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ENERGY EFFICIENCY OF SHIPS

Report on annual carbon intensity and efficiency of the existing fleet (Reporting years: 2019, 2020, 2021 and 2022)

Note by the Secretariat

SUMMARY

Executive summary:	This document reports on demand-based and supply-based carbon intensity for the years 2019, 2020, 2021 and 2022, in accordance with the *2022 Guidelines for the development and management of the IMO Ship fuel oil consumption database* (resolution MEPC.349(78)).
Strategic direction, if applicable:	3
Output:	3.7
Action to be taken:	Paragraph 21
Related documents:	MEPC 68/INF.24/Rev.1; MEPC 70/18; MEPC 71/17; MEPC 76/6/1, MEPC 76/7/5; MEPC 77/6/1; MEPC 79/6/1; MEPC 81/6; ISWG-GHG 12/1; resolutions MEPC.278(70); MEPC.338(76); MEPC.346(78) and MEPC.349(78)

Background

1 Regulation 27.10 of MARPOL Annex VI requires the Secretary-General to produce an annual report to the Committee summarizing the data submitted to the IMO Ship Fuel Oil Consumption Database in GISIS (hereinafter referred to as "IMO DCS"), the status of missing data, and other relevant information as may be requested by the Committee.

2 Following the entry into effect of the mandatory collection and reporting of ship fuel oil consumption data from 1 January 2019 (regulation 27 of MARPOL Annex VI), the Secretariat has submitted annual IMO DCS reports to the Committee summarizing the data reported for the years 2019, 2020, 2021 and 2022, as set out in documents MEPC 76/6/1, MEPC 77/6/1, MEPC 79/6/1 and MEPC 81/6, respectively.

3 In conjunction with the adoption of the IMO short-term GHG reduction measures in June 2021, in particular the annual reduction factor to ensure continuous improvement of the ship's operational carbon intensity (the 'Z' factor, as set out in regulation 28 of MARPOL

Annex VI), the Committee also adopted the *2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines* (CII reduction factors guidelines, G3) (resolution MEPC.338(76)).

4 Paragraph 1.5 of the CII reduction factors guidelines (G3) states that the Organization should continue to monitor development in annual carbon intensity improvement using both demand-based and supply-based measurements in parallel to the annual analysis of the fuel consumption data reported to the IMO DCS.

5 These two types of measurements of operational carbon intensity referred to in the CII reduction factors guidelines (G3) originate from the report of the Correspondence Group on the Development of Technical Guidelines on Carbon Intensity Reduction (MEPC 76/7/5), as follows:

.1 the "supply-based measurement" indicating the CO_2 emissions per transport work proxy (similar to AER or cgDIST of individual ships); and

.2 the "demand-based measurement" indicating the CO_2 emissions per actual transport work of international shipping (similar to EEOI of individual ships).

6 The Secretariat already provides annual carbon intensity information based on the supply-based measurement approach (AER or cgDIST for each EEDI ship size, as applicable) in the annual IMO DCS reports (for instance, see table 3 in the annex to document MEPC 81/6).

7 With regard to the demand-based measurement, MEPC 79 noted that the Secretariat was not in a position to calculate carbon intensity developments on the basis of demand-based measurements due to the absence of cargo data or, ideally, transport work data in the IMO DCS, and therefore requested the Secretariat to proceed with the procurement of such data for future reporting on demand-based carbon intensity developments to the Committee (MEPC 79/15, paragraphs 6.4.4 and 6.5).

8 Consequently, following an open tender process, the Secretariat contracted UMAS International to estimate demand-based carbon intensity for 2019 to 2022 using a mathematical modelling process, which leverages AIS data, provided by Spire Maritime, and data submitted to IMO DCS.[1]

9 It is recalled that MEPC 80 approved draft amendments to appendix IX of MARPOL Annex VI on 'Information to be submitted to the IMO DCS', including the addition of the field "Total Transport Work" and other fields to enhance the granularity of the reporting (MEPC 81/3/2). If adopted by MEPC 81, these amendments would facilitate the Secretariat to calculate demand-based measurements of carbon intensity for future reporting years.

Developments in operational carbon intensity of international shipping

10 Table 3 of the Fourth IMO GHG Study *2020* contains supply-based and demand-based carbon intensity estimates for international shipping from 2008 to 2018, which are shown in figures 1 and 2 below, respectively.

[1] The data and methodology used to calculate demand-based carbon intensity for the purpose of this document do not interpret existing IMO instruments nor prejudge any future policy developments at IMO.

11 Sections 5.4.1 and 5.4.2 of the CII reduction factors guidelines (G3) contain information related to measurements of carbon intensity against the 2030 target to reduce the carbon intensity of international shipping by at least 40%, compared to 2008 levels, as set out in the Initial IMO GHG Strategy and the 2023 IMO GHG Strategy.

12 The CII reduction factors guidelines (G3) refer to the Fourth IMO GHG Study 2020 to estimate the carbon intensity reduction in 2019 compared to 2008 to be 23.6% using a supply-based metric, and 33.3% using a demand-based metric.

13 Table 1 below provides annual average supply-based carbon intensity measurements for 2019 to 2022, based on the AER/cgDIST metrics, as calculated by the Secretariat using the data submitted to IMO DCS from 2019 to 2022. On the basis of the data procured by the Secretariat, the demand-based carbon intensity measure, using the Estimated EEOI metric, has also been calculated (further explanations of the calculations and method are set out in the annex to this document).

Table 1: Average annual carbon intensity and percentage change compared to 2019

	Annual average carbon intensity and percentage change in carbon intensity compared to 2019						**IMO DCS Fuel Consumption Report to Committee**	
Year	**AER**		**cgDIST**		**Estimated EEOI**		**Report to Committee**	**Total fuel consumption (tonnes)**
2019	5.90	0.0%	8.44	0.0%	10.94	0.0%	MEPC 76/6/1	213 million
2020	5.83	-1.2%	8.24	-2.3%	10.92	-0.2%	MEPC 77/6/1	212 million
2021	5.89	-0.1%	8.34	-1.2%	10.90	-0.4%	MEPC 79/6/1	203 million
2022	5.66	-4.1%	8.05	-4.6%	10.89	-0.5%	MEPC 81/6	213 million

14 Figures 1 and 2 below show overall developments/trends in carbon intensity, using supply-based and demand-based measures, respectively, on the basis of the Fourth IMO GHG Study 2020 data and the data submitted to IMO DCS combined with the procured data.

Figure 1: Supply-based carbon intensity of international shipping

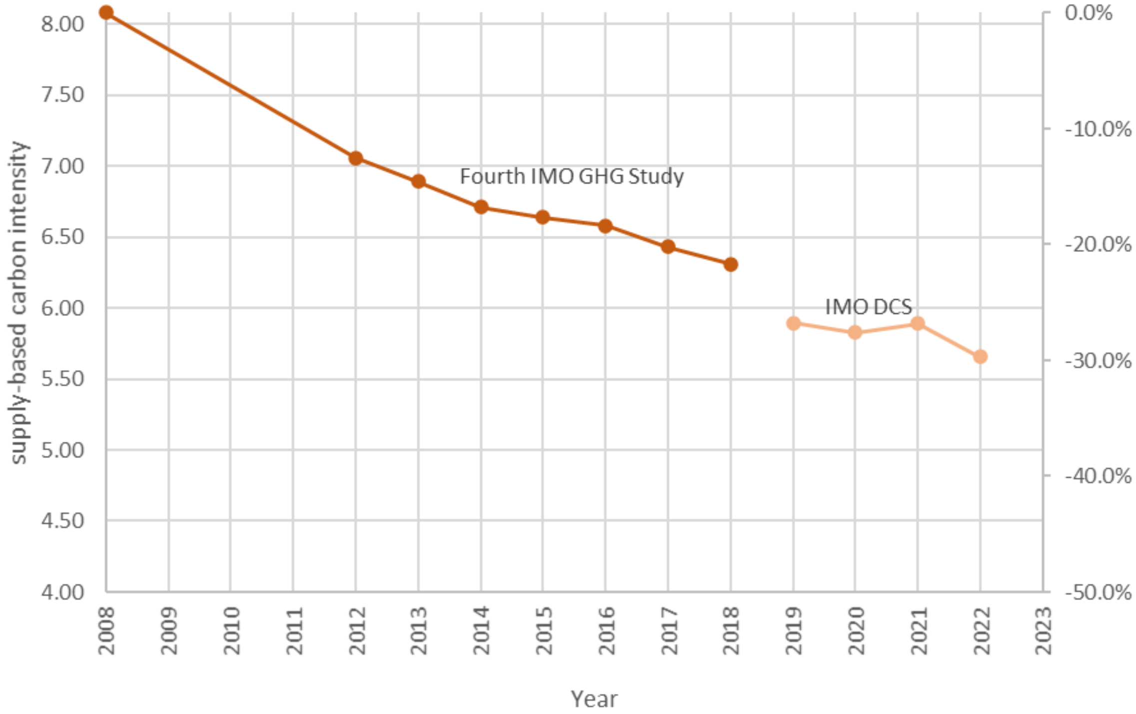
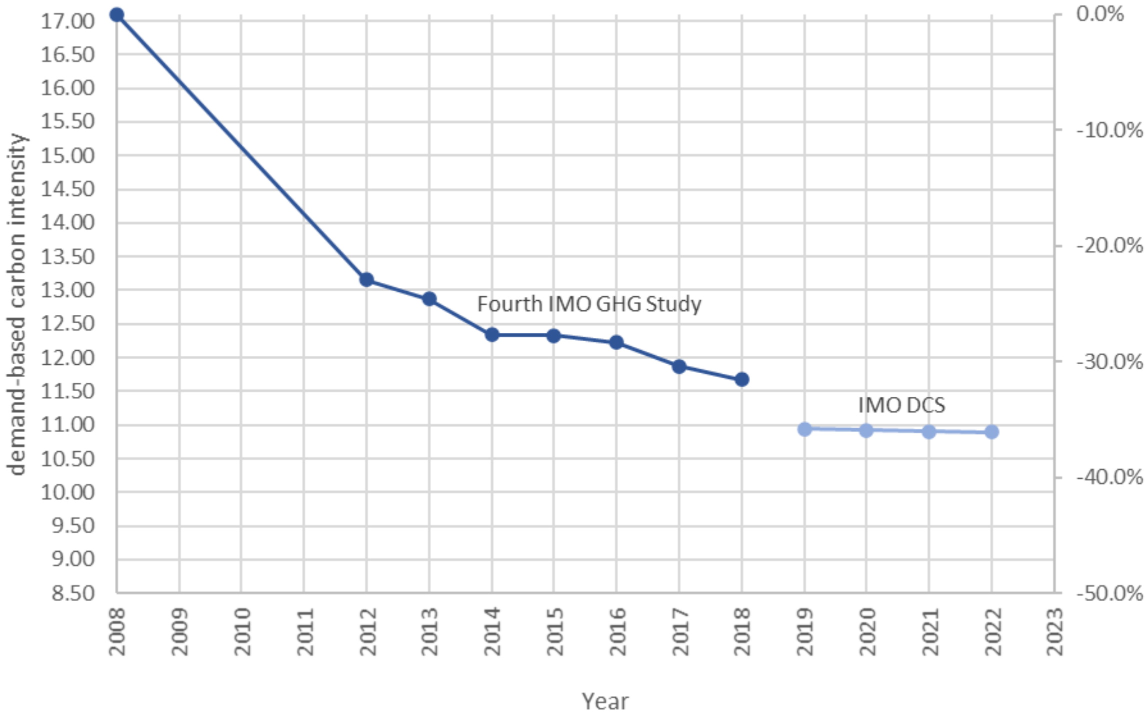


Figure 2: Demand-based carbon intensity of international shipping



15 As also stated in paragraph 5.1 of the CII reduction factors guidelines (G3), it is recalled that the scope and data collection methods applied in the Fourth IMO GHG Study 2020 are inconsistent with those under IMO DCS. The Fourth IMO GHG Study 2020 includes ships under 5,000 gross tonnes and uses information on the global shipping fleet, mainly from IHS ship data (now S&P Global), which is mapped to AIS data and combined with mathematical models to estimate cargo, ship activity, fuel consumption, emissions, efficiency, carbon intensity, etc. In comparison, for 2019 to 2022, ship fuel consumption data from IMO DCS does not include ships under 5,000 gross tonnes and is mapped to the procured AIS data mainly for the purpose of estimation of cargo, efficiency and carbon intensity. Therefore, it should be noted that the percentage changes shown in figures 1 and 2, in particular the comparison of carbon intensity of 2019 to 2022 against that of 2008, are indicative in nature due to being derived from two different datasets.

Main findings on carbon intensity developments of the shipping fleet for the period from 2019 to 2022

16 The annex to this document contains a more detailed overview of the carbon intensity developments for the period 2019 to 2022, broken down into ship types and sizes. More detailed calculations, assumptions and descriptions of the method used are also set out in the report in the annex.

17 In accordance with section 6 of the *2022 Guidelines for the development and management of the IMO Ship Fuel Oil Consumption Database* (resolution MEPC.349(78)), the ship types and size categories used in the Fourth IMO GHG Study 2020 were used when examining carbon intensity trends to provide a more disaggregated and representative view of the carbon intensity of different ship types and sizes, when compared to using the EEDI and CII ship types and sizes.

18 The procured data and associated method estimates demand-based carbon intensity (Estimated EEOI) using AIS draught data as a substitute for reported cargo data. However, this method leads to some uncertainties resulting from the use of AIS draught data (as explained in detail in paragraph 23 of the annex). Calculations using reported cargo data, ideally transport work, would therefore be more accurate.

19 Following the analysis of the carbon intensity of the shipping fleet from 2019 to 2022, the following general outcomes can be noted:

.1 for the period 2019 to 2022, as an average across the fleet:

.1 supply-based carbon intensity in AER/cgDIST demonstrated an overall decrease of up to 4.6% relative to 2019, but with yearly fluctuations; and

.2 demand-based carbon intensity expressed in EEOI has only very gradually changed between years to just below 0.5% in 2022, relative to 2019, but also demonstrating a more consistent value when comparing between reporting years;

.2 supply-based carbon intensity, expressed in AER and cgDIST, and demand-based carbon intensity, expressed in estimated EEOI, are not strongly correlated for all ship types and sizes;

.3 the overall changes in carbon intensity for the global fleet are relatively small; however, when dividing the fleet into Fourth IMO GHG Study 2020 ship types and sizes, larger differences in carbon intensity developments can be observed when comparing between AER/cgDIST and EEOI and for different ship types and sizes, as explained further in the annex; and

.4 in general, bigger ship size categories showed a bigger reduction in carbon intensity compared to smaller ship size categories.

20 It is recalled that EEOI and AER/cgDIST are different metrics for measuring carbon intensity. In general, if practical, demand-based metrics that are specific to what is being transported or what a ship is doing can be advantageous. Work is currently ongoing, as part of the CII review, to understand and consider different metrics for measuring carbon intensity.

Action requested of the Committee

21 The Committee is invited to consider the report on the carbon intensity of the existing fleet for 2019 to 2022 and relevant information in this document and, in particular, to:

.1 note the general outcomes as set out in paragraph 19 and in the annex;

.2 note the limitations of calculating the estimated demand-based carbon intensity using AIS draught data; and that this is not a full substitute for reported cargo data or, ideally, transport work data to IMO DCS, as explained in more detail in the annex; and

.3 take action as appropriate.

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ANNEX

REPORT ON THE CARBON INTENSITY OF THE EXISTING FLEET FROM 2019 to 2022

Introduction

1 Regulation 27.10 of MARPOL Annex VI requires the Secretary-General to produce an annual report to the Committee summarizing the data submitted to the IMO Ship Fuel Oil Consumption Database in GISIS (hereinafter referred to as "IMO DCS"), the status of missing data and other relevant information as may be requested by the Committee.

2 Following the entry into effect of the mandatory collection and reporting of ship fuel oil consumption data from 1 January 2019 (regulation 27 of MARPOL Annex VI), the Secretariat has submitted annual IMO DCS reports to the Committee for 2019, 2020, 2021 and 2022, as set out in documents MEPC 76/6/1, MEPC 77/6/1, MEPC 79/6/1 and MEPC 81/6, respectively.

3 Paragraph 1.5 of the *2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines* (CII reduction factors guidelines, G3) (resolution MEPC.338(76)) states that:

> "The Organization should continue to monitor developments in annual carbon intensity improvement using both demand-based and supply-based measurement in parallel to the annual analysis of the fuel consumption data reported to the IMO DCS"

4 Supply-based measurements of carbon intensity, i.e. AER and cgDIST, can be calculated from the data submitted in IMO DCS and are included in reports to the Committee.

5 However, in the absence of cargo or, ideally, transport work data reported in the IMO DCS, it has not been possible to calculate demand-based measurements of carbon intensity in reports to the Committee.

6 The Secretariat contracted UMAS International, to carry out a mathematical modelling process, which leverages AIS data, provided by Spire Maritime, and data from IMO DCS, to estimate demand-based carbon intensity for 2019 to 2022.

7 The method used for calculating demand-based measurements of operational carbon intensity by the contractor builds on the method developed for the Third IMO GHG Study 2014 and the Fourth IMO GHG Study 2020.

8 The outcomes of the measurements of operational carbon intensity for reporting years 2019, 2020, 2021 and 2022, for each Fourth IMO GHG Study 2020 ship type and size, are set out in tables 3, 4, 5 and 6, respectively, of this report.

9 It is recalled that MEPC 80 approved draft amendments to appendix IX of MARPOL Annex VI on Information to be submitted to IMO DCS, including the addition of the field "Total Transport Work" and other fields to enhance the granularity of the reporting (MEPC 81/3/2). If adopted by MEPC 81, these amendments would allow the Secretariat to calculate demand-based measurements of carbon intensity for future reporting years using the reported transport work data instead of AIS draught data.

Carbon intensity developments of the shipping fleet for the period from 2019 to 2022

10 Table 1 below contains the annual average supply-based carbon intensity measurements for 2019 to 2022, based on the AER/cgDIST metrics, as calculated by the Secretariat using the data submitted to IMO DCS from 2019 to 2022. On the basis of the data procured by the Secretariat, the demand-based carbon intensity measure, using the Estimated EEOI metric, has also been calculated.

11 Annual average carbon intensity shown in table 1 was calculated using a method similar to the one used in the Fourth IMO GHG Study 2020 where "deadweight" was applied as a weighting factor (see section 3.2.4 of the Fourth IMO GHG Study 2020).

Table 1: Average annual carbon intensity and percentage change compared to 2019

	Annual average carbon intensity and percentage change in carbon intensity compared to 2019						**IMO DCS Fuel Consumption Report to Committee**	
Year	**AER**		**cgDIST**		**Estimated EEOI**		**Report to Committee**	**Total fuel consumption (tonnes)**
2019	5.90	0.0%	8.44	0.0%	10.94	0.0%	MEPC 76/6/1	213 million
2020	5.83	-1.2%	8.24	-2.3%	10.92	-0.2%	MEPC 77/6/1	212 million
2021	5.89	-0.1%	8.34	-1.2%	10.90	-0.4%	MEPC 79/6/1	203 million
2022	5.66	-4.1%	8.05	-4.6%	10.89	-0.5%	MEPC 81/6	213 million

Method to estimate transport work and energy efficiency/carbon intensity

12 For each individual ship, the transport work (distance travelled multiplied by cargo) and energy efficiency were estimated by combining fuel consumption data submitted to IMO DCS with cargo mass and voyage distance estimates derived from large amounts of Satellite AIS data.

13 Cargo mass for each ship was estimated from draught observations from Satellite AIS data and relationships between draught displacement and lightweight as per the approach outlined in document MEPC 68/INF.24/ Rev.1 (Secretariat).

14 In tables 3, 4, 5 and 6, the demand-based carbon intensity is quantified for each ship type and size category using the estimated EEOI. The estimated EEOI takes into account the estimated cargo carried and is calculated according to the *Guidelines for Voluntary use of the ship energy efficiency operational indicator (EEOI)*, MEPC.1/Circ.684, as follows:

$$EEOI = \frac{\sum_i \sum_j (\mathrm{FC}_{ij} \times C_{Fj})}{\sum_i (m_{cargo,i} \times D_i)}$$

Where:
i = voyage number
j = fuel type
FC_{ij} = mass of fuel consumed for the voyage i and fuel type j.
C_{Fj} = fuel mass to CO_2 mass conversion factor for the voyage i and fuel type j.
$m_{cargo,i}$ = cargo carried (tonnes) or work done (number of TEU or passengers) for voyage i
D_i = distance in nautical miles corresponding to the cargo carried or work done for voyage i

For the method used here $m_{cargo,i}$ is in tonnes and $EEOI$ has the units gCO_2/t.nm. The CO_2 emissions, the nominator in the equation, is the total annual CO_2 emissions reported to IMO DCS (calculated by multiplying annual fuel consumption by the carbon factor for each fuel type). MEPC.1/Circ.684 indicates that EEOI can be calculated using tonnes, TEU or passengers as the cargo unit. The method used limits the calculation of EEOI to tonnes as the cargo unit.

15 To reduce potential bias and uncertainty around ship type and size group statistics for transport work, only ships that passed the filtering criteria outlined below were included for the calculations:

.1 over 60% of the hours in a year have at least one dynamic AIS message for the ship to support identification of voyages throughout the year;

.2 ship has been observed within the first month of the year to ensure that statistics are most likely limited to ships operating over the full year;

.3 the number of reported unique draughts is greater than 10% of each ship type and size grouping – this provides a lower limit on the reporting of draught, and removes those ships that are minimally updating the ships draught in the AIS message; and

.4 the total distance travelled by the ship is greater than 10% of each ship type and size grouping. This minimally ensures that the ship is actively engaged on transport work.

Matching the AIS fleet to the IMO DCS fleet

16 The IMO number in the reported IMO DCS data is used to match ships between IMO DCS and AIS. The AIS fleet may be different to the IMO DCS fleet because:

.1 ships are excluded that have multiple entries for a single IMO number in the IMO DCS data;

.2 ships are excluded that cannot be identified in AIS, as their Fourth IMO GHG Study 2020 category cannot be identified; and

.3 if the ship is indicated in the AIS database as being in a type that is excluded from the analysis, then the ship is excluded. The excluded ship types are Service – other, Service – tug, Miscellaneous – fishing, Yacht, Offshore, Miscellaneous – other.

Filtering the AIS fleet

17 The matched data derived from Satellite AIS, including Transport Work and EEOI, is filtered using the filters described in paragraph 15.

18 In tables 3, 4, 5 and 6, AER and cgDIST, measurements of supply-based carbon intensity have also been calculated from IMO DCS data to compare with the filtered EEOI.

19 In some cases the sample size was significantly reduced after filtering. For this reason there are "Mean Deadweight Tonnage" columns in tables 3, 4, 5, and 6, to allow for the Mean Deadweight of the IMO DCS fleet to be compared to the filtered AIS fleet.

20 In addition, to ensure the sample, after filtering, remained representative of the wider ship types and sizes, AER or cgDIST were compared before and after the application of the filtering and sample size was checked.

212 Table 2 shows the Fourth IMO GHG Study 2020 ship types and sizes that after filtering were found to have a supply-based carbon intensity that deviated more than 10%, or greater, compared to the unfiltered DCS fleet.

Table 2: Ship type and size categories where supply-based carbon intensity deviation of filtered to unfiltered DCS is greater than 10% for each year

2019	2020	2021	2022
Chemical tanker, 10000-19999	Bulk carrier, 0-9999	Chemical tanker, 10000-19999	Bulk carrier, 0-9999
Ferry-RoPax, 10000-19999	Chemical tanker, 10000-19999	Ferry-RoPax, 10000-19999	Ferry-RoPax, 10000-19999
General cargo, 0-4999	Ferry-pax only, 2000-+	Ferry-RoPax, 20000-+	Ferry-RoPax, 5000-9999
Liquefied gas tanker, 0-49999	Ferry-RoPax, 10000-19999	General cargo, 0-4999	General cargo, 0-4999
	Ferry-RoPax, 20000-+	Liquefied gas tanker, 100000-199999	Liquefied gas tanker, 100000-199999
	Ferry-RoPax, 5000-9999	Oil tanker, 20000-59999	Oil tanker, 60000-79999
	General cargo, 0-4999	Oil tanker, 10000-19999	Refrigerated bulk, 2000-5999
	Liquefied gas tanker, 100000-199999	Other liquids tankers, 1000-+	Ro-Ro, 0-4999
	Oil tanker, 10000-19999	Ro-Ro, 0-4999	

22 The filters outlined in paragraph 15 were identified to reduce the errors and uncertainty in the estimation of transport work.

23 In addition, AIS (including draught reporting) was investigated and, from a ship type and size grouping perspective, was found to be as good as 2018, the final reporting year for the Fourth IMO GHG Study 2020. However, uncertainties in AIS estimated allocative utilization, payload utilization, transport work and EEOI persist, driven in particular by the following factors:

.1 uncertainty in identification of voyages: The identification of port stops is contingent on coverage around ports. If coverage is insufficient at a port location, the voyage stop will not be identified;

.2 uncertainty in estimation of voyage distance: Voyage distance is estimated by summing haversine distance between interpolated and reported hourly resampled ship locations;

.3 sparse reporting of draught and alignment with voyage: in order to estimate the cargo on board, a draught is required that is accurately reported. It is assumed that the draught reported on the voyage is correct. However, it is observed that as draught is typically a manually entered value, the values that appear in the AIS may be sparse, in particular for smaller size categories. This is indicated by low values of unique reported draughts to the number of voyages within the year. The effect is that an initially correct reported draught persists beyond the voyage for which it is assigned. For example, if a ship were deployed on a fully laden and ballast round trip throughout the year, a persisted draught that was initially set for the laden leg would result in an almost doubling of transport work for the ship. This, in turn, would result in a nearly 50% reduction in its estimated EEOI, when compared with the true value;

.4 modelled estimate of cargo derived from reported draught: The cargo estimation model assumes an average value of fuel carried as well as a draught threshold indicating ballast conditions. As these are "average" values they may not be representative on a per voyage basis; and

.5 estimation of representative statistics due to sample size limitation: The selection of filters to be applied to the fleet for estimation of a representative transport work was based on reducing the uncertainty and maximising sample size in order that representative values of carbon intensity be generated. Due to the latter, many filters, such as those demanding a greater requirement of draught reporting and port coverage, were excluded because the sample size reduced so significantly.

24 In addition, Payload Utilization and Allocative Utilization are also included in tables 3, 4, 5 and 6, and are useful to understand how ships are loaded and are calculated, according to document MEPC 68/INF.24/Rev.1, as follows:

.1 Payload Utilization is defined as follows:

$$Payload\ Utilization = \frac{\text{Average Payload Mass}}{Deadweight}$$

.2 Allocative Utilization is defined as follows:

$$Allocative\ Utilization = \frac{Distance\ Travelled\ Loaded}{Total\ Distance\ Travelled}$$

25 Also, Overall Utilization is the product of both Payload Utilization and Allocative Utilization.

Outcome of analysis of carbon-intensity

26 During the derivation of transport work and analysis of carbon-intensity of the shipping fleet from 2019 to 2022, the following can be noted:

.1 the Fourth IMO GHG Study 2020 ship types and sizes provide a more disaggregated, and more representative, estimate of carbon intensity as it accounts for the significant scale effects of energy efficiency; however, the limitation of IMO DCS data to vessels over 5,000 gross tonnes results in smaller size categories having very low vessel numbers;

.2 the impact of filtering the fleet for the estimation of EEOI, in some cases significantly reduced the sample size to below statistical threshold for representative sample size, i.e. more than 30 samples;

.3 the estimation of transport work (distance travelled multiplied by cargo), and in particular cargo estimation per voyage, is limited by the coverage accuracy of reported draught, which is sparse in many cases;

.4 General cargo, Liquefied gas tanker, Chemical tanker and Oil tanker, in general, saw a reduction in supply-based carbon intensity for each year relative to 2019;

.5 in general, bigger ship size categories showed a bigger reduction in carbon intensity compared to smaller ship size categories;

.6 some Containership, Bulk carrier and Cruise size2 categories indicated an increased supply-based carbon intensity in 2021 relative to 2019 followed by a reduction in carbon intensity in 2022 relative to 2021;

.7 some Ro-Ro, Vehicle and Ferry-RoPax in in most size categories indicated a trend in increasing carbon intensity from 2020 to 2022 relative to 2019;

.8 when comparing between weighted averages between years, supply-based carbon intensity in AER/cgDIST demonstrated an overall decrease of around 3.60-3.72%, but with yearly fluctuations demand-based carbon intensity expressed in EEOI has gradually increased, just below 1% relative to 2019, but also demonstrating a more consistent value when comparing between reporting years; and

.9 trends in changes relative to 2019 for EEOI and supply based carbon intensity are not strongly correlated for all types and sizes; this can be partially attributed to differences in DCS reported Deadweight/Gross Tonnage and Distance versus AIS estimated values as well as uncertainty around the cargo estimation.

27 The following tables 3, 4, 5 and 6 contain operational carbon intensity data for each reporting year from 2019 to 2022, respectively.

[2] In this context it is recalled that the Committee had noted the progress of the work to develop an alternative carbon intensity metric for cruise passenger ships, led by the Cruise Ship Safety Forum (CSSF), see also document MEPC 79/7/21.

Table 3: Operational Carbon Intensity for 2019 using Fourth IMO GHG Study ship types and sizes and ships of 5,000 GT and above

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
Bulk carrier (DWT)	0-9999	55	7,929	7,917	88.5	67.3	16.51	0.0	23.37	0.0	26.41	0.0
	10000-34999	1535	28,511	29,996	86.9	62.6	8.60	0.0	13.58	0.0	13.68	0.0
	35000-59999	2892	49,783	49,008	83.2	63.7	6.12	0.0	10.39	0.0	10.67	0.0
	60000-99999	3375	76,000	75,961	82.5	56.3	4.23	0.0	7.74	0.0	8.81	0.0
	100000-199999	1201	170,192	173,206	82.8	49.8	2.77	0.0	5.36	0.0	6.69	0.0
	200000+	536	250,834	239,084	86.6	43.0	2.25	0.0	4.33	0.0	6.22	0.0
Chemical Tanker (DWT)	0-4999	0										
	5000-9999	318	8,295	8,206	81.1	94.8	20.55	0.0	30.40	0.0	27.74	0.0
	10000-19999	1009	15,350	16,198	80.2	67.8	15.46	0.0	24.34	0.0	22.84	0.0
	20000-39999	676	32,437	32,377	79.6	71.2	10.12	0.0	15.93	0.0	15.36	0.0
	40000+	1297	48,938	49,630	72.7	53.9	6.99	0.0	11.54	0.0	15.34	0.0
Containership (TEU)	0-999	447	10,073	10,366	67.8	100.0	24.34	0.0	29.61	0.0	33.19	0.0
	1000-1999	1140	19,109	19,236	65.3	100.0	15.93	0.0	19.80	0.0	22.86	0.0
	2000-2999	602	35,334	34,966	60.8	100.0	11.75	0.0	14.82	0.0	18.11	0.0
	3000-4999	754	52,367	52,819	61.0	100.0	9.80	0.0	11.99	0.0	15.07	0.0
	5000-7999	534	75,272	76,410	59.1	100.0	8.95	0.0	9.75	0.0	13.75	0.0
	8000-11999	608	110,707	111,132	58.2	100.0	7.11	0.0	7.87	0.0	11.21	0.0
	12000-14499	228	147,884	148,776	60.6	100.0	6.00	0.0	6.08	0.0	9.51	0.0
	14500-19999	113	181,974	187,696	59.9	100.0	5.09	0.0	5.18	0.0	7.20	0.0
	20000-+	64	200,145	195,521	63.4	100.0	4.84	0.0	4.45	0.0	7.20	0.0
Cruise	0-1999	0										
	2000-9999	22	1,093	968	96.6	100.0	192.16	0.0	28.14	0.0	254.16	0.0

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
	10000-59999	91	3,808	3,874	96.0	100.0	154.40	0.0	17.46	0.0	144.25	0.0
	60000-99999	98	8,291	8,229	96.3	100.0	121.36	0.0	12.99	0.0	127.41	0.0
	100000-149999	63	10,958	11,009	96.6	99.8	115.72	0.0	10.39	0.0	117.51	0.0
	150000-+	25	14,052	13,441	95.0	99.9	103.32	0.0	8.40	0.0	119.63	0.0
Ferry-pax only (GT)	0-299	0										
	300-999	0										
	1000-1999	0										
	2000-+	5	2,950				173.00	0.0	63.80	0.0		
Ferry-RoPax (GT)	0-1999	0										
	2000-4999	1	5,995	5,995	86.2	99.9	46.47	0.0	34.17	0.0	44.31	0.0
	5000-9999	63	1,368	1,286	89.6	100.0	303.96	0.0	46.42	0.0	256.14	0.0
	10000-19999	111	3,535	4,521	80.6	100.0	107.94	0.0	22.55	0.0	100.03	0.0
	20000-+	240	6,434	6,607	80.0	100.0	94.33	0.0	18.15	0.0	97.59	0.0
General Cargo (DWT)	0-4999	37	3,677	3,824	87.4	100.0	43.24	0.0	22.77	0.0	42.16	0.0
	5000-9999	806	8,174	8,157	83.4	70.4	18.24	0.0	24.30	0.0	29.15	0.0
	10000-19999	908	13,455	13,850	77.6	78.0	14.11	0.0	19.32	0.0	22.86	0.0
	20000-+	713	37,898	39,147	78.9	63.8	7.74	0.0	11.74	0.0	14.18	0.0
Liquefied gas tanker (CBM)	0-49999	453	15,930	14,529	72.9	61.8	19.92	0.0	22.79	0.0	27.07	0.0
	50000-99999	303	53,058	53,540	84.8	46.5	7.62	0.0	8.75	0.0	18.38	0.0
	100000-199999	434	84,555	85,091	76.8	92.9	10.14	0.0	7.63	0.0	14.94	0.0
	200000-+	43	120,294	112,413	76.1	100.0	10.01	0.0	8.41	0.0	14.69	0.0
Oil tanker	0-4999	1	4,995	4,995			28.13	0.0	27.52	0.0		
	5000-9999	188	7,669	7,689	78.6	91.5	23.59	0.0	30.79	0.0	29.13	0.0
	10000-19999	126	14,935	15,420	80.3	98.0	18.43	0.0	27.77	0.0	25.02	0.0

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	**Mean Deadweight Tonnage**	**Mean Deadweight Tonnage**	**Payload Utilization (%)**	**Allocative Utilization (%)**	**Median AER**	**AER change to 2019 (%)**	**Median cgDIST**	**cgDIST change to 2019 (%)**	**Median EEOI**	**EEOI change to 2019 (%)**
	20000-59999	453	45,193	45,207	79.4	47.4	9.02	0.0	14.51	0.0	18.87	0.0
	60000-79999	399	72,797	73,109	77.7	55.0	6.31	0.0	11.03	0.0	12.47	0.0
	80000-119999	956	109,532	110,084	78.0	54.6	4.76	0.0	8.68	0.0	10.29	0.0
	120000-199999	563	156,085	155,766	82.0	47.8	3.50	0.0	6.72	0.0	8.14	0.0
	200000-+	752	307,559	308,025	78.0	48.9	2.39	0.0	4.59	0.0	5.88	0.0
Other liquids (DWT)	0-999	0										
	1000-+	13	30,823	28,976	72.7	95.1	11.76	0.0	13.07	0.0	20.89	0.0
Refrigerated bulk (DWT)	0-1999	0										
	2000-5999	7	5,914	6,321	88.0	100.0	35.53	0.0	35.70	0.0	48.44	0.0
	6000-9999	147	7,662	7,575	73.4	100.0	32.24	0.0	35.30	0.0	49.91	0.0
	10000-+	126	12,648	12,824	67.8	96.4	24.37	0.0	25.84	0.0	41.89	0.0
Ro-ro (DWT)	0-4999	28	4,423	4,596	70.6	100.0	47.18	0.0	21.49	0.0	56.62	0.0
	5000-9999	107	7,239	7,238	74.1	100.0	34.69	0.0	22.40	0.0	51.32	0.0
	10000-14999	115	12,261	12,325	77.4	100.0	32.92	0.0	13.88	0.0	43.29	0.0
	15000-+	80	27,167	29,177	73.8	100.0	15.31	0.0	8.16	0.0	21.57	0.0
Vehicle (GT)	0-29999	65	5,520	5,110	36.5	100.0	43.20	0.0	12.81	0.0	123.64	0.0
	30000-49999	167	13,664	13,869	33.6	100.0	22.13	0.0	6.93	0.0	59.26	0.0
	50000-+	482	20,848	20,723	31.3	100.0	16.29	0.0	5.47	0.0	50.10	0.0

Table 4: Operational Carbon Intensity for 2020 using Fourth IMO GHG Study ship types and sizes and ships of 5,000 GT and above

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
Bulk carrier (DWT)	0-9999	51	10,728	12,574	88.6	67.6	14.41	-12.7	21.43	-8.3	21.71	-17.8
	10000-34999	1518	28,587	29,501	86.6	61.5	8.33	-3.2	13.12	-3.4	13.48	-1.4
	35000-59999	2967	49,714	48,307	82.8	61.2	5.96	-2.6	10.08	-3.0	11.01	3.2
	60000-99999	3668	75,847	75,349	81.6	53.6	4.13	-2.3	7.53	-2.7	9.01	2.2
	100000-199999	1231	169,657	171,662	82.8	47.5	2.68	-3.3	5.17	-3.6	6.43	-3.8
	200000+	606	251,876	240,826	87.5	43.0	2.20	-2.2	4.28	-1.3	5.87	-5.6
Chemical Tanker (DWT)	0-4999	0										
	5000-9999	319	8,313	8,222	80.4	96.3	20.00	-2.7	29.22	-3.9	27.40	-1.2
	10000-19999	1020	15,651	16,449	80.6	69.8	14.92	-3.5	23.60	-3.0	21.25	-7.0
	20000-39999	693	32,304	31,934	80.5	68.7	9.55	-5.6	15.16	-4.9	15.31	-0.3
	40000+	1359	52,588	49,715	73.6	52.2	6.78	-3.0	11.23	-2.7	15.14	-1.3
Containership (TEU)	0-999	458	10,268	10,199	66.6	100.0	24.42	0.3	28.97	-2.1	32.91	-0.9
	1000-1999	1147	19,213	19,220	65.3	100.0	15.49	-2.8	19.35	-2.3	22.29	-2.5
	2000-2999	618	35,209	36,194	61.0	100.0	11.39	-3.1	14.17	-4.4	17.01	-6.1
	3000-4999	764	52,945	55,340	61.0	100.0	9.79	-0.1	11.97	-0.2	14.78	-1.9
	5000-7999	524	77,638	76,281	59.9	100.0	8.76	-2.1	9.53	-2.3	13.65	-0.7
	8000-11999	619	111,228	111,315	58.2	100.0	7.15	0.6	7.91	0.6	10.60	-5.5
	12000-14499	230	148,790	149,201	59.7	100.0	6.11	1.8	6.23	2.4	9.02	-5.2
	14500-19999	122	182,981	180,424	63.3	100.0	5.24	2.9	5.40	4.4	7.69	6.8
	20000-+	80	208,232	206,918	64.8	100.0	4.70	-2.8	4.67	4.8	7.47	3.8
Cruise	0-1999	0										
	2000-9999	22	1,137	1,131	96.6	100.0	288.36	50.1	41.51	47.5	291.54	14.7

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	**Mean Deadweight Tonnage**	**Mean Deadweight Tonnage**	**Payload Utilization (%)**	**Allocative Utilization (%)**	**Median AER**	**AER change to 2019 (%)**	**Median cgDIST**	**cgDIST change to 2019 (%)**	**Median EEOI**	**EEOI change to 2019 (%)**
	10000-59999	88	3,975	4,143	96.1	100.0	233.54	51.3	25.73	47.4	214.57	48.8
	60000-99999	86	8,281	8,309	96.6	100.0	192.81	58.9	18.82	44.9	170.78	34.0
	100000-149999	60	10,874	11,253	96.5	100.0	172.18	48.8	14.36	38.2	151.88	29.3
	150000-+	27	14,616	14,001	94.2	100.0	143.38	38.8	11.43	35.9	152.32	27.3
Ferry-pax only (GT)	0-299	0										
	300-999	0										
	1000-1999	0										
	2000-+	4	2,708	4,211	96.0	100.0	449.21	159.7	94.76	48.5	260.42	
Ferry-RoPax (GT)	0-1999	0										
	2000-4999	1	5,995				26.14	-43.8	19.22	-43.8		
	5000-9999	67	1,365	1,390	96.6	100.0	329.47	8.4	49.03	5.6	189.19	-26.1
	10000-19999	117	3,475	4,258	80.4	100.0	131.67	22.0	24.83	10.1	101.17	1.1
	20000-+	235	6,495	6,793	78.4	100.0	99.94	6.0	18.72	3.2	102.50	5.0
General Cargo (DWT)	0-4999	36	3,725	3,952	85.7	100.0	43.31	0.2	22.37	-1.8	41.56	-1.4
	5000-9999	812	8,702	8,128	82.6	72.2	17.54	-3.8	23.38	-3.8	29.69	1.8
	10000-19999	921	13,474	13,804	77.5	72.3	13.86	-1.8	19.07	-1.3	22.82	-0.2
	20000-+	721	38,446	39,607	79.6	59.5	7.65	-1.2	11.49	-2.1	14.45	1.9
Liquefied gas tanker (CBM)	0-49999	459	15,807	14,697	74.7	61.2	18.84	-5.4	21.88	-4.0	26.52	-2.0
	50000-99999	327	53,123	53,560	84.5	42.5	7.67	0.6	8.82	0.9	20.37	10.9
	100000-199999	456	85,249	87,233	75.7	94.6	9.74	-4.0	7.35	-3.6	14.04	-6.0
	200000-+	44	120,512	117,045	74.4	100.0	10.30	3.0	8.62	2.6	15.30	4.2
Oil tanker (DW	0-4999	0										
	5000-9999	183	7,660	7,750	81.1	91.3	22.62	-4.1	30.48	-1.0	26.98	-7.4
	10000-19999	116	14,539	15,165	81.9	64.1	17.97	-2.5	27.21	-2.0	25.67	2.6

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet: DCS and AIS Matched Fleet	Non-Filtered DCS Fleet: Mean Deadweight Tonnage	Filtered AIS Fleet: Mean Deadweight Tonnage	Filtered AIS Fleet: Payload Utilization (%)	Filtered AIS Fleet: Allocative Utilization (%)	Non-Filtered DCS Fleet: Median AER	Non-Filtered DCS Fleet: AER change to 2019 (%)	Non-Filtered DCS Fleet: Median cgDIST	Non-Filtered DCS Fleet: cgDIST change to 2019 (%)	Filtered AIS Fleet: Median EEOI	Filtered AIS Fleet: EEOI change to 2019 (%)
	20000-59999	463	46,451	45,233	80.3	46.2	8.91	-1.2	14.53	0.2	20.37	7.9
	60000-79999	406	72,839	73,414	77.0	54.0	6.27	-0.6	10.94	-0.8	12.86	3.2
	80000-119999	961	109,479	110,203	78.9	52.8	4.74	-0.5	8.66	-0.2	10.06	-2.2
	120000-199999	578	155,305	155,330	82.4	44.5	3.52	0.5	6.72	0.0	8.96	10.1
	200000-+	750	306,807	308,859	78.5	43.9	2.33	-2.4	4.48	-2.3	6.03	2.5
Other liquids (DWT)	0-999	0										
	1000-+	13	30,823	32,086	72.8	94.8	12.03	2.4	12.99	-0.7	21.58	3.3
Refrigerated bulk (DWT)	0-1999	0										
	2000-5999	5	5,743	5,910	87.1	100.0	29.66	-16.5	32.10	-10.1	42.71	-11.8
	6000-9999	141	7,623	7,722	69.3	100.0	30.35	-5.9	33.96	-3.8	50.50	1.2
	10000-+	110	12,925	13,097	68.1	96.1	24.84	1.9	25.84	0.0	39.95	-4.6
Ro-ro (DWT)	0-4999	26	4,397	4,492	68.4	100.0	44.50	-5.7	22.76	5.9	52.21	-7.8
	5000-9999	105	7,327	7,248	72.1	100.0	35.81	3.2	22.13	-1.2	51.47	0.3
	10000-14999	109	12,254	12,217	76.0	100.0	32.87	-0.1	14.19	2.2	42.81	-1.1
	15000-+	75	25,401	24,724	74.3	100.0	16.33	6.7	8.78	7.6	22.62	4.9
Vehicle (GT)	0-29999	68	5,496	6,316	36.9	100.0	43.80	1.4	13.48	5.2	103.79	-16.1
	30000-49999	164	13,630	13,881	31.9	100.0	22.39	1.2	6.99	0.9	59.48	0.4
	50000-+	488	20,926	21,213	30.4	100.0	16.03	-1.6	5.36	-2.0	48.11	-4.0

Table 5: Operational Carbon Intensity for 2021 using Fourth IMO GHG Study ship types and sizes and ships of 5,000 GT and above

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
Bulk carrier (DWT)	0-9999	58	8,021	8,145	85.9	59.3	15.39	-6.7	23.10	-1.1	23.98	-9.2
	10000-34999	1454	28,283	29,999	87.0	63.6	8.58	-0.2	13.53	-0.3	13.43	-1.8
	35000-59999	2914	49,361	47,725	82.5	62.4	6.34	3.5	10.69	2.9	11.35	6.3
	60000-99999	3811	75,815	74,791	81.0	56.1	4.38	3.6	7.99	3.2	9.16	3.9
	100000-199999	1244	169,415	171,378	81.9	50.3	2.79	0.9	5.40	0.7	6.42	-4.0
	200000+	651	249,079	239,448	87.0	43.6	2.20	-2.0	4.27	-1.6	5.96	-4.2
Chemical Tanker (DWT)	0-4999	0										
	5000-9999	312	8,307	8,278	78.0	99.3	20.31	-1.2	30.51	0.3	27.13	-2.2
	10000-19999	1002	15,438	16,182	79.5	68.1	15.05	-2.7	23.53	-3.3	21.69	-5.1
	20000-39999	685	32,345	31,585	78.8	72.0	9.51	-6.0	14.97	-6.0	15.17	-1.3
	40000+	1428	52,567	49,892	73.2	52.1	6.51	-6.9	10.85	-6.0	15.07	-1.7
Containership (TEU)	0-999	442	10,013	10,103	70.0	100.0	24.16	-0.7	29.26	-1.2	32.32	-2.6
	1000-1999	1171	19,112	19,727	67.5	100.0	16.28	2.2	20.18	1.9	21.97	-3.9
	2000-2999	680	35,841	36,309	63.5	100.0	11.75	0.0	14.86	0.3	16.73	-7.6
	3000-4999	783	52,109	53,387	62.6	100.0	10.47	6.9	12.79	6.6	15.33	1.8
	5000-7999	518	75,606	76,168	61.3	100.0	9.34	4.4	10.14	4.0	14.18	3.1
	8000-11999	624	111,605	112,220	60.9	100.0	7.62	7.2	8.46	7.6	11.50	2.6
	12000-14499	241	147,928	147,009	61.5	100.0	6.33	5.4	6.55	7.7	9.39	-1.3
	14500-19999	142	179,157	176,145	63.8	100.0	5.33	4.8	5.60	8.1	7.41	3.0
	20000-+	93	211,753	211,992	65.5	100.0	4.86	0.4	4.71	5.7	7.07	-1.8
Cruise	0-1999	0										
	2000-9999	18	1,111	1,174	96.6	100.0	258.90	34.7	38.09	35.3	256.39	0.9

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
	10000-59999	76	3,647	3,631	94.9	100.0	265.02	71.6	27.73	58.8	294.25	104.0
	60000-99999	80	8,436	8,293	95.5	100.0	208.51	71.8	21.63	66.5	183.00	43.6
	100000-149999	64	10,858	10,845	96.3	100.0	176.64	52.6	15.10	45.4	162.83	38.6
	150000-+	32	14,741	14,786	83.6	100.0	128.14	24.0	10.35	23.2	110.51	-7.6
Ferry-pax only (GT)	0-299	0										
	300-999	0										
	1000-1999	0										
	2000-+	3	3,291	4,211	95.3	100.0	162.43	-6.1	58.40	-8.5	169.89	
Ferry-RoPax (GT)	0-1999	0										
	2000-4999	0										
	5000-9999	71	1,335	1,307	78.5	100.0	336.06	10.6	49.64	6.9	288.55	12.7
	10000-19999	110	3,692	4,145	77.5	100.0	111.91	3.7	24.13	7.0	81.75	-18.3
	20000-+	244	6,577	7,048	82.0	100.0	93.91	-0.4	18.41	1.4	94.91	-2.7
General Cargo (DWT)	0-4999	32	3,638	3,744	85.7	100.0	43.27	0.0	24.71	8.5	40.08	-4.9
	5000-9999	803	8,180	8,153	84.3	71.8	17.16	-5.9	23.20	-4.6	28.17	-3.4
	10000-19999	931	13,675	13,773	80.1	75.0	14.13	0.1	19.29	-0.2	21.25	-7.1
	20000-+	815	38,496	39,877	80.6	62.0	7.59	-1.8	11.65	-0.8	14.11	-0.5
Liquefied gas tanker (CBM)	0-49999	460	15,848	14,942	75.6	57.9	19.53	-2.0	22.01	-3.4	27.95	3.3
	50000-99999	349	53,392	53,493	84.7	44.4	7.30	-4.2	8.36	-4.4	19.39	5.5
	100000-199999	520	86,156	89,045	75.4	87.3	8.63	-15.0	6.72	-12.0	13.16	-11.9
	200000-+	45	121,272	121,078	75.2	100.0	9.64	-3.7	8.22	-2.2	14.11	-4.0
Oil tanke r (DW	0-4999	0										
	5000-9999	176	7,670	7,708	81.5	95.7	23.66	0.3	30.04	-2.4	30.56	4.9
	10000-19999	126	14,604	14,968	81.1	55.6	17.83	-3.2	27.36	-1.5	28.77	15.0

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
	20000-59999	435	44,783	45,565	79.5	48.4	8.98	-0.4	14.18	-2.3	18.66	-1.1
	60000-79999	399	72,876	73,421	76.7	49.9	6.26	-0.8	10.92	-1.0	13.49	8.2
	80000-119999	982	109,747	109,693	78.6	53.5	4.61	-3.1	8.38	-3.5	9.79	-4.9
	120000-199999	585	155,770	155,284	80.8	45.9	3.42	-2.3	6.58	-2.1	8.87	9.0
	200000-+	751	306,511	308,033	78.6	44.1	2.20	-8.2	4.24	-7.7	5.99	2.0
Other liquids (DWT)	0-999	0										
	1000-+	8	30,439	28,945	75.0	100.0	10.99	-6.6	12.31	-5.8	16.04	-23.2
Refrigerated bulk (DWT)	0-1999	0										
	2000-5999	9	5,703	5,242	85.1	100.0	31.78	-10.6	35.97	0.7	38.05	-21.5
	6000-9999	137	7,605	7,577	72.7	100.0	33.96	5.3	37.48	6.2	46.31	-7.2
	10000-+	121	13,092	13,586	70.9	99.4	24.95	2.4	26.37	2.1	39.82	-4.9
Ro-ro (DWT)	0-4999	27	4,484	4,515	68.7	100.0	43.55	-7.7	22.57	5.0	56.02	-1.1
	5000-9999	100	7,412	7,508	74.3	100.0	36.36	4.8	22.09	-1.4	50.36	-1.9
	10000-14999	109	12,177	12,308	78.1	100.0	33.00	0.3	14.21	2.4	40.47	-6.5
	15000-+	88	26,297	28,558	76.5	100.0	16.48	7.7	8.25	1.2	21.43	-0.7
Vehicle (GT)	0-29999	64	5,718	5,763	38.4	100.0	41.37	-4.2	12.68	-1.0	98.05	-20.7
	30000-49999	146	13,433	13,781	32.7	100.0	22.50	1.7	6.93	0.0	59.98	1.2
	50000-+	488	20,886	21,061	32.3	100.0	16.80	3.2	5.56	1.8	48.42	-3.4

Table 6: Operational Carbon Intensity for 2022 using Fourth IMO GHG Study ship types and sizes and ships of 5,000 GT and above

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
Bulk carrier (DWT)	0-9999	55	8,040	7,836	84.6	67.7	17.22	4.3	24.50	4.8	27.37	3.6
	10000-34999	1,373	28,331	28,905	86.0	60.1	8.47	-1.6	13.35	-1.7	14.86	8.6
	35000-59999	2,885	49,245	48,241	81.4	61.9	6.17	0.7	10.41	0.2	11.57	8.4
	60000-99999	3,930	75,794	75,009	80.6	54.5	4.20	-0.6	7.67	-0.8	9.12	3.5
	100000-199999	1,245	169,471	170,425	81.8	48.8	2.63	-4.9	5.06	-5.6	6.52	-2.5
	200000+	677	247,986	244,206	87.8	39.6	2.11	-6.2	4.08	-5.8	6.08	-2.2
Chemical Tanker (DWT)	0-4999	0										
	5000-9999	316	8,266	8,184	79.6	98.7	20.83	1.3	30.61	0.7	29.30	5.6
	10000-19999	977	15,536	16,062	80.3	70.6	14.94	-3.3	23.62	-3.0	21.65	-5.2
	20000-39999	685	32,331	31,901	79.9	70.8	9.49	-6.2	15.09	-5.3	15.08	-1.8
	40000+	1,445	49,520	49,988	73.2	52.0	6.41	-8.3	10.65	-7.8	14.93	-2.6
Containership (TEU)	0-999	440	10,210	10,294	68.8	100.0	23.11	-5.1	28.02	-5.4	31.96	-3.7
	1000-1999	1,208	19,282	19,670	67.8	100.0	15.37	-3.5	19.38	-2.1	21.28	-6.9
	2000-2999	710	34,982	34,575	64.1	100.0	11.56	-1.6	14.36	-3.1	16.43	-9.3
	3000-4999	788	52,404	53,340	62.5	100.0	10.07	2.7	12.47	4.0	15.43	2.4
	5000-7999	520	75,482	76,483	61.2	100.0	9.13	2.0	9.94	2.0	13.93	1.3
	8000-11999	634	112,655	113,623	60.1	100.0	7.26	2.1	8.15	3.5	11.29	0.8
	12000-14499	242	147,819	146,075	60.6	100.0	5.90	-1.6	6.19	1.7	9.09	-4.4
	14500-19999	161	177,112	176,353	63.3	100.0	5.14	1.0	5.32	2.8	7.51	4.4
	20000-+	100	213,095	217,919	63.4	100.0	4.72	-2.5	4.55	2.2	7.10	-1.4
Cru	0-1999	0										

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
	2000-9999	29	1,148	1,134	96.0	100.0	209.29	8.9	28.08	-0.2	188.63	-25.8
	10000-59999	95	3,491	3,455	93.0	100.0	179.99	16.6	18.34	5.0	182.12	26.3
	60000-99999	81	8,440	8,536	96.4	99.9	128.45	5.8	13.28	2.3	137.23	7.7
	100000-149999	69	10,942	10,961	95.4	100.0	116.19	0.4	10.21	-1.7	127.41	8.4
	150000-+	37	15,138	14,885	87.4	100.0	103.64	0.3	8.54	1.6	111.61	-6.7
Ferry-pax only (GT)	0-299	0										
	300-999	0										
	1000-1999	0										
	2000-+	4	3,448				170.36	-1.5	63.93	0.2		
Ferry-RoPax (GT)	0-1999	0										
	2000-4999	0										
	5000-9999	69	1,273	1,340	66.2	100.0	377.98	24.4	56.39	21.5	425.44	66.1
	10000-19999	109	3,533	3,710	72.3	100.0	120.59	11.7	23.96	6.2	160.87	60.8
	20000-+	253	6,638	7,185	81.4	100.0	91.98	-2.5	18.64	2.7	99.39	1.8
General Cargo (DWT)	0-4999	31	3,549	3,184	82.3	100.0	43.18	-0.1	23.36	2.6	40.29	-4.4
	5000-9999	773	8,211	8,178	83.3	71.0	17.10	-6.2	22.92	-5.7	29.38	0.8
	10000-19999	977	13,606	13,658	79.6	76.8	13.99	-0.9	19.06	-1.4	22.68	-0.8
	20000-+	869	38,366	39,100	79.3	61.1	7.44	-3.8	11.44	-2.5	15.18	7.1
Liquefied gas tanker (CBM)	0-49999	453	15,897	14,564	75.4	61.8	19.57	-1.7	22.09	-3.0	25.10	-7.3
	50000-99999	371	53,578	53,483	84.5	41.2	7.09	-7.0	8.03	-8.2	21.35	16.2
	100000-199999	526	86,804	89,220	76.1	85.9	8.74	-13.8	6.78	-11.1	12.94	-13.4
	200000-+	43	120,860	123,535	76.0	100.0	10.10	1.0	8.36	-0.5	15.20	3.4
	0-4999	0										

Fourth IMO GHG Study Ship Types and Sizes		Non-Filtered DCS Fleet		Filtered AIS Fleet			Non-Filtered DCS Fleet				Filtered AIS Fleet	
		DCS and AIS Matched Fleet	Mean Deadweight Tonnage	Mean Deadweight Tonnage	Payload Utilization (%)	Allocative Utilization (%)	Median AER	AER change to 2019 (%)	Median cgDIST	cgDIST change to 2019 (%)	Median EEOI	EEOI change to 2019 (%)
	5000-9999	171	7,699	7,596	80.7	97.3	23.38	-0.9	30.30	-1.6	31.30	7.4
	10000-19999	104	14,715	15,054	81.6	61.2	15.99	-13.2	24.68	-11.1	25.81	3.2
	20000-59999	407	45,017	45,243	79.3	47.0	8.43	-6.6	13.46	-7.2	18.77	-0.6
	60000-79999	378	73,086	73,664	78.2	56.0	6.48	2.7	11.32	2.6	12.06	-3.2
	80000-119999	978	110,249	111,158	78.3	51.5	4.49	-5.8	8.16	-6.0	10.17	-1.2
	120000-199999	605	156,647	156,041	79.4	48.0	3.42	-2.3	6.50	-3.3	8.43	3.5
	200000-+	771	307,948	308,372	76.8	45.8	2.15	-10.3	4.13	-10.1	5.95	1.3
Other liquids (DWT)	0-999	0										
	1000-+	13	30,548	26,376	75.4	95.0	12.21	3.9	12.31	-5.8	19.21	-8.0
Refrigerated bulk (DWT)	0-1999	0										
	2000-5999	7	5,435	5,554	85.0	74.2	53.86	51.6	37.85	6.0	45.02	-7.1
	6000-9999	131	7,627	7,567	76.3	95.3	29.80	-7.6	33.35	-5.5	46.02	-7.8
	10000-+	125	12,910	13,737	70.2	99.3	24.59	0.9	25.36	-1.9	36.36	-13.2
Ro-ro (DWT)	0-4999	22	4,594	4,490	76.0	100.0	56.92	20.7	22.06	2.6	44.55	-21.3
	5000-9999	93	7,326	7,466	73.1	100.0	35.52	2.4	21.55	-3.8	50.41	-1.8
	10000-14999	106	12,358	12,185	79.1	100.0	32.20	-2.2	13.87	-0.1	39.52	-8.7
	15000-+	98	24,917	26,688	74.2	100.0	16.68	9.0	8.34	2.2	22.02	2.1
Vehicle (GT)	0-29999	55	5,822	5,729	35.4	100.0	43.55	0.8	13.54	5.7	113.03	-8.6
	30000-49999	155	13,438	13,962	34.1	100.0	22.68	2.5	7.15	3.2	57.87	-2.3
	50000-+	479	20,812	20,681	32.1	100.0	16.98	4.3	5.62	2.9	51.48	2.8

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