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Agenda item 4

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PREVENTION OF AIR POLLUTION FROM SHIPS

Considerations of the EEDI Baselines

Submitted by China

SUMMARY

Executive summary:	This document provides comments and proposals on the EEDI Baseline formula on the basis of the results upon the recalculation of EEDI values for oil tanker, dry bulk carriers and containerships from LRFP database
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.1 and 7.3.1.3
Action to be taken:	Paragraph 8
Related documents:	MEPC 58/23, GHG-WG 2/2/1, GHG-WG 2/2/7, GHG-WG 2/2/8, GHG-WG 2/2/9, GHG-WG 2/2/18, GHG-WG 2/2/22, GHG-WG 2/WP.1 and MEPC 59/4/2

Introduction

1 This document is submitted in accordance with the provisions of paragraph 4.10.5 of the Guidelines on the organization and method of work of the MSC and MEPC and their subsidiary bodies (MSC-MEPC.1/Circ.2).

2 At GHG-WG2, a number of delegations pointed out some aspects which need careful consideration in the calculation and determination of the EEDI baselines. The Netherlands and Japan pointed out in their documents GHG-WG 2/2/1 and GHG-WG 2/2/18, respectively, that there are large variations in the EEDI values of smaller vessels. A poor correlation of EEDI values would cause a low reliability of the baselines, therefore, mandatory requirements of EEDI should not be considered for ships below 20,000 DWT. Sweden recommended in its document GHG-WG 2/2/8 that the determination of baselines should be based on an acceptable correlation factor R^2 which must reach a value of at least [0.XY] within reasonable filtering of off-set data with sampled ships. China has also pointed out in its document GHG-WG 2/2/9 that the attained EEDI values of Common Structural Rules (CSR) dry bulk carriers are higher than those of

non-CSR dry bulk carriers with the same deadweight capacity, and those CSR carriers with larger deadweight have worse EEDI performance. The correlation of EEDI values for containerships is poor, and an alternative baseline formula should be considered.

3 EEDI baselines are considered as a reference benchmark for energy efficiency design and construction for new ships and therefore the determination of baselines is particularly important.

4 China recalculated the baselines for oil tankers, dry bulk carriers and container ships from LRFP database built in the latest 10 years (from 1998 to 2007) according to the agreed principles at GHG-WG 2, using the same assumptions proposed by Denmark in document GHG-WG 2/2/7. Based on this recalculation, China put forward proposals for the establishment of baselines.

Recalculation results

5 The baselines are calculated with the average EEDI values using the following expression as agreed at GHG-WG 2:

$$\text{Baseline value} = a \cdot \text{Capacity}^{-c}$$

The data which are more than two standard deviations from the original regression line are removed and a new regression line is calculated as the baselines. The results are as follows:

.1 **Dry bulk carriers** (The total number of dry bulk carriers from LRFP database is 2,337, in which 92 carriers are of invalid data, therefore 2,245 in all are used for the calculation.)

DWT	0~1999	2000~ 9999	10000~ 19999	20000 ~	All	Invalid data
Number of ships	0	54	56	2135	2245	92
Removed data from the recalculation of baselines	---	20	0	3	23	---
Number of ships which EEDI above baseline	-	9	43	1064	1116	
CSR bulk carriers	0	1	2	23	26	---

Dry bulk carriers	a	Range of Capacity	c	R^2	Number of samples
	1001.2	≥2000DWT	0.4817	0.9159	2245
	1111.4	≥10000DWT	0.491	0.9043	2191
	1052.3	≥20000DWT	0.4862	0.8932	2145
	111.07	<10000DWT	0.2374	0.5376	54
	192.02	<20000DWT	0.3045	0.7781	110
CSR bulk carriers	328.29	≥8000	0.3743	0.9289	26

It is clear that from the above table of dry bulk carriers that the number of ships below 20,000 DWT is very limited and their EEDI values have large deviations. Among the 23 ships removed from the recalculation, 20 ships are below 20,000 DWT. The number of ships below 20,000 DWT for which the attained EEDI values are above the baseline, accounts for 50% of all ships in this deadweight range in general, however, the attained EEDI values of 43 ships between 10,000 DWT to 20,000 DWT which account for 77% of the total number of ships in this range of deadweight, are above the baseline (higher than required EEDI values).

The attained EEDI values of all 16 CSR dry bulk carriers above 35,000 DWT are higher than the required EEDI values calculated by the baseline formula based on non-CSR bulk carriers.

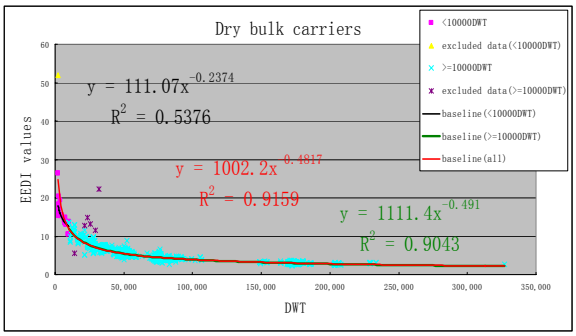

Figure 1- baselines based on 10000DWT segment size

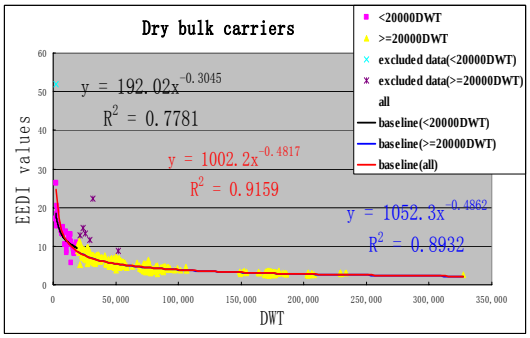

Figure 2- baselines based on 20000DWT segment size

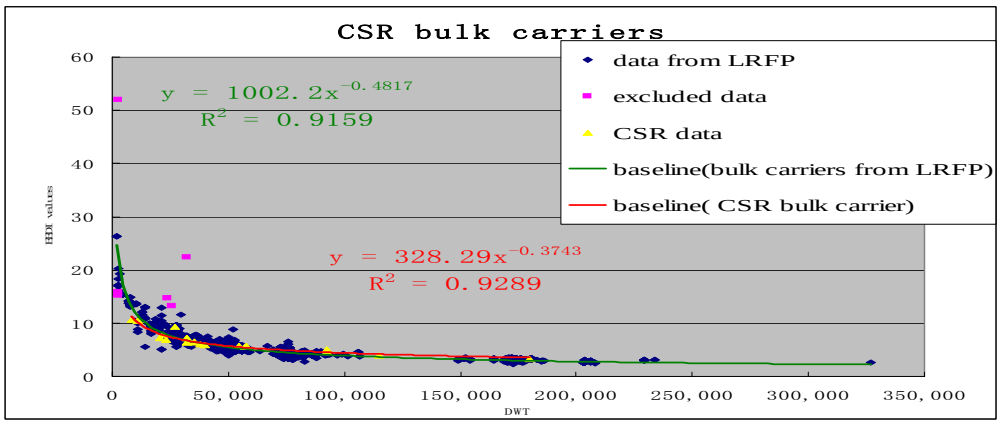

Figure 3- comparison between non-CSR and CSR dry bulk carriers

.2 Containerships: (The total number of container ships from the LRFP database is 2,321, in which 35 ships are of invalid data, therefore, 2,286 in all are used for the calculation.)

DWT	0~1999	2000~ 9999	10000~ 19999	20000 ~	All	Invalid data
Number of ships	10	258	453	1565	2286	35
Removed number from the recalculation of baseline	9	17	12	4	42	--

Containerships	a	Range of Capacity	c	R^2	Number of samples
	122.13	≥1000DWT	0.2012	0.6114	2286
	85.28	≥10000DWT	0.1683	0.4806	2018
	51.85	≥20000DWT	0.1231	0.2299	1565
	22.96	<10000DWT	0.0062	0.0002	268
	313.18	<20000DWT	0.3002	0.4455	721

From the calculation results on the construction period of ships, the baseline of ships built on or after year 2000 is obviously higher than the baseline for ships built prior to 2000 (see Figure 8), which illustrates that the newly built ships have higher EEDI values.

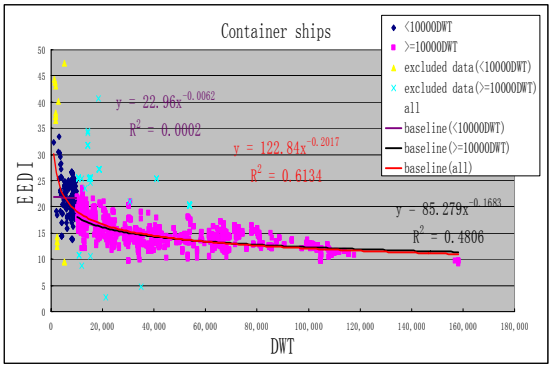

Figure 4- baselines based on 10000DWT segment size

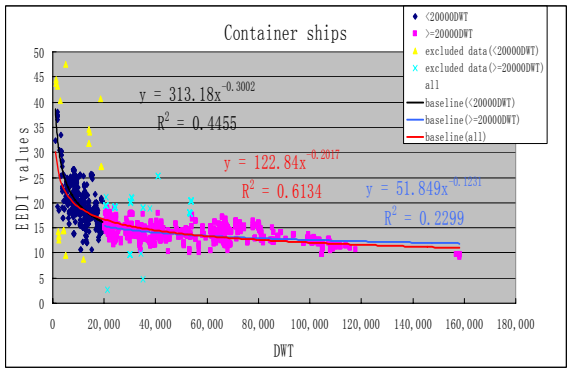

Figure 5- baselines based on 20000DWT segment size

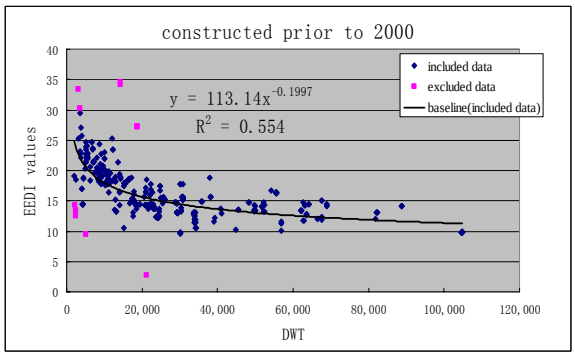

Figure 6- baselines for container ships prior to 2000

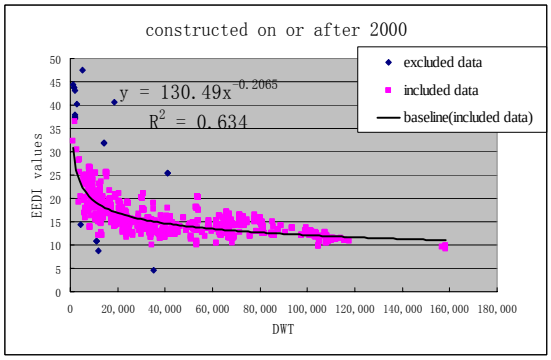

Figure 7- baselines for container ships on or after 2000

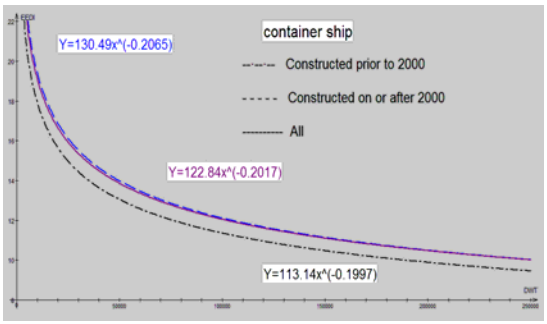

Figure 8- comparison of baselines for container ships

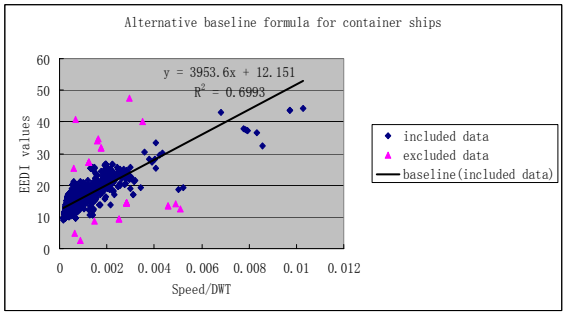

Figure 9- Alternative baseline formula for container ships

Considering the poor correlation of EEDI values for container ships, the factor of speed is suggested to be added in the baseline formula. According to an alternative baseline formula proposed in document GHG-WG 2/2/22 by CESA, the baseline for containerships is recalculated as follows, using Speed/DWT as the input variable and an improved correlation is obtained, but it is still low (see Figure 9).

DWT	0~1999	2000~ 9999	10000~ 19999	20000 ~	All	R^2
Number of ships	10	258	453	1565	2286	
Removed number from the recalculation	0	15	12	3	30	
Baseline=a·(Speed/ DWT)+b						0.6993

.3 Oil tankers (The total number of oil tankers from LRFP database is 1993, in which 394 ships are of invalid data or below 400 GT, therefore 1599 in all are used for the calculation.)

DWT	<600	600~ 4999	5000~ 9999	10000~ 19999	20000~	All	Invalid data
Number of ships	3	190	66	52	1288	1599	394
Removed number from the recalculation of baseline	3	2	1			6	--

Note: The removed ships are all below 10,000 DWT.

Oil tankers	a	Range of Capacity	c	R^2	Number of samples
	1127.1	All DWT	0.4832	0.9639	1599
	864.11	≥10000DWT	0.4606	0.9225	1340
	836.24	≥20000DWT	0.4578	0.9047	1288
	1101.9	<10000DWT	0.4776	0.6078	259
	1218.1	<20000DWT	0.4905	0.7268	311

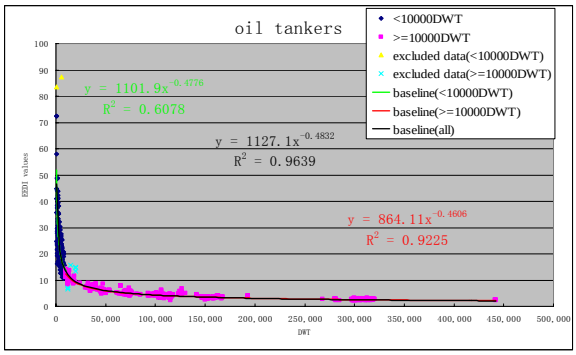

Figure 10- baselines based on 10000DWT segment size

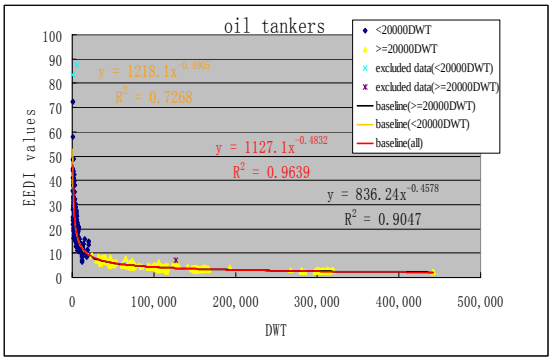

Figure 11- baselines based on 20000DWT segment size

Impact by Tier II NO_x emission standard of marine engines

6 From information provided by engine manufactures, Tier II NO_x emission standards will cause 2% to 5% increase of fuel consumption. The comparison of attained EEDI values and required EEDI values based on the assumptions of average fuel increase 2% and 5% respectively is as follows, taking oil tankers as an example:

	Tier I	Tier II	
Fuel consumption increase	----	2%	5%
Ship number which attained EEDI above baseline (required value)	803	941	1123
Non-compliance percentage	50%	59%	70%

From the above table, the EEDI performance will be worse due to the increase in fuel consumption caused by implementation of the Tier II NOx emission standards using different technologies to reduce NO_x emission without considerations of the X reduction factor as proposed in annex 6 to document MEPC 58/4.

Summary and proposals

7 In light of the information provided in paragraphs 5 and 6 above, China is of the view that the baselines should be determined based on not only different ship types but also different capacity segments of the same ship-type. Furthermore, the impacts of IMO safety and pollution prevention requirements, being and to be implemented in the latest few years, should be carefully considered. China would like to point out the following aspects to be considered further and provide proposals for addressing these issues:

.1 The baselines methodology seriously depends on the sampled data used for the EEDI calculation, different results will be obtained by using different samples and different number of ships. Therefore guidelines for selection of samples and calculation method should be established, for example, how many ships and what kind of ships should be included, what kind of ships should be excluded, what kind of calculation methodology should be used?

.2 Although the number of dry bulk carriers under 20,000 DWT is small and their EEDI values have a large deviation, it should not be an excuse for their exemption from the EEDI requirements. However, EEDI requirements based on the baseline of the whole range of capacity have different impacts on different capacity ranges, especially on deadweights between 10,000 to 20,000 DWT. Therefore the baselines should be set based on different deadweight capacity segments;

.3 CSR dry bulk carriers with higher safety standards have worse EEDI performance, especially those with deadweight above 35,000 DWT. A separate baseline should be set or a correction factor (f_{CSR}) should be given for CSR ships, f_{CSR} need to be further considered;

.4 The implementation of Tier II NO_x emission standards will cause EEDI performance worse where 10% to 20% more ships fail to meet EEDI requirements. Therefore, ships required to apply Tier II NO_x emission standards should be given a compensate value [Y%], that is:

$$\text{Required EEDI} = (1 + [Y\%]) \times \text{baseline value}$$

Meanwhile, the X reduction factor should be removed, because it is difficult to determine the extent of energy efficiency improvement by future energy saving technologies. At present, the required EEDI should be set fixed;

.5 Considering the impact on EEDI of increasing new IMO safety requirements, an appropriate correction factor should be developed; and

.6 The correlation of EEDI values of container ships is poor even with consideration of ship speed. Furthermore, the baseline of ships built on or after 2000 is obviously higher than the baseline of ship built prior to 2000. Therefore the factors causing large deviation of EEDI values of container ships should be further identified to make the baselines more reasonable and feasible.

Action requested of the Committee

8 The Committee is invited to consider the comments and proposals provided above and take action as appropriate.