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BULLETIN 373

FACILITATION OF TRANSPORT AND TRADE IN **LATIN AMERICA AND THE CARIBBEAN**

Towards the decontamination of maritime transport in international trade: methodology and estimation of CO_2 emissions

Background

Maritime transport is essential to the global economy. It carries more than 80% of international trade by volume and over 70% in value terms (UNCTAD, 2018). Owing to this importance, the emissions generated by ships are a central issue in reducing the carbon footprint of international trade, along with other pollutants generated by human activities on the planet. In this context, it is

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Following on from *FAL Bulletin* No. 372 concerning the new regulation on sulphur emissions from maritime transport, the aim of this document is to present the methodology for calculating CO_2 emissions generated by maritime transport in international trade. This methodology was used to obtain a preliminary estimate of emissions from a representative sample of exports from Latin America and the Caribbean. The sample was obtained from export tonnages from eight countries in 2017, and represents nearly 70% of total regional exports.

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particularly important to be aware of the causes and magnitude of the emissions generated, in order to develop specific reduction and mitigation actions at the international, regional, national and local levels.

The International Maritime Organization (IMO) is the specialized agency of the United Nations which is responsible for the technical regulation of maritime transport. Its mission is "to promote safe, secure, environmentally sound, efficient and sustainable shipping through cooperation."

This mission will be accomplished by adopting the highest possible standards of maritime security and safety, navigational efficiency and the prevention and control of pollution caused by ships, as well as by considering related legal issues and effectively implementing IMO instruments to ensure that they are universally and uniformly applied (IMO, 2019a).

In particular, in order to reduce greenhouse gas (GHG) emissions from ships, IMO has adopted two mandatory measures under the International Convention for the Prevention of Pollution from Ships (the MARPOL Convention). The first is the mandatory establishment of an energy efficiency design index (EEDI) for new ships, which sets a minimum energy efficiency level per capacity mile (ton mile) (IMO, 2019b) for different ship types and size segments; as well as a ship energy efficiency management plan (SEEMP), which is a method for shipping companies to monitor ship efficiency through an energy efficiency operational indicator (EEOI) which enables shipowners to measure the efficient fuel consumption of a ship in service and calibrate the effect of any change in the ship's operation. The second measure is the Initial Strategy on Reduction of GHG Emissions established in 2018 by the Marine Environment Protection Committee (MEPC) during its seventy-second session held at its headquarters in London, which contains the IMO 2020 regulation governing the sulphur content in a ship's fuel, which was extensively analysed in *FAL Bulletin* No. 372 (Barleta and Sánchez, 2019).

In this context, this issue of the Bulletin takes a further step in the effort to reduce GHG emissions from international maritime transport, by establishing a methodology for measuring the carbon emissions generated by the international maritime trade of Latin America and the Caribbean.

I. General calculation methodology

This bulletin proposes a first approximation to a methodology for estimating emissions of carbon dioxide equivalent (and possibly other emissions) generated by maritime transport in the course of international trade. In addition, it makes a preliminary estimate of the carbon emissions generated by the region's exports. Future work will refine the methodology and extend its application to the rest of international trade, while adding new countries, ship types and maritime routes.

The basis for estimating CO_2 and other GHG emissions is fuel consumption by type of ship. According to the reports issued by the International Council on Clean Transport (ICCT) of June 2014 (IMO, 2015) and October 2017 (ICCT, 2017), multiple factors and variables affect the amount and composition of CO_2 emissions from ships, including the following:

- **Ship type**, which determines the type of hull, the typical operating draught, the propulsion system and the type of cargo carried.
- **Ship size**, which is a decisive factor in fuel consumption.
- **Maximum and average speed**, measured in knots; also determined by the type of vessel and its cargo, but which directly affects fuel consumption (the faster the speed, the greater the consumption).
- **Percentage of maximum draught**, which determines the level of resistance and hence the work the propulsion system must do to overcome it.
- **Hull fouling factor**, which determines the level of friction exerted by the water on the hull.
- **Type of route**, which varies according to whether the service is inter-oceanic, offshore or coastal, which in turn determines the environmental and climatic factors in which navigation takes place —coastal routes are presumed to be protected from environmental factors such as storms, currents, etc.
- **Average power of the propulsion system in kilowatts**, which determines the maximum and average speed for which the ships was designed.
- **Engine type**, since ships operate with different engines and fuels and therefore emit different quantities and types of gases. Low speeds operating on diesel and medium speeds on heavier fuels.

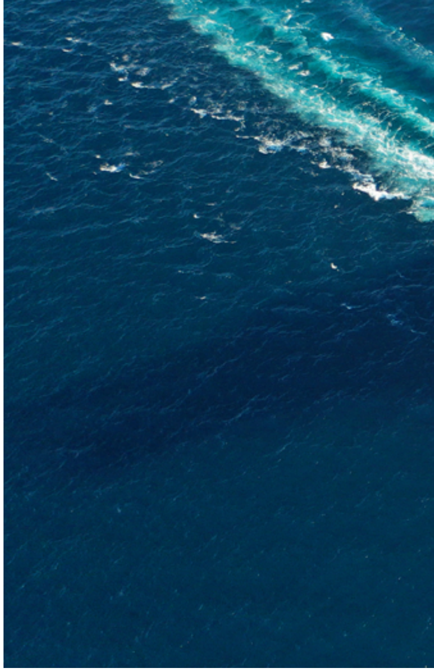
In addition to these variable factors, in the *Third IMO Greenhouse Gas Study 2014* (2015), IMO also develops the concept of emission factors for each type of fuel. The exact way to estimate a ship's emissions is through detailed knowledge of the foregoing elements and their interactions: the fuel consumption for each journey, the exact distance travelled, the speed used, the total tonnage carried on each journey and the time travelled. This information is collected online from the ship's operator. In addition, a factor that is not taken into account in the estimates is fuel consumption during the time the ship is in port, while loading and unloading and related operations are completed.

The above makes clear that an accurate emissions calculation requires a huge amount of ship and voyage information. Accordingly, the key obstacles to establishing best practices and standardizing methodologies include the lack of information, the cost of collecting it, the absence of incentives to collect and analyse data, and the fact that it is difficult to monetize the benefits of emission reductions as perceived by ship operators and cargo beneficiaries.

Taking these considerations into account, the proposed methodology bases its calculation on Annex 2 of the *Ship Emissions Toolkit*, which proposes an online calculator for estimating CO_2 emissions;[1] together with provided in Guides No. 2 and No. 3 (GloMEEP Project and others, 2018). The calculator is a tool for estimating the emissions of a country's shipping fleet over the course of a year, based on a set of assumptions and on other factors of uncertainty associated with operational design, speed, draught, atmospheric conditions, consumption and emission factors, all of which vary.

The data on ship type, size category and average annual fuel consumption are pre-filled by the model, and then used as a basis for calculating daily fuel consumption for each type and size of ship. This is then extrapolated to origin-destination pairs, with their respective distances and number of days' voyage, to estimate emissions by type and size of ship for each route. In order to estimate the distance between the origin and destination pairs, by type of product exported, ports of origin and destination are chosen for the type of cargo in question. Then the online tool (http://www.sea-distances.org) is used to determine the

[1] See [online] https://glomeep.imo.org/resources/fleet-and-co2-calculator/.



distance between them in nautical miles. Where more than one route is possible, the shortest has been chosen. Average speeds were used for each type of ship, according to data provided in the Third IMO Greenhouse Gas Study (IMO, 2015).

II. Application of the methodology for estimating the CO_2 emissions associated with Latin American exports

The cargo volume of each ship was calculated from the tonnage exported by sea in 2017,[2] mainly grains, minerals (especially iron and coal), oil and products, for eight Latin American countries (Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru and Uruguay).

For each country, a sample of the main products exported was constructed (arranged in descending tonnage order), together with the different origin-destination pairs, to which the corresponding ports were assigned depending on the country and type of good. Goods are classified using the 2007 Harmonized Commodity Description and Coding System (HS) at the four-digit level.

The tonnages considered in the sample represent 67.3% of the Latin America and the Caribbean region's total exports, with country representativeness as shown below. Once the products with the greatest weight in the export basket have been selected, the main destinations are identified, and this constitutes the sample on which the work is finally done (see table 1).

Table 1
Sample representativeness, 2017

Country	Total exports transported by sea (tons)	Exports selected for the sample (tons)	Sample as a percentage of total exports
Argentina	97 208 423	58 771 248	60.5%
Brazil	666 662 063	425 839 950	63.9%
Chile	59 918 197	38 973 381	65.0%
Colombia	152 230 471	94 348 533	62.0%
Ecuador	30 800 031	24 299 556	78.9%
Mexico	490 974 810	217 412 042	44.3%
Peru	44 312 947	32 312 263	72.9%
Uruguay	6 140 748	4 307 481	70.1%

Source: ECLAC International Transport Database (BTI).

The results of the maritime transport emissions calculations are shown in tables 2 to 10 for each country respectively.

As can be seen in table 2, grains account for a large proportion of Argentina's export volume transported by sea, with oil-cake (pellets) and other solid waste from the extraction of soybean oil (soybeans) along with maize, wheat and soybeans representing nearly 74.1% of the total volume exported. Considering the most important destinations for these products (and those that complete the leading ten), emissions are estimated at 1,032,023 tons of CO_2 equivalent for a product/destination sample representing 60.5% of the country's total maritime exports.

[2] The data is extracted from ECLAC's international transport database (BTI), which provides information on the physical volume of exports and imports by mode of transport. This database has not been published.

Table 2

Argentina: maritime transport emissions associated with the main exported products, 2017

HS 2007 heading	HS 2007 commodity description	Tonnage	Share of product in total goods exports	Cumulative share of main destinations in total exports of the selected product	Sample size (product and destination)	CO_2 emissions (kg equivalent)
2304	Oil-cake and other solid residues; whether or not ground or in the form of pellets, resulting from the extraction of soya-bean oil	28 240 059	29.1%	55.1%	16.0%	262 855 203
1005	Maize (corn)	23 558 702	24.2%	66.7%	16.2%	284 534 817
1001	Wheat and meslin	12 935 043	13.3%	71.7%	9.5%	101 243 690
1201	Soya beans, whether or not broken	7 288 084	7.5%	98.8%	7.4%	166 678 870
1507	Soya-bean oil and its fractions; whether or not refined, but not chemically modified	4 905 703	5.0%	75.0%	3.8%	109 442 922
1003	Barley	2 559 086	2.6%	73.6%	1.9%	25 764 489
2302	Bran, sharps and other residues; whether or not in the form of pellets derived from the sifting, milling or other working of cereals or of leguminous plants	2 056 941	2.1%	77.7%	1.6%	21 966 602
3826	Biodiesel and mixtures thereof; not containing or containing less than 70% by weight of petroleum oils or oils obtained from bituminous minerals	1 650 310	1.7%	92.0%	1.6%	20 595 412
2709	Petroleum oils and oils obtained from bituminous minerals; crude	1 529 295	1.6%	98.5%	1.5%	32 907 241
2710	Petroleum oils and oils from bituminous minerals, not crude; preparations n.e.c, containing by weight 70% or more of petroleum oils or oils from bituminous minerals; these being the basic constituents of the preparations; waste oils	1 122 327	1.2%	74.1%	0.9%	6 033 971
					60.5%	1 032 023 218

Source: Prepared by the authors.

Table 3 shows that Brazil's main export product, iron ore, represents 57% of its total volume exported. Emissions are estimated at 4,800,145 tons of CO_2 equivalent for a product/destination sample comprising 64.2% of its total maritime exports.

For the case of Chile, table 4 shows that the main products exported, by volume, are minerals (iron, salt, copper concentrates). Emissions are estimated at 551,766 tons of CO_2 equivalent for a product/destination sample representing 64.8% of the country's total maritime exports.

Table 3
Brazil: maritime transport emissions associated with the main exported products, 2017

HS 2007 heading	HS 2007 commodity description	Tonnage	Share of product in total goods exports	Cumulative share of main destinations in total exports of the selected product	Sample size (product and destination)	CO_2 emissions kg equivalent
2601	Iron ores and concentrates; including roasted iron pyrites	379 794 552	57.0%	70.2%	40.0%	3 172 548 629
1201	Soya beans, whether or not broken	66 117 468	9.9%	87.4%	8.7%	551 521 330
2709	Petroleum oils and oils obtained from bituminous minerals; crude	51 965 421	7.8%	88.3%	6.9%	757 468 772
1005	Maize (corn)	27 289 890	4.1%	47.3%	1.9%	106 522 007
1701	Cane or beet sugar and chemically pure sucrose, in solid form	28 547 476	4.3%	39.1%	1.7%	40 550 665
2304	Oil-cake and other solid residues; whether or not ground or in the form of pellets, resulting from the extraction of soya-bean oil	14 176 943	2.1%	64.8%	1.4%	79 340 316
4703	Chemical wood pulp, soda or sulphate, other than dissolving grades	13 084 291	2.0%	75.1%	1.5%	41 837 464
2818	Aluminium oxide (including artificial corundum); aluminium hydroxide	9 727 594	1.5%	73.6%	1.1%	22 053 836
7207	Iron or non-alloy steel; semi-finished products thereof	7 650 718	1.1%	48.3%	0.6%	11 186 042
2710	Petroleum oils and oils from bituminous minerals, not crude; preparations n.e.c, containing by weight 70% or more of petroleum oils or oils from bituminous minerals; these being the basic constituents of the preparations; waste oils	4 891 838	0.7%	76.5%	0.6%	17 116 488
					64.2%	4 800 145 548

Source: Prepared by the authors.

Table 4
Chile: maritime transport emissions associated with the main exported products, 2017

HS 2007 heading	HS 2007 commodity description	Tonnage	Share of product in total goods exports	Cumulative share of main destinations in total exports of the selected product	Sample size (product and destination)	CO_2 emissions kg equivalent
2601	Iron ores and concentrates; including roasted iron pyrites	14 127 139	23.6%	85.6%	20.2%	163 678 776
2501	Salt (including table salt and denatured salt); pure sodium chloride whether or not in aqueous solution; sea water	9 974 127	16.6%	92.5%	15.4%	79 700 792
2603	Copper ores and concentrates	9 270 731	15.5%	83.2%	12.9%	106 738 302
4401	Fuel wood, in logs, billets, twigs, faggots or similar forms; wood in chip or particles; sawdust and wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms	3 866 347	6.5%	100.0%	6.4%	76 679 010
7403	Copper; refined and copper alloys, unwrought	2 606 923	4.4%	76.6%	3.3%	23 815 915
4407	Wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm	1 853 812	3.1%	65.7%	2.0%	21 262 602
3104	Fertilizers; mineral or chemical, potassic	1 343 282	2.2%	68.7%	1.5%	10 518 922
2204	Wine of fresh grapes, including fortified wines; grape must	1 157 242	1.9%	59.4%	1.1%	16 597 534
2701	Coal; briquettes, ovoids and similar solid fuels manufactured from coal	1 143 388	1.9%	94.8%	1.8%	52 774 344
					64.8%	551 766 199

Source: Prepared by the authors.

In the case of Colombia (see table 5), coal, oil and petroleum oils are the main export products, in volume terms, transported by sea. Emissions are estimated at 612,711 tons of CO_2 equivalent for a product/destination sample of 62.0% of its total maritime exports.

Table 5

Colombia: maritime transport emissions associated with the main exported products, 2017

HS 2007 heading	HS 2007 commodity description	Tonnage	Share of product in total goods exports	Cumulative share of main destinations in total exports of the selected product	Sample size (product and destination)	CO_2 emissions kg equivalent
2701	Coal; briquettes, ovoids and similar solid fuels manufactured from coal	102 712 947	67.5%	60.5%	40.8%	357 948 154
2709	Petroleum oils and oils obtained from bituminous minerals; crude	34 107 354	22.4%	74.1%	16.6%	193 385 526
2710	Petroleum oils and oils from bituminous minerals, not crude; preparations n.e.c, containing by weight 70% or more of petroleum oils or oils from bituminous minerals; these being the basic constituents of the preparations; waste oils	4 705 648	3.1%	73.4%	2.3%	28 897 134
2704	Coke and semi-coke; of coal, lignite or peat, whether or not agglomerated; retort carbon	2 519 939	1.7%	72.6%	1.2%	14 403 639
2713	Petroleum coke, petroleum bitumen; other residues of petroleum oils or oils obtained from bituminous minerals	638 972	0.4%	87.7%	0.4%	9 957 962
1701	Cane or beet sugar and chemically pure sucrose, in solid form	631 580	0.4%	63.8%	0.3%	790 467
1511	Palm oil and its fractions; whether or not refined, but not chemically modified	549 501	0.4%	78.1%	0.3%	5 177 149
3904	Polymers of vinyl chloride or of other halogenated olefins, in primary forms	294 588	0.2%	79.4%	0.2%	2 151 056
					62.0%	612 711 088

Source: Prepared by the authors.

In Ecuador, oil and bananas are the main export products, in volume terms, transported by sea (see table 6). Emissions are estimated at 136,416 tons of CO_2 equivalent for a product/destination sample of 78.9% of the country's total maritime exports.

Table 7, reporting the case of Mexico, shows that oil, motor vehicles and their accessories are the main products, by volume, exported by sea, although the estimates shown are subject to the limitations indicated in the table footnote. Emissions are estimated at 3,701,432 tons of CO_2 equivalent for a product/destination sample representing 44.3% of the country's total maritime exports.

In the case of Peru (see table 8), iron ore, petroleum gases, copper minerals and calcium phosphate are the main products, by volume, exported by sea. Emissions are estimated at 368,969 tons of CO_2 equivalent, for a product/destination sample of 75.3% of its total maritime exports.

Table 6
Ecuador: maritime transport emissions associated with the main exported products, 2017

HS 2007 heading	HS 2007 commodity description	Tonnage	Share of product in total goods exports	Cumulative share of main destinations in total exports of the selected product	Sample size (product and destination)	CO_2 emissions kg equivalent
2709	Petroleum oils and oils obtained from bituminous minerals; crude	18 950 246	61.5%	91.8%	56.5%	93 794 891
803	Bananas, including plantains; fresh or dried	6 574 309	21.4%	59.3%	12.7%	28 951 377
2710	Petroleum oils and oils from bituminous minerals, not crude; preparations n.e.c, containing by weight 70% or more of petroleum oils or oils from bituminous minerals; these being the basic constituents of the preparations; waste oils	2 362 414	7.7%	94.5%	7.2%	5 040 916
4403	Wood in the rough, or roughly squared	350 279	1.1%	98.9%	1.1%	5 514 456
1801	Cocoa beans; whole or broken, raw or roasted	284 398	0.9%	64.6%	0.6%	1 788 691
1511	Palm oil and its fractions; whether or not refined, but not chemically modified	193 591	0.6%	73.6%	0.5%	851 730
804	Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens; fresh or dried	139 408	0.5%	76%	0.3%	474 357
					78.9%	136 416 416

Source: Prepared by the authors.

Table 7
Mexico: maritime transport emissions associated with the main exported products, 2017

HS 2007 heading	HS 2007 commodity description	Tonnage	Share of product in total goods exports	Cumulative share of main destinations in total exports of the selected product	Sample size (product and destination)	CO_2 emissions kg equivalent
2709	Petroleum oils and oils obtained from bituminous minerals; crude	109 743 777	22.4%	68.5%	15.3%	275 982 492
8703	Motor cars and other motor vehicles; principally designed for the transport of persons (other than those of heading no. 8702), including station wagons and racing cars	62 884 190	12.8%	43.4%	5.6%	1 779 089 812
8708	Motor vehicles; parts and accessories	43 573 770	8.9%	82.5%	7.3%	659 195 181
3305	Hair preparations; for use on the hair	22 682 118	4.6%	66.2%	3.1%	215 223 005
2501	Salt (including table salt and denatured salt); pure sodium chloride whether or not in aqueous solution; sea water	21 906 126	4.5%	79.6%	3.6%	263 015 681
2203	Beer made from malt	18 066 234	3.7%	48.0%	1.8%	105 136 281
2710	Petroleum oils and oils from bituminous minerals, not crude; preparations n.e.c, containing by weight 70% or more of petroleum oils or oils from bituminous minerals; these being the basic constituents of the preparations; waste oils	14 418 507	2.9%	77.8%	2.3%	104 635 633
2520	Gypsum; anhydrite; plasters (consisting of calcined gypsum or calcium sulphate), coloured or not, with or without small quantities of accelerators or retarders	10 252 354	2.1%	80.8%	1.7%	22 339 651
203	Meat of swine; fresh, chilled or frozen	9 622 710	2.0%	98.6%	1.9%	169 591 216
8212	Razors and razor blades; (including razor blade blanks in strips)	7 476 148	1.5%	74.9%	1.1%	77 698 474
1005	Maize (corn)	3 305 922	0.7%	98.5%	0.7%	29 524 980
					44.3%	3 701 432 407

Source: Prepared by the authors.
Note: This calculation is preliminary owing to the nature of the goods exported by Mexico, which requires the inclusion of other ship types to be included, particularly containers. As the methodology for calculating of the level of emissions from vessels of this type is still being improved, the figures shown must be treated with caution.

Table 8

Peru: maritime transport emissions associated with the main exported products, 2017

HS 2007 heading	HS 2007 commodity description	Tonnage	Share of product in total goods exports	Cumulative share of main destinations in total exports of the selected product	Sample size (product and destination)	CO_2 emissions kg equivalent
2601	Iron ores and concentrates; including roasted iron pyrites	10 086 756	30%	100%	30.2%	157 519 312
2711	Petroleum gases and other gaseous hydrocarbons	3 971 809	12%	87%	10.3%	59 632 346
2603	Copper ores and concentrates	3 704 703	11%	74%	8.2%	72 577 710
2510	Natural calcium phosphates; natural aluminium calcium phosphates and phosphatic chalk	3 215 777	10%	87%	8.4%	25 482 484
2710	Petroleum oils and oils from bituminous minerals, not crude; preparations n.e.c, containing by weight 70% or more of petroleum oils or oils from bituminous minerals; these being the basic constituents of the preparations; waste oils	1 949 535	6%	85%	4.9%	20 948 907
2608	Zinc ores and concentrates	1 522 292	5%	64%	2.9%	14 768 321
2301	Flours, meal and pellets, of meat or meat offal, of fish or of crustaceans, molluscs or other aquatic invertebrates, unfit for human consumption; greaves	1 329 268	4%	89%	3.6%	11 430 100
2807	Sulphuric acid; oleum	988 040	3%	97%	2.9%	1 802 841
2709	Petroleum oils and oils obtained from bituminous minerals; crude	854 105	3%	100%	2.6%	673 108
2607	Lead ores and concentrates	519 961	2%	84%	1.3%	4 134 526
					75.3%	368 969 653

Source: Prepared by the authors.

Lastly, table 9 shows the case of Uruguay, for which soybeans, wood (in the rough) and rice are the leading exports, in volume terms, transported by sea. Emissions are estimated at 74,159 tons of CO_2 equivalent for a product/destination sample encompassing 70.3% of its total maritime exports.

Table 9

Uruguay: maritime transport emissions associated with the main exported products, 2017

HS 2007 heading	HS 2007 commodity description	Tonnage	Share of product in total goods exports	Cumulative share of main destinations in total exports of the selected product	Sample size (product and destination)	CO_2 emissions kg equivalent
1201	Soya beans, whether or not broken	1 694 964	28%	87%	24.1%	22 000 537
4403	Wood in the rough, whether or not stripped of bark or sapwood, or roughly squared	1 157 973	19%	99%	18.7%	17 600 967
1006	Rice	839 499	14%	50%	6.8%	3 236 499
4401	Fuel wood, in logs, billets, twigs, faggots or similar forms; wood in chip or particles; sawdust and wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms	627 868	10%	100%	10.2%	4 470 945
1107	Malt; whether or not roasted	268 674	4%	89%	3.9%	422 212
202	Meat of bovine animals; frozen	257 782	4%	75%	3.1%	2 727 009
4407	Wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm	173 494	3%	74%	2.1%	1 609 813
102	Bovine animals; live	87 573	1.4%	94%	1.3%	22 091 670
					70.3%	74 159 653

Source: Prepared by the authors.

In addition, it is possible to calculate each country's share in total emissions from international maritime transport, estimated at 870,000,000 tons equivalent.[3] The percentages in question are shown in table 10.

The figures reported in table 10 show that the CO_2 equivalent emissions generated by the sample countries' international maritime trade account for at least 1.3% of total global emissions generated by this transportation mode.

Table 10
Maritime transport emissions associated with the main exported products, 2017

Country	CO_2 emissions, in tons equivalent	Share in total global international maritime transport emissions
Argentina	1 032 023	0.12%
Brazil	4 800 146	0.55%
Chile	551 766	0.06%
Colombia	612 711	0.07%
Ecuador	136 416	0.02%
Peru	368 970	0.04%
Uruguay	74 160	0.01%
Mexico	3 701 432	0.43%
Total	10 878 807	1.3%
Emissions from global maritime transport	870 000 000	

Source: Prepared by the authors.

III. Final remarks

The Economic Commission for Latin America and the Caribbean (ECLAC) proposes this calculation methodology, which, together with the assumptions discussed above, enables a preliminary estimate of the minimum emissions from maritime transport in international trade. This calculation represents "minimum" emissions because it does not include a number of aspects to be improved in future estimates, such as emissions during the stay in the port, among others.

The aim of this study has been to provide the international community with a methodology for estimating the CO_2 emissions generated by international maritime transport, since reducing them is essential for moving towards cleaner transport. Given the enormous complexity of this calculation because of the wide variety of ships, specializations, sizes, engines, routes, navigation conditions, and other factors —in other words the set of variables and factors that determine total emissions— the methodology presented here has the great advantage of simplifying the calculation, by using the information that is available to all actors in the trade, transport and distribution chain.

The methodology is also applicable to the information that exists on international trade, such as the type of product, the main origins and destinations and the volumes transported. In other words, the methodology used in this study makes it possible to connect data on trade with data on the transport of the goods traded. On this occasion it was applied to exports; but it can also be applied to imports, which is the next step in the analysis.

The quantitative result shows that 67.3% of the region's total exports, representing over 896 million tons of products carried by vessel from Latin America and the Caribbean in 2017, generates just under 11 million tons of CO_2 equivalent, or 1.3% of the 870 million tons emitted by international maritime transport per year, according to the latest known global estimate.

The figures in this preliminary study are small relative to the overall total. Nonetheless, further development is needed on two measures which would significantly reduce the emission of all pollutants from international maritime transport. The first is the urgent

[3] Calculated by Det Norske Veritas (DNV) [online] https://www.dnvgl.com/.

need to improve international regulation. The second is to consider where responsibility for emissions should lie: in other words, which party is responsible for adopting measures to reduce emissions, the exporting or the importing country?

Mention has been made of various initiatives leading to a reduction in CO_2 emissions caused by international maritime transport and of the many concerns that arise in relation to specific actions in this area. As noted in FAL Bulletin No. 372, "the decontamination of the maritime (or, more broadly, waterborne) transport process is an important part of efforts to combat the causes and effects of climate change. Progress made in terms of international regulation, such as achieved by the entry into force of IMO 2020, shows that such an initiative is feasible and may yield positive results."

It is also time to question whether such actions are sufficient, or whether a broader set of measures should be implemented to secure the expected results. A combination of regulatory measures in conjunction with incentives, such as a carbon tax, among other possible alternatives, would seem to be a more appropriate way forward.

Economic measures, such as technical and economic regulations including tax instruments and the design of incentives, should also be accompanied by efforts in industry and science to identify the "clean" technologies that are most effective in achieving the goal of decontamination. Which are the most suitable engines and fuels? Is natural gas the lowest-impact fuel, or does it reduce carbon emissions but release other pollutants? What trade route design can foster decontamination without impairing normal trade performance? Should navigation speed merely be limited or should optimum speed be promoted within the framework of adjusted trade routes?

It is important to note that measures are already in place and will surely have to be intensified in order to make transport cleaner and reduce emissions; but they should always be proactive for sustainable development. In other words, adjustments cannot be made by reducing economic and commercial activity, but instead through regulations and measures that strike a balance between market incentives and mandatory regulations.

It is also important to recognize that, regardless of the consumption and emissions caused by maritime transport, the party responsible for the GHG footprint generated by international maritime trade remains an open question, since the vessel is merely a vehicle that is contracted to transport cargo whose beneficiaries extend along the supply chain, ranging from the producer to the final consumer. The complication arises because despite the fact that trade has become globalized, geographical and political boundaries still prevail, in which the main maritime transport actors are dispersed across different countries and geographical regions that have their own policies and jurisdictions.

For that reason, with regard to trade as such, a fundamental issue is to assign responsibility for the emissions: the countries that emit CO_2 directly or those that buy the goods associated with those emissions? By tracking the "consumption emissions" that represent the CO_2 imported through trade, it is possible to partly explain the carbon transfers associated with the decline in manufacturing in developed countries in recent decades.

Lastly, a factor that also needs to be included in the analysis and should be taken into consideration is the fact that consumption, like ship emissions, is difficult to quantify and allocate to the cargo as the values vary, depending on the use made of the ship, together with the repositioning voyage, in which the ship may travel partially or completely empty. In other words, the same journey may generate different GHG emissions per unit of cargo transported.

The effort to reduce transport emissions will require convergence between the different parties in the supply chain. The role of the International Maritime Organization is central to these objectives, along with the other international agencies and all governmental and non-governmental actors related to the activity. ECLAC remains at the disposal of all parties in this connection.

Moreover, given the preliminary nature of this study, the authors ask all readers to share their comments and criticisms with us, to enable us to improve the methodology and the estimates made.

IV. Bibliography

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V. Publications of interest

FAL Bulletin 372

Towards the decontamination of international maritime transport

Eliana P. Barleta
Ricardo J. Sánchez

This *FAL Bulletin* pursues two objectives. The first is to share information and a few reflections about the IMO 2020 Regulation. To that end, it provides an introduction to Annex VI of MARPOL and to the possible impacts, expectations, and uncertainties it poses for the maritime sector. Supplementing the information and reflections presented by the authors, it will also contain comments by the professionals and experts in the field who responded to the survey conducted by the authors to ascertain where Latin America and the Caribbean stands vis-à-vis these changes in the regulations. The second objective is to provide a brief introduction to the study being undertaken by the Infrastructure Services Unit (ISU) to estimate the CO_2 emissions from the international maritime transport of the countries of the region.

Available in: Spanish

FAL Bulletin 366

Reflections on the future of container ports in view of the new containerization trends

Ricardo J. Sánchez
Eliana Barleta

Recent years have seen a relative slowdown in container movements, which cannot be fully explained by fluctuations in the world economy. The authors note that the year-on-year change in throughput is decreasing relative to changes in GDP. In an attempt to explain these "seesaw" variations, several hypotheses are proposed and some are demonstrated, in particular the reprimarization of the economy, the miniaturization of cargoes, the possible decrease in transshipments, and the increasing use of 40-foot containers.

Available in: Spanish English