12, a new paragraph 13 is added as follows:

"**Statement of Compliance - Operational Carbon Intensity**

13 The Statement of Compliance pursuant to regulation [6.8] of this Annex shall be valid for the calendar year in which it is issued and for the first [three] [five] months of the following calendar year. All Statements of Compliance shall be kept on board for at least [three] years.

Regulation 10

Port State control on operational requirements

7 Paragraph 5 is amended as follows:

"5 In relation to chapter 4 of this Annex, any port State inspection shall be limited to verifying, when appropriate, that there is a valid Statement of Compliance related to fuel oil consumption reporting, Statement of Compliance related to Operational Carbon Intensity and an International Energy Efficiency Certificate on board, in accordance with article 5 of the Convention.",

New paragraph 6 and 7 are added as follows:

"6 Notwithstanding the requirements in paragraph 5, any port State inspection shall verify, when appropriate, the duly implementation of the corrective strategy and/or methods of ships rated as D or E.

7 Notwithstanding the requirements in paragraph 5 and 6, any port State inspection shall verify, when appropriate, the proof of other means for remedy of a ship rated as D for three consecutive years or a ship rated as E"

Regulation 22

Ship Energy Efficiency Management Plan (SEEMP)

8 New paragraph .2 *bis* and .2 *ter* is added as follows:

".2 *bis* Before the commencement of the compliance period, a ship to which regulation 22B applies shall update the SEEMP to include the required CIIs for the next three years, in conjunction with the appropriate strategy and/or methods to achieve these targets, to the satisfactory of the Administration.

.2 *ter* Ships shall self-monitor the operational carbon intensity performance continuously and calculate their annual attained CII as soon as the data are available. In the case where a ship would be rated as D or E, corrective strategy and/or methods shall also be included in updating the SEEMP. In the case where a ship would be rated as D for three consecutive years or rated as E, other means for remedy shall be additionally included in updating the SEEMP."

11 After existing appendix X, new appendices XI and XII are inserted as follows:

APPENDIX XI

Form of Confirmation of Compliance – Operational Carbon Intensity

CONFIRMATION OF COMPLIANCE – OPERATIONAL CARBON INTENSITY

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC. XXX (XX), to amend the International Convention for the Prevention of Pollution by Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention") under the authority of the Government of:

……

(full designation of the Party)

by.....

(full designation of the competent person or organization authorized under the provisions of the Convention)

Particulars of ship®

Name of ship……

IMO Number……

Distinctive number or letters……

Port of registry……

Gross tonnage……

Deadweight……

Type of ship……

[Size group……]

Specific carbon intensity indicator (CII) [☐AER; ☐EEPI; ☐XXX …]

Required CII in the following three years in accordance with [Regulations/Guidelines]:

Year	Required CII
[2023]	
[2024]	
[2025]	

THIS IS TO CONFIRM:

Taking into account the [Guidelines on super SEEMP adopted by resolution MEPC.XXX(XXX)], the ship's SEEMP has been developed and complies with regulation 22B of Annex VI of the Convention.

Issued at……...

(place of issue of Certificate)

Date (dd/mm/yyyy)……... ……

(date of issue) *(signature of duly authorized official issuing the Certificate)*

(seal or stamp of the authority, as appropriate)

APPENDIX XII

Form of Statement of Compliance – Operational Carbon Intensity

STATEMENT OF COMPLIANCE – OPERATIONAL CARBON INTENSITY

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC. XXX (XX), to amend the International Convention for the Prevention of Pollution by Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention") under the authority of the Government of:

……

(full designation of the Party)

by.....

(full designation of the competent person or organization authorized under the provisions of the Convention)

Particulars of ship®

Name of ship……

IMO Number……

Distinctive number or letters……

Port of registry……

Gross tonnage……..

Deadweight……

Type of ship……

[Size group……]

Specific carbon intensity indicator [☐AER; ☐EEPI; ☐XXX …]

Required CII in the previous calendar year……

Attained CII in the previous calendar year: ……

THIS IS TO DECLARE:

1. That the ship has been surveyed by this Administration in accordance with regulation 22B of Annex VI of the Convention, covering ship operations from (dd/mm/yyyy) through (dd/mm/yyyy); and
2. The operational carbon intensity of the ship in this compliance period is rated as: ☐A; ☐B; ☐C; ☐D; ☐E.

This Statement of Compliance is valid until (dd/mm/yyyy) ……

Issued at: ……

(place of issue of Statement)

Date (dd/mm/yyyy) …… ……

(date of issue) *(signature of duly authorized official issuing the Statement)*

(seal or stamp of the authority, as appropriate) "

Appendix

1 Summary of corrective strategy and/or measures (only relevant to a ship rated as D or E)

……
……

2 Summary and proof of other means for remedy (only relevant to a ship rated as E, and a ship rated as D for three consecutive years)

……
……

***

ANNEX 3

SKETCHES OF THE PROPOSED SUPPORTING GUIDELINES

G1: Guidelines on Carbon Intensity Indicators and the Calculation Methods (CII guidelines)

Brief introduction

1 These guidelines provide the definition, the applicability, and the calculation method of each specific carbon intensity indicator for ships.

Main elements

2 Main elements of these guidelines are sketched as follows:

"[Definition

1 In regulation 22B of MARPOL Annex VI, indicators applied to specific ship types to indicate the operational energy efficiency performance are generally referred to as the Carbon Intensity Indicator (CII).

2 The specific carbon intensity indicators for use with regulation 22B of MARPOL Annex VI are defined as follows:

.1 $cwDIST$: CO_2 emissions per unit of capacity (in deadweight tonnage) and unit of distance travelled (tonnes/dwt·nm);

.2 $cgDIST$: CO_2 emissions per unit of capacity (in gross tonnage) and unit of distance travelled (tonnes/gt·nm);

.3 $ctDIST$: CO_2 emissions per unit of capacity (in teu) and unit of distance travelled (tonnes/teu·nm);

.4 $EEPI$: CO_2 emissions per unit of capacity and unit of distance travelled whilst laden (tonnes/dwt·nm);

.5 $EEOI$: CO_2 emissions per actual cargo/passenger turnover (the product of payload and the corresponding distance travelled), as per MEPC.1/Circ.684;

.6 …

Applicability

3 The applicability of the specific indicators is specified in table 1.

Table 1: Applicability of the specific indicators

Indicator	Ship type
cgDIST	cruise passenger ship, …
ctDIST	container ships, …
…	…

Calculation methods

4 All the indicators listed in paragraph 2 can be calculated through dividing the annual aggregated CO_2 emissions by the annual aggregated transport work or proxies thereof, as follows:

Annual average CII = annual CO_2 / annual transport work (proxies)

5 The calculation of annual aggregated CO_2 emissions is as follows:
…

6 The calculation of annual aggregated transport work or proxies is as follows:

.1 for *cwDIST* , …

.2 for *cgDIST* , …

.3 for … **]"**

Timelines for development

3 The applicability of specific carbon intensity indicators should be determined taking into account the existing experience, the third and fourth IMO GHG studies and the 2019 statistical data collected through IMO DCS. The related proposals or comments submitted to previous sessions, including those from the Russian Federation and IMCA (MEPC 74/6), CLIA (MEPC 74/6/1), China (ISWG-GHG 6/2/10) and some others, should be taken into account. Thus, this document can be initiated at MEPC 75 and finalized by MEPC 76 (October 2020), ready for use as a basis in developing other guidelines.

G2: Guidelines on the Reference Lines for Use with Carbon Intensity Indicators (Reference line Guidelines)

Brief introduction

1 These guidelines provide: 1) the methods to calculate the reference lines for use with carbon intensity indicators, and 2) the ship type specific carbon intensity reference lines as requested by regulation 22B of MARPOL Annex VI.

Main elements

2 Main elements of these guidelines are sketched as follows:

"[General

1 The carbon intensity reference lines should be established for each ship type to which regulation 22B of MARPOL Annex VI is applicable in a transparent and robust manner, based on the specific indicators stipulated in guidelines developed by the Organization [referring to CII Guidelines (G1)].

2 Ship types are defined in regulation 2 of MARPOL Annex VI. The carbon intensity reference line for each ship type, in conjunction with the decided reduction factors determined in accordance with guidelines developed by the Organization [referring to the Reduction factor Guidelines (G3)], is used for the determination of the required CII of a ship over time.

Definition of a carbon intensity reference line

3 A carbon intensity reference line is defined as a curve representing the median carbon intensity performance of a defined group of ships in the year of 2008.

4 One reference line is developed for each ship type to which regulation 22B of MARPOL Annex VI is applicable, ensuring that only data from comparable ships are included in the calculation of each reference line.

5 The reference line value is formulated as follows:

$$CII_{ref} = a_0 Capacity^{-c} \quad (1)$$

where the definition of $Capacity$ is identical with the one used in each carbon intensity indicator; and

[[1]Option 1: a_0 and c are parameters derived from the regression curve fit. For ship types where an EEDI reference line is available, parameter c can be identical with the one therein], or

[[2]Option 2: a_0 and c are parameters derived from the regression curve fit].

[1] Rationale behind Option 1: the marginal effect of the ship size on the carbon intensity performance is constant and can be regarded as identical with that on design efficiency. Therefore, the values of parameter "c" can be inherited from EEDI reference line formulas.

[2] Rationale behind Option 2: the marginal effect of the ship size on the carbon intensity performance is constant, but may be different from that on design efficiency. Therefore, the parameter "c" needs to be estimated based on operational data.

Data sources

6 Data for estimating the carbon intensity level of international shipping in the year of 2008 are scarce, which are expected to be derived from the Third and Fourth IMO GHG Study. [If Option 2 were followed, the distribution characteristics of operational energy efficiency performance of individual ships (for calculating parameter c) are expected to be provided by the Fourth IMO GHG Study, and can be additionally estimated and validated by member states using the statistical data collected under IMO DCS in 2019 and 2020.]

Method to develop carbon intensity reference lines

Natural logarithmic transformation

7 To estimate the parameters in Eq.(1), a linear logarithmic regression model is developed as follows:

$$\ln(CII_{ref}) = \ln a_0 - c\ln(Capacity) + \varepsilon \qquad (2)$$

where ε is the error term. The natural logarithmic transformation is applied mainly for two purposes: first, the right-skewed distribution of the original data can be largely remedied; second, the difference in intercept $\ln a_0$ can be roughly interpreted as the approximation of percentage change of the reference values, while the slope $-c$ represents the partial effect of ship size on carbon intensity performance.

Estimating parameter a_0 and c

8 Given the limited data available for the year of 2008, parameter a_0 and c can be estimated following a two-step approach[3]:

Step 1, to estimate the slope of a reference line based on years where statistical data of individual ships are available. The median regression is applied to estimate parameter c in Eq.(2), taking the data collected through IMO DCS in 2019 [and data in other recent years provided by the Fourth IMO GHG Study] as the sample(s).

Step 2, to estimate the intercept of the reference line based on the data of the year of 2008. Given the estimated value $\hat{c}$, Eq.(2) can be transformed as follows:

$$\ln(CII_{ref}) = \ln a_0 - \hat{c}\ln(Capacity) + \mu \qquad (3)$$

Then, the constant term $\ln a_0$ can be estimated using the sparse data available for the year of 2008.

9 The estimates of parameters should be validated, and be corrected when necessary, using the statistical data collected through IMO DCS in 2020.

[3] If Option 1 were followed, the calculation of parameter would be irrelevant for certain ship types.

Ship type specific carbon intensity reference lines

10 The parameters for determining the ship type specific reference lines, for use in Eq.(1), are specified in table 1.

Table 1 Parameters for determining the ship type specific reference lines

Ship type	Capacity	a_0	c
Bulk carrier	DWT	XXX	[0.477]
Cruise passenger ship	GT	XXX	[0.214]
…	…		

] "

Timelines for development

3 The ship type specific CII reference lines should be developed based on the determined specific carbon intensity indicators, as well as the concrete statistical data from the year of 2019 and 2020, collected through the IMO DCS. Thus, these guidelines can be initiated at MEPC 75. Taking into account the Indicator Guidelines (G1, finalized in MEPC 76) and the concrete data inputs (from 2019 and 2020) as the basis, this document can be finalized in MEPC 77（[May] 2021）, ready for use in developing the Rating Guidelines (G4).

G3: Guidelines on the Carbon Intensity Reduction Factors for Specific Ship Types (Reduction factor Guidelines)

Brief introduction

1 These guidelines provide: 1) the methods to estimate the achieved carbon intensity reduction by specific ship types as well as by international shipping as a whole; and 2) the ship type [and size group] specific annual carbon intensity reduction factors, as from 2023 to 2030, as requested by regulation 22B of MARPOL Annex VI.

Main elements

2 Main elements of these guidelines are sketched as follows:

"[General

1 The carbon intensity reduction factors should be determined for each ship type [and size group] to which regulation 22B of MARPOL Annex VI is applicable in a transparent and robust manner, based on the specific indicators stipulated in guidelines developed by the Organization [referring to the CII Guidelines (G1)].

2 Ship types are defined in regulation 2 of MARPOL Annex VI. The carbon intensity reduction factors for each ship type [and size group], in conjunction with the reference lines developed in accordance with guidelines developed by the Organization [referring to the Reference line Guidelines (G2)], are used for the determination of the required CIIs of a ship over time.

Definition of a carbon intensity reduction factor

3 A reduction factor is a positive value in percentage to stipulate how far the required CII should be below the reference value.

4 The reduction factor for each calendar year as from 2023 is determined for each ship type [and size group], to which regulation 22B of MARPOL Annex VI is applicable.

5 The values of the reduction factor for each ship type [and size group] should increase over time, or at least hold at a certain level, ensuring that the reduction of carbon intensity of international shipping by at least 40% by 2030 can be achieved as a whole.

Data sources

6 Data on the carbon intensity level of international shipping in 2008 are expected to be derived from the Third & Fourth IMO GHG Study. The distribution characteristics of operational energy efficiency performance of individual ships are expected to be derived from the Fourth IMO GHG Study (for the year 2012-2018) and the statistical data collected under IMO DCS in 2019 and 2020.

Method to determine carbon intensity reduction factors

Method to estimate the achieved carbon intensity reduction of specific ship types

7 As stipulated in the Reference line Guidelines (G2), a linear logarithmic carbon intensity reference line of a specific ship type i is $\ln(CII_{ref}) = \ln a_0 - c\ln(Capacity)$.

8 For a specific year y, the carbon intensity reduction achieved by ship type i as a whole can be estimated by introducing a dummy variable to the linear logarithmic carbon intensity reference line equation, as follows:

$$\ln(attained\ CII_y) = \ln a_0 - c\ln(Capacity) - \Delta_y Year \quad (1)$$

where $Year$ is the dummy variable (a binary variable of value 1 or 0) representing a specific calendar year, and Δ_y can be interpreted as the carbon intensity reduction achieved when compared with the reference level (the year 2008). For a small value of $\hat{\Delta}_y$, such as 1% to 5%, $\hat{\Delta}_y$ can be an acceptable approximation of the achieved reduction factor in percentage(denoted $\hat{R}'_{segment_i,y}$), meaning $\hat{R}'_{segment_i,y} \approx \hat{\Delta}_y$. For a larger value, the reduction factor in percentage should be calculated through $\hat{R}'_{segment_i,y} = 1 - \exp(-\hat{\Delta}_y)$.

Method to estimate the achieved carbon intensity reduction of international shipping

9 For a specific year y, the achieved carbon intensity reduction of international shipping as a whole, denoted as $R'_{shipping,y}$, can be calculated as the weighted average of the carbon intensity reduction achieved by all ship types, calculated as $R'_{shipping,y} = \sum R'_{segment_i,y} f'_{i,y}$, where $R'_{segment_i,y}$ represents the carbon intensity reduction achieved by ship type i, estimated following the method in paragraph 8; and $f'_{i,y}$ is the weight, which is equal to the proportion of CO_2 emitted by ship type i to the total emissions of international shipping.

Plausible ranges of reduction factors

10 To achieve the given carbon intensity reduction target of international shipping for year y ($R_{shipping,y}$) , the following restriction on the carbon intensity reduction factors of each ship type ($R_{segment_i,y}$) should be satisfied: $\sum R_{segment_i,y} f_{i,y} \geq R_{shipping,y}$.

11 To ensure the continuous decline of the carbon intensity towards a rational level, the following restriction should be satisfied: $0 \leq R_{segment_i,y} \leq R_{segment_i,y\lim}$, where $R_{segment_i,y\lim}$ represents the maximum reduction potential of ship type i by year y , which can be decided taking into account the technical and operational methods available, as well as the carbon intensity reduction already achieved.

12 The restrictions specified in paragraph 10 and 11 may be satisfied by a range of values. In such cases, a moderate value should be taken as a starting point, subject to a thorough review by 2026.

The ship type [and size group] specific carbon intensity reduction factors

13 The agreed carbon intensity reduction factors for ship type i [and size group] in year y ($R_{segment_i,y}$) are specified in table 1.

Table 1: Carbon intensity reduction factors (fitting in original data form)

Ship type	[Size group]	Reduction factor $R_{segment_i,y}$			
		2023	…	2029	2030
Bulk carrier	…	X%	…	…	…
Cruise passenger ship	…	…	…	…	…
…	…	…	…	…	Y%

14 For a given reduction factor $R_{segment_i,y}$, the equivalent logarithmic reduction factor ($\Delta_{segment_i,y}$) can be calculated through $\Delta_{sement_i,y} = -\ln(1-R_{segment_i,y})$. Then, the values of $\Delta_{segment_i,y}$ for calculating the required CII are stipulated in table 2, which is essentially equivalent to table 1.

Table 2: Carbon intensity reduction factors (fitting in logarithmic data form)

Ship type	[Size group]	$\Delta_{segment_i,y}$			
		2023	…	2029	2030
Bulk carrier	…	$-\ln(1-X\%)$	…	…	…
Cruise passenger ship	…	…	…	…	…
…	…	…	…	…	$-\ln(1-Y\%)$

The required CII for specific ship type [and size group]

15 Based on the carbon intensity reduction factor ($R_{segment_i,y}$) in table 1, the required CII for ship type i [and size group] in year y can be calculated as :

$$required\ CII_y = a_0 Capacity^{-c}(1-R_{segment_i,y}) \quad (2)$$

16 Based on the carbon intensity reduction factor ($\Delta_{segment_i,y}$) in table 2, the logarithmic required CII for ship type i [and size group] in year y can be calculated as :

$$\ln(required\ CII_y) = (\ln a_0 - \Delta_{segment_i,y}) - c\ln(Capacity) \quad (3)$$

17 In Eq.(2) and Eq.(3), parameters a_0 and c are identical with those used in the reference line as relevant. **] "**

Timelines for development

3 The ship type [and size group] specific carbon intensity reduction factors should be developed based on the determined specific carbon intensity indicators, the concrete statistical data in the year 2019 and 2020 collected through IMO DCS, as well as the data derived from the Third & Fourth IMO GHG Study. Thus, this document can be initiated in MEPC 75. Taking the CII Guidelines (G1, finalized at MEPC 76) and the concrete data inputs (in 2020 and 2021) as the basis, this document can be finalized at MEPC 77（[May] 2021）, ready for use in developing the Rating Guidelines (G4).

G4: Guidelines for Rating the Operational Energy Efficiency Performance of Ships (Rating Guidelines)

Brief introduction

1 These guidelines provide the methods to assign an operational energy efficiency performance rating to a ship, as requested by regulation 22B of MARPOL Annex VI, based on the deviation of the attained CII from the target value.

Main elements

2 Main elements of these guidelines are sketched as follows:

"[General

1 An operational energy efficiency performance rating should be assigned to each ship to which regulation 22B of MARPOL Annex VI is applicable in a transparent and robust manner.

2 Ship types are defined in regulation 2 of MARPOL Annex VI. The specific carbon intensity indictor applicable to a ship, as well as the required and attained CII values are specified in the guidelines developed by the Organization [referring to the CII Guidelines (G1), the Reference line Guidelines (G2) and the Reduction factor Guidelines (G3)].

Framework of the operational energy efficiency performance rating

3 To rate a ship's operational energy efficiency performance means to assign a ranking label from among the five grades (A, B, C, D and E) to the ship based on the attained carbon intensity indicator, indicating a major superior, minor superior, moderate, minor inferior, or inferior performance level.

4 To facilitate the rating assignment, four boundaries are defined for the five-grade rating mechanism, namely superior boundary, lower boundary, upper boundary, and inferior boundary, as per Regulation 22B of MARPOL Annex VI. Thus, a rating can be assigned through comparing the attained CII of a ship with the boundary values.

5 As a standard scenario, if ships of type i as a whole have just achieved the carbon intensity target in year y, meaning the median regression curve of the attained CIIs over ship capacity roughly overlaps the required values. Then the appropriate boundaries are expected to generate the following results: the middle 30% ships throughout the capacity, in terms of the attained CIIs, are assigned rating C, while the upper 20% and further upper 15% are assigned rating D and E respectively, the lower 20% and further lower 15% are assigned rating B and A respectively, as illustrated in Figure 1.

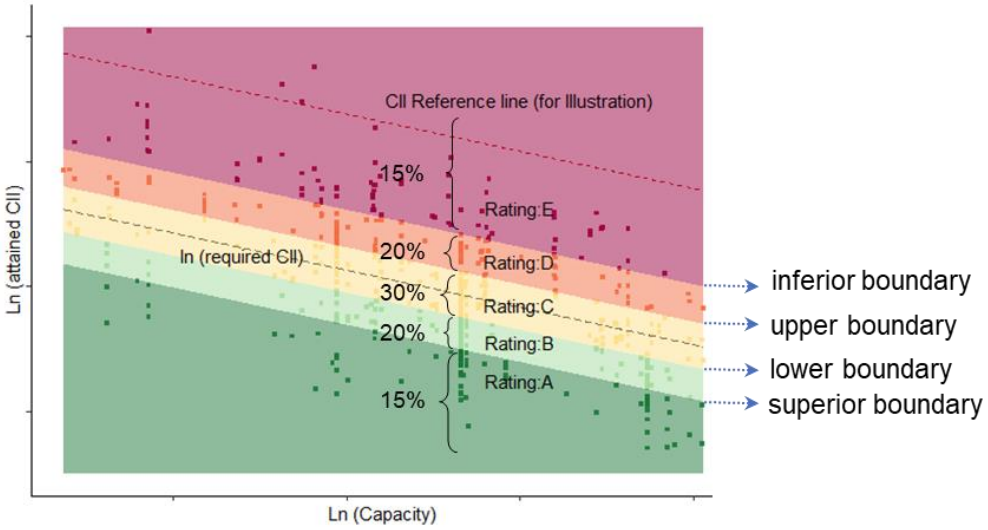

Figure 1: Operational energy efficiency performance rating scale

6 Given the increasing carbon intensity reduction factors over time, the boundaries for defining performance ratings should be synchronized accordingly. Note that the factual rating results may not be always identical with the standard scenario. For instance, the sum of the proportion of ships rated as D and E might be 40% rather than 35%, or the sum of the proportion of ships rated as A and B might be 42% rather than 35%. In such cases, a larger proportion of ships rated as D and E would imply an under performance of this ship type, while a larger proportion of ships rated as A and B would imply a superior performance, relative to the carbon intensity reduction target of international shipping. The concrete gap or excess can be estimated in accordance with the Reduction rate Guidelines (G3).

Data sources

7 Data used to determine the boundaries for rating scale are derived from the Fourth IMO GHG Study (for the year 2012-2018), and the statistical data collected through IMO DCS in 2019 and 2020.

Method to determine the rating boundaries

8 The boundaries can be determined by the required CII in conjunction with the vectors indicating the direction and distance they deviate from the required value (denoted as dd vectors for easy reference), as illustrated in Figure 2.

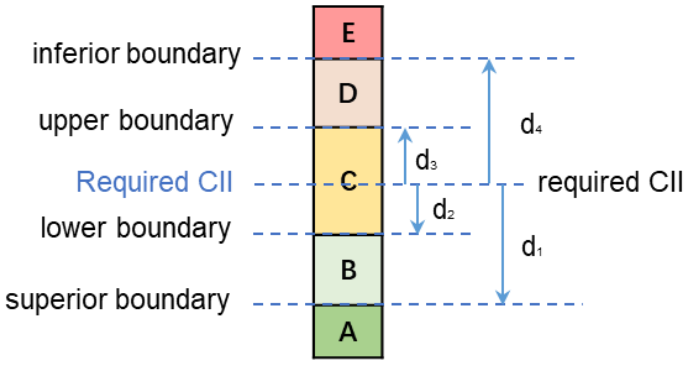

Figure 2: dd vectors and rating bands

9 Statistically, the dd vectors depend on the distribution of the attained CII of the ships concerned, which can be estimated through a quantile regression based on the statistical data in recent years. For a specific calendar year, the quantile regression model can be developed as follows:

$$\ln(attained\ CII) = \delta^{(p)} - c\ln(Capacity) + \varepsilon^{(p)}, \quad p = \{0.15, 0.35, 0.50, 0.65, 0.85\} \quad (1)$$

where p is the typical quantile, meaning the proportion of observations with a lower value is $p\%$; and $\varepsilon^{(p)}$ is the error term.

10 The quantile regression lines are illustrated in Fig.3.

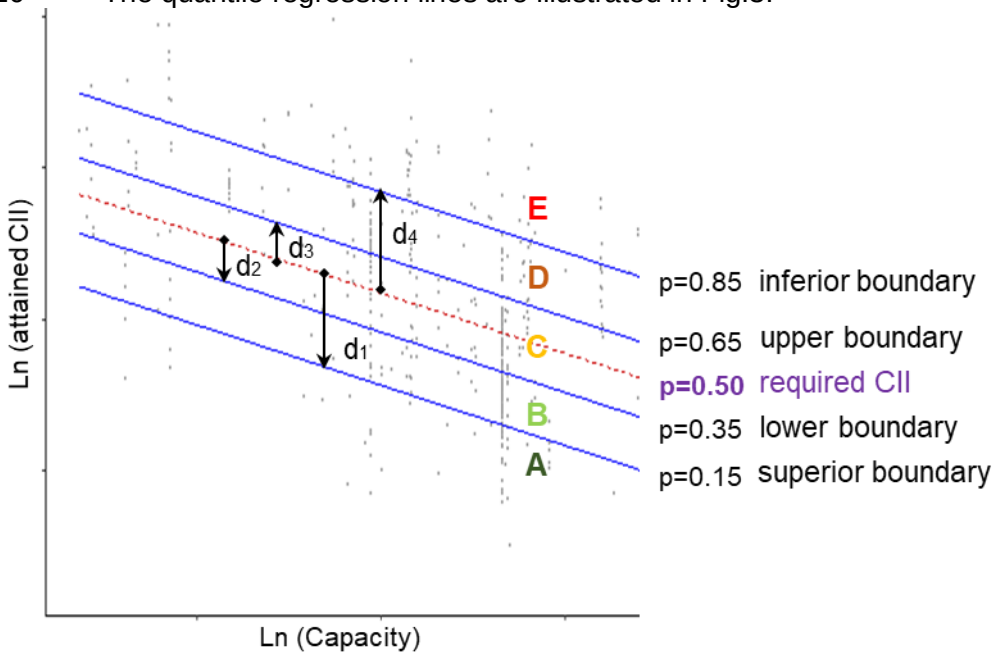

Figure 3: Quantile regression lines

11 Then, the dd vectors can be calculated based on the estimates of the intercept ($\hat{\delta}^{(p)}$), in accordance with Eq.(2).

$$\left.\begin{aligned} \hat{d}_1 &= \hat{\delta}^{(0.15)} - \hat{\delta}^{(0.50)} \\ \hat{d}_2 &= \hat{\delta}^{(0.35)} - \hat{\delta}^{(0.50)} \\ \hat{d}_3 &= \hat{\delta}^{(0.65)} - \hat{\delta}^{(0.50)} \\ \hat{d}_4 &= \hat{\delta}^{(0.85)} - \hat{\delta}^{(0.50)} \end{aligned}\right\} \quad (2)$$

12 Given the availability of statistical data of multiple years, for instance 2019 and 2020 [as well as years before 2019 provided by the fourth IMO GHG Study], the mean value of each dd vector can be taken as the plausible estimate.

The rating boundaries for ship type i in year y

13 As stipulated in the Reduction factor Guidelines (G3), for ship type i, the required CIIs can be presented as a linear logarithmic formula, which shares the same slope with the reference line. The difference between the two intercepts is the equivalent reduction factor. Thus, for a specific year y, the required CII for ship type i in a logarithmic formula can be presented as follows:

$$\ln(required\ CII_{i,y}) = (\ln a_0 - \Delta_{segment_i,y}) - c\ln(Capacity) \qquad (3)$$

where parameters a_0, $\Delta_{segment_i,y}$, and c can be given by the Reduction factor Guidelines (G3).

14 On this basis, the four boundaries of the rating scale for ship type i in year y can be derived from the linear logarithmic formulas, as follows:

$$\left.\begin{aligned}
&\ln\text{ (superior boundary)} = (\ln a_0 - \Delta_{segment_i,y} + d_1) - c\ln(Capacity)\\
&\ln\text{ (lower boundary)} = (\ln a_0 - \Delta_{segment_i,y} + d_2) - c\ln(Capacity)\\
&\ln\text{ (upper boundary)} = (\ln a_0 - \Delta_{segment_i,y} + d_3) - c\ln(Capacity)\\
&\ln\text{ (inferior boundary)} = (\ln a_0 - \Delta_{segment_i,y} + d_4) - c\ln(Capacity)
\end{aligned}\right\} \quad (4)$$

15 Through an exponential transformation, the four boundaries fitted in the original data form can be derived, as follows:

$$\left.\begin{aligned}
&\text{superior boundary} = \exp(d_1)\cdot required\ CII_{i,y}\\
&\text{lower boundary} = \exp(d_2)\cdot required\ CII_{i,y}\\
&\text{upper boundary} = \exp(d_3)\cdot required\ CII_{i,y}\\
&\text{inferior boundary} = \exp(d_4)\cdot required\ CII_{i,y}
\end{aligned}\right\} \quad (5)$$

16 By comparing the attained CII of a specific ship with the boundaries, a rating can be assigned as stipulated in Regulation 22B of MARPOL Annex VI. Note that the direct comparison between the logarithmic values can facilitate the process while yielding the same rating results.**] "**

Timelines for development

3 The boundaries for the rating sale depend on 1) the required CII, which will be provided Reduction rate Guidelines; and 2) the four *dd vectors*, which have to be estimated based on concrete statistical data in the year 2019 and 2020 collected through IMO DCS, and the data derived from the third and fourth IMO GHG studies. Thus, these guidelines can be initiated in MEPC 75. Taking the Reference line Guidelines and the Reduction rate Guidelines (G2 and G3 finalized at MEPC 77), as well as the concrete data inputs (in 2020 and 2021) as the basis, this document can be finalized at MEPC 78（[Apr.] 2022）, ready for use of the ship owners in preparing the super SEEMP.