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12th session
Agenda item 2

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CONSIDERATION OF ANY ISSUE ARISING FROM THE FINAL REPORT OF THE CORRESPONDENCE GROUP ON CARBON INTENSITY REDUCTION

CII reference line for self-unloading bulk carriers

Submitted by ICS and INTERCARGO

SUMMARY

Executive summary:	The Organization has adopted regulations requiring all ships to monitor and report their Carbon Intensity Indicator (CII) and compare the attained CII with a reference line. The CII is defined as the amount of carbon emitted per year divided by the transport capacity provided (gram CO_2 per DWT per mile). Ocean-going self-unloading bulk carriers are specialised ships equipped with onboard cargo-handling systems, enabling them to discharge without shore-based unloading equipment. Because the onboard cargo-handling systems are powered by electricity generated on board from fuel, a significant share of their CO_2 emissions stems from cargo handling, resulting in a higher CII than bulk carriers of a similar size without cargo handling systems. The report set out in the annex analyses CII data of ocean-going self-unloaders and calculates a reference line for this ship type according to the G2 guidelines. The data sample includes DCS data of 54 ocean-going self-unloaders, representing 66% of the affected ocean going self-unloader bulk carriers. The study found that the 2019 CII of self-unloaders is on average 21% higher than the reference line for bulk carriers. A median regression fit was made to the self-unloader data, which further highlights the difference between bulk carriers and ocean-going self-unloaders. This median regression fit is the basis for a proposed reference line for ocean-going self-unloaders.
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 8
Related documents:	MEPC 78/7/11

Background

1 The Organization has adopted MARPOL Annex VI Regulation 28 which requires all ships to monitor and report their Carbon Intensity Indicator (CII) (Resolution MEPC.328(76)). The CII is defined as the amount of carbon emitted per year divided by the transport capacity provided (gram CO_2 per DWT per mile), according to the *2021 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1)*. The G1 guidelines specify the CII as follows:

$$attained\ CII_{ship} = \frac{\sum_{j=1}^{N} FC_j \times C_{Fj}}{C \times D_t}$$

Where:

j is the fuel oil type;

FC_j is the total mass (in grams) of consumed fuel oil of type in the calendar year, as reported under IMO DCS;

C_{Fj} represents the fuel oil mass to CO2 mass conversion factor for fuel oil type;

C represents the ship's capacity, which is deadweight tonnage for bulk carriers; and

D_t represents the total distance travelled (in nautical miles), as reported under IMO DCS.

2 Ships that use a significant share of fuel for non-propulsion purposes have a higher CII than other ships, because the additional CO_2 emissions are reflected in the numerator but not in the denominator of the CII.

3 Ocean-going self-unloading bulk carriers are specialized ships equipped with onboard cargo-handling systems, enabling them to discharge without shore-based unloading equipment. This equipment typically comprises conveyor belt systems or pneumatic systems to move cargo from the hold to a discharge boom on deck. Because the onboard cargo-handling systems are powered by electricity generated on board from fuel, a significant share of their CO_2 emissions stems from cargo handling, resulting in a higher CII than bulk carriers of a similar size without cargo handling systems.

4 MEPC 76 has established a Correspondence Group (CG) to develop draft guidelines on correction factors for certain ship types, operational profiles and/or voyages for the CII Calculations (G5). The group has considered special reference lines for subtypes of generic ship types, such as high speed craft. The group did not consider ocean-going self-unloading bulk carriers in detail.

5 The co-sponsors have carried out a study to analyse the difference in CII of self-unloaders compared to bulk carriers and establish what the CII reference line for ocean-going self-unloaders would be, if the Committee was to decide to make a special provision for this group of ships.

6 The report set out in the annex details the results of the study and follows the structure of the questionnaire of the CG.

Conclusions of the study

7 An analysis of 2019 DCS submissions of about 66% of the ocean-going self-unloader fleet shows that their CII is, on average, 21% higher than the reference CII for bulk carriers of the same size. The negative impacts could be addressed by developing a dedicated reference line for ocean-going self-unloaders. Following the applicable guidelines, the formula for such a reference line would be:

$$CII_{ref} = 5498 \cdot dwt^{-0.621}$$

Action requested of the Working Group

8 The Group is invited to consider the results of the study set out in annex, and to assign a dedicated CII reference line to self-unloading bulk carriers.

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ANNEX

STUDY REPORT

CII REFERENCE LINE FOR OCEAN-GOING SELF-UNLOADERS

CII Reference line for ocean-going self-unloaders

CE Delft

Committed to the Environment

CII Reference line for ocean-going self-unloaders

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Delft, CE Delft, March 2022

Publication code: 22.220129.051

Shipping / Carbon dioxide / Emissions / Policy / International / Measures / Incentives / Effects / Analysis
FT : Ocean-going self-unloading bulk carriers

Client: Algoma
Your reference: 220129/JF

Publications of CE Delft are available from www.cedelft.eu

Further information on this study can be obtained from the contact person Jasper Faber (CE Delft)

Content

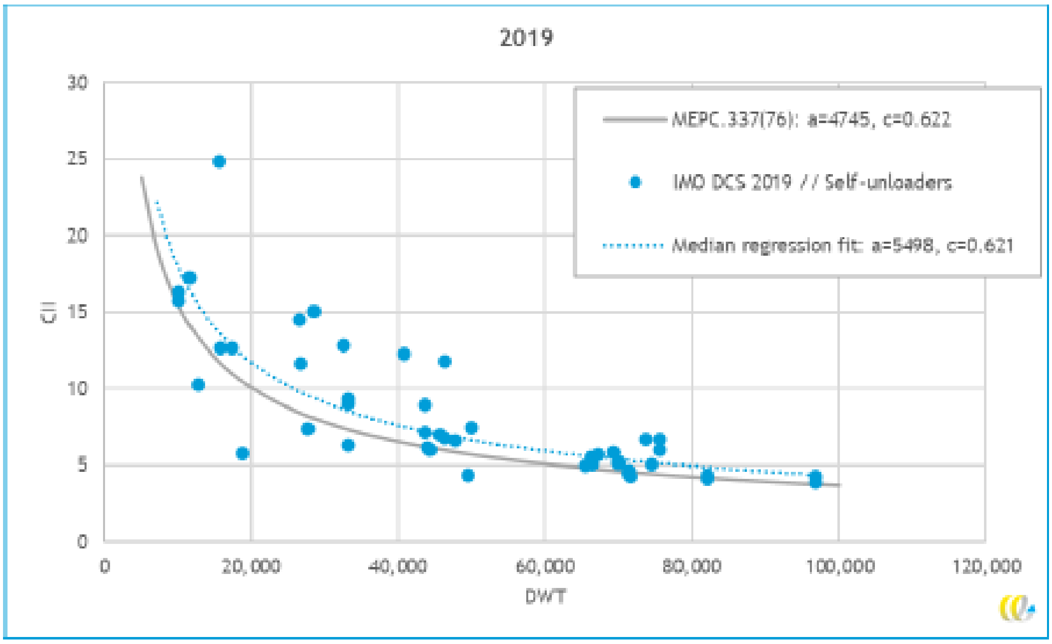
Summary

The IMO has adopted regulations requiring all ships to monitor and report their Carbon Intensity Indicator (CII) and compare the attained CII with a reference line. The CII is defined as the amount of carbon emitted per year divided by the transport capacity provided (gram CO_2 per dwt per mile).

Ocean-going self-unloading bulk carriers are specialized ships equipped with onboard cargo-handling systems, enabling them to discharge without shore-based unloading equipment. Because the onboard cargo-handling systems are powered by electricity generated on board from fuel, a significant share of their CO_2 emissions stems from cargo handling, resulting in a higher CII than bulk carriers of a similar size without cargo handling systems.

This report analyses CII data of ocean-going self-unloaders and calculates a reference line for this ship type according to the IMO guidelines. The data sample includes DCS data of 54 ocean-going self-unloaders, representing 66% of the affected ocean going self-unloader bulk carriers. We found that the 2019 CII of self-unloaders is on average 21% higher than the reference line for bulk carriers. A median regression fit was made to the self-unloader data, see Figure 1, which further highlights the difference between bulk carriers and ocean-going self-unloaders. This median regression fit is the basis for a proposed reference line for ocean-going self-unloaders.

Figure 1 - IMO DCS 2019 ocean-going self-unloading bulk carrier data (excluding one outlier), a median regression fit of this data and the bulk carrier reference line



1 Introduction

The IMO has adopted MARPOL Annex VI Regulation 28 which requires all ships to monitor and report their Carbon Intensity Indicator (CII) (Resolution MEPC.328(76)). The CII is defined as the amount of carbon emitted per year divided by the transport capacity provided (gram CO_2 per dwt per mile), according to the 2021 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1). The G1 guidelines specify the CII as follows:

$$attained\ CII_{ship} = \frac{\sum_{j=1}^{N} FC_j \times C_{Fj}}{C \times D_t}$$

Where
- j is the fuel oil type;
- FC_j is the total mass (in grams) of consumed fuel oil of type in the calendar year, as reported under IMO DCS;
- C_{Fj} represents the fuel oil mass to CO2 mass conversion factor for fuel oil type;
- C represents the ship's capacity, which is deadweight tonnage for bulk carriers; and
- D_t represents the total distance travelled (in nautical miles), as reported under IMO DCS.

Ships that use a significant share of fuel for non-propulsion purposes have a higher CII than other ships, because the additional CO_2 emissions are reflected in the numerator but not in the denominator of the CII.

Ocean-going self-unloading bulk carriers are specialized ships equipped with onboard cargo-handling systems, enabling them to discharge without shore-based unloading equipment. This equipment typically comprises conveyor belt systems or pneumatic systems to move cargo from the hold to a discharge boom on deck. Because the onboard cargo-handling systems are powered by electricity generated on board from fuel, a significant share of their CO_2 emissions stems from cargo handling, resulting in a higher CII than bulk carriers of a similar size without cargo handling systems.

MEPC has established a correspondence group to develop Draft Guidelines on correction factors for certain ship types, operational profiles and/or voyages for the CII Calculations (G5). The group has considered special reference lines for subtypes of generic ship types, such as high speed craft. The group did not consider ocean-going self-unloading bulk carriers in detail.

A group of operators of ocean-going self-unloading bulk carriers has asked CE Delft to analyse the difference in CII of self-unloaders compared to bulk carriers and establish what the CII reference line for ocean-going self-unloaders would be, if the MEPC were to decide to make a special provision for this group of ships.

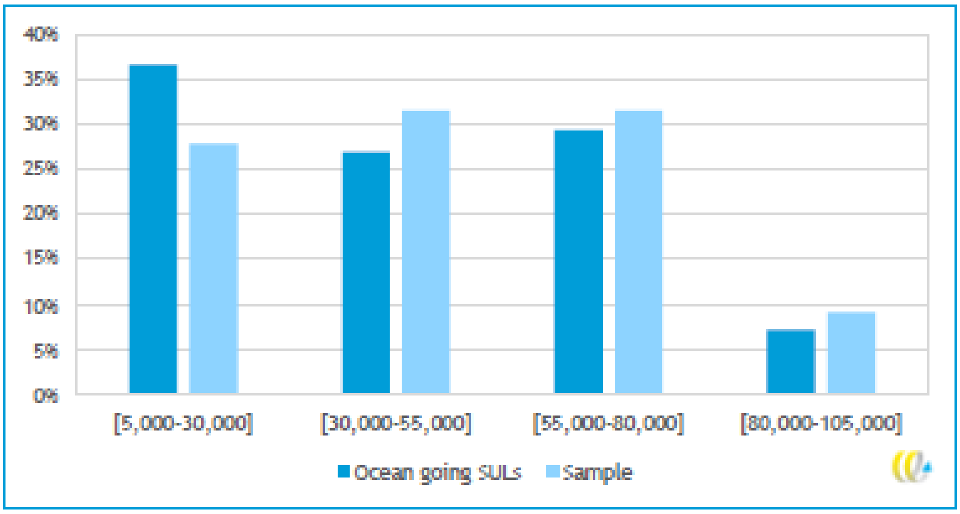
This report follows the structure of the questionnaire of the correspondence group. Chapter 2 provides for the reference line for ocean-going self-unloaders. Chapter 3 analyses the advantages and disadvantages as well as the reasons for such a reference line. Chapter 4 analyses the accuracy of the proposal.

2 Capacity to Assess their effects

2.1 Adjusted reference line for ocean-going self-unloading bulk carriers

IMO DCS data of 54 ocean-going self-unloading bulk carriers was collected from five different groups of operators for the years 2019 and 2020. By analysing the database from IHS Markit Fairplay we identify 82 affected ocean-going self-unloading bulk carriers[1]. The sample analysed here comprises 54 ocean-going self-unloading bulk carriers, resulting in a sample rate of 66%. The sample has comparatively more relatively large self-unloaders than the world fleet, see Figure 2.

Figure 2 - Histogram of DWT for the identified 82 affected ocean-going self-unloaders from HIS Markit Fairplay and our sample of 54 self-unloaders



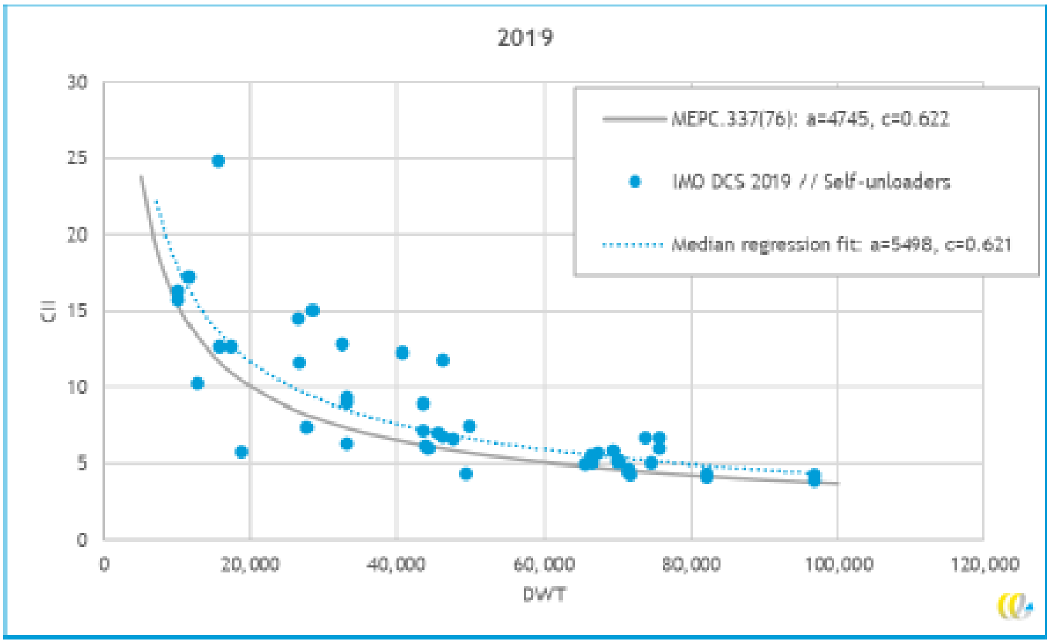
We analysed IMO DCS data of ocean-going self-unloaders for 2019 and 2020. In Figure 3 the 2019 IMO DCS data of ocean-going self-unloaders is plotted. For six ships there was no 2019 fuel data available, and one outlier was excluded[2], leaving us with 47 data points for 2019. A median regression fit for these 47 datapoints of self-unloader is added. Self-unloaders are currently categorized as bulk carriers, therefore the reference line of bulk carriers according to MEPC.337(76) is also added. We can see that most of the self-unloader datapoints have a higher CII than the bulk carrier reference line. On average the CII of the ocean-going self-unloaders is 21% higher than the bulk carrier reference line for the corresponding DWT. The fitted median regression line to the self-unloader data further highlights the difference between the bulk carrier and ocean-going self-unloader, and clearly demonstrates that including ocean-going self-unloaders in the bulk carrier category is to the disadvantage of ocean-going self-unloaders.

[1] The IHS Markit Fairplay database lists 77 ocean-going self-unloading bulk carriers. Out of those 9 are less than 5,000 DWT and therefore unaffected. Our sample consisted 14 additional ocean-going SULs, which were not listed in the IHS Market Fairplay database. Therefore we find a total of 77-9+14=82 ocean-going SULs.

[2] For both years, datapoints with over 300% difference in CII values compared to the bulk carrier reference line were excluded. These datapoints corresponded to ships with little distance travelled and were burning fuel when stationary or at dock.

We have also analysed the ocean-going self-unloader 2020 IMO DCS data, see Annex A. Similar behaviour was found, confirming the difference in CII of ocean-going self-unloaders and bulk carriers, and demonstrating consistency over both years.

Figure 3 - IMO DCS 2019 ocean-going self-unloading bulk carrier data (excluding one outlier), a median regression fit of this data and the bulk carrier reference line



2.2 Estimated number of ships affected

Our analysis of the IHS Markit Fairplay database identifies 82 self-unloading ocean going bulk carriers that would be affected.[1]

2.3 Estimated percentage of ships affected

This would affect 100% of the ocean-going self-unloaders. According to the Clarksons World Fleet Register there are 12,751 bulk carriers, therefore 0.6% of the bulk carriers would be affected. Excluding ocean-going self-unloaders would probably not make a significant change in the bulk carrier reference line.

3 Policy Justification

3.1 Impacts of attained CII for ocean-going self-unloading bulk carriers

The analysis presented in Paragraph 2.1 above demonstrates the negative impact of including ocean-going self-unloaders in the bulk carrier reference line. Self-unloading bulk carriers are specialized ships equipped with onboard cargo-handling systems, enabling them to discharge without shore-based unloading equipment. Because the onboard cargo-handling systems are powered by electricity generated on board from fuel, a significant share of their CO_2 emissions stems from cargo handling, resulting in a higher CII than bulk carriers of a similar size without cargo handling systems. The implications are that disproportionally many of the ocean-going self-unloading bulk carriers will be rated D or E.

These negative impacts can be resolved by removing ocean-going self-unloaders from the current bulk carrier category under the CII Framework and by assigning ocean-going self-unloaders a new category of their own with appropriate metrics.

3.2 Case studies

To show the impact of the onboard cargo-handling systems, we have analysed power capacity data of a 77,000 DWT ocean-going self-unloader that has recently been converted from a bulk carrier. The total installed power on the converted ship is 6.7 MW. New additional equipment was installed with a loading and unloading capacity of 2.6 MW. Therefore, the cargo-handling equipment is calculated to have a 38% contribution in total installed power, making it likely to have a significant contribution in the CO_2 emissions, especially for shorter routes.

3.3 Statistical analysis CII

See Paragraph 2.1.

3.4 Perverse incentives if not implemented

Many ocean-going self-unloaders operate in a short sea shipping trade along coastlines, where cargo shippers have choices for different modes. If ocean-going self-unloaders would be rated D or E, there is a risk that their cargo would be transported by other modes, which are less energy efficient and thus would increase overall emissions to move that cargo. Self-unloaders also provide emissions efficiencies to the wider transportation system as they generally offload their cargo in ports without cranes or other equipment. Therefore, they generally cannot be substituted by other ships, as the cargo can only be delivered at those locations with the required cargo handling infrastructure.

3.5 Perverse incentives if implemented

A theoretical perverse incentive could be that ocean-going self-unloading bulk carriers start acting as normal bulk carriers, by not using the unloading equipment, and gain a relative advantage in their CII rating. However, this would be operationally highly unlikely. First, self-unloaders can rapidly unload cargoes. Typically, a cargo of 30,000 tonnes can be unloaded in 8 to 10 hours. This allows for rapid port turnaround and is core to the ship owner or operator's business model. Rapid turnaround means more cargo carried over time and more revenue. Conventional bulk carriers take much longer to unload, often measured in days.

Also, self-unloaders often go to harbours where there is no unloading equipment, so not operating the unloading systems would result in a loss of business.

Additionally, the cargo on a self-unloader is stored in a hold with the bottom typically shaped in inverted pyramidal square (a V shape) to allow the cargo to descend by gravity feed onto the unloading system below. Conventional bulk carriers generally are designed with flat bottom holds which allows access to unloading equipment (clam shell excavators, tracked loaders lowered into the hold). Such equipment is not able to unload this cargo in a self-unloader without significantly damaging the ship. The only way to unload this cargo properly is by using the self-unloading equipment.

Hence, the perverse incentive described above is unlikely both from a business perspective and from the structural design of the vessel.

4 Accuracy

4.1 Demonstrate accuracy of the proposal

See Paragraph 2.1. The median regression fit of the IMO DCS 2019 data has a R^2 of 0.62. The ocean-going self-unloader data for 2019 was 21% higher than the bulk carrier reference line, the 2020 data 23% higher (see Annex A), demonstrating consistency over both years.

4.2 Over-correction

No such situation has been identified. The method provides a reference line tailored specifically to ocean-going self-unloaders using actual ship data reported to the DCS.

4.3 Overlaps

No such situation has been identified. Again, the method provides a reference line tailored specifically to ocean-going self-unloaders using actual ship data reported to the DCS.

5 Conclusions

Ocean-going self-unloading bulk carriers are specialized ships equipped with onboard cargo-handling systems, enabling them to discharge without shore-based unloading equipment. Because the onboard cargo-handling systems are powered by electricity generated on board from fuel, a significant share of their CO_2 emissions stems from cargo handling, resulting in a higher CII than bulk carriers of a similar size without cargo handling systems.

An analysis of 2019 DCS submissions of about 66% of the ocean-going self-unloader fleet shows that their CII is, on average, 21% higher than the reference CII for bulk carriers of the same size. The negative impacts could be addressed by developing a dedicated reference line for ocean-going self-unloaders. Following the applicable guidelines, the formula for such a reference line would be:

$$CII_{ref} = 5498 \cdot dwt^{-0.621}$$

A Analysis of 2020 IMO DCS data

Figure 4 shows the IMO DCS ocean-going self-unloader data for 2020 (49 datapoints: no fuel data for two ships in 2020, and three outliers were excluded), including a median regression fit to this data and the bulk carrier reference line. The 2020 data shows similar behaviour to 2019, with most datapoints being above the bulk carrier reference line. On average the 2020 data is 23% higher than the corresponding bulk carrier reference line, consistent with the difference in 2019.

Figure 4 - IMO DCS 2020 ocean-going self-unloading bulk carrier data (excluding outliers), a median regression fit of this data and the bulk carrier reference line