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PREVENTION OF AIR POLLUTION FROM SHIPS

Consideration of a market-based mechanism: Leveraged Incentive Scheme to improve the energy efficiency of ships based on the International GHG Fund

Submitted by Japan

SUMMARY

Executive summary:	This document provides details of the Leveraged Incentive Scheme, which is a modified version of the International GHG Fund proposed by Denmark (MEPC 59/4/5); the purpose of the scheme is to accelerate energy efficiency improvement of ships through strong economic incentives
Strategic direction:	7.3
High-level action:	7.3.1
Planned Output:	7.3.1.3
Action to be taken:	Paragraph 38
Related documents:	MEPC 57/4/4, MEPC 57/21, MEPC 57/INF.13; GHG-WG 1/5/1, GHG-WG 1/5/4; MEPC 58/4, MEPC 58/4/22, MEPC 58/23; MEPC 59/4/5, MEPC 59/4/34, MEPC 59/4/35; MEPC 60/4/35 and MEPC 60/4/36

Introduction

1 This document follows the submission deadline provided in MEPC 60/1/Add.1 for those bulky documents relying on the outcome of the fifteenth Conference of Parties (COP 15) to the United Nations Framework Convention on Climate Change (UNFCCC). It was considered that the design of the market-based measures, including the Leveraged Incentive Scheme proposed in this document, would be related to a possible outcome at COP 15, in particular, possible guidance to IMO that may have included guiding principles and target-setting for international shipping emissions.

2 At the fifty-ninth session of the Marine Environment Protection Committee (MEPC 59), as mentioned in paragraph 4.103 of document MEPC 59/24, the Committee considered document MEPC 59/4/34 (Japan), which supported the International GHG Fund proposed by Denmark with additional suggestion that ships could pay the contribution directly to the Fund, and not via fuel

suppliers, through electronic accounts established for individual ships. Japan further proposed a Leveraged Incentive Scheme in which ships ranked as "good performance ships" would benefit from refunds out of the collected revenues, thereby creating a strong economic incentive to accelerate the improvements in the energy efficiency of ships.

3 The concept of the Leveraged Incentive Scheme is that a part of the GHG contributions which are collected on marine bunker is refunded to ships labelled as "good performance ships" in order to produce strong incentives for efficiency improvement so that:

.1 new ships will be designed and built as efficiently as possible by applying the optimum package of available technologies; and

.2 both new and existing ships will be operated in optimized ways in terms of efficiency as an individual ship and a fleet.

In addition, the Leveraged Incentive Scheme is compatible with the general preference shown at MEPC 59 that a part of revenue goes to mitigation and adaptation projects in developing countries.

4 In this document, Japan elaborates on the system design of the "Leveraged Incentive Scheme" of which details had not been fully introduced in document MEPC 59/4/34. Such details cover the collection of contribution, the method of evaluating ships' performance and labelling ships as "good performance ships", and the method for refund to such "good performance ships".

How the Leveraged Incentive Schemes work?

Step 1: Collection of contribution

5 The contribution is collected from all ships (possibly with an exclusion of small ships) in a mandatory manner, with a fixed amount per tonne of purchased fuel.

Step 2: Data collection by each individual ship

6 In case of "criteria No.2 of the performance appraisal" (relating to the energy efficiency during operation, see paragraphs 20 to 28 below), the EEOI values have to be monitored and recorded by each ship. This is NOT mandatory for all ships; only those owners/operators who consider their ship performance to be good or improved would conduct such a data collection voluntarily, for possible refund of a part of the contribution that they had already paid.

Step 3: The third party verification of the collected data and the application for a refund

7 In case of refund relating to "criteria No. 2 of the performance appraisal", the data collected in step 2 should be verified by the Administration or an recognized organization, and the refund application should be accompanied by the report of this verification. The refund application with "criteria No.1 of the performance appraisal" (superior EEDI values in excess of required EEDI, see paragraphs 12 to 19 below) should be accompanied by relevant international certificate which is to be issued in accordance with the requirements of the EEDI (see MEPC 60/4/35), thus not requiring any specific verification process. Like step 2, this is NOT mandatory for all ships, and is only applicable to those ships that apply for refund.

Step 4: Confirmation of submitted data, labelling as "good performance ships", calculation of refund values by the International GHG Fund, and remittance of the refund

8 This administrative process is carried out by an International GHG Fund to be established. Labelling would be done as an automatic calculation based on a standard template for the submitted data, following the pre-determined criteria of "good performance ships" and corresponding refund rates, avoiding any arbitrary judgment. The International GHG Fund would have to predetermine the "budget" for refunding, considering both the level of incentives necessary for investing in improving the efficiency of ships and the allocation of revenues for other purposes. In case the total necessary refund amount calculated from the pre-set refund rates exceeds the budget for the refund, each refund rate would be adjusted so that the total refund value meets the budget.

How the GHG contributions would be collected (relating to Step 1)

9 As proposed in document MEPC 59/4/34, Japan is of the view that direct payment of the contributions to the International GHG Fund through electronic accounts of individual ships is suitable for collecting the contribution (Figure 1). Such direct payment can reduce administrative costs included in the contribution collection, and would lead to a fraud-free system of transferring the paid contributions to the International GHG Fund.

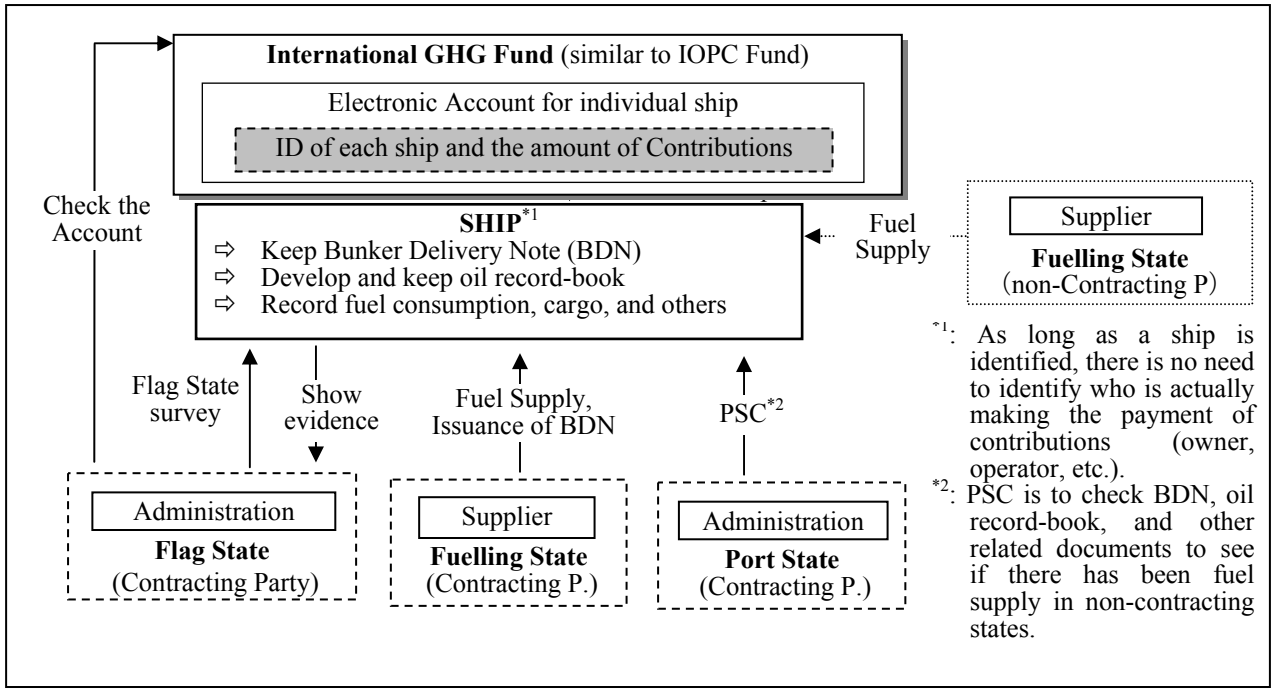


Figure 1: Illustration of the direct transfer of contributions

What criteria should be used for the performance appraisal and labelling of "good performance ships" (relating to Steps 2, 3 and 4)?

10 It should be recalled that the Committee had adopted, on a trial basis at this stage, the Energy Efficiency Design Index (EEDI) as a method for energy efficiency evaluation of new ships at the design stage (MEPC.1/Circ.681), and the Energy Efficiency Operational Indicator (EEOI) as a method for energy efficiency evaluation of ships in operation (MEPC.1/Circ.684).

11 The EEDI can be a tool to evaluating the "potential" performance in terms of energy efficiency of a "hardware" (= ship): the way of operating the ship cannot be reflected in the EEDI. On the other hand, the EEOI indicates how the ship is operated with the hardware (ship itself) being untouched as a given condition. The way to achieve the highest possible energy efficiency is to:

.1 firstly procure and use a good hardware (to be reflected in EEDI); and

.2 operate such hardware "wisely" (to be reflected in EEOI).

Therefore, it is considered appropriate to use dual criteria for performance appraisal: one is the performance of the hardware based on the EEDI, and the other is the performance of operation based on the EEOI. It should be noted that the operational performance may include various aspects from the pure techniques and skills of navigation, fleet management and business efforts to increase the load factor of individual ships.

Criteria No.1 of the performance appraisal: rewarding the well designed and built ships having superior EEDI values by far exceeding the required EEDI

12 As discussed in MEPC 60/4/35 (Japan, Norway, and the United States), when the requirements of the EEDI are put into force, an attained EEDI of an individual ship should be below its required EEDI. The required EEDI would be determined by the baselines and by the reduction ratio (X) developed by the organization and should be strengthened in a gradual manner, such as the following examples, to ensure the constant energy efficiency improvements for new ships (MEPC 59/INF.26 and MEPC 60/4/35).

Phase 1: For ships of which contract is signed from [1 January 2013 to 31 December 2017]

X= aa %;

Phase 2: For ships of which contract is signed from [1 January 2018 to 31 December 2022]

X= bb %; and

Phase 3: For ships of which contract is signed from [1 January 2023 to 31 December 2027]

X= cc %.

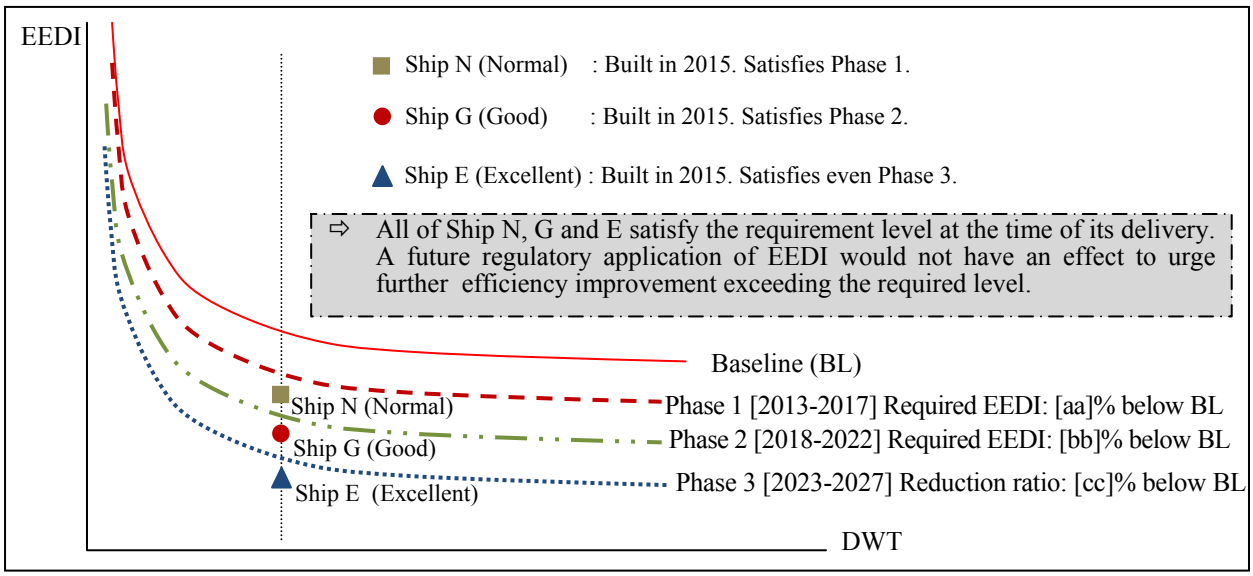


Figure 2: Shift of required EEDI lines

13 Since the start of phase 1 (the first period after the EEDI requirements are enacted), all new ships would have to satisfy the required EEDI; the attained EEDI for all new ships would have to be below the "phase 1 required EEDI" line in Figure 2. Ship N, which is constructed during phase 1, satisfies the required EEDI (marginally below the "phase 1 required EEDI" line), thus Ship N has no problem to be allowed to operate. Ship G and Ship E, both of which are constructed during phase 1 like Ship N, satisfy the required EEDI of phase 1. In this sense, there is no difference between how Ship G and Ship E are treated and how Ship N is treated in the context of the mandatory EEDI requirements.

14 Criteria No. 1 of the performance appraisal under the Leveraged Incentive Scheme is to differentiate Ship N, Ship G and Ship E, based on their EEDI level. Ship N is "normal" as it marginally satisfies the phase 1 required EEDI line, thus not eligible for any reward[1]. Ship G has a lower EEDI than Ship N, and satisfies not only the phase 1 required EEDI line but also satisfy the phase 2 required EEDI line. In this regard, it is appropriate to reward Ship G for "the achievement in advance"; Ship G has achieved a lower EEDI than the phase 1 requirement, which is even below the phase 2 requirement, although it is a phase 1 ship.

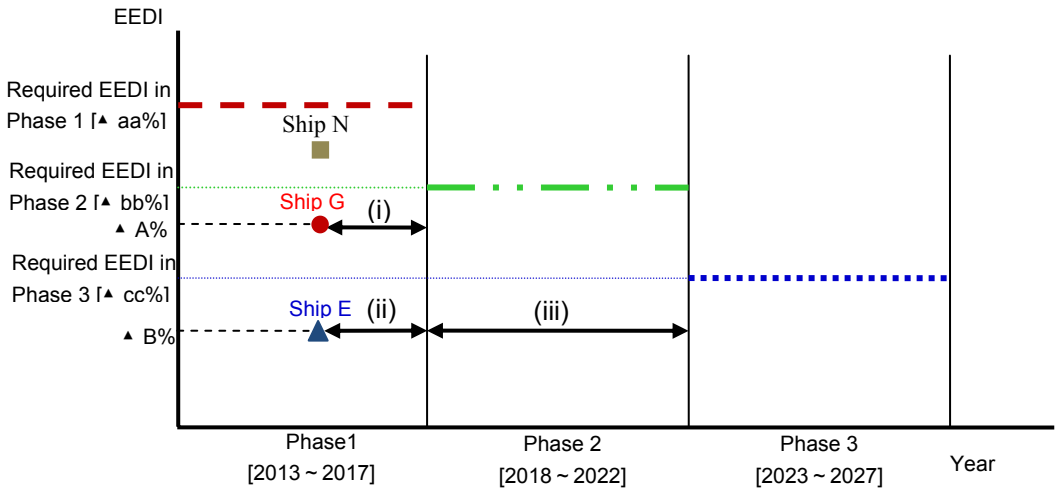


Figure 3: Eligibility for refund by the "achievement in advance" of the required EEDI

15 The next question is for how long a time a reward for "achievement in advance" should be extended. When it comes to the starting date of phase 2, Ship G is no longer special; all new ships to be built at that time (phase 2) would have to satisfy the phase 2 required EEDI line. Therefore it is considered appropriate that such special reward for Ship G would cease at the start of phase 2 when Ship G becomes an "ordinary" ship, just like many other ships that are constructed in phase 2 and thus are required to satisfy the phase 2 required EEDI line. The period (i) in Figure 3 would be the period that Ship G is eligible for refund.

16 Ship E has an attained EEDI value which is lower than Ship G's (below the phase 2 required EEDI line), and even lower than the phase 3 required EEDI line. This means that Ship E is satisfying the required EEDI lines of two phases ahead and is thereby more "advanced" than "ordinary" ships in phase 1 (i.e. Ship N) and even better than a "good" ship (Ship G). The "excellent" Ship E should be made eligible for a higher refund rate than Ship G, and the eligible period should continue until such time that Ship E no longer is special, i.e., the start of phase 3; Ship E could obtain refund in period (ii) and (iii).

[1] EEDI would have to be recalculated for a ship that has gone through major conversion, as necessary. If recalculated EEDI satisfies the criteria for refund, the ship can apply for refund.

17 A further question is how to set the degree of reward, namely, the refund rates and the respective duration of eligibility. The simplest way is to use fixed and step-wise refund rates based on how many phases that the attained EEDI of a particular ship is ahead of time (see Table 1). In Figure 3, Ship G during phase 1 has an attained EEDI which is ahead by one phase (satisfying the phase 2 required EEDI line in the phase 1 period), thus, for example, Ship G is rewarded by a 50% refund rate until its advantage is lost (i.e. during period (i)). Ship E has an attained EEDI which is ahead by two phases (satisfying the phase 3 required EEDI line already in the phase 1 period), thus would be rewarded, for example, 100%. In phase 2, Ship E is advanced by one phase only, thus eligible for a 50% refund rate. In phase 3, the reward for Ship E would cease to exist, as it becomes an "ordinary" ship by that time.

Table 1: An example of setting refund rates: a simple step-wise approach

	Phase 1	Phase 2	Phase 3
Ship N (built in phase 1)	No refund	No refund	No refund
Ship G (built in phase 1)	[50]% refund rate Advanced by one phase	No refund	No refund
Ship E (built in phase 1)	[100]% refund rate Advanced by two phases	[50]% refund rate Advanced by one phase	No refund

18 This simple way of setting the refund rates have some flaws, especially, it may be problematic that Ship G-1 of which the attained EEDI is marginally below the phase 2 required EEDI line would be treated in the same way as Ship G-2 of which the attained EEDI is marginally above the phase 3 required EEDI line, although there is a considerable deviation in the EEDI of these two ships.

19 One possible way of solving the problem is to use linearly progressing refund rates, based on the relative position of the attained EEDI of a particular ship against the benchmarks, namely the phase 2 required EEDI line and the phase 3 required EEDI line, as illustrated below in Figure 4.

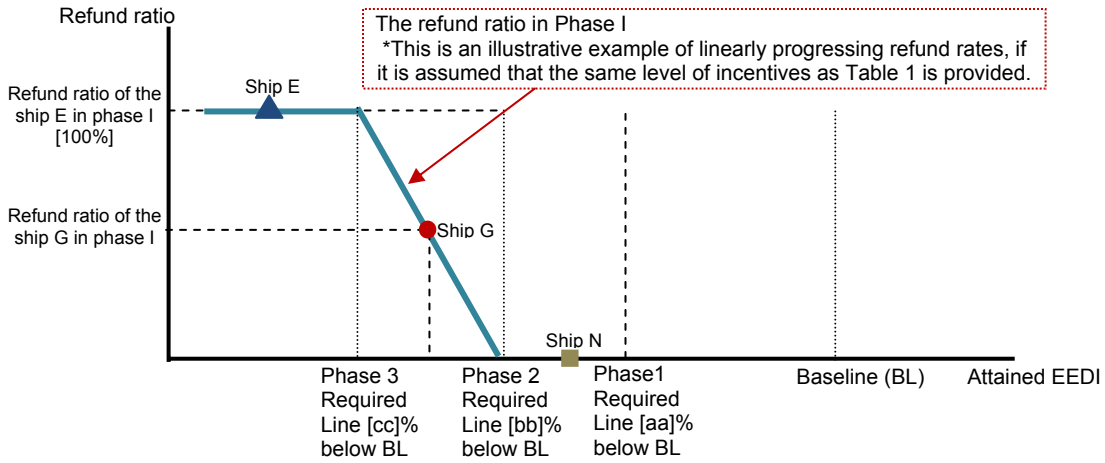
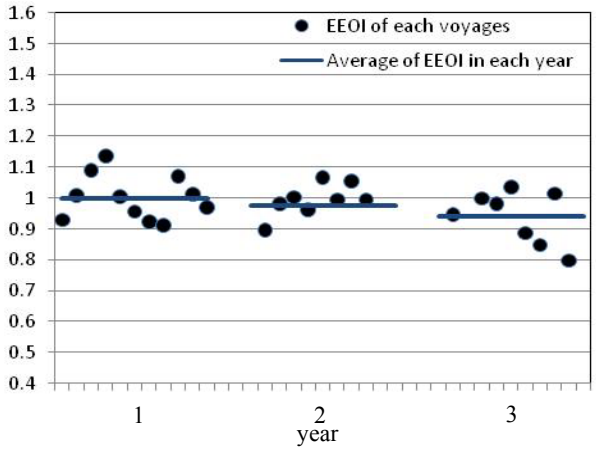


Figure 4: An example of linearly progressing refund rate

Criteria No.2 of the performance appraisal: rewarding "wise" operation in terms of energy efficiency

20 Japan has examined the actual EEOI on a series of 90 ships over a three year period to check the feasibility of evaluation by the EEOI. Based on this analysis, Japan is of the view that it is possible to use the EEOI as an evaluation tool to label "good performance ships". It is clear that there is considerable fluctuation of the EEOI value depending on voyages, especially in the case of ships which transport low density cargo, but the EEOI trend can be observed if the average EEOI is calculated for a reasonably long time span, e.g., one year (Figure 5). Although it would be feasible to use the EEOI to label "good performance ships", it is also possible, as shown in annex 1, to remove the effects of market fluctuation on the EEOI value, by removing the cargo factor from the EEOI calculation formula.



*Each data is normalized by the average of EEOI in year 1.
*Above two graphs are examples of the dry cargo carrier.

Figure 5: Actual EEOI of each voyage and Average of EEOI in each year

21 It is widely recognized that the EEOI can vary significantly even between identical sister ships because of the effects of the operational pattern including the navigating route prevailing. A ship with worse EEOI than other ships in the same ship size/type category cannot be punished; the reason for the higher (worse) EEOI may be unavoidable, for example tough sea conditions on a route in which a ship has been engaged and relatively high frequency of voyages (i.e. short distance of one voyage) which is determined by the transportation needs and thus cannot be changed.

22 The EEOI is a common tool to monitor improvement of ships' efficiency. Based on the common understanding that the EEOI should not be used for the comparison of ship performance among different ships, the evaluation should not intend to compare the performance, i.e. absolute level of the efficiency of different ships. Instead, the evaluation using EEOI would be to assess the relative improvement of efficiency of the same ship over a reasonably long time span.

23 Fully understanding such precaution of using the EEOI, Japan considers that there could be appropriate ways to utilize the EEOI in the criteria of performance appraisal in terms of energy efficiency. As briefly argued in document MEPC 59/4/34, there should be two different patterns to label "good performance ships".

Pattern 1: Achieving relative improvement of EEOI over the past. EEOI improved by a certain margin from the past average of EEOI for the same ship; and

Pattern 2: Keeping the EEOI below a pre-fixed "benchmark", which is to be set for each ship size/type category.

24 The "benchmark" in this context is a target EEOI to be predetermined for each ship size/type category. It is presumed that ship size/type categories would follow those used in the second IMO GHG Study 2009. The benchmark should not be an excessively ambitious target, and it may be an "average" EEOI for ships in each category, which can be derived from the data in the second IMO GHG Study 2009. It should be emphasized that the benchmark does not constitute any requirement or mandatory standard for the EEOI; it is a yardstick to be used to judge the eligibility for refund, and there would be no requirement for ships' EEOI being below such a benchmark. Further analyses on setting the benchmark are provided in annex 2.

25 Pattern 1 means that, even though a ship's EEOI is high in absolute terms, if compared to other ships by unavoidable reasons such as route and operation specificity, a ship's EEOI could improve over the past records of the same ship. Such a ship should be ranked "good performance ship" as it achieved "relative" improvements over a long time span. As illustrated below (Figure 6), ship C will be rated "good performance ship" as its EEOI in [2015] is better than its EEOI of the average of the two preceding years [2013-2014].

26 "Pattern 1 – Good performance ship" rating can be given to any ship, even if it is old and has lower energy efficiency as hardware potential, and even if it is engaged in transport operations in tough sea conditions with high frequency of voyages, which put it in disadvantage in achieving low (good) EEOI in absolute terms. Those ships would have equal chance to be rewarded if they made efforts and achieved "relative" improvements over their own records in the past. As all ships are motivated, it has a vast potential to achieve the overall objective of controlling CO_2 emission from ships.

27 On another front, there may be ships which already have taken most of the applicable operational measures to improve the efficiency, and their EEOI levels are already good (low) in the respective ship type/size category; in this case, it is difficult for those ships to further improve the efficiency. Pattern 2 of rating "good performance ships" takes into account this situation where the efficiency improvement has saturated. Ship D, which has already achieved considerable efficiency improvement and whose EEOI is thus below the EEOI benchmark, would be rated "good performance ship" on the condition that the EEOI has not deteriorated from the monitoring period, i.e., that Ship D maintained its good EEOI level.

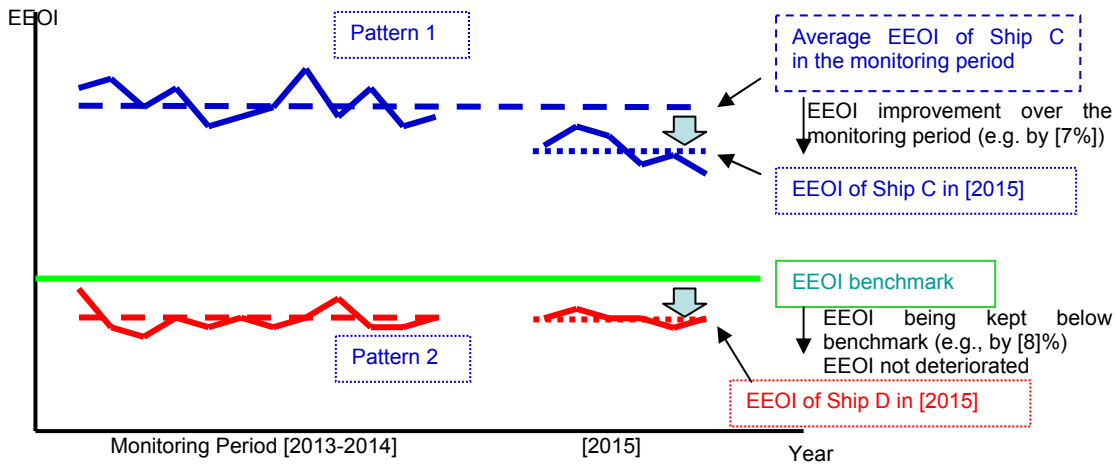


Figure 6: Pattern 1 and 2 of rating "good performance ship"

28 The refund ratio should be decided according to the level of EEOI improvement rates (pattern 1) and the deviation of the EEOI from the benchmark (pattern 2). An example of setting the refund rates, based on the hypothetical situation of Ship C and Ship D in Figure 6, is provided in Figure 7. In this example, ship C which achieved [7%] improvement of its EEOI over its own past records would receive [40%] of the GHG contributions it has paid in advance. Ship D, which has, at least, maintained its already good EEOI level, and was [8%] better than the EEOI benchmark, receives [60%] of the GHG contributions that have been paid by it. It should be noted, as explained in paragraph 8, that pre-fixed refund ratios may have to be reset if the total necessary refund amount exceeds the budget determined by the International GHG Fund.

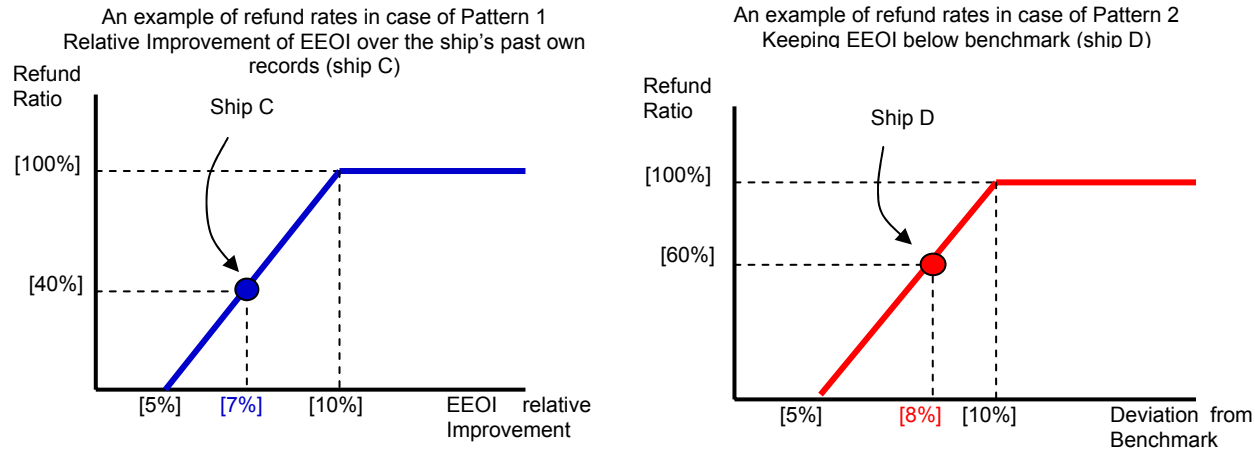


Figure 7: An example of setting the refund rates

29 Paragraphs 12 to 28 provide the illustrative examples of setting the refund rates. In the actual implementation of the Leveraged Incentive Scheme, the setting of refund rates would be carried out by the International GHG Fund; various implementation aspects including the refund rate setting are subject to the decision-making process under the International GHG Fund, thus, the decisions would rest upon the Parties to the legal instrument which would establish the Fund. The Fund may wish to operate implementation tools such as the performance appraisal criteria and refund rates flexibly; rates and criteria may change each year, although the Fund may wish to retain a certain degree of stability.

How the refund to the "good performance ship" would function (relating to Step 4)

30 Any ships subject to this scheme may apply to the International GHG Fund for refund when it believe its hardware potential and/or operational performance satisfy criteria No.1 and/or No.2, respectively. Filing such application, which necessitates the collection of relevant data over a sufficiently long time span in case of utilizing criteria No.2, is not mandatory, but is on the ships' own initiative. The data that accompany the application should be verified by the Administration or an organization recognized by it. In case of criteria No.1, which relates to the ships' hardware potential (the advance achievement of the required EEDI), specific verification would not be necessary because the international certificate for the EEDI would provide enough evidence for the International GHG Fund to almost automatically determine whether the ship is eligible for refund.

31 In case of criteria No.2, the verification procedure of the relevant data, i.e. EEOI and its components throughout the year, should be further examined. The potential administrative burden on both sides (the ship side (owner/operator) and the verifier) should be considered.

A possible approach is to limit the verification to "system check". For example, ships may be equipped with a continuous monitoring device to record its fuel consumption which is an important input to calculate the EEOI, and the verifier may check proper functions of such devices in advance. There is no need for the verifier to be on board all the time, instead, the verifier may trust the data submitted by the ship side, as far as such data are recorded in the device that had been verified and that may be subject to spot-check for proper functioning.

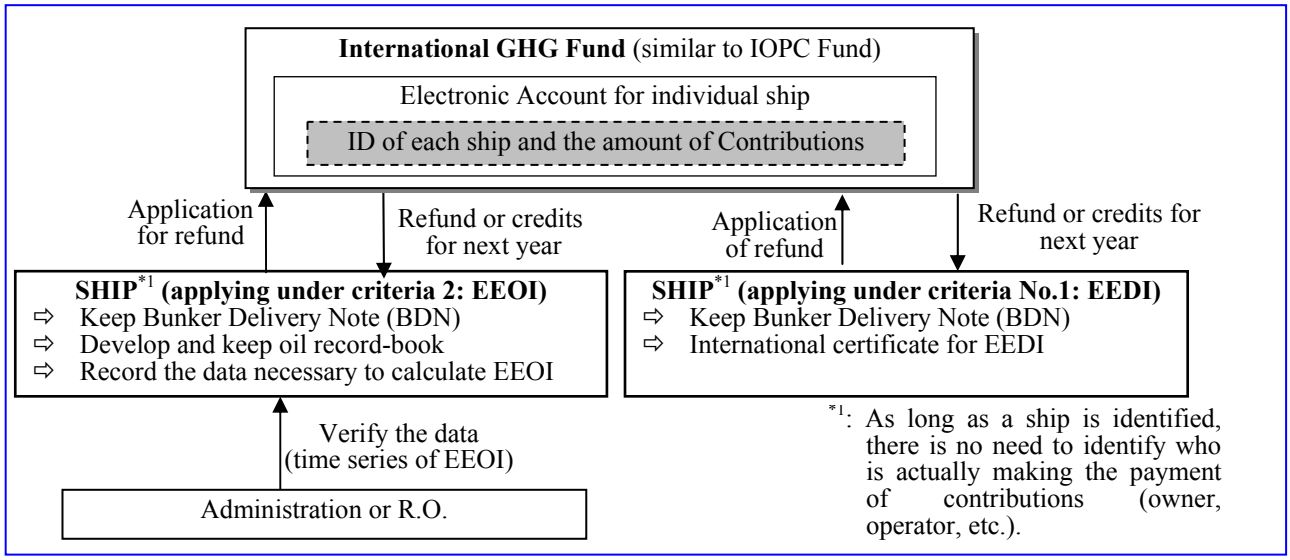


Figure 8: Illustration of the refund

The flow from contribution collection to refund

32 The flow from the contribution collection to the refund is illustrated in Figure 9. A ship can choose either receiving the refunds from the International GHG Fund or retaining the refunds as credits for the contributions in the next year.

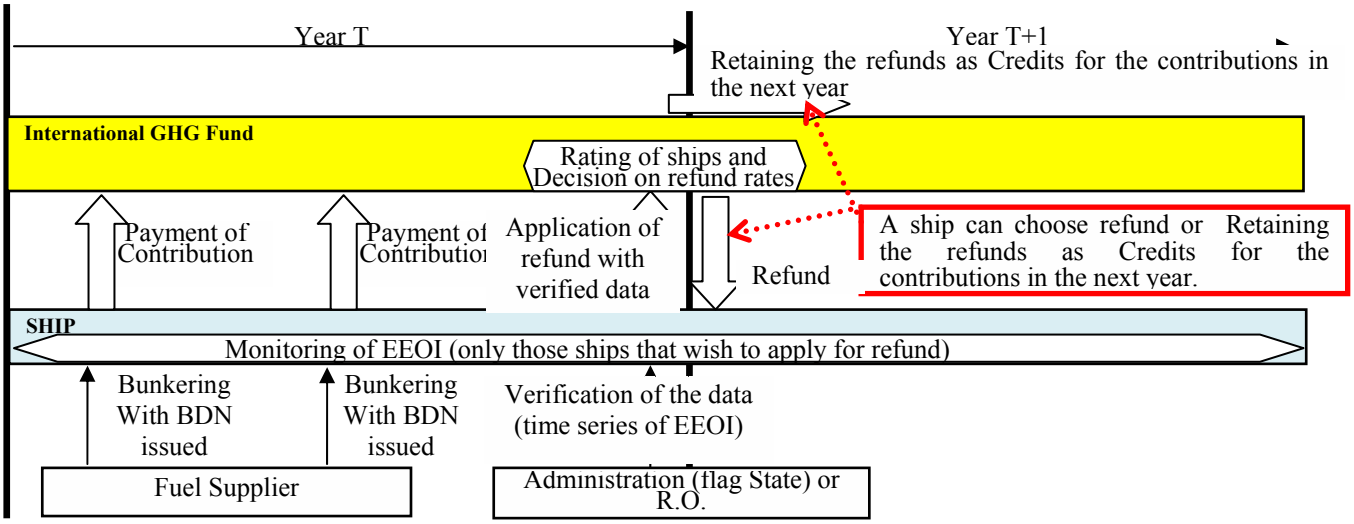


Figure 9. The flow from payment of Contribution to Refund

Methodologies for impact assessment of this market-based measure on international shipping

33 Annex 16 of document MEPC 59/24/Add.1 indicates the work plan for further consideration of market-based measures: "MEPC 60 would further consider the methodology and

criteria for feasibility studies and impact assessments in relation to international shipping, giving priority to the overall impact on the maritime sectors of developing countries". Here is the outline of the methodology of feasibility study and impact assessment for Incentive Leveraged Scheme proposed in this document.

34 As written in paragraph 20, Japan has examined the actual EEOI data over three years for a series of 90 ships to check the feasibility of introducing a performance appraisal based on the EEOI. In order to evolve the feasibility study to the impact study on international shipping, it would be necessary to conduct scenario-based analysis, making appropriate sets of assumption. For example, among 90 ships of which the EEOI data have been collected, there are nine bulk cargo carriers, and this group could be regarded as "model fleet" or a hypothetical company operating such a fleet.

35 There are several sets of assumptions to be set for running the scenario analysis. The actual data is available only for three years, and the first set of assumptions to be made would be future efficiency improvements for the sample ship groups. This is related to refund under criteria No.2 of the performance appraisal. The second set of assumptions is related to the replacement to new ships where their attained EEDI would be compared to the phases 1, 2 and 3 EEDI required line, relating to criteria No.1 of the performance appraisal.

36 Figure 10 shows a concept impact study of the Leveraged Incentive Scheme. Application of the refund rate formula explained in paragraphs 17,19 and 28 to the "model" fleet, coupled with the assumptions on the efficiency improvements, would estimate the costs of operating the model fleet for the company that operate them.

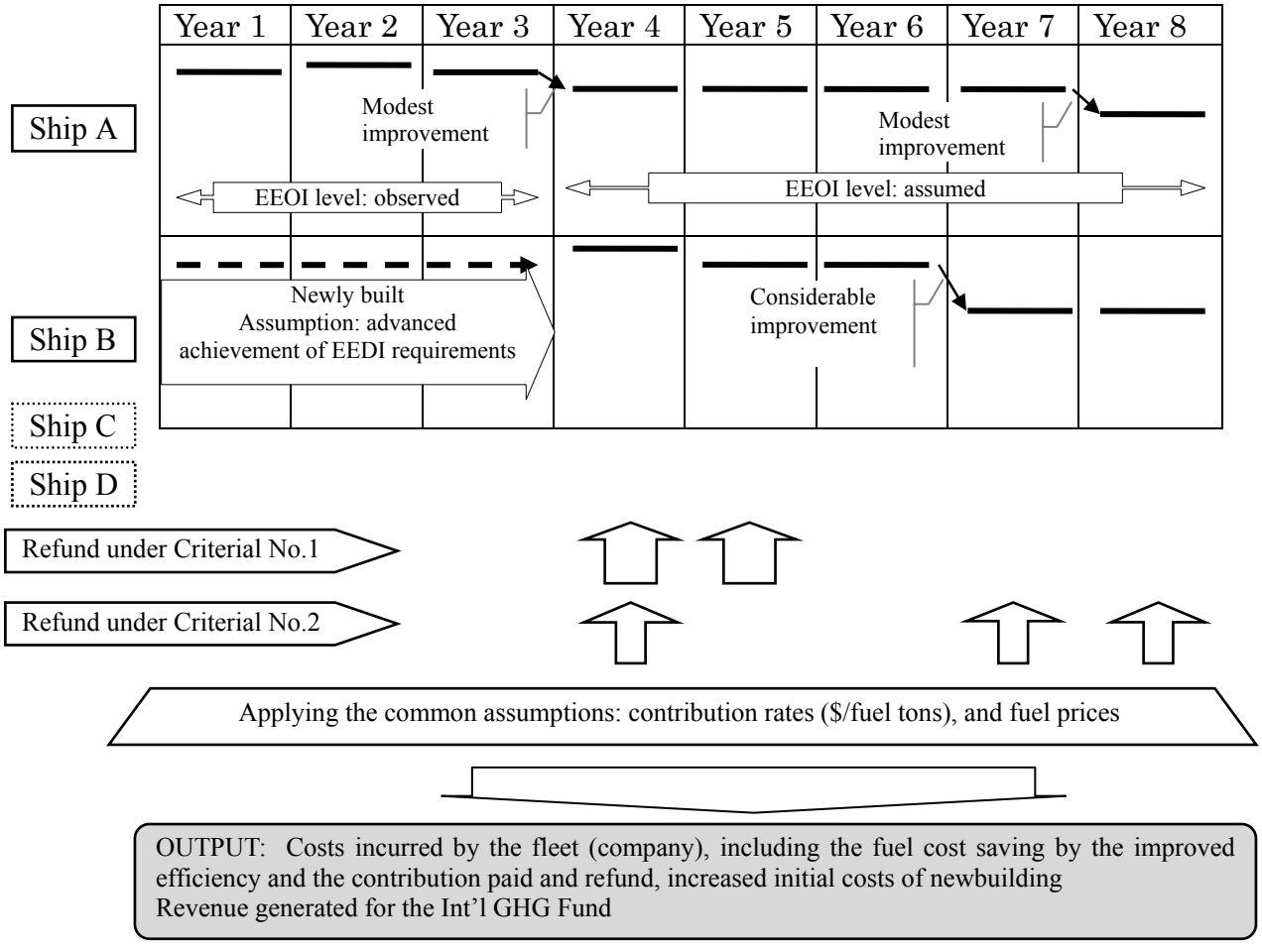


Figure 10. Concept of the impact study: estimated costs for "model fleet"

Summary of main advantages of the GHG Fund and Leveraged Incentive Scheme

37 The Leveraged Incentive Scheme would strengthen the effects of the International GHG Fund by encouraging the shipping industry to invest more in procuring highly efficient ships (i.e. with low values of attained EEDI), and, after starting the operation of their ships, to exercise the optimum combination of operational measures. It also has the following merits:

.1 the scheme is designed to attract wider participation as any ship, no matter whether they are new or old, and no matter which routes they are engaged in, would have an equal opportunity to be rewarded as "good performance ship" and to benefit from the refund; and

.2 the revenues to be generated from the contribution can be utilized for various purposes including adaptation and mitigation in developing countries.

Action requested of the Committee

38 The Committee is invited to consider the proposal contained in this document and take action as appropriate.

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ANNEX 1

FURTHER CONSIDERATION FOR REMOVING THE CARGO FACTOR FROM THE EEOI EVALUATION

The EEOI formula presents integrated efficiency of ships, and can be broken down as follows.

The first item indicates the energy efficiency which removed the effect of the M_{cargo} ("$EEOI_{capacity}$", hereafter). This is the modified EEOI under a hypothetical situation that the full cargo capacity is always utilized. The second item is an inverted load factor.

$$EEOI = \frac{FC \times C_F}{M_{c\arg o} \times D} = \underbrace{\frac{FC \times C_F}{Capacity \times D}}_{EEOI_{capacity}} \times \underbrace{\frac{Capacity}{M_{c\arg o}}}_{\text{Inverted load factor}}$$

FC :	Fuel consumption on voyage
C_F :	Conversion Factor of the fuel used
M_{cargo} :	The mass of cargo transported
Capacity :	Capacity of vessel
D :	Distance of voyage

The effects of market fluctuations may be significant in the EEOI values. In an unfavorable shipping market condition, the load factor can be low, and EEOI tends to be high (bad), even with the efforts of conducting optimum operation. By breaking down the EEOI formula as above, the effects of the market would appear in the second item (inverted load factor), and the trend of the first item ($EEOI_{capacity}$) represents the effects of operational measures, with the market factor being excluded.

As mentioned at paragraph 20, it is possible to use EEOI as evaluation tool to label "good performance ships"; however, $EEOI_{capacity}$ also could be an alternative evaluation tool, excluding the effects of market fluctuation.

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ANNEX 2

FURTHER ANALYSIS ON SETTING THE BENCHMARK OF EEOI

The benchmark should be developed depending on ship types – e.g., ship types used in the *Second IMO GHG Study 2009*. Figure 7 shows the EEOI of bulk carriers. The dotted line is the total efficiency of bulkers shown in the *Second IMO GHG Study 2009*[2], and the solid line is the envisioned baseline of dry cargo carriers. There are two options to establish the EEOI benchmark, one option is using the methodology un the *Second IMO GHG Study 2009* which intended to indicate realistic levels of transport efficiency for various categories of ships, another option is using the EEDI baselines with upwards adjustments.

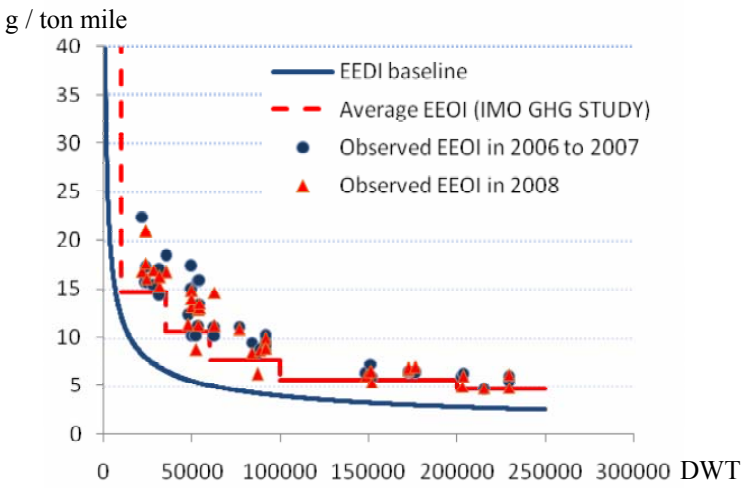

Figure 7: Possible Benchmark of EEOI and observed EEOI

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[2] MEPC 59/INF.10, annex, page 174, Table 9-1, converted from "g of CO_2/tonne-km" to "g of CO_2/tonne-NM".