Assessing Emissions of UK International Maritime Traffic

Patrick Rigot-Müller[1]*, *John Mangan*[2], *Chandra Lalwani*[3] and *John Dinwoodie*[4]

[1] School of Marine Science & Technology, Newcastle University, Newcastle, UK
Email: patrick.rigot-muller@ncl.ac.uk

[2] Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University, Hong Kong
Email: john.mangan@ncl.ac.uk

[3] Hull University Business School, University of Hull, Hull, UK
Email: c.lalwani@hull.ac.uk

[4] School of Management, Plymouth University, Plymouth, UK
Email: j.dinwoodie@plymouth.ac.uk

* *corresponding author*

Abstract

The purpose of this paper is to present an assessment method to evaluate carbon emissions of the UK international seaborne traffic from 2000 to 2010. We use f traffic data from the UK's Department for Transport (DfT) and assess the corresponding shipping emissions, using emission factors provided by the IMO. This analysis covers liquid bulk, dry bulk, containers and general cargo traffic, for inwards and outwards directions. The result shows a total of 22.6 MT CO2, in 2010 (14.7 MT for inwards flows and 7.9 MT for outwards flows), compared to 19.7 MT in 2000. Container cargo is the category with the largest contribution, 9.3 MT out of 22.6 MT in 2010.

Keywords: Maritime transport, shipping, carbon emissions, United Kingdom

1. Introduction and description of the problem

Due to its systemic trans-boundaries nature, international shipping emissions have been excluded so far from the Kyoto Protocol. A study from the IMO published in 2009 (IMO, 2009), estimated international shipping had emitted 870 MT in 2007, or 2.7% of global anthropogenic CO2 emissions. This result is presented in a global form and no result at a country level is proposed.
We present in this paper a method to assess shipping emissions of the UK international seaborne traffic. The approach is based on Maritime Statistics data from the UK Department for Transport (Department for Transport, 2010), and covers 11 years of shipping activity (from 2000 to 2010). The DfT file shows flows by year, UK port, foreign country, direction, cargo description and ship type. For the 11 years covering our analysis, the total file had 72370 lines that we call in this paper, flows.

The major problem, when apportioning international shipping emissions, consists in defining the appropriate share of emissions to a specific country for each shipping voyage. We assumed that an apportionment based on the "ownership" of the cargo (buyer or seller), weight-based, seemed to be the most appropriate.

2. Review of relevant literature

Several studies have provided assessments for global shipping emissions and many of them provided literature reviews (AEA Energy and Environment, 2008; UNCTAD 2009; Tyndall Centre for Climate Research, 2010). All studies and comparisons show that there is a large range of different results,

suggesting that this assessment exercise still has important uncertainties, as illustrated in Table 1 and Figure 1.

Table 1: Estimates of fuel consumption, CO2 emissions from international shipping, and projected growth

Table 7

Estimates of fuel consumption, CO_2 emissions from international shipping, and projected growth

	Base year	CO_2: millions of tonnes	Fuel: millions of tonnes	Percentage of world fuel combustion [a]	Projected emissions growth
Second IMO GHG Study 2009	2007	870	277	3.1	By a factor of 1.1-1.2 by 2020 & 2.2-3.1 by 2050 [c]
IMO/Group of Experts (2007)	2007	1120	369	4.1	+30% by 2020
IMO GHG Study (2000)	1996	419.3	138	1.6	--
IEA (2005)	2005	543	214	2.0	--
TRT Trasporti e Territorio	2006	1003	NA	3.7	--
Endressen et al., 2007 [b]	2002	634	200	2.3	+ 100–200% by 2050
Eide et al., 2007 [b]	2004	704	220	2.6	+ 100–200% by 2050
Eide et al., 2007 [b]	2006	800	350	2.9	+ 100–200% by 2050
Corbett et al., 2003 [b]	2001	912	289	3.1	--

[a] Based on IEA 2005 data for world CO_2 emissions from fuel combustion.

[b] Obtained from secondary sources, including the Second IMO GHG Study 2009.

[c] Base values, and according to six main scenarios under the IPCC *Special Report on Emission Scenarios*: A1F1, A1B, A1T, A2, B1 and B2.

Source: UNCTAD (2009)

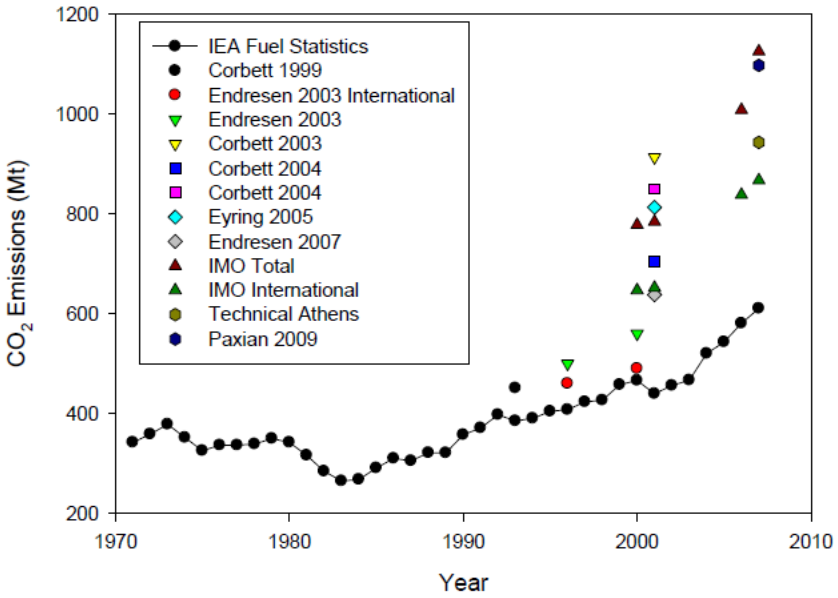

Figure 1: Estimated CO2 release for total and international shipping
Source: Tyndall Centre for Climate Research (2010)

The question on how to apportion shipping emissions of a specific country has been addressed for the UK in two recent studies (Tyndall Centre for Climate Research, 2010; Committee on Climate Change, 2011). In the Tyndall study (Tablee 2) study, we can see that excluding method 8, all proposed

apportionment methods are considered on a basis that is not related to shipping emissions itself (GDP, value of import/export, weight of loaded/unloaded cargo, etc) or to the actual traffic (bunker sales). It appear to us that methods linking the cargo and the ship work (shipping voyage), putting them into the "method 8" class, should be explored in more details.

Table 2: Top-down proxy apportionment methods to determine UK apportionment of CO2 emissions from international shipping

Table 5-2: Top-down proxy apportionment methods to determine UK's apportionment of CO_2 emissions from international shipping

Apportionment method		Indicator option Description	UK	Global	UK shipping emissions % of global	UK shipping emissions Mt CO_2	Source
1	No apportionment	n/a					
2	Reported bunker fuel sales	UNFCCC bunker fuel sales	7.05 Mt CO_2			7.05	(UNFCCC 2010)
3	Reported fuel consumption	No data available					
4	National emissions	UK and global CO2 emissions excluding land use, land use change	557.86 Mt CO_2	28928.12 Mt CO_2	1.93	16.16	(UNSTATS 2009)
5	Location of emissions	Bottom-up model only					
6	Flag of ship	Registered vessels	12810 dwt (1000)	1042351 dwt (1000)	1.23	10.30	(UNCTAD 2007)
7a	Freight tonnes loaded	Freight loaded by UK and global seafaring trade	218.63 Mt	7416 Mt	2.95	24.70	(EUROSTAT 2010) (UNCTAD 2007)
7b	Freight tonnes unloaded	Freight unloaded by UK	365.11 Mt	7416 Mt	4.92	41.26	
8	Port of departure or destination of cargo	See Method 7 plus ship movements					
9a	Exporter (producer) of cargo	Trade exported by UK in US Dollars	444 US $ bn	11861 US $ bn	3.75	31.40	(UN Comtrade 2010)
9b	Importer (consumer) of cargo	Trade imported by the UK in US Dollars	606 US $ bn	12084US $ bn	5.02	42.05	
10	Owner of the cargo	Bottom-up model only					
11	National GDP	UK GDP	2436 US $ bn	48882 US $ bn	4.98	41.76	(IMF 2009)

Source: Tyndall Centre for Climate Research (2010)

The Committee on Climate Change, starting from the Tyndall report results (Figure 2) released in 2011 a study aiming to assess shipping emissions under this approach. They used, to assess ship work, trade statistics and LMIU data. LMIU data provide detailed information about the vessel traffic at UK ports and their previous and/or next ports of call. However, this information doesn't provide a clear traceability of the origin and/or destination of the cargo which is loaded/unloaded in UK ports. The scope of this analysis covered the years 1990-2006 (from which they made time extrapolation) and the import trade only. The analysis also tries to take into consideration transhipped flows using some assumed transhipment point in the globe. The CCC proposes then a range of 12-16 MTCO2 for UK international shipping, based on import flows.

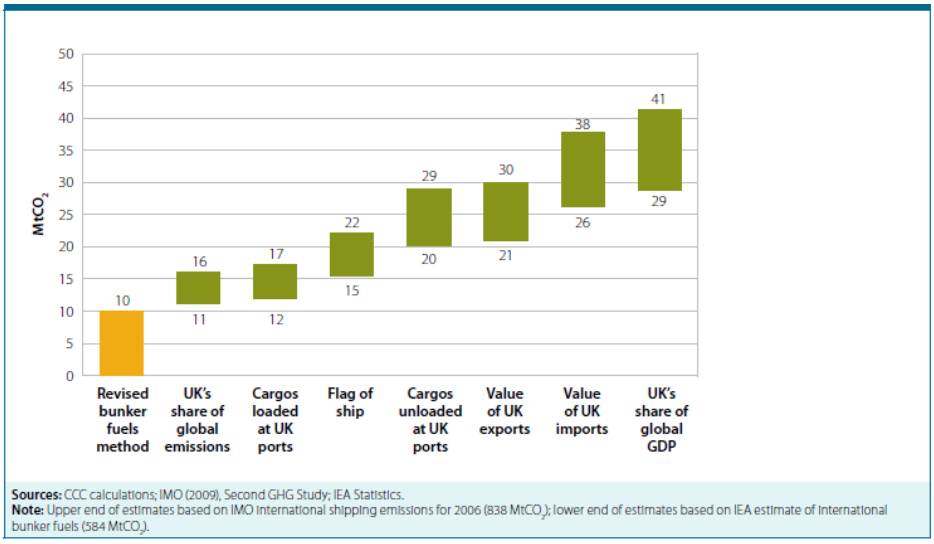

Figure 2: UK international shipping emissions in 2006 according to bunker fuel and top-down methodologies

Source: The Committee on Climate Change (2011)

In our approach, we will provide results for the period 2000-2010, for inwards and outwards flows, and using DfT data. We will use the emissions factors provided by the IMO in 2009 (segmented by ship type and size) and we will estimate ship size using the average vessel size by port and by type, provided by Eurostat.

3. Methodology and analysis

Emissions are calculated for each type of cargo, for each route and each year, using the formula:

$$\text{Emissions} = EF \times DISTANCE \times CARGO. \quad (1)$$

Where,

- Emissions = Total CO2 emission apportioned to the cargo transported (expressed in gCO2).
- EF = Emission Factor of the vessel used (expressed in gCO2/Tonne.nm).
- DISTANCE = Distance between the UK port and the destination country (expressed in nm).
- CARGO = Cargo weight (expressed in Tonnes).

3.1. Emission factors

For this study, we used emission factors from IMO (IMO, 2009), as shown in appendix 1. These emission factors are segmented by ship size and by vessel type. For each flow, DfT statistics provide information about the cargo description in 5 distinctive classes (Liquid Bulk, Dry Bulk, Lo-Lo container, Ro-Ro, Other General Cargo) and the ship type in 27 classes (Full Container Vessel, Bulk Carrier, Oil-Tanker, Oil-Chemical Tanker…). The IMO reports its emissions factors in 10 ship classes. The table associating DfT vessels types with IMO classes is shown in appendix 2. For a few cases, when the vessel type seemed inconsistent with the cargo description, the latter one was used to describe the vessel, as a DfT expert stated that the cargo description data seemed in overall more reliable than the ship type.

We do not discuss, in this paper, the overall reliability of IMO's emission factors, even though we consider that further studies are necessary in order to provide more accurate results. The methodology used here can be easily updated as more accurate emission factors are available. Also, we didn't apply any annual improvement rate on ship efficiency; we only considered average evolution of the ship size, as we will see in the next section.

3.2. Assessing the ship size

The assessment of ship size for each route represents a major challenge due to the absence of appropriate data that could be collected for long time ranges. In this study we have used transport data provided by Eurostat on vessel traffic at UK ports. The DfT also provides statistics about the vessel size, but Eurostat data was preferred because the size segmentation is more detailed (3 to 4 size classes for the DfT, compared to 23 for Eurostat) and because both the number of calls and the Gross Tonnage (GT) were indicated, allowing to calculate an average vessel size per port per year. When data were not available for a port, we used the minimum size or, for more important flows, the average size for this same port in the closest available year. Such lack of data usually happen for minor flows excepted for Milford Haven port, for which no data was available on Eurostat from 2003 onwards. We used then Eurostat 2002 data for the period 2003-2008 and then updated the vessel size for tankers using DfT 2008 data for the years 2008-2010. Table 3 below shows that from 2000 to 2010 the average GT of vessels calling in UK ports increased from 11,908 to 16,762, representing an average continuous growth rate (CAGR) of 3.5%. The analysis of this table suggests that the observed

reduction of the number of vessels arrivals (CAGR = -3.4%) was compensated by this increase in the average GT at port.
This evolution has an impact on the choice of the emission factors . When, for a specific port, the average vessel size moves from a specific class to the next one, lower emissions factors will be applied. In this model, we kept the discrete approach as provided by the IMO (using classes), without the use of any function for the calculations of emission factors.

Table 3: Average Vessel size at UK ports

Year	GT (in thousands)	Number of vessels	Average GT
2000	4,085,401	343,078	11,908
2001	4,120,810	335,036	12,300
2002	4,118,710	323,552	12,730
2003	4,210,119	315,166	13,358
2004	4,270,238	304,366	14,030
2005	4,066,428	286,974	14,170
2006	3,996,390	267,590	14,935
2007	4,364,008	279,624	15,607
2008	4,086,129	260,360	15,694
2009	4,002,750	233,676	17,129
2010	4,098,122	244,484	16,762
CAGR 2000-2010	0.30%	-3.40%	3.50%

Source: Eurostat (extracted in 2012)

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3.3. Assessing distances

There are 2842 shipping routes (UK port – Foreign country) in the DfT file. We have assigned a distance corresponding to the shortest shipping route between the two countries. For the major routes, representing 40% of the total tonnages, we have assigned a distance corresponding to the UK port and the foreign port most likely to handle this specific type of cargo for this specific route. For routes representing the remaining tonnages (from 40% until 99.999% of the total tonnages), we have assigned the distance between a standard UK port and the major port in the foreign country. For the minor routes representing less than 0.001% of the tonnages, we have assigned a standard distance, usually the distance assigned to a neighbouring country. Distances have been collected from three different web sources, according to their availability: http://www.portworld.com, http://sea-distances.com/ and http://www.searates.com. It wasn't necessary, with this approach, to evaluate the impact of sea-sea transhipment operations since DfT data provide the information about the foreign country of loading or unloading of the cargo.

4. Results and analysis

The analysis of shipping emissions for the period 2000-2010 is shown in the figures 3 and 4 and tables 4 to 7. We can see from Figure 3 and Table 4 that emissions from inwards flows represent more than those for outwards flows, which is consistent with the fact that the UK imports more tonnage than it exports. The increase observed in this period of 11 years (2000-2010) corresponds to a continuous average growth rate of 0.7%, mostly on inwards flows.

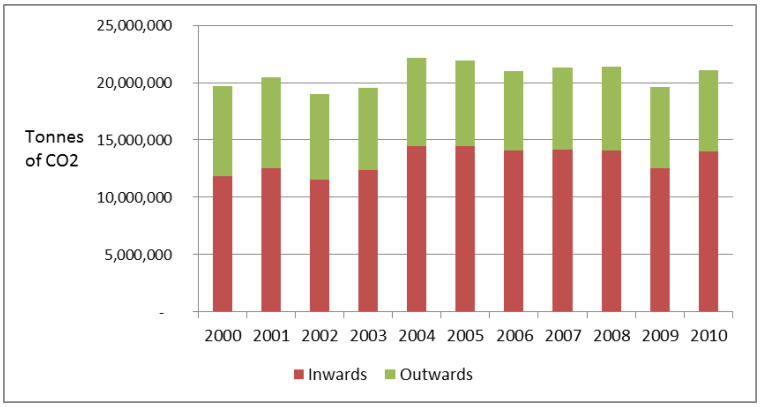

Figure 3: UK international seaborne traffic emissions 2000-2010
Source: Authors (2012)

Table 4: UK international seaborne traffic emissions 2000-2010

Year	Inwards	Outwards	Total ($MTCO_2$)
2000	11.9	7.8	19.7
2001	12.6	7.9	20.4
2002	11.5	7.5	19.0
2003	12.4	7.2	19.6
2004	14.5	7.7	22.2
2005	14.4	7.5	21.9
2006	14.1	6.9	21.0
2007	14.1	7.2	21.3
2008	14.1	7.3	21.4
2009	12.5	7.1	19.6
2010	14.0	7.1	21.1

CAGR = 0.7%

Source: Authors (2012)

If we look at Table 5, we can see that the change in the average distance is limited, with a CAGR of 0.56%. The actual trend is in fact almost flat, considering that the average distance for the year 2000 is exceptionally low (only 2002 reached as well an average distance under 1650 nautical miles).

Table 5: Average distances, in nautical miles 2000-2010

Year	Avg distance*
2000	1,627
2001	1,695
2002	1,628
2003	1,697
2004	1,789
2005	1,754
2006	1,698
2007	1,669
2008	1,695
2009	1,661
2010	1,720

* weighted by tonnes of cargo

CAGR = 0.56%

Source: Authors (2012)

Table 6 shows the average ship efficiency, or emission factor applied to the UK for each year (all cargoes, all directions). The annual emission factor is the result of the total emissions for the year, divided by the total ship work. We can see a significant increase of the average emission factor

(increasing at an annual rate of 1.2%), which can seem surprising when we know from table 3 that the average ship gross tonnage has increased.

Table 6: UK international seaborne average emission factors 2000-2010, in gCO2/T.nm

Year	Avg Ship Efficiency
2000	21.8
2001	21.9
2002	21.6
2003	21.4
2004	22.2
2005	21.9
2006	21.8
2007	22.5
2008	23.0
2009	24.1
2010	24.6
CAGR = 1.2%	

Source: Authors (2012)

In order to understand this behaviour, we have to look at Table 7, where we can see the total emissions in 2000 and 2010 by cargo description. This table shows that the traffic of containers has increased significantly in the total share, which suggests that the increase in the average emission factor is due to a higher share of container flows in the total UK seaborne trade.

Table 7: UK international seaborne emissions by cargo description 2000-2010

Cargo Description	2000	2010	CAGR 2000-2010
Lo-Lo containers	40%	44%	1.8%
Liquid Bulk	23%	28%	2.8%
Dry Bulk	21%	13%	-4.1%
Roll-on/Roll-off	10%	11%	1.5%
Other general cargo	7%	5%	-3.5%
Grand Total	**100%**	**100%**	**0.7%**

Source: Authors (2012)

Figure 4 illustrates the evolution of the main components used for calculating the CO_2 emissions, during the period 2000-2010. It suggests that the main reason for this relative stability of international shipping emissions is the decrease of the cargo handled (a 10% decrease from 2000 to 2010).

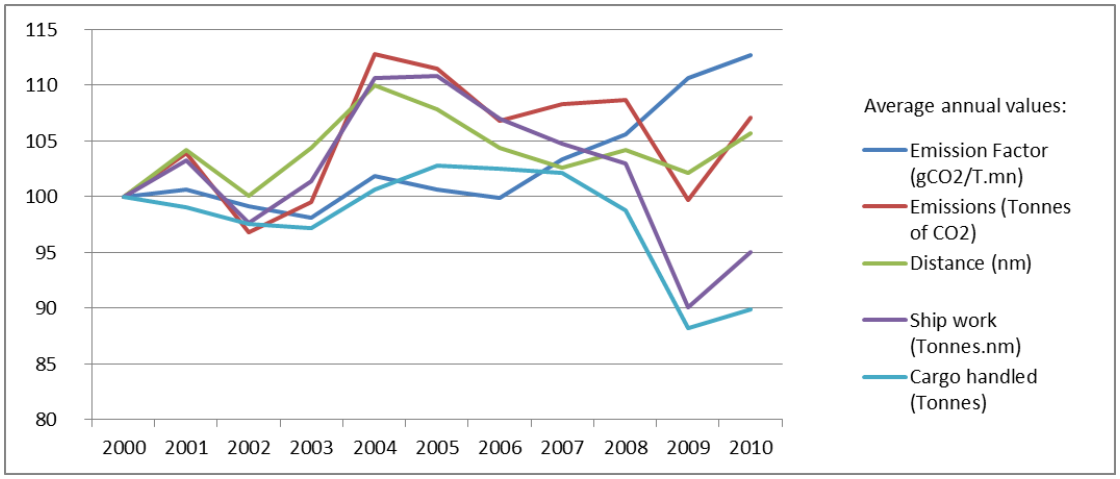

Figure 4: UK international seaborne CO_2 emissions, main components 2000-2010
Source: Authors (2012)

5. Discussion and conclusions

The analysis of the international shipping emissions of UK traffic was realised with the use of Maritime Statistics from the DfT and emission factors from the IMO 2nd GHG Study (IMO, 2009). If, in one hand, data from the DfT are considered reliable, the emission factors used and the method used to assess ship sizes will add some uncertainty in the model. Indeed, the emission factors from the IMO consist of global results concerning a specific period of time only (without time or regional variations), and the average vessel size that we used were applied to all routes, for a specific ship type, departing from a specific port.
However, results show interesting and consistent trends, such as a reduction of the total tonnage and with an increased average emission factor due to a probable cargo profile transfer, mainly from dry bulk towards containerised products.
Further work should be developed in associating the shipping emissions with the actual commodities transported, in order to understand the impact of energy supply change (typically from coal to natural gas) in shipping emissions. Also, we aim to associate, with a reasonable level of detail, shipping emissions with trade statistics, in order to offer a CO_2 apportionment strategy directly related with UK trade.

References

AEA Energy and Environment (2008), Greenhouse gas emissions from shipping: trends, projections and abatement potential.

Committee on Climate Change (2011), Review of UK shipping emissions: Supporting analysis, Committee on Climate Change: London.

Department for Transport (2010), Maritime Statistics 2009, Department for Transport: London.

Gilbert, P., Bows, A., Starkey, R. (2010), Shipping and climate change: Scope for unilateral action, Tyndall Centre for Climate Change Research, The University of Manchester: Manchester.

International Maritime Organisation (2009), Second IMO GHG Study, IMO: London.

UNCTAD (2009), Review of Maritime Transport 2009, UNTAD Secretariat: Geneva.

Appendix 1 – Emission Factors Table (source: IMO, 2009)

Results from IMO 2009 study	Size	Unit	Average cargo capacity (tonne)	Average yearly capacity utilization	Average service speed (knots)	Transport work per ship (tonne-NM)	Loaded efficiency (gCO2/tonne-km)	Total efficiency (gCO2/tonne-km)	Total efficiency (gCO2/tonne.nm)
Crude oil tanker	200,000+	dwt	295,237	48%	15.4	14,197,046,742	1.6	2.9	5.4
Crude oil tanker	120,000–199,999	dwt	151,734	48%	15.0	7,024,437,504	2.2	4.4	8.1
Crude oil tanker	80,000–119,999	dwt	103,403	48%	14.7	4,417,734,613	3.0	5.9	10.9
Crude oil tanker	60,000–79,999	dwt	66,261	48%	14.6	2,629,911,081	4.3	7.5	13.9
Crude oil tanker	10,000–59,999	dwt	38,631	48%	14.5	1,519,025,926	5.2	9.1	16.9
Crude oil tanker	0–9,999	dwt	3,668	48%	12.1	91,086,398	20.7	33.3	61.7
Products tanker	60,000+	dwt	101	55%	15.3	3,491,449,962	3.3	5.7	10.6
Products tanker	20,000–59,999	dwt	40	55%	14.8	1,333,683,350	7.2	10.3	19.1
Products tanker	10,000–19,999	dwt	15	50%	14.1	464,013,471	11.3	18.7	34.6
Products tanker	5,000–9,999	dwt	7	45%	12.8	170,712,388	14.8	29.2	54.1
Products tanker	0–4,999	dwt	18	45%	11.0	37,598,072	26.5	45.0	83.3
Chemical tanker	20,000+	dwt	322	64%	14.7	1,831,868,715	5.7	8.4	15.6
Chemical tanker	10,000–19,999	dwt	15	64%	14.5	820,375,271	7.3	10.8	20.0
Chemical tanker	5,000–9,999	dwt	7	64%	14.5	382,700,554	10.7	15.1	28.0
Chemical tanker	0–4,999	dwt	18	64%	14.5	72,147,958	18.6	22.2	41.1
LPG tanker	50,000+	m3	46,656	48%	16.6	2,411,297,106	5.2	9.0	16.7
LPG tanker	0–49,999	m3	312	48%	14.0	89,631,360	27.0	43.5	80.6
LPG tanker	200,000+	m3	9,752	48%	19.6	5,672,338,333	5.4	9.3	17.2
LPG tanker	0–199,999	m3	621	48%	19.6	3,797,321,655	8.4	14.5	26.9
Bulk carrier	200,000+	dwt	227	50%	14.4	10,901,043,017	1.5	2.5	4.6
Bulk carrier	100,000–199,999	dwt	163	50%	14.4	7,763,260,284	1.8	3.0	5.6
Bulk carrier	60,000–99,999	dwt	74	55%	14.4	3,821,361,703	2.7	4.1	7.6
Bulk carrier	35,000–59,999	dwt	45	55%	14.4	2,243,075,236	3.8	5.7	10.6
Bulk carrier	10,000–34,999	dwt	26	55%	14.3	1,268,561,872	5.3	7.9	14.6
Bulk carrier	0–9,999	dwt	2,400	60%	11.0	68,226,787	22.9	29.2	54.1
General cargo	10,000+	dwt	15	60%	15.4	866,510,887	7.6	11.9	22.0
General cargo	5,000–9,999	dwt	6,957	60%	13.4	365,344,150	10.1	15.8	29.3
General cargo	0–4,999	dwt	2,545	60%	11.7	76,945,792	10.9	13.9	25.7
General cargo	10,000+ (100+ TE	dwt	18	60%	15.4	961,054,062	8.6	11.0	20.4
General cargo	5,000–9,999 (100-	dwt	7	60%	13.4	243,599,799	13.8	17.5	32.4
General cargo	0–4,999 (100+ TE	dwt	4	60%	11.7	120,938,043	15.5	19.8	36.7
Refrigerated cargo		All	64	50%	20.0	392,981,809	12.9	12.9	23.9
Container	8,000+	TEU	686	70%	25.1	6,968,284,047	11.1	12.5	23.1
Container	5,000–7,999	TEU (90 dwt)	40,355	70%	25.3	4,233,489,679	15.2	16.6	30.7
Container	3,000–4,999	TEU (70 dwt)	28,784	70%	23.3	2,820,323,533	15.2	16.6	30.7
Container	2,000–2,999	TEU (40 dwt)	168	70%	20.9	1,480,205,694	18.3	20.0	37.0
Container	1,000–1,999	TEU (25 dwt)	7	70%	19.0	578,339,367	29.4	32.1	59.4
Container	0–999	TEU (10 dwt)	35	70%	17.0	179,809,363	33.3	36.3	67.2
Vehicle	4,000+	ceu	7,908	70%	19.4	732,581,677	25.2	32.0	59.3
Vehicle	0–3,999	ceu	2,808	70%	17.7	226,545,399	47.2	57.6	106.7
Ro-Ro	2,000+	lm	5,154	70%	19.4	368,202,021	45.3	49.5	91.7
Ro-Ro	0–1,999	lm	1,432	70%	13.2	57,201,146	55.2	60.3	111.7

Appendix 2 – Ship Conversion Table

DfT : Cargo description > Detailed Ship Type (tons)	IMO GHG Type (emissions)	Eurostat : Ship arrival types (size)
Dry Bulk > Bulk carrier	Bulk carrier	Dry bulk carriers
Dry Bulk > Bulk-oil carrier	Bulk carrier	Dry bulk carriers
Dry Bulk > Container [FC]	Container	Container ships
Dry Bulk > Dredger	Bulk carrier	Miscellaneous vessels (dredgers, research vessels, others)
Dry Bulk > Drilling	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Dry Bulk > Dry cargo barge	Bulk carrier	Dry cargo barges
Dry Bulk > Fish processing	General cargo	Fishing vessels
Dry Bulk > Fishing	General cargo	Fishing vessels
Dry Bulk > Gen cargo multi deck	General cargo	Non-specialised general cargo carriers
Dry Bulk > Gen cargo single deck	General cargo	Non-specialised general cargo carriers
Dry Bulk > General cargo barge	General cargo	Non-specialised general cargo carriers
Dry Bulk > General cargo multi deck	General cargo	Non-specialised general cargo carriers
Dry Bulk > General cargo single deck	General cargo	Non-specialised general cargo carriers
Dry Bulk > Liquid gas carrier	LPG tanker	Liquid bulk ships (tankers)
Dry Bulk > Misc non-trading	Bulk carrier	Miscellaneous vessels (dredgers, research vessels, others)
Dry Bulk > Offshore production and suppor	General cargo	Vessels for offshore activities
Dry Bulk > Offshore supply	Bulk carrier	Vessels for offshore activities
Dry Bulk > Oil tanker	Crude oil tanker	Liquid bulk ships (tankers)
Dry Bulk > Oil-chemical tanker	Products tanker	Liquid bulk ships (tankers)
Dry Bulk > Other nes	Bulk carrier	Dry bulk carriers
Dry Bulk > Reefer	Bulk carrier	Dry bulk carriers
Dry Bulk > Ro-Ro cargo	Ro-Ro	Non-specialised general cargo carriers
Dry Bulk > Ro-Ro other cargo	Ro-Ro	Non-specialised general cargo carriers
Dry Bulk > Ro-Ro passenger	Ro-Ro	Passenger vessels - excluding cruise ships
Dry Bulk > Specialised carrier	Bulk carrier	Specialized carriers
Dry Bulk > Tug	General cargo	Tugs
Dry Bulk > Unknown	Bulk carrier	Dry bulk carriers
Liquid bulk > Bulk carrier	Products tanker	Liquid bulk ships (tankers)
Liquid bulk > Bulk-oil carrier	Crude oil tanker	Liquid bulk ships (tankers)
Liquid bulk > Chemical tanker	Chemical tanker	Liquid bulk ships (tankers)
Liquid Bulk > Drilling	Products tanker	Miscellaneous vessels (dredgers, research vessels, others)
Liquid bulk > Fishing	General cargo	Non-specialised general cargo carriers
Liquid bulk > Gen cargo multi deck	General cargo	Non-specialised general cargo carriers
Liquid bulk > Gen cargo single deck	General cargo	Non-specialised general cargo carriers
Liquid bulk > General cargo multi deck	General cargo	Non-specialised general cargo carriers
Liquid bulk > General cargo single deck	General cargo	Non-specialised general cargo carriers
Liquid bulk > Liquid gas carrier	LPG tanker	Liquid bulk ships (tankers)
Liquid bulk > Misc non-trading	Products tanker	Miscellaneous vessels (dredgers, research vessels, others)
Liquid bulk > Offshore production and suppor	General cargo	Vessels for offshore activities
Liquid bulk > Offshore supply	General cargo	Vessels for offshore activities
Liquid bulk > Oil tanker	Crude oil tanker	Liquid bulk ships (tankers)
Liquid bulk > Oil-chemical tanker	Products tanker	Liquid bulk ships (tankers)
Liquid bulk > Other nes	Products tanker	Liquid bulk ships (tankers)
Liquid bulk > Other tanker	Products tanker	Liquid bulk ships (tankers)
Liquid bulk > Reefer	Chemical tanker	Liquid bulk ships (tankers)
Liquid bulk > Research	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Liquid bulk > Specialised carrier	General cargo	Specialized carriers
Liquid Bulk > Tug	Products tanker	Tugs
Liquid bulk > Unknown	Products tanker	Liquid bulk ships (tankers)
Lo-Lo containers > Bulk carrier	Bulk carrier	Dry bulk carriers
Lo-Lo containers > Container [FC]	Container	Container ships
Lo-Lo containers > Dredger	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Lo-Lo containers > Drilling	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Lo-Lo containers > Dry cargo barge	General cargo	Dry cargo barges
Lo-Lo containers > Fish processing and catching	General cargo	Fishing vessels
Lo-Lo containers > Fishing	General cargo	Fishing vessels
Lo-Lo containers > Gen cargo multi deck	General cargo	Non-specialised general cargo carriers
Lo-Lo containers > Gen cargo single deck	General cargo	Non-specialised general cargo carriers
Lo-Lo containers > Gen cargo-passenger	General cargo	Passenger vessels - excluding cruise ships
Lo-Lo containers > General cargo barge	General cargo	Dry cargo barges
Lo-Lo containers > General cargo multi deck	General cargo	Non-specialised general cargo carriers
Lo-Lo containers > General cargo single deck	General cargo	Non-specialised general cargo carriers
Lo-Lo containers > Liquid gas carrier	LPG tanker	Liquid bulk ships (tankers)
Lo-Lo containers > Misc non-trading	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Lo-Lo containers > Offshore supply	General cargo	Vessels for offshore activities
Lo-Lo containers > Reefer	Refrigerated cargo	Container ships
Lo-Lo containers > Ro-Ro cargo	Ro-Ro	Non-specialised general cargo carriers
Lo-Lo containers > Ro-Ro container	Ro-Ro	Non-specialised general cargo carriers
Lo-Lo containers > Ro-Ro other cargo	Ro-Ro	Non-specialised general cargo carriers
Lo-Lo containers > Ro-Ro passenger	Ro-Ro	Passenger vessels - excluding cruise ships
Lo-Lo containers > Specialised carrier	Container	Specialized carriers
Lo-Lo containers > Tug	General cargo	Tugs
Lo-Lo containers > Unknown	Container	Container ships
Other general cargo > Bulk carrier	General cargo	Non-specialised general cargo carriers
Other general cargo > Bulk-oil carrier	General cargo	Non-specialised general cargo carriers
Other general cargo > Container [FC]	General cargo	Non-specialised general cargo carriers
Other general cargo > Dredger	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Other general cargo > Drilling	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Other general cargo > Dry cargo barge	General cargo	Dry cargo barges
Other general cargo > Fishing	General cargo	Fishing vessels
Other general cargo > Gen cargo multi deck	General cargo	Non-specialised general cargo carriers
Other general cargo > Gen cargo single deck	General cargo	Non-specialised general cargo carriers
Other general cargo > Gen cargo-passenger	General cargo	Passenger vessels - excluding cruise ships
Other general cargo > General cargo barge	General cargo	Dry cargo barges
Other general cargo > General cargo multi deck	General cargo	Non-specialised general cargo carriers
Other general cargo > General cargo single deck	General cargo	Non-specialised general cargo carriers
Other general cargo > Liquid gas carrier	LPG tanker	Liquid bulk ships (tankers)
Other general cargo > Misc non-trading	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Other general cargo > Offshore production and suppor	General cargo	Vessels for offshore activities
Other general cargo > Offshore supply	General cargo	Vessels for offshore activities
Other general cargo > Oil tanker	Crude oil tanker	Liquid bulk ships (tankers)
Other general cargo > Oil-chemical tanker	Products tanker	Liquid bulk ships (tankers)
Other general cargo > Other nes	General cargo	Non-specialised general cargo carriers
Other general cargo > Reefer	Refrigerated cargo	Non-specialised general cargo carriers
Other general cargo > Research	General cargo	Miscellaneous vessels (dredgers, research vessels, others)
Other general cargo > Ro-Ro cargo	Ro-Ro	Non-specialised general cargo carriers
Other General Cargo > Ro-Ro container	Ro-Ro	Non-specialised general cargo carriers
Other general cargo > Ro-Ro other cargo	Ro-Ro	Non-specialised general cargo carriers
Other general cargo > Ro-Ro passenger	Ro-Ro	Passenger vessels - excluding cruise ships
Other general cargo > Specialised carrier	General cargo	Specialized carriers
Other general cargo > Tug	General cargo	Tugs
Other general cargo > Unknown	General cargo	Non-specialised general cargo carriers
Roll-on/Roll-off > Container [FC]	Container	Container ships
Roll-on/Roll-off > Gen cargo multi deck	General cargo	Non-specialised general cargo carriers
Roll-on/Roll-off > Gen cargo single deck	General cargo	Non-specialised general cargo carriers
Roll-on/Roll-off > Reefer	Ro-Ro	Non-specialised general cargo carriers
Roll-on/Roll-off > Ro-Ro cargo	Ro-Ro	Non-specialised general cargo carriers
Roll-on/Roll-off > Ro-Ro other cargo	Ro-Ro	Non-specialised general cargo carriers
Roll-on/Roll-off > Ro-Ro passenger	Ro-Ro	Passenger vessels - excluding cruise ships
Roll-on/Roll-off > Specialised carrier	Ro-Ro	Specialized carriers
Roll-on/Roll-off > Unknown	Ro-Ro	Non-specialised general cargo carriers
Ro-Ro Non-SP > Ro-Ro container	Ro-Ro	Non-specialised general cargo carriers
Ro-Ro Non-SP > Ro-Ro other cargo	Ro-Ro	Non-specialised general cargo carriers
Ro-Ro Non-SP > Ro-Ro passenger	Ro-Ro	Passenger vessels - excluding cruise ships
Ro-Ro Non-SP > Specialised carrier	Ro-Ro	Specialized carriers
Ro-Ro Non-SP > Unknown	Ro-Ro	Non-specialised general cargo carriers
Ro-Ro Self-Prop > Ro-Ro container	Ro-Ro	Non-specialised general cargo carriers
Ro-Ro Self-Prop > Ro-Ro other cargo	Ro-Ro	Non-specialised general cargo carriers
Ro-Ro Self-Prop > Ro-Ro passenger	Ro-Ro	Passenger vessels - excluding cruise ships
Ro-Ro Self-Prop > Specialised carrier	Ro-Ro	Specialized carriers
Ro-Ro Self-Prop > Unknown	Ro-Ro	Non-specialised general cargo carriers