Clean Cargo

A Smart Freight Centre Partnership

2023 Global Ocean Container Greenhouse Gas Emission Intensities

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Smart Freight Centre. Clean Cargo 2023 Global Ocean Container Greenhouse Gas Emission Intensities. July 2024.

Smart Freight Centre

Smart Freight Centre (SFC) is an international non-profit organization focused on reducing the emission impacts of global freight transportation. Smart Freight Centre's vision is a zero-emission global logistics sector by 2050 or earlier, consistent with 1.5° pathways. Smart Freight Centre's mission is to accelerate the reduction of logistics emissions by fostering collaboration within the global logistics ecosystem.

The SFC's goal is to mobilize the global logistics ecosystem, particularly members and partners, to track and reduce its greenhouse gas emissions to achieve 1.5° pathways.

Clean Cargo

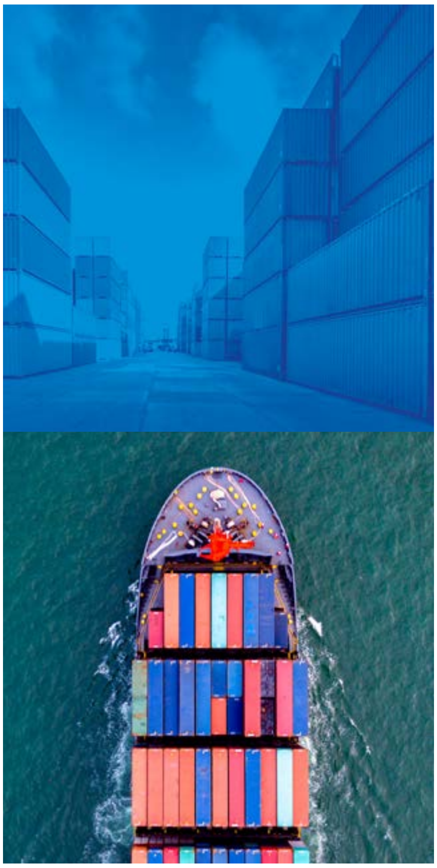
Clean Cargo is a collaborative initiative between ocean container carriers, freight forwarders, and cargo owners.

Clean Cargo serves as a source of high-quality containership greenhouse gas emission performance information that supports members in their work to decarbonize containerized ocean cargo transportation. Specifically, the Clean Cargo secretariat collects operational and technical data from ocean container carriers to generate containership emission performance information that:

- Offers access to primary data following the GLEC standardized framework and ISO 14083.
- By providing a standardized methodology and guideline for measuring and reporting carbon emissions associated with ocean container carriers enables members to identify areas for improvement and track progress in reducing emissions.
- Facilitates accurate greenhouse gas emissions inventory calculations for Clean Cargo members.
- This data-driven approach allows members to make informed decisions about their supply chain choices on ocean freight procurement decisions to minimize their carbon emission impact.

Clean Cargo also serves as a forum for sharing best practices for decarbonization amongst members.

2023 Greenhouse gas emission performance information



The emission performance information presented in this report is calculated using the Clean Cargo methods for a series of ocean container transportation trade lanes. The information in Table 1 represents the average annual performance[1] across all reporting Clean Cargo ocean container carrier members. For 2023, there were 18 reporting Clean Cargo carriers. These carriers accounted for approximately 88.3% of global ocean container freight capacity (by volume). By number, Clean Cargo carriers operated 4098 cellular vessels, representing 68.6% of the total container vessels at the end of 2023.

Clean Cargo emission intensities are based on emission factors that incorporate greenhouse gas emissions related to combustion and energy use resulting from all United Nations Framework Convention on Climate Change Kyoto Protocol greenhouse gases (currently, CO2, methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF6), and nitrogen trifluoride (NF3)). The emission factors that underly the Clean Cargo emission intensities include emissions associated with the entire life cycle of the production and use of each energy source.

Clean Cargo greenhouse gas emission intensities are shown in Table 1:

- **Are calculated based on each vessel's nominal capacity, assuming a 70% vessel capacity utilization factor (roundtrip voyage).**
- **Differentiate between emission intensities for refrigerated cargo (refrigerated) and non-refrigerated cargo (dry) based on each vessel's nominal refrigerated container capacity (reefer plugs) and the vessel's reported number of days of operation.**
- **Reflect emissions associated with the entire life cycle of the fuel consumed in the carriers' vessels (that is, the Table 1 emission intensities are Well-to-Wake intensities).**

Clean Cargo carrier member data used in calculating the emission intensities undergoes third-party verification.

Additional information on the methods behind the emission intensities included in Table 1 is accessible here.

1 Ocean cargo shippers and freight forwarders interested in carrier-specific emissions performance information are welcome to contact Smart Freight Centre at info@smartfreightcentre.org to learn more about membership in Clean Cargo.

Table 1 Average carrier dry and refrigerated container emission intensities in grams of carbon dioxide equivalent per twenty-foot equivalent unit-kilometer (gCO2e / TEU-km). Intensities reflect "Well-to-Wake" emission factors and assume 70% vessel capacity utilization.

In addition, for the trade from North Europe to/from North America's West Coast, there are no figures available for the report 2023[2]

Additional information on the methods behind the emission intensities included in Table 1 is accessible here.

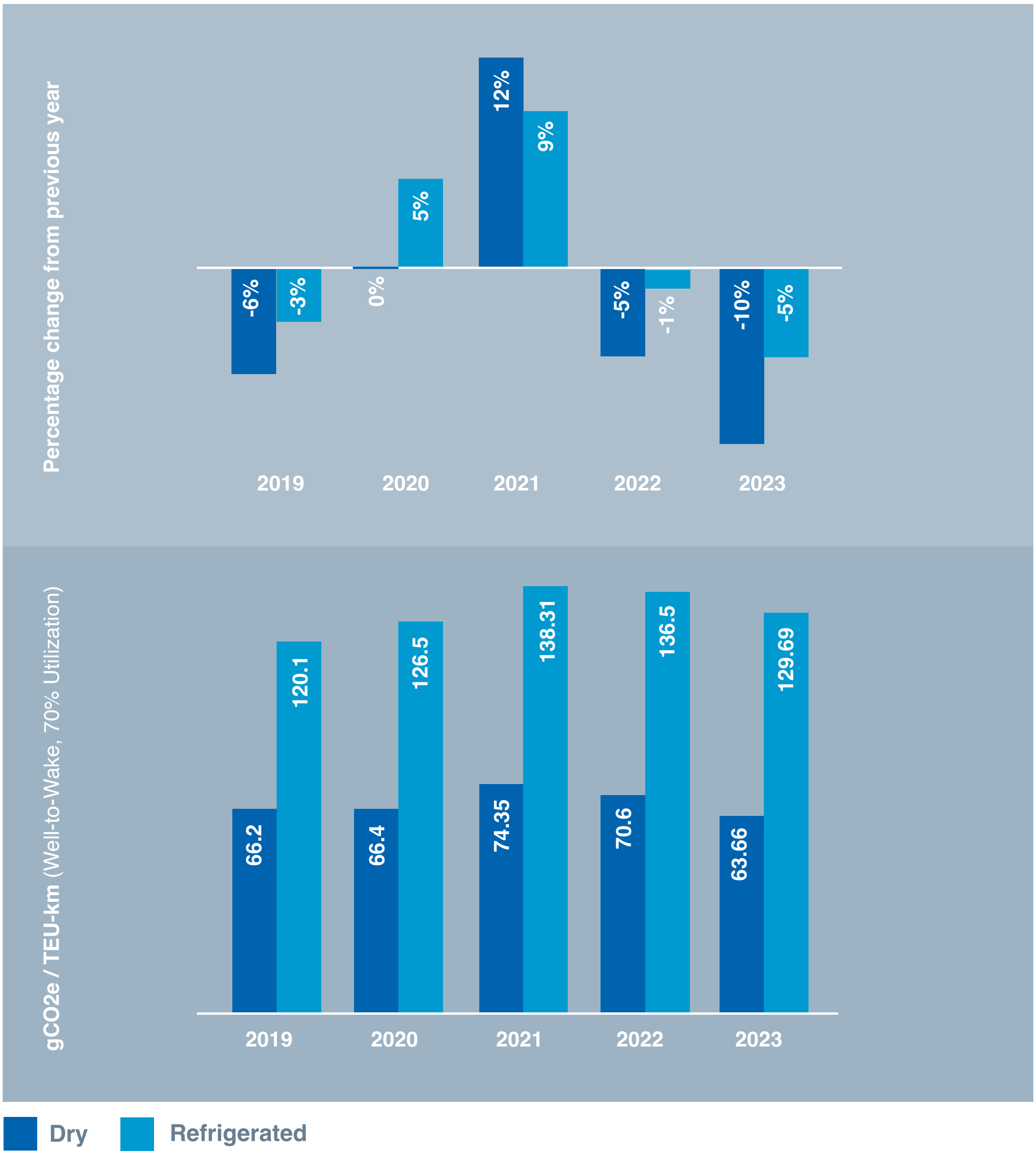
TRADE LANE	2023 Number of vessels: 4,098		2022 Number of vessels: 3,971		2021 Number of vessels: 3,737		2020 Number of vessels: 3,740		2019 Number of vessels: 3,493	
	Dry	Refrigerated	Dry	Refrigerated	Dry	Refrigerated	Dry	Refrigerated	Dry	Refrigerated
Asia to-from Africa	72.3	140.6	83.8	151.0	87.7	155.4	75.3	143.5	74.3	133.1
Asia to-from Mediterranean/Black Sea	42.1	109.0	48.7	114.5	48.0	111.4	46.6	104.7	50.3	104.8
Asia to-from Middle East/India	64.2	127.9	68.6	133.1	73.7	137.5	60.5	121.3	56.2	111.1
Asia to-from North America East Coast/Gulf	54.1	114.0	63.1	123.4	64.7	120.4	57.8	111.6	60.2	107.4
Asia to-from North America West Coast	56.8	120.7	65.7	131.7	71.3	138.2	64.1	121.7	67.1	116.5
Asia to-from North Europe	38.7	100.6	39.6	102.1	42.3	102.0	44.1	100.5	42.3	93.1
Asia to-from Oceania	85.0	152.4	96.0	165.6	100.7	168.6	88.4	149.2	86.4	138.6
Asia to-from South America (Including Central America)	61.0	120.7	70.8	127.3	71.5	125.9	63.1	118.2	60.5	109.9
Europe (North and Med) to-from Africa	89.4	163.9	99.7	172.7	102.2	174.0	100.2	171.3	100.9	164.9
Europe (North and Med) to-from S America (Inc Cent America)	71.7	138.3	81.6	142.8	79.6	139.7	68.8	126.2	67.4	121.2
Europe (North and Med) to-from Middle East/India	54.6	121.1	63.2	129.5	68.5	132.6	58.9	119.2	55.8	108.3
Europe (North and Med) to-from Oceania (via Suez/via Panama)	78.6	139.6	81.9	141.4	82.8	139.5	81.9	138.7	80.0	131.2
Mediterranean/Black Sea to-from North America East Coast/Gulf	80.4	152.0	92.0	167.0	88.4	154.0	77.1	139.2	80.1	136.6
Mediterranean/Black Sea to-from North America West Coast	56.4	130.6	48.9	122.8	62.3	131.1	71.9	129.9	77.8	134.4
North America East Coast/Gulf/West Coast to-from Africa	111.3	180.1	131.7	192.2	134.2	193.5	124.3	201.1	138.9	190.7
North America East Coast/Gulf/West Coast to-from Oceania	74.1	133.1	80.0	145.1	109.7	173.7	103.5	156.0	106.4	156.7
N America E Coast/Gulf/W Coast to-from S America (Inc Cent America)	84.1	152.6	88.1	153.3	91.6	156.5	82.5	143.2	82.3	134.7
N America E Coast/Gulf/W Coast to-from Middle East/India	72.8	135.0	75.3	138.6	79.9	137.7	70.9	125.9	66.0	115.9
North Europe to-from North America East Coast/Gulf	78.0	143.6	88.9	160.6	92.2	159.5	84.5	144.4	86.9	141.1
North Europe to-from North America West Coast			76.4	142.0	88.6	170.0	75.9	134.2	64.0	117.5
South America (Including Central America) to-from Africa	101.0	174.9	138.2	206.6	110.6	186.8	122.4	200.0	115.9	174.0
Intra Africa	115.1	214.0	133.7	224.9	135.2	233.0	127.1	219.0	118.3	201.2
Intra North America East Coast/Gulf/West Coast	214.5	294.5	202.9	283.0	171.5	233.7	177.6	241.8	143.2	203.3
Intra South America (Including Central America)	100.1	176.3	116.4	193.0	108.4	176.0	103.9	177.0	103.1	169.9
South East Asia to-from North East Asia	90.1	157.8	98.6	169.6	98.1	168.3	84.0	148.4	91.3	150.6
Intra North East Asia	100.7	177.1	110.7	184.8	118.9	187.8	103.5	182.8	101.7	173.7
Intra South East Asia	116.1	195.2	125.2	202.1	117.4	193.2	112.5	194.2	102.6	176.8
North Europe to-from Mediterranean/Black Sea	64.4	131.0	73.1	140.5	104.2	173.9	95.8	160.1	98.8	158.0
Intra Mediterranean/Black Sea	137.5	240.2	158.8	264.8	148.2	250.2	134.3	239.4	128.3	220.6
Intra North Europe	141.3	234.9	140.3	232.9	143.3	233.2	138.4	221.6	139.8	221.4
Intra Middle East/India	106.3	187.2	117.6	197.1	126.1	223.2	108.9	197.1	95.9	171.6
Other	84.9	162.9	85.9	164.3	106.7	179.2	110.9	182.5	78.3	139.9
Average Across all Trade Lanes	63.7	129.7	70.6	136.5	74.4	138.3	66.4	126.5	66.2	120.1

2 None of the Clean Cargo Ocean Container Carriers reported Vessel on this tradelane.

Emission intensity trends

Clean Cargo carrier GHG emission intensities for 2023, averaged across all reporting carriers and all trade lanes, were approximately 10% (dry) and 5% (refrigerated) lower than the 2022 emission intensities.

Figure 1 The 2019-2023 trend in global average Clean Cargo carrier emission intensities (gCO2e/ TEU-km, assuming 70% vessel capacity utilization and using Well-to-Wake emission factors).



Overall trends

Geopolitical tensions continued to leave their mark in 2023. Russia-Ukraine war and deteriorating US-China relations strained the atmosphere on the global stage. The complexity deepened with the eruption of the Israel–Hamas war in October. The world has again become more fragmented, with widespread consequences for the global economy and trade. The year saw a gradual easing of inflationary pressures from peak levels. However, economies are still experiencing inflation at elevated levels, forcing central banks to act and posing ongoing challenges for the global economy. Striking a delicate balance between taming high inflation and fostering economic growth remains a crucial concern for central banks worldwide.

Technological advancements in artificial intelligence (AI) accelerated during 2023, bringing a wave of optimism to the shipping industry. AI's potential contribution to reducing emissions and improving energy efficiency is gaining prominence, paving the way for a more sustainable future for global seaborne transport.

World seaborne trade volumes increased by around 3% in 2023. However, the increased cost of living has shifted consumption patterns, leading to decreased demand for containerized goods and container vessels. This shift in consumer behaviour has significantly impacted the shipping industry, affecting both trade volumes and vessel demand.

The shipping industry is volatile, and shipowners are used to adjusting accordingly. During 2023, container shipowners and operators reduced vessel speeds and idled capacity to cope with the significant fall in demand.

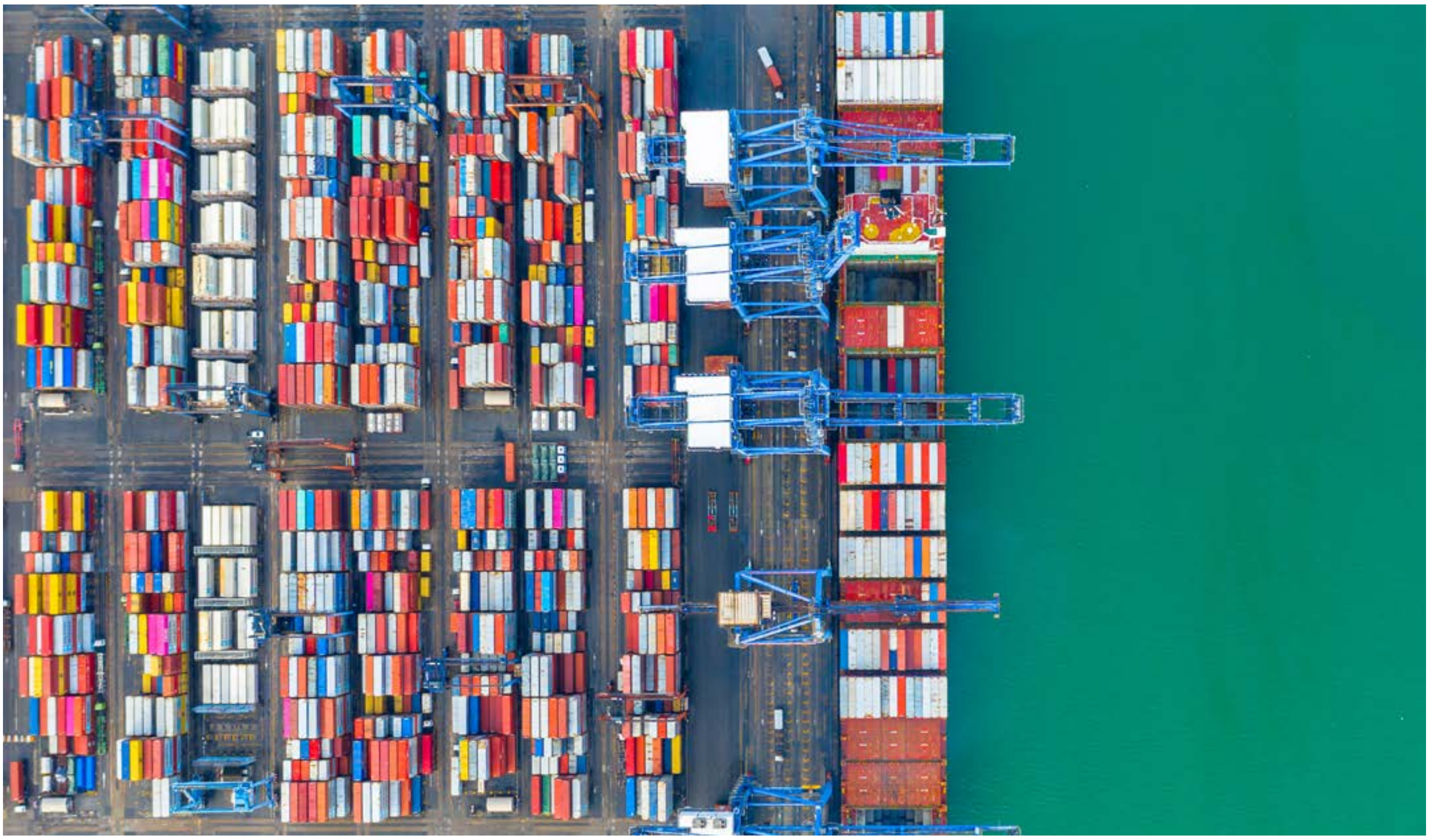
The climate agenda is front and centre in the shipping industry. No silver bullets exist, but the maritime sector is fortunate to navigate a global regulatory framework governed by the International Maritime Organization (IMO). In 2023, the IMO reached a consensus to tighten GHG regulations, closing some of the gap with the objectives of the Paris Agreement. Starting in 2024, the shipping industry will begin operating by new rules introduced by the IMO.

The IMO has introduced technical and operational measures to ensure the shipping industry reduces its climate footprint. The Energy Efficiency Design Index (EEDI) requires new vessels to be built to reduce the industry's climate impact. At the same time, the Carbon Intensity Indicator (CII) targets the operational efficiency of existing vessels.

Regional initiatives supplement global regulations. The European Union has included the shipping industry in its Emission Trading System (ETS) from 2024. This introduces a carbon tax on CO2 emissions from vessels entering EU ports. Moreover, a vital component of the EU's Fit for 55 packages is the FuelEU Maritime initiative, which aims to stimulate demand for renewable and low-emission fuels in the maritime sector. The FuelEU Maritime regulation is expected to take effect in 2025.

The container market has continued its downward ride after stellar years during the pandemic.

The fleet's cargo-carrying capacity increased significantly during 2023, when high inflation and soaring interest rates reduced demand for containerized goods. As a result, both freight rates and second-hand ship prices experienced substantial declines. A massive inflow of vessels is still projected for 2024 and next year, while high inflation is expected to continue to weigh on the outlook for the global economy. The container market is, therefore, expected to suffer from surplus vessel capacity in the coming years, likely leading to further declines in freight rates and increased scrapping of vessels.



Potential drivers of the intensity changes

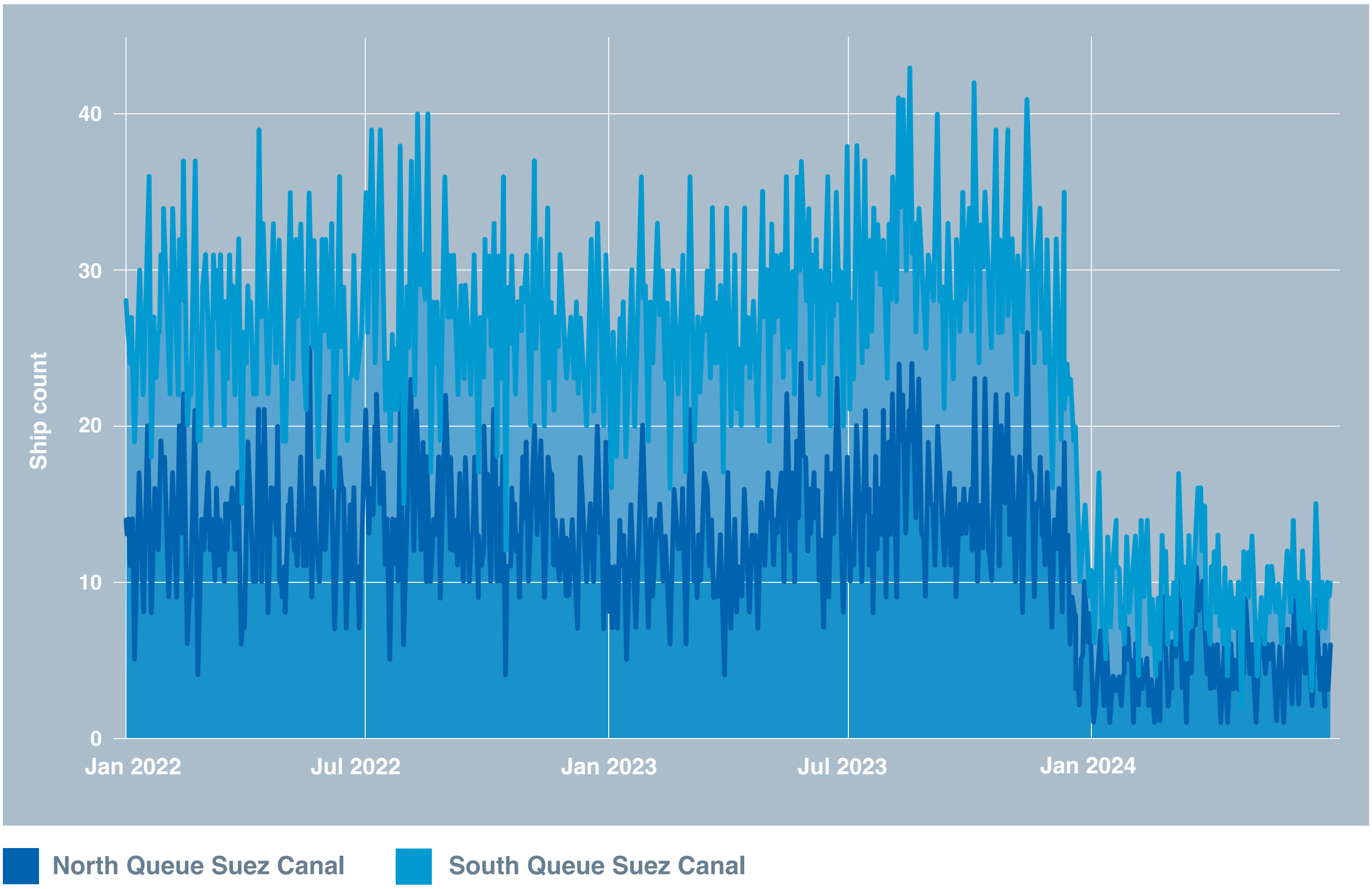
The volume of international maritime trade has steadily increased over the last decade, with over 80% of world merchandise trade shipped by sea. Efficient, environmentally friendly, and low-cost maritime transport systems that connect global supply chains are the driving force for sustainable economic growth.

Given the competitive business environment, an ocean container shipping company seeks efficient freight solutions through on-time delivery by enhancing service schemes and fleet deployment. Finding the optimal routes, schedules, and plans for a fleet of various container vessels is challenging and becomes more so when, in most cases, considering the uncertainty that governs the maritime shipping environment.

Uncertainty in maritime transport is either because of variations in operating parameters or unexpected disruptions. Some important operation parameters relate to port bottlenecks, container terminals, and waiting time before berthing. Unexpected disruptions refer to rare or one-off occurrences, like port closure, congestion, berth prioritization, and inclement weather. This is significant for an ocean container carrier with many container vessels dispersed in the seas. For example, on November 19, 2023, missiles were fired from Houthi rebels in Yemen, backed by Iran and siding with Palestine in the conflict. This happened in the Red Sea and the Bab al-Mandab Strait. The situation risks seafarers' lives and is unsustainable for global trade.

Subsequently, Ocean Container Lines announced diverting several vessels due to the threat in the Red Sea, giving new extended sailing plans through the Cape of Good Hope in Africa. It is a similar example; in March 2021, a 20125 TEU container vessel, buffeted by winds, blocked the Suez Canal for six days, resulting in a long queue of vessels lining up to pass, delaying reaching their destinations on time. In this regard, 70–80% of vessel round trips experience delays (sometimes for days) in at least one port. (See following Chart 1)

Chart 1 **Suez Canal Congestion (only container ships)**



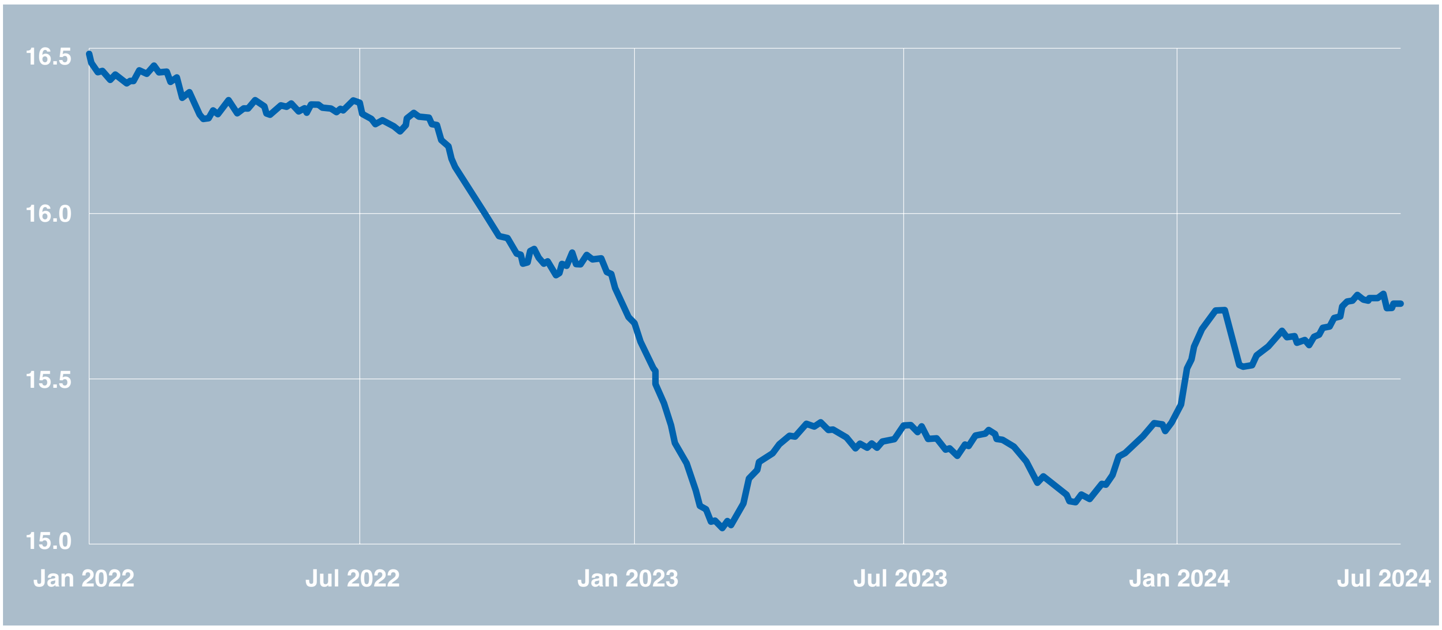
Source: Alphaliner Market info 2022-2023

Ocean container vessels need to take several countermeasures to reduce the adverse effects of sudden disruptions. A vessel's schedule can be recovered by actions like (a) omitting a port, (b) adjusting the vessel speed, and (c) swapping the order of ports. To mitigate delays caused by one or more call ports, a ship would increase its speed to get back on schedule, significantly increasing the fuel consumption rate and, consequently, the amount of CO_2 emitted. However, swapping of call ports is impractical for a vessel with a fixed order of calls or one that needs to load and unload goods.

What factors might have contributed to the decreased fleetwide average greenhouse gas emission intensity for 2023, and could other external factors influence this reduction?

The decreased fleetwide average GHG emission intensity for 2023 compared to 2022 can be attributed to several factors closely related to better fleet operations. Reduced port congestion has led to fewer speed-ups, resulting in more balanced and lower average speeds (See Chart 2). This operational improvement directly affects carbon intensity, as vessel congestion negatively impacts it. Therefore, alleviating congestion has contributed significantly to the reduction in carbon intensity.

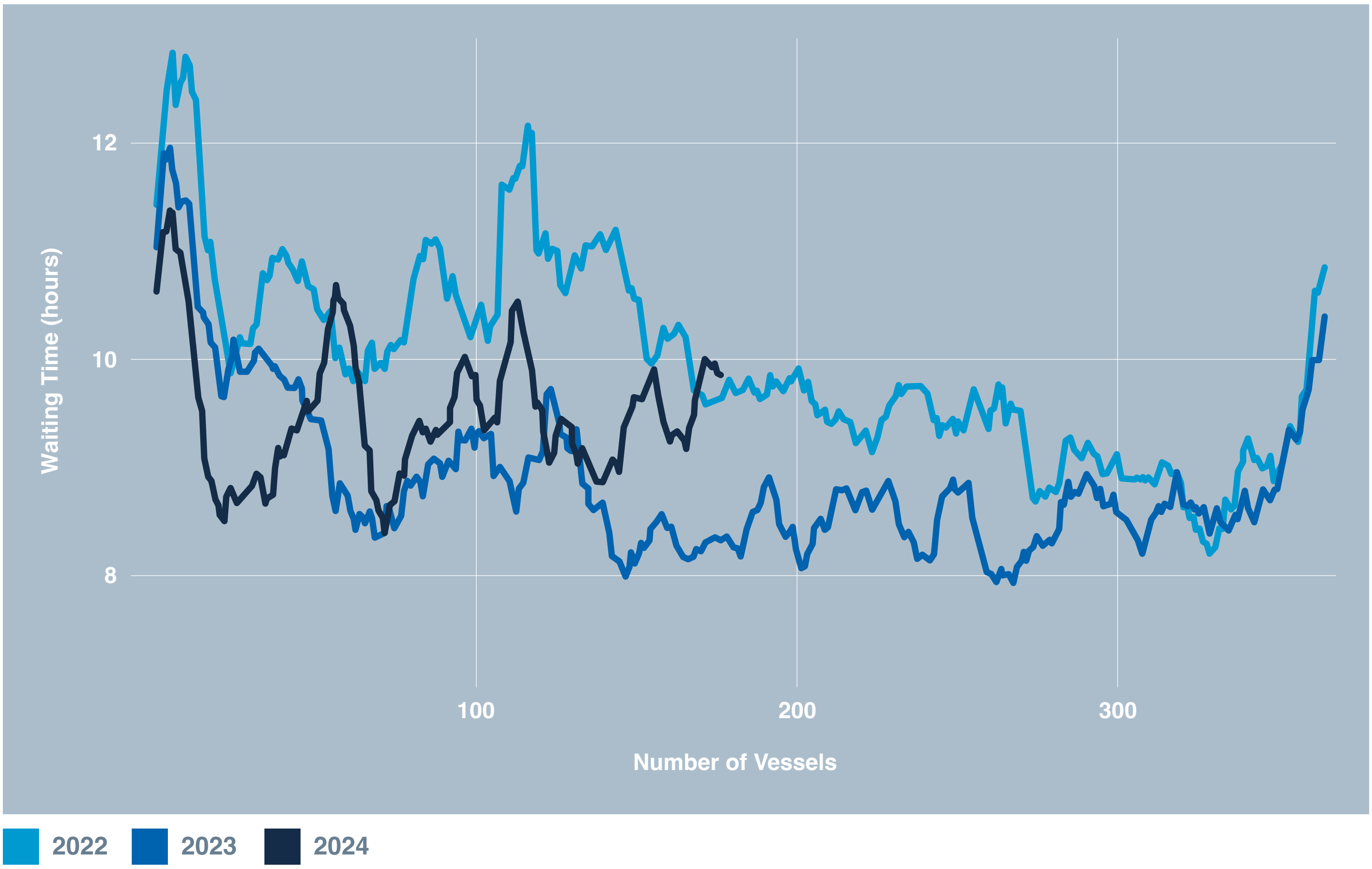
Chart 2 Global Container ships – Average Speed (knots)



Source: Alphaliner Market info 2022-2023

Improvements to existing vessels, such as modifications to the bulbous bow and other retrofitting measures, along with adding significant new buildings to the fleet, have further supported emission reductions. The stabilization of maritime transportation supply chains following COVID-induced disruptions that impacted vessel activities in 2021 and 2022 has also played a role. As vessel operations normalize (See Chart 3), the need to increase speed to recover from delays decreases, allowing for more opportunities for speed optimization.

Chart 3 Container Vessels W/T - Seasonality



Source: Alphaliner Market info 2022-2023

Another contributing factor is the high vessel capacity utilization. Larger vessels, when fully utilized, often operate at lower emission intensities than smaller vessels. If the increase in capacity is due to the upsizing of each vessel, it leads to an improvement in carbon intensity. The fleet's upsizing and the anticipated positive effects of this on carbon intensity also support the observed reduction in GHG emission intensity.

Additionally, several external factors might be influencing this reduction. Stricter international regulations on GHG emissions from shipping are pushing the industry towards more efficient operations. Technological advancements in marine propulsion systems, hull designs, and fuel types contribute to lower emissions. Economic factors, such as fluctuations in fuel prices, can incentivize more fuel-efficient practices and technologies. Environmental awareness and corporate responsibility pressures from stakeholders, including investors and customers, are driving shipping companies to focus more on reducing their carbon footprint. Collaborative efforts within the maritime industry to reduce emissions and improve efficiency, such as data sharing and joint development projects, also play a significant role.

In summary, the decrease in fleetwide average GHG emission intensity in 2023 compared to 2022 results from improved fleet operations, technological enhancements, supply chain stabilization, and efficient capacity utilization. External factors such as regulatory changes, technological advances, economic considerations, increased environmental awareness, and collaborative industry efforts contribute to this positive trend.

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Using the 2023 emission performance intensities

For further information on how to apply the 2023 Clean Cargo greenhouse gas emission intensities in greenhouse gas emission footprint calculations, please see the Global Logistics Emissions Council Framework.

Information

For more information on Smart Freight Centre or Clean Cargo, please visit our website at www.smartfreightcentre.org.

You can also contact Smart Freight Centre directly by email at info@smartfreightcentre.org, or by phone at +31 6 4695 4405.