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# ENERGY EFFICIENCY OF SHIPS

## Report on annual carbon intensity and efficiency of the fleet (Reporting year: 2024)

### Note by the Secretariat

**SUMMARY**

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|---|---|
| *Executive summary:* | This document reports on demand-based and supply-based carbon intensity for the year 2024, in accordance with the *2022 Guidelines for the development and management of the IMO Ship fuel oil consumption database* (resolution MEPC.349(78)), using the mathematical modelling process described in document MEPC 81/6/1. |
| *Strategic direction, if applicable:* | 3 |
| *Output:* | 3.7 |
| *Action to be taken:* | Paragraph 20 |
| *Related documents:* | MEPC 68/INF.24/Rev.1; MEPC 70/18; MEPC 71/17; MEPC 76/6/1; MEPC 77/6/1; MEPC 79/6/1; MEPC 81/6, MEPC 81/6/1; MEPC 82/6/38; MEPC 83/6 and MEPC 84/6/1 |

## 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 the "IMO DCS"), the status of missing data and such 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 (MARPOL Annex VI, regulation 27), the Secretariat has submitted annual IMO DCS reports to the Committee summarizing the data reported for the years 2019, 2020, 2021, 2022, 2023 and 2024, as set out in documents MEPC 76/6/1, MEPC 77/6/1, MEPC 79/6/1, MEPC 81/6, MEPC 82/6/38 and MEPC 84/6/1, 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 a 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 developments 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 The 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 by China et al.) 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 (such as 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 type, as applicable) in the annual IMO DCS reports to MEPC (e.g. table 3 in the annexes to documents MEPC 81/6, MEPC 82/6/38 and MEPC 84/6/1).

7 With regard to the demand-based measurements, in the absence of actual cargo-related data, in particular transport work, the Secretariat contacted UMAS International to estimate demand-based carbon intensity by using a mathematical modelling process, which leverages AIS data, provided by Kpler (Spire Maritime) and data submitted to the IMO DCS.*

8 Document MEPC 83/6 (Secretariat) contains information on the demand-based and supply-based carbon intensity of international shipping for the year 2023. This document reports on both demand-based and supply-based carbon intensity developments for the period from 2019 to 2024.

***Improvements to the IMO DCS and reporting on carbon intensity***

9 MEPC 81 adopted amendments to appendix IX of MARPOL Annex VI (resolution MEPC.385(81) 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 also adopted related *Amendments to the 2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP) (resolution MEPC.346(78))* (resolution MEPC.388(81)).

10 As also noted in document MEPC 84/6/1, the Secretariat has tested and updated the IMO DCS GISIS module to enable the reporting of enhanced granularity and transport work on a voluntary basis from 1 January 2025 and on a mandatory basis from 1 January 2026.

**Developments in operational carbon intensity of international shipping**

11 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 incorporated in the overall developments/trends in carbon intensity in figures 1 and 2 below, respectively.

12 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.

* 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.

13 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. Further information is given in document MEPC 76/INF.10 (China et al.).

***Method used to estimate the carbon intensity developments of the shipping fleet for the period from 2019 to 2024***

14 The mathematical modelling process described in detail in document MEPC 81/6/1 has been used to directly compare the 2019 to 2022 carbon intensity developments with the carbon intensity developments up to 2024, set out in the annex to this document.

15 MEPC 83 noted the uncertainty in AIS-based cargo estimations (MEPC 83/17, paragraph 6.14). A significant source of this uncertainty is due to inconsistency in the input of the ship's draught in voyage-related AIS data and the uncertainty concerning the volume of ballast water carried on a voyage. Additionally, it should be noted that the uncertainty varies across ship types and sizes. This uncertainty should be taken into consideration when reviewing table 1 in the annex.

16 Table 1 below provides annual average supply-based and demand-based measurements of carbon intensity for 2019 to 2024, using AER and cgDIST metrics and estimated EEOI, respectively.

**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 | 203 million |
| **2021** | 5.89 | -0.1% | 8.34 | -1.2% | 10.90 | -0.4% | MEPC 79/6/1 | 212 million |
| **2022** | 5.66 | -4.1% | 8.05 | -4.6% | 10.89 | -0.5% | MEPC 81/6 | 213 million |
| **2023** | 5.32 | -9.7% | 7.60 | -9.9% | 10.42 | -4.8% | MEPC 82/6/38 | 211 million |
| **2024** | 5.29 | -10.3% | 7.53 | -10.8% | 10.08 | -7.9% | MEPC 84/6/1 | 223 million |

17 Figures 1 and 2 below show overall developments/trends in carbon intensity, using both supply-based and demand-based measures, respectively. As explained in document MEPC 81/6/1, the comparison between the Fourth IMO GHG Study and IMO DCS data is indicative in nature, due to being derived from two different data sets.

18 The average annual carbon intensity from 2019 to 2024 shown in figures 1 and 2 has been slightly adjusted to be in line with the estimated supply-based and demand-based carbon intensity reduction rates achieved in the year 2019, 23.6% and 33.3%, respectively, relative to 2008, as described in the CII Reduction Factors Guidelines (G3). The indicative results show that the average supply-based and demand-based carbon intensity in 2024 has reduced by 31.5% and 38.6%, respectively, compared to 2008.

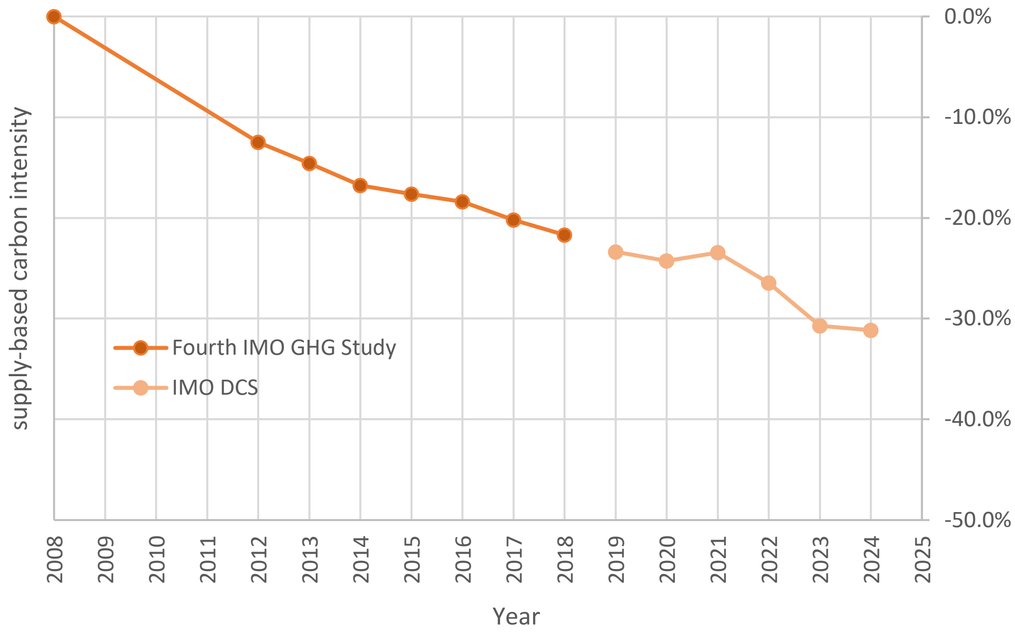


**Figure 1: Supply-based (AER) carbon intensity of international shipping (2008-2024)**

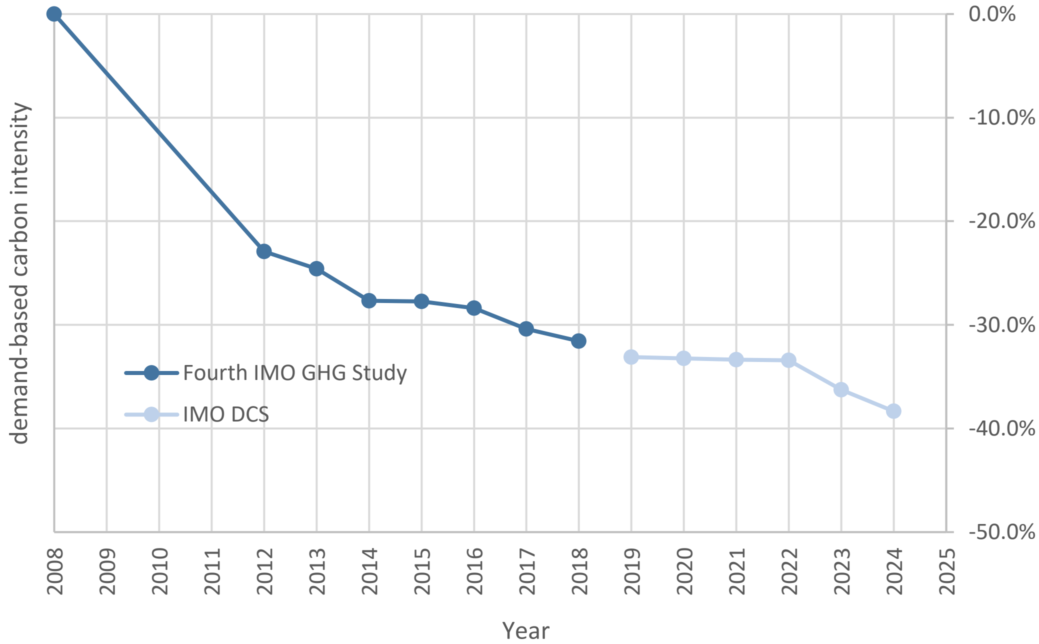


**Figure 2: Demand-based (estimated EEOI) carbon intensity of international shipping (2008-2024)**

**Carbon intensity developments of the shipping fleet for the period from 2019 to 2024**

19 Following the analysis of the carbon intensity of the shipping fleet from 2019 to 2024, the following general comments can be noted:

.1 as an average across the fleet, supply-based carbon intensity in AER and cgDIST demonstrated an overall decrease of up to 10.8% in 2024 relative to 2019, but with yearly fluctuations (see figure 1);

.2 the trend of reduction in average fleet supply-based and demand-based carbon intensity relative to 2019, highlighted in document MEPC 83/6, has continued in 2024;

.3 in general, across the Fourth IMO GHG Study 2020 ship types and sizes (see table 1 in the annex) directional changes in median AER and cgDIST relative to 2019 are consistent with those in median EEOI change, but with differences in magnitude except for oil tankers, which are less correlated; and

.4 across the three highest emitting ship types (bulk carriers, containerships and oil tankers), there are differences in AER efficiency improvements between the size ranges (see table 1 in the annex) with improvements of at least 6% over 2019 AER levels across most size ranges.

**Action requested of the Committee**

20 The Committee is invited to consider the demand-based and supply-based carbon intensity of the existing fleet for 2019 to 2024 and relevant information set out in this document and, in particular, to:

.1 note the carbon intensity developments of the shipping fleet from 2019 to 2024, as set out in paragraphs 18 and 19, and the report on the carbon intensity of the fleet for 2024, as set out in the annex; and

.2 take action as appropriate.

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## ANNEX

## REPORT ON THE CARBON INTENSITY OF THE FLEET FOR 2024

### Background

1 In the absence of cargo-related data, in particular transport work, the Secretariat contacted UMAS International to estimate demand-based carbon intensity for 2019 to 2024 by using a mathematical modelling process which leverages AIS data, provided by Kpler (Spire Maritime), and data submitted to the IMO DCS. The mathematical modelling process/method and its uncertainties are explained in detail in document MEPC 81/6/1 and its annex.

### Carbon intensity developments for 2024

2 The carbon intensity outcome for 2024, presented in table 1, was calculated using the same mathematical modelling process explained in document MEPC 81/6/1, which contains the carbon intensity outcomes for international shipping for 2019 to 2022.

**Table 1: Operational carbon intensity for 2024 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of DCS and AIS Matched ships | 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) | 0-9,999 | 61 | 8,041 | 8,115 | 89.5 | 57.4 | 16.22 | -1.8 | 22.08 | -5.5 | 26.87 | 1.7 |
| | 10,000-34,999 | 1,301 | 28,154 | 29,877 | 86.8 | 61.8 | 7.90 | -8.1 | 12.63 | -7.0 | 13.66 | -0.2 |
| | 35,000-59,999 | 2,950 | 48,928 | 47,641 | 83.6 | 63.9 | 5.67 | -7.5 | 9.56 | -7.9 | 10.10 | -5.3 |
| | 60,000-99,999 | 4,218 | 75,513 | 75,030 | 82.3 | 57.1 | 3.99 | -5.6 | 7.25 | -6.2 | 8.06 | -8.5 |
| | 100,000-199,999 | 1,211 | 169,989 | 171,321 | 85.9 | 51.0 | 2.56 | -7.5 | 4.94 | -7.9 | 6.15 | -8.0 |
| | 200,000+ | 724 | 244,403 | 246,604 | 89.9 | 41.3 | 2.07 | -7.9 | 4.01 | -7.5 | 5.56 | -10.6 |

| Fourth IMO GHG Study Ship Types and Sizes | | Non-Filtered DCS Fleet | | Filtered AIS Fleet | | | Non-Filtered DCS Fleet | | | | Filtered AIS Fleet | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of DCS and AIS Matched ships | 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 (%) |
| Chemical Tanker (DWT) | 0-4,999 | 0 | | | | | | | | | | |
| | 5,000-9,999 | 331 | 8,219 | 8,156 | 79.9 | 97.8 | 19.47 | -5.3 | 28.43 | -6.5 | 26.51 | -4.4 |
| | 10,000-19,999 | 969 | 15,638 | 15,997 | 81.0 | 71.9 | 14.13 | -8.6 | 22.02 | -9.5 | 22.37 | -2.0 |
| | 20,000-39,999 | 691 | 32,018 | 31,534 | 80.1 | 72.7 | 9.19 | -9.2 | 14.57 | -8.6 | 13.97 | -9.1 |
| | 40,000+ | 1,444 | 49,694 | 50,006 | 73.7 | 52.5 | 6.37 | -8.8 | 10.59 | -8.3 | 14.62 | -4.7 |
| Containership (TEU) | 0-999 | 438 | 10,183 | 10,398 | 68.2 | 100.0 | 22.69 | -6.8 | 27.57 | -6.9 | 32.29 | -2.7 |
| | 1,000-1,999 | 1,330 | 19,665 | 20,544 | 66.3 | 100.0 | 14.00 | -12.1 | 17.73 | -10.5 | 19.45 | -14.9 |
| | 2,000-2,999 | 786 | 35,367 | 35,746 | 63.2 | 100.0 | 10.41 | -11.4 | 12.96 | -12.5 | 15.37 | -15.2 |
| | 3,000-4,999 | 842 | 53,473 | 55,892 | 62.5 | 100.0 | 9.12 | -7.0 | 11.43 | -4.7 | 13.72 | -8.9 |
| | 5,000-7,999 | 639 | 78,978 | 78,022 | 62.3 | 100.0 | 7.57 | -15.4 | 8.72 | -10.6 | 11.70 | -14.9 |
| | 8,000-11,999 | 655 | 115,899 | 116,097 | 59.4 | 100.0 | 6.63 | -6.7 | 7.65 | -2.7 | 10.16 | -9.3 |
| | 12,000-14,499 | 299 | 151,546 | 150,298 | 57.9 | 100.0 | 5.39 | -10.1 | 5.66 | -6.9 | 8.46 | -11.1 |
| | 14,500-19,999 | 259 | 180,342 | 176,937 | 61.4 | 100.0 | 4.59 | -9.9 | 5.15 | -0.4 | 7.26 | 0.9 |
| | 20,000+ | 141 | 226,106 | 231,240 | 62.7 | 100.0 | 4.46 | -7.9 | 4.47 | 0.3 | 6.81 | -5.4 |
| Cruise passenger ship (GT) | 0-1,999 | 0 | | | | | | | | | | |
| | 2,000-9,999 | 27 | 1,263 | 1,259 | 96.6 | 100.0 | 177.45 | -7.7 | 25.30 | -10.1 | 181.33 | -28.7 |
| | 10,000-59,999 | 101 | 3,600 | 3,380 | 95.9 | 100.0 | 159.63 | 3.4 | 16.27 | -6.8 | 147.32 | 2.1 |
| | 60,000-99,999 | 81 | 9,733 | 9,872 | 96.3 | 100.0 | 113.18 | -6.7 | 12.10 | -6.8 | 122.38 | -4.0 |
| | 100,000-149,999 | 71 | 11,110 | 11,055 | 96.1 | 100.0 | 106.29 | -8.2 | 9.71 | -6.5 | 117.17 | -0.3 |
| | 150,000+ | 37 | 15,790 | 16,344 | 87.8 | 100.0 | 84.68 | -18.0 | 7.90 | -6.0 | 99.35 | -17.0 |
| Ferry-pax | 0-299 | 0 | | | | | | | | | | |
| | 300-999 | 0 | | | | | | | | | | |
| | 1,000-1,999 | 0 | | | | | | | | | | |

| Fourth IMO GHG Study Ship Types and Sizes | | Non-Filtered DCS Fleet | | Filtered AIS Fleet | | | Non-Filtered DCS Fleet | | | | Filtered AIS Fleet | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of DCS and AIS Matched ships | 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 (%) |
| only (GT) | 2,000+ | 5 | 2,496 | 1,450 | 74.1 | 100.0 | 462.35 | 167.2 | 50.31 | -21.2 | 203.69 | |
| Ferry-RoPax (GT) | 0-1,999 | 0 | | | | | | | | | | |
| | 2,000-4,999 | 0 | | | | | | | | | | |
| | 5,000-9,999 | 64 | 1,292 | 1,185 | 68.6 | 100.0 | 355.15 | 16.8 | 44.21 | -4.8 | 360.31 | 40.7 |
| | 10,000-19,999 | 85 | 3,707 | 3,895 | 70.1 | 100.0 | 90.01 | -16.6 | 22.21 | -1.5 | 120.72 | 20.7 |
| | 20,000+ | 244 | 6,570 | 7,348 | 80.1 | 100.0 | 86.51 | -8.3 | 17.03 | -6.2 | 93.43 | -4.3 |
| General Cargo (DWT) | 0-4,999 | 36 | 3,786 | 3,718 | 86.9 | 100.0 | 41.05 | -5.1 | 23.45 | 3.0 | 44.43 | 5.4 |
| | 5,000-9,999 | 715 | 8,201 | 8,197 | 84.6 | 69.8 | 16.62 | -8.9 | 22.44 | -7.7 | 28.73 | -1.4 |
| | 10,000-19,999 | 985 | 13,774 | 14,050 | 78.3 | 71.3 | 13.02 | -7.7 | 17.83 | -7.7 | 22.66 | -0.9 |
| | 20,000+ | 379 | 33,434 | 36,567 | 77.9 | 66.4 | 9.16 | 18.4 | 12.44 | 6.0 | 16.02 | 13.0 |
| Liquefied gas tanker (CBM) | 0-49,999 | 473 | 16,456 | 15,861 | 75.5 | 63.1 | 17.34 | -12.9 | 19.61 | -13.9 | 21.43 | -20.8 |
| | 50,000-99,999 | 405 | 54,313 | 55,017 | 87.4 | 37.2 | 6.79 | -11.0 | 7.63 | -12.8 | 20.24 | 10.1 |
| | 100,000-199,999 | 604 | 87,649 | 90,270 | 76.2 | 81.2 | 7.00 | -31.0 | 5.47 | -28.4 | 12.10 | -19.0 |
| | 200,000+ | 45 | 126,628 | 123,165 | 75.1 | 100.0 | 8.46 | -15.4 | 7.44 | -11.4 | 12.81 | -12.8 |
| Oil tanker (DWT) | 0-4,999 | 0 | | | | | | | | | | |
| | 5,000-9,999 | 169 | 7,634 | 7,788 | 83.1 | 98.1 | 21.98 | -6.8 | 28.06 | -8.9 | 30.13 | 3.4 |
| | 10,000-19,999 | 112 | 14,734 | 14,845 | 84.1 | 74.1 | 14.70 | -20.2 | 21.59 | -22.3 | 25.34 | 1.3 |
| | 20,000-59,999 | 358 | 45,946 | 45,373 | 79.2 | 48.7 | 7.94 | -11.9 | 12.72 | -12.3 | 17.72 | -6.1 |
| | 60,000-79,999 | 330 | 73,232 | 73,319 | 78.0 | 55.3 | 5.90 | -6.4 | 10.34 | -6.3 | 13.00 | 4.3 |
| | 80,000-119,999 | 920 | 110,824 | 111,667 | 79.2 | 51.5 | 4.16 | -12.7 | 7.49 | -13.8 | 9.56 | -7.1 |
| | 120,000-199,999 | 581 | 156,649 | 156,626 | 79.0 | 46.2 | 3.26 | -7.0 | 6.25 | -7.1 | 8.07 | -0.8 |
| | 200,000+ | 760 | 308,083 | 307,431 | 77.9 | 43.7 | 2.16 | -9.8 | 4.15 | -9.6 | 6.09 | 3.6 |

| Fourth IMO GHG Study Ship Types and Sizes | | Non-Filtered DCS Fleet: Number of DCS and AIS Matched ships | 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 (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Other liquids (DWT) | 0-999 | 0 | | | | | | | | | | |
| | 1,000+ | 14 | 31,401 | 31,007 | 78.6 | 70.5 | 10.39 | -11.6 | 11.64 | -11.0 | 19.28 | -7.7 |
| Refri-gerated bulk (DWT) | 0-1,999 | 0 | | | | | | | | | | |
| | 2,000-5,999 | 6 | 6,426 | 6,880 | 85.2 | 100.0 | 34.07 | -4.1 | 39.42 | 10.4 | 58.14 | 20.0 |
| | 6,000-9,999 | 135 | 7,691 | 7,462 | 73.9 | 100.0 | 29.81 | -7.5 | 32.63 | -7.6 | 48.12 | -3.6 |
| | 10,000+ | 120 | 13,099 | 13,484 | 68.1 | 100.0 | 22.51 | -7.6 | 23.92 | -7.4 | 36.09 | -13.8 |
| Ro-ro (DWT) | 0-4,999 | 24 | 4,235 | 4,249 | 74.3 | 100.0 | 41.27 | -12.5 | 20.55 | -4.4 | 50.03 | -11.6 |
| | 5,000-9,999 | 85 | 7,263 | 7,157 | 75.1 | 100.0 | 34.01 | -1.9 | 21.53 | -3.9 | 48.93 | -4.7 |
| | 10,000-14,999 | 103 | 12,264 | 12,250 | 77.8 | 100.0 | 31.80 | -3.4 | 13.80 | -0.6 | 41.17 | -4.9 |
| | 15,000+ | 94 | 26,921 | 26,399 | 71.2 | 100.0 | 16.42 | 7.3 | 7.35 | -9.9 | 23.86 | 10.6 |
| Vehicle (GT) | 0-29,999 | 53 | 5,714 | 6,052 | 34.8 | 100.0 | 34.32 | -20.5 | 11.35 | -11.4 | 97.76 | -20.9 |
| | 30,000-49,999 | 140 | 13,300 | 13,298 | 36.3 | 100.0 | 21.40 | -3.3 | 6.43 | -7.2 | 55.95 | -5.6 |
| | 50,000+ | 511 | 20,893 | 21,033 | 32.1 | 100.0 | 15.47 | -5.0 | 5.20 | -4.8 | 46.49 | -7.2 |

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