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MARINE ENVIRONMENT PROTECTION COMMITTEE 83rd session Agenda item 6	MEPC 83/6 18 November 2024 Original: ENGLISH Pre-session public release: ☒

ENERGY EFFICIENCY OF SHIPS

Report on annual carbon intensity and efficiency of the fleet (Reporting year: 2023)

Note by the Secretariat

SUMMARY

Executive summary:	This document reports on demand-based and supply-based carbon intensity for the year 2023, 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 21
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 and MEPC 82/6/38

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 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 and 2023, as set out in documents MEPC 76/6/1, MEPC 77/6/1, MEPC 79/6/1, MEPC 81/6 and MEPC 82/6/38, 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 and MEPC 82/6/38).

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

8 Document MEPC 81/6/1 (Secretariat) contains information on the demand-based and supply-based carbon intensity of international shipping for the period from 2019 to 2022. This document reports on both demand-based and supply-based carbon intensity developments for the period from 2019 to 2023.

Improvements to IMO DCS and reporting on carbon intensity

9 MEPC 81 adopted draft 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.388(81)).

10 In this regard, MEPC 82 noted:

.1 the ongoing improvements to the reporting process in the IMO DCS module in GISIS, in particular, the intended timeline and updates to report transport work and added granularity from 1 January 2025 (MEPC 82/17, paragraph 6.4.2); and

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

.2 that in the absence of cargo-related data, in particular transport work, the Secretariat intended to submit information on the demand-based carbon intensity of international shipping for the period from 2019 to 2023 intensity to MEPC 83 (MEPC 82/17, paragraph 6.4.5).

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*.

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 2023

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 2023 carbon intensity developments, set out in the annex to this document.

15 The uncertainty in AIS-based cargo estimation has been highlighted in document MEPC 81/6/1. 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 measurements for 2019 to 2023, 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

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 2023 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 2023 has reduced by 31.0% and 36.5%, respectively, compared to 2008.

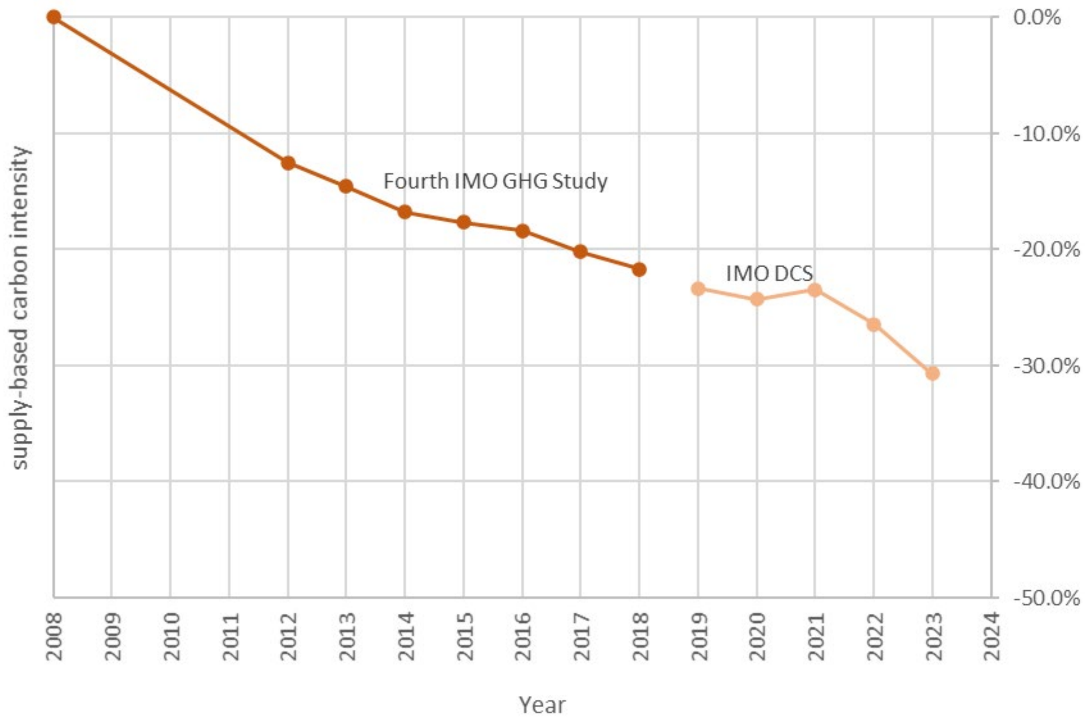

Figure 1: Supply-based (AER) carbon intensity of international shipping (2008-2023)

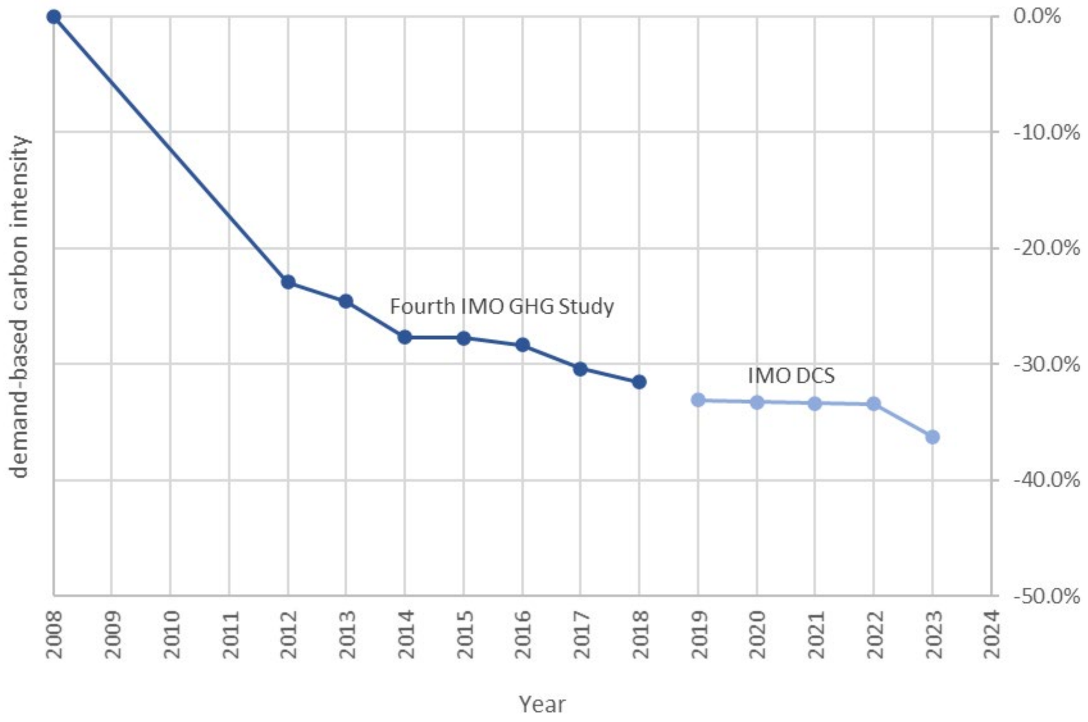

Figure 2: Demand-based (estimated EEOI) carbon intensity of international shipping (2008-2023)

Carbon intensity developments of the shipping fleet for the period from 2019 to 2023

19 Following the analysis of carbon intensity of the shipping fleet from 2019 to 2023, 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 9.9% in 2023 relative to 2019, but with yearly fluctuations (see figure 1);

.2 the emerging trend after 2021 is a reduced average fleet supply-based carbon intensity, which is also reflected in the demand-based carbon intensity (see table 1), but weaker in magnitude for the latter;

.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; and

.4 across the three highest emitting ship types (bulk carriers, containerships and oil tankers), there are differences in efficiency improvements between the size ranges (see table 1 in the annex). While bulk carriers and oil tankers see the greatest improvement in median AER for the larger sizes over the time period, mid-range containerships (5,000 to 14,499 TEU) show the greatest improvement in median AER in 2023 when compared with 2019.

20 The carbon intensity of shipping has shown a greater decrease in 2023, compared to the period from 2019 to 2022, using both AER and cgDIST and Estimated EEOI as indicators of carbon intensity. There are likely a number of possible reasons for this; for example, the short-term measures (EEXI and CII) entered into force in 2023, and the change in efficiency may also have been caused by changes in shipping routes driven by geopolitical events leading to longer voyages.

Action requested of the Committee

21 The Committee is invited to consider the demand-based and supply-based carbon intensity of the existing fleet for 2019 to 2023 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 2023, as set out in paragraphs 19 and 20, and the detailed report on the carbon intensity of the fleet for 2023, as set out 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 reported to the IMO DCS; and

.3 take action as appropriate.

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ANNEX

REPORT ON THE CARBON INTENSITY OF THE FLEET FOR 2023

Background

1 In the absence of cargo-related data, in particular transport work, the Secretariat contracted UMAS International to estimate demand-based carbon intensity for 2023 by using a mathematical modelling process which leverages AIS data, provided by Spire Maritime, and data submitted to 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 2023

2 The carbon intensity outcome for 2023 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 2023 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	55	8,073	7,914	91.8	59.7	14.87	-9.9	21.45	-8.2	25.95	-1.7
	10,000-34,999	1,245	28,035	29,307	86.0	59.4	8.01	-6.9	12.74	-6.2	14.58	6.6
	35,000-59,999	2,840	49,365	48,485	82.5	61.6	5.70	-6.8	9.69	-6.7	10.87	1.8
	60,000-99,999	4,036	75,655	74,694	81.6	55.8	4.02	-4.9	7.32	-5.4	8.56	-2.9
	100,000-199,999	1,229	169,784	172,364	82.1	48.7	2.56	-7.6	4.95	-7.7	6.23	-6.9

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 (%)
	200,000+	702	245,942	244,162	87.5	39.4	2.05	-9.0	3.96	-8.7	6.15	-1.0
Chemical Tanker (DWT)	0-4,999	0										
	5,000-9,999	313	8,243	8,225	79.6	98.9	20.12	-2.1	29.14	-4.2	28.11	1.3
	10,000-19,999	942	15,586	15,741	80.2	70.3	14.61	-5.5	22.69	-6.8	21.96	-3.9
	20,000-39,999	674	32,185	31,862	79.4	69.5	9.40	-7.1	14.83	-7.0	14.85	-3.4
	40,000+	1,424	49,615	50,127	73.2	52.0	6.39	-8.5	10.67	-7.6	15.08	-1.7
Containership (TEU)	0-999	428	10,207	10,413	66.7	100.0	22.35	-8.2	27.00	-8.8	32.28	-2.7
	1,000-1,999	1,261	19,457	20,100	65.1	100.0	14.22	-10.7	18.06	-8.8	20.34	-11.0
	2,000-2,999	733	35,103	34,744	62.7	100.0	10.63	-9.5	13.16	-11.1	15.81	-12.7
	3,000-4,999	801	52,850	53,212	61.1	100.0	9.10	-7.2	11.26	-6.1	14.28	-5.2
	5,000-7,999	543	77,392	77,203	59.9	100.0	7.76	-13.4	8.65	-11.3	12.72	-7.5
	8,000-11,999	641	114,732	115,963	57.1	100.0	6.49	-8.7	7.43	-5.5	10.48	-6.5
	12,000-14,499	261	150,010	147,712	56.5	100.0	5.43	-9.6	5.80	-4.7	8.71	-8.5
	14,500-19,999	202	177,948	175,462	61.1	100.0	4.59	-9.8	4.95	-4.4	7.03	-2.4
	20,000+	128	224,359	224,648	60.6	100.0	4.34	-10.3	4.26	-4.3	6.78	-5.9
Cruise passenger ship (GT)	0-1,999	0										
	2,000-9,999	31	1,185	1,209	96.6	100.0	189.11	-1.6	26.14	-7.1	169.91	-33.1
	10,000-59,999	99	3,404	3,034	95.7	99.9	170.21	10.2	16.70	-4.4	159.46	10.5
	60,000-99,999	75	8,586	8,664	95.6	100.0	119.58	-1.5	12.54	-3.5	119.21	-6.4
	100,000-149,999	66	11,400	11,227	96.6	100.0	109.63	-5.3	10.17	-2.1	116.95	-0.5
	150,000+	38	15,467	15,068	92.0	100.0	94.86	-8.2	8.17	-2.8	112.32	-6.1
Ferry-pax	0-299	0										
	300-999	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)	1,000-1,999	0										
	2,000+	5	3,070				106.15	-38.6	49.05	-23.1		
Ferry-RoPax (GT)	0-1,999	0										
	2,000-4,999	0										
	5,000-9,999	56	1,413	1,559	94.3	100.0	196.62	-35.3	37.68	-18.8	148.06	-42.2
	10,000-19,999	87	3,539	3,995	74.5	100.0	102.70	-4.9	22.30	-1.1	100.88	0.8
	20,000+	224	6,630	7,365	82.0	100.0	87.05	-7.7	17.43	-3.9	92.43	-5.3
General Cargo (DWT)	0-4,999	28	3,457	3,608	82.2	100.0	39.17	-9.4	23.31	2.3	50.70	20.3
	5,000-9,999	725	8,236	8,310	83.1	67.9	16.99	-6.9	22.72	-6.5	29.68	1.8
	10,000-19,999	958	13,818	14,349	77.6	69.6	13.20	-6.5	18.51	-4.2	23.54	2.9
	20,000+	349	33,664	35,568	77.1	65.1	9.35	20.9	12.57	7.1	16.15	13.9
Liquefied gas tanker (CBM)	0-49,999	443	16,420	15,327	75.4	66.3	18.47	-7.2	21.08	-7.5	22.24	-17.9
	50,000-99,999	397	53,964	54,047	84.6	40.7	6.92	-9.2	7.76	-11.3	20.57	11.9
	100,000-199,999	549	87,141	90,242	75.7	85.8	8.01	-21.0	6.27	-17.9	11.52	-22.9
	200,000+	44	126,893	128,424	74.1	100.0	9.30	-7.1	8.12	-3.3	14.74	0.4
Oil tanker (DWT)	0-4,999	0										
	5,000-9,999	149	7,552	7,714	82.5	98.6	22.36	-5.2	28.86	-6.3	28.09	-3.6
	10,000-19,999	104	14,528	15,002	83.2	72.8	14.69	-20.3	21.05	-24.2	22.41	-10.4
	20,000-59,999	365	44,969	45,569	79.4	46.6	8.13	-9.9	13.18	-9.1	18.44	-2.3
	60,000-79,999	356	73,295	73,328	78.2	51.3	6.46	2.4	11.11	0.7	13.43	7.7
	80,000-119,999	919	110,485	110,693	78.5	52.0	4.24	-10.9	7.67	-11.6	9.97	-3.1
	120,000-199,999	569	156,726	156,627	78.9	46.5	3.24	-7.4	6.20	-7.7	8.66	6.4
	200,000+	744	308,191	307,947	76.2	45.7	2.14	-10.6	4.13	-10.1	5.75	-2.2

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 (%)
Other liquids (DWT)	0-999	0										
	1,000+	13	30,720	31,391	76.7	75.0	11.99	2.0	12.16	-7.0	18.81	-9.9
Refri-gerated bulk (DWT)	0-1,999	0										
	2,000-5,999	7	5,959	5,565	89.4	100.0	38.11	7.3	37.57	5.2	55.86	15.3
	6,000-9,999	121	7,634	7,504	74.3	100.0	28.67	-11.1	32.87	-6.9	48.00	-3.8
	10,000+	118	12,645	13,124	67.8	99.0	23.87	-2.1	25.05	-3.1	37.53	-10.4
Ro-ro (DWT)	0-4,999	21	4,491	4,426	77.4	100.0	41.43	-12.2	21.72	1.1	59.67	5.4
	5,000-9,999	87	7,188	7,084	72.5	100.0	34.10	-1.7	20.62	-7.9	49.54	-3.5
	10,000-14,999	104	12,250	12,035	77.3	100.0	31.85	-3.2	13.66	-1.6	41.34	-4.5
	15,000+	99	26,134	24,855	72.3	100.0	17.66	15.4	7.67	-5.9	25.92	20.2
Vehicle (GT)	0-29,999	54	5,710	5,880	35.2	100.0	37.89	-12.3	11.65	-9.1	110.00	-11.0
	30,000-49,999	147	13,305	13,540	34.3	100.0	22.07	-0.3	6.81	-1.7	58.93	-0.6
	50,000+	499	20,862	20,309	31.9	100.0	16.68	2.4	5.52	1.0	51.15	2.1

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