Clean Cargo Working Group Global Trade Lane Emissions Factors

August 2012

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Introduction

For nearly a decade, Clean Cargo—the industry's largest collaborative effort to measure and report on environmental impact—has worked with ocean carriers, cargo owners ("shippers"), third-party logistics companies, and other stakeholders to meet their needs by creating credible methodologies and tools to gather vessel-by-vessel carrier environmental performance data and, in particular, carbon footprint data.

This is the third year that Clean Cargo has released its average trade lane emissions data in an effort to improve transparency and understanding of environmental impacts from goods transport.

The following data reports on over 2,000 ships calculated from 13 of the world's leading ocean container carriers, collectively representing more than 60 percent of ocean container capacity worldwide.

About Clean Cargo Working Group

Clean Cargo Working Group is a global, business-to-business initiative dedicated to improving the environmental performance of marine container transport. Clean Cargo creates practical tools for measuring, evaluating, and reporting the environmental impacts of global goods transportation, helping ocean freight carriers track and benchmark their performance and easily report to customers in a standard format, and cargo owners (shippers) review and compare carriers' environmental performance when reporting and making informed buying decisions. Clean Cargo works with other initiatives in the global transportation value chain to improve alignment and facilitate performance improvement across modal segments. Today, Clean Cargo tools represent the industry standard for measuring and reporting ocean carriers' environmental performance on carbon-dioxide emissions. Of global container transport, 60 percent is covered under the Clean Cargo data collection process, and the group includes 11 of the top 15 world liner fleet operators, giving access to the largest global environmental dataset in the maritime industry.

For More Information

For more information contact Angie Farrag, Clean Cargo Project Manager at afarrag@bsr.org.

For a list of current members and information on how to join, visit the Clean Cargo website at www.bsr.org/cleancargo.

Clean Cargo Year-over-Year Trade Lane Emissions Factors

(Average grams CO_2 / TEU-km)

CO_2 Emissions by Trade Lane ($g\ CO_2$ / TEU-km)	2011 (2,000+ vessels)		2010 (1,900+ vessels)		2009 (1,026 vessels)	
	Dry Container	Reefer Container	Dry Container	Reefer Container	Dry Container	Reefer Container
Asia--Africa	70.6	98.8	81.6	115.3	84.87	110.51
Asia--South America (EC/WC)	67.4	94.4	75.1	102.8	80.57	104.4
Asia--Oceania	79.1	109.1	103.9	133.2	92.8	120.34
Asia--North Europe	52.2	80.4	55.4	84.4	67.26	93.91
Asia--Mediterranean	65.0	93.9	65.0	95.5	67.52	96.71
Asia--North America EC	71.9	97.4	74.8	101.0	78.15	97.44
Asia--North America WC	65.1	92.3	69.8	97.8	74.2	97.13
Asia--Middle East/India	69.1	96.8	71.9	100.4	73.72	103.5
North Europe--North America EC (incl. Gulf)	75.9	103.6	81.2	111.6	85.41	112.46
North Europe--North America WC	75.2	102.3	74.0	100.0	79.81	104.64
Mediterranean--North America EC (incl. Gulf)	79.3	110.9	88.5	125.7	80.03	108.83
Mediterranean--North America WC	85.9	119.2	56.8	87.1	59.69	89.93
Europe (North & Med)--Middle East/India	70.9	101.5	69.5	101.9	76.19	106.1
Europe (North & Med)--Africa	87.6	129.0	85.7	128.8	88.67	122.65
Europe (North & Med)--Oceania (via Suez / via Panama)	87.6	118.2	94.8	126.5	101.52	128.62
Europe (North & Med)--Latin America/South America	79.3	108.6	82.3	115.7	87.33	114.91
North America--Africa	76.9	103.9	87.3	122.6	97.37	139.65
North America EC--Middle East/India	78.7	104.6	81.6	106.4	84.2	108.59
North America--South America (EC/WC)	71.4	97.0	77.8	110.6	84.96	112.84
North America--Oceania	85.5	112.9	87.7	115.3	100.48	126.87
South America (EC/WC)--Africa	68.6	89.5	84.6	116.0	77.81	97.79
Intra-Americas (Caribbean)	87.9	116.6	101.8	142.9	102.28	133.41
Intra-Asia	70.4	99.0	80.9	112.5	76.14	100.67
Intra-Europe	118.1	174.7	104.8	152.2	72.75	102.59
Fleet-wide average CO_2 Performance	**68.1**	**97.4**	**72.2**	**102.7**	**75.16**	**98.23**

Notes:

- "Dry" = non-refrigerated cargo
- "Reefer" = refrigerated cargo
- "TEU" = twenty-foot equivalent unit, used to describe capacity of container vessels

Annex I – CO_2 Calculation Methodology

Clean Cargo has developed a standardized CO_2 calculation methodology to enable CO_2 benchmarking, drive improvements, and improve data quality over time.

The methodology is used exclusively by Clean Cargo member carriers to calculate vessel emissions as part of the Clean Cargo Performance Metrics disclosure. Following is a description of how CO_2 emissions factors (in gCO_2/TEU-km) are calculated for the purposes of the Clean Cargo Performance Metrics.

CALCULATION OF VESSEL CO_2 EMISSIONS
Clean Cargo carriers report on the following data for each vessel through the annual Clean Cargo Performance Metrics data collection process:

- Nominal capacity in 20-foot equivalent container units (TEUs)
- Number of reefer plugs
- Distance sailed
- Fuel consumed (HFO and MDO/MGO reported separately)
- Timeframe of data

The Clean Cargo Performance Metrics Tool uses this information to calculate vessel CO_2 emissions. A general formula for this calculation is:

*Total kg fuel consumed for containers, multiplied by 3114.4 gCO_2/kg fuel, divided by the product of [maximum nominal TEU capacity * total distance sailed]*

The calculation methodology for dry containers is based on International Maritime Organization (IMO) guidance for emissions and carbon contents of fuels. Clean Cargo will continue to align with IMO standards as they improve over time.

Clean Cargo members receive full access to the calculation methodologies and the ability to work with the group to shape future standards. The group continuously improves the methodology to increase the accuracy of data. Improvements are based on factors such as: changes to IMO protocols, new GHG standards, availability of better emissions factors, availability of more accurate data, utilization adjustments, and stakeholder expectations.

Annex II - CO_2 Formula

CO2 Formula

(Note: the input sheet is designed to automatically calculate grams CO2/TEU-km based on carrier inputs)

CO2 formula for dry containers:

$$i_{Dry} = \frac{\left(\sum_{a,k} c \cdot m_{fuel\ .a,k} \right) - m_{RC} \cdot c}{V_{total} \cdot d}$$

CO2 formula that integrates reefer containers:

$$i_{Reefer} = \frac{\left(\sum_{ak} c \cdot m_{fuel,k} \right) - m_{RC} \cdot c}{V_{total}\, d} + \frac{m_{RC} \cdot c}{V_{Reefer} \cdot d}$$

With these definitions of variables:

$$\sum_{a,k} c \cdot m_{fuel\ .a,k} = c \cdot m_{fuel\ ,HFO\ ,ME} + c \cdot m_{fuel\ ,HFO\ ,AE} + c \cdot m_{fuel\ ,HFO\ ,Boiler} + \ldots$$

$$\ldots c \cdot m_{fuel\ ,MDO\ ,ME} + c \cdot m_{fuel\ ,MDO\ ,AE} + c \cdot m_{fuel\ ,MDO\ ,Boiler}$$

a	Different Aggregates running on fuel (ME, AE, Boiler, Incinerator)
k	Different fuel types used on board (HFO, MDO)
$\lfloor m_{fuel} \rfloor = kg$	Mass of fuel consumed during specified period (incl. Time at berth, river and sea) by all consumers (ME, AE, Boiler, Incinerator)
$\lfloor m_{RC} = 1.9TEU \cdot w_{fuel} \cdot x_{Plugs} \cdot z_{time} \rfloor = kg$	Mass of fuel used for operating reefers
$\lfloor w_{fuel} \rfloor = \frac{kg}{TEU}$	Mass of fuel consumed by one reefer TEU within one year
$\lfloor V_{cargo} \rfloor = TEU$	loaded onto a specific ship while at STATUTORY summer draft, and complying with the SOLAS safe visibility regulation (Chapter V "Safety of navigation", Regulation 22
$V_{Reefer} = 1.9TEU \cdot x_{Plugs}$	
$\lfloor x_{Plugs} \rfloor$	Number of reefer plugs on the vessel
1.9 TEU	Number of TEU per plug. (We have several sizes of reefers e.g. 20', 40' and 45'. 1.9 is the average number of 20'reefer per reefer plug.)
$[d] = km$	Total distance sailed during specified period (Incl. River, ports and sea distance)
$[z_{time}]$	Percentage of one year calculation is provided for (if one year $z_{time} = 1$)

And these constants:

$w_{fuel} = \overline{P}_{Reefer} \cdot t \cdot y_{utility}$	= 3.8kW * .23kg/kWh * 365 days * 24hours/day * 25% = 1914 kg/reefer-year
$\overline{P}_{Reefer}$	Clean Cargo WG average power consumption of reefers = 3.8 kw
$\lfloor y_{Utility} \rfloor = 91d = 25\%$	Reefer plugs utilization per year (based on Maersk and Hamburg Süd data)
$c = 3114 \frac{g}{kg}$	IMO-approved emissions factor, as of 2005

Annex III – Clean Cargo Trade Lane Definitions

Trade Regions	Countries in the Region	Sample Ports in Region
Africa	Angola, Cameroon, Kenya, Namibia, Nigeria, Somalia, Senegal, South Africa, Tanzania, Mauritania, The Gambia, Guinea-Bissau, Cape Verde, Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Togo, Benin, Gabon, São Tomé & Príncipe, Equatorial Guinea, Congo, Democratic Republic of the Congo, Mozambique, Madagascar, Seychelles, Comoros, Mauritius	Luanda, Douala, Mombasa, Tripoli, Cape Town, Durban, Dakar, Walvis Bay, Port Elizabeth, Dar es Salaam, Mogadishu
Asia	Japan, Korea, China, Taiwan, Philippines, Vietnam, Malaysia, Cambodia, Thailand, Indonesia, Singapore, Burma, Brunei, East Timor, Philippines, Russia (Pacific)	Singapore, Shanghai, Yantian, Dalian, Busan, Hong Kong, Shekou, Surabaya, Kobe, Port Klang, Manila, Kaohsiung, Laem Chabang, Ho Chi Minh
Mediterranean / Black Sea	Italy, Spain, Portugal, France (Mediterranean), Greece, Turkey, Russia, Ukraine, Libya, Slovenia, Croatia, Montenegro, Albania, Bulgaria, Romania, Russia (Black Sea), Georgia, Cyprus, Syria, Lebanon, Israel, Tunisia, Algeria, Morocco, Malta, Gibraltar	Gioia Tauro, Algeciras, Lisbon, Odessa, Istanbul, Novorossiysk, Genoa, Barcelona
Middle East / India	Pakistan, Sri Lanka, Bangladesh, India, United Arab Emirates, Oman, Saudi Arabia, Bahrain, Qatar, Kuwait, Iraq, Egypt, Jordon, Djibouti, Sudan, Yemen, Eritrea, Iran, Maldives	Port Qasim, Nhava Sheva, Jeddah, Jebel Ali, Salalah, Colombo, Mina Sulman, Chittagong, Port Said, Chennai, Bandar Abbas, Aqaba, Shuwaikh, Suakin, Latakia, Abu Dhabi, Hodeidah
North America East Coast / Gulf	Canada (East Coast), United States (East Coast and Gulf Coast), Mexico (East/Gulf Coast), Cuba, Haiti, Dominican Republic, Bahamas, Caribbean Island nations	Miami, Savannah, Charleston, Houston, Newark, Montreal, Toronto, Veracruz
North America West Coast	Canada (West Coast), United States (West Coast), Mexico (West/Pacific Coast)	Los Angeles/Long Beach, Oakland, Tacoma, Vancouver, Lázaro Cárdenas
North Europe	Sweden, Norway, Denmark, Netherlands, Belgium, United Kingdom, France (Atlantic), Russia (North European), Finland, Estonia, Latvia, Lithuania, Poland, Germany, Ireland	Rotterdam, Bremerhaven, Antwerp, Felixstowe, Gothenburg, Copenhagen, Le Havre, Oslo, Vyborg, Hamburg, Southampton
South America (incl. Central America)	Guatemala, Honduras, Belize, Costa Rica, Nicaragua, El Salvador, Panama, Columbia, Venezuela, Brazil, Uruguay, Argentina, Chile, Peru, Ecuador, Guyana, French Guiana, Suriname	Itaguaí, Itajaí, Santos, Rio Grande, Paranaguá, Buenos Aires, Buenaventura, Iquique, Antofagasta, Callao, Guayaquil, Valparaíso
Oceania	Australia, New Zealand, Papua New Guinea, Pacific Island nations	Auckland, Melbourne, Sydney, Adelaide, Brisbane, Fremantle