MODULE 3 | 3.7

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Shipping

SLOCAT Partnership on Sustainable, Low Carbon Transport

Transport, Climate and Sustainability
Global Status Report - 3rd edition

Key findings

Demand trends

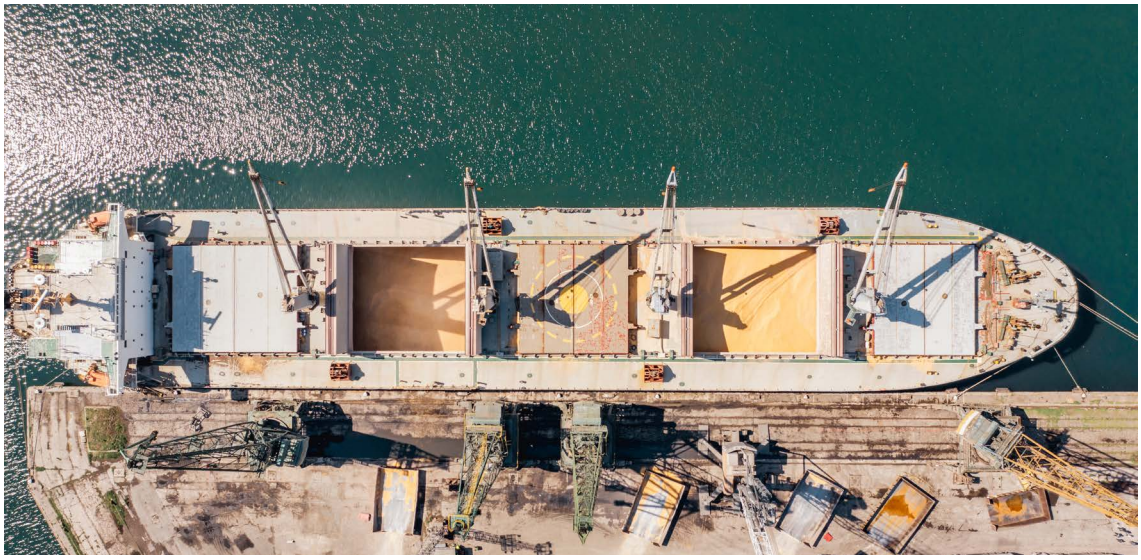
- Maritime trade volumes have increased four-fold in the last four decades, leading to more competitive shipping rates through economies of scale. The maritime shipping industry moves around 11 billion tonnes of goods annually, roughly 300 times more than is moved by aircraft.
- At the beginning of 2023, global container shipping rates were almost back to pre-pandemic levels, defying predictions of the pandemic driving a paradigm shift in container shipping.
- Following the Russian invasion of Ukraine in February 2022, the capacity of container shipping fleets was reduced in the Russian Federation, and operations at Ukrainian ports were suspended until July 2022, when grain exports resumed.
- As much as 40% of maritime trade consists of transporting fossil fuels (such as oil, coal and liquefied natural gas, LNG) from points of fuel production to points of fuel consumption. By 2050, global fossil fuel demand is projected to decline 80% for coal, 50% for oil, and 25% for natural gas, which could lead to stranded assets for fossil fuel transport in the shipping industry.
- The average age of the world's container shipping vessels increased from 10.3 years in 2011 to 13.7 years in 2022. This ageing global fleet is leading to increasing pollution per unit of volume.
- Since mid-2020, higher shipping costs have been driven by events such as the COVID-19 pandemic and the Russian invasion of Ukraine.
- As of 2021, advanced biofuels for shipping cost two to three times as much as conventional fuel and thus were not yet widely commercially viable.
- Inland waterway freight activity in the European Union (EU) increased 3.3% in 2021, with container ship demand rebounding after several years of volatility.

Emission trends

- Carbon dioxide (CO_2) emissions from the international shipping sector grew 5% in 2021, reversing a decline in 2020 and returning to 2017 levels. CO_2 emissions from the world's maritime shipping fleet grew an estimated 4.7% in 2022 and increased 23.8% overall between 2012 and 2022.
- Although international shipping has the lowest CO_2 emissions per tonne-kilometre among transport modes, the sector emitted around 700 million tonnes of CO_2 in 2021, a total exceeded by only five countries: China, the United States, India, the Russian Federation and Japan.
- Even in a scenario in which measures taken by the International Maritime Organization (IMO) contribute to lowering emissions, a 15% decline in emissions between 2021 and 2030 is needed to enable the sector to achieve net zero emissions by 2050.
- In 2019, inland waterway transport produced far fewer CO_2 emissions than road or rail transport while contributing to several of the United Nations Sustainable Development Goals. Inland waterway transport is responsible for 2% of the global greenhouse gas emissions from transport.
- Roughly 5% of maritime fuels must be zero carbon by 2030 to achieve the targets of the Paris Agreement. As of 2021, however, biofuels accounted for less than 1% of total shipping energy use.
- Sails are making a comeback in decarbonisation pledges, with more than 20 commercial ships using "wind-assist" technologies retrofitted to existing vessels as of 2023. Battery-electric propulsion is emerging as a low-emission option for the marine shipping sector, due to its considerable potential for emission reduction.
- A global carbon price on maritime shipping would create further incentives to accelerate development of biofuels, wind propulsion and battery-electric vessels.

Policy developments

- An IMO submission in 2022 suggests increased ambition towards mitigating emissions, with the Energy Efficiency Existing Ship Index and the Carbon Intensity Indicator entering into force in 2023.
- In June 2023, the IMO adopted a revised strategy to reduce greenhouse gas emissions from international shipping to at least 70% below 2008 levels by 2040, and striving for 80%. This is a major improvement from the IMO's initial 2018 strategy, which aimed at a 50% reduction by 2050.
- Overall, the revised IMO strategy raises the level of ambition for emission mitigation and is estimated to place the international shipping sector well within the carbon budget required to align with a scenario of keeping global temperature rise below 2 degrees Celsius (°C) compared to pre-industrial levels. However, the strategy remains insufficient to support the carbon budget in a scenario of keeping global temperature rise within 1.5°C.
- The revised IMO strategy does not directly enforce a carbon price for maritime shipping despite earlier IMO working group meetings giving hope for such an economic levy, which was seen as a breakthrough by many Parties to the Paris Agreement.
- As of 2022, only 35% of major maritime shipping companies had set a target for net zero emissions by 2050 and/or had committed to the 2018 IMO target of a 50% emission reduction by 2050. A third of commitments by firms had identified a fuel strategy, with LNG being the most common conventional fuel and ammonia the most common alternative fuel.
- During 2021 and 2022, a varied group of ports, cities, cargo owners, and shipping companies and manufacturers issued commitments and calls for decarbonising the sector by 2050 and making zero-emission vessels widespread by 2030.
- For domestic maritime transport (coastal and inland shipping), very few efforts are in place to support a shift from road freight to inland waterways.
- The Maritime Just Transition Task Force of the UN Framework Convention on Climate Change was established in 2021 to facilitate a decarbonised shipping industry, followed by the launch of the Just Transition Work Programme in 2022. Maritime shipping has been identified as one of the "hard-to-abate" sectors targeted under the Mitigation Work Programme adopted in 2022.
- Emissions from international shipping continue to be outside the scope of countries' Nationally Determined Contributions (NDCs) towards reducing emissions, due to a lack of clarity in the Paris Agreement.
- With additional cost pressures deriving from the Russian Federation's invasion of Ukraine, and despite the new IMO targets, there is a strong risk that shipping decarbonisation will slip further down the policy agenda.



Overview

Maritime shipping was much less affected by the COVID-19 pandemic than other forms of transport, and by early 2023 global container shipping rates had nearly returned to 2019 levels. Containers were moving rapidly in and out of China, whereas container activity in Europe and the United States was slower to recover due to ongoing port congestion.

Due to trade restrictions with the Russian Federation – a leading oil and gas exporter – energy costs and thus shipping costs increased in 2022. Many ships had to be rerouted, as transport to and from the Russian Federation and Ukraine was at least temporarily halted, leading to additional delays, higher port charges and increased pressure on storage capacity.

In 2023, a key policy development in the maritime shipping sector was the International Maritime Organization's (IMO) adoption of a revised strategy to address greenhouse gas emissions from international shipping, including ambitious targets to reduce emissions up to 80% by 2040, compared to 2008 levels.[1] Under the new strategy, the international shipping sector would be able stay within the carbon budget required to keep global temperature rise below 2 degrees Celsius (°C) (although not below 1.5°C).[2]

Additional policy steps during 2021 and 2022 included the establishment of the Maritime Just Transition Task Force and the launch of the Just Transition Work Programme, which support a safe, equitable and human-centred transition towards a decarbonised shipping industry; these initiatives also help to advance progress on the United Nations Sustainable Development Goals (SDGs), including SDG 3 (health and well-being), SDG 8 (decent work and economic growth) and SDG 10 (reduced inequalities).[3]

Demand trends

Maritime trade volumes have increased four-fold in the last four decades, leading to more competitive shipping rates through economies of scale.[4] **The maritime shipping industry moves around 11 billion tonnes of goods annually, roughly 300 times more than is moved by aircraft.**[5] In the European Union (EU), maritime shipping accounts for around 80% of total exports and imports by volume (and around 50% by value).[6]

At the beginning of 2023, global container shipping rates were almost back to pre-pandemic levels, defying predictions of the pandemic driving a paradigm shift in container shipping.[7] Trends for 2022 showed containers moving in and out of China faster than ever, while ongoing congestion in Europe and the United States continued to slow the recovery of global maritime shipping.[8]

Following the Russian invasion of Ukraine in February 2022, the capacity of container shipping fleets was reduced in the Russian Federation, and operations at Ukrainian ports were suspended until July 2022, when grain exports resumed.[9] Reduced grain exports resulted in higher food prices, as the Russian Federation and Ukraine had been responsible for 53% of global trade in sunflower oil and 27% of trade in wheat (as of early 2022).[10] Sourcing of grains and other food imports has since shifted to Australia and Brazil, among other countries.[11]

In vulnerable regions that depend highly on maritime transport, such as small-island developing states, consumer prices could increase up to 8.1% between 2021 and 2022, according to the UN Conference on Trade and Development (UNCTAD).[12] As a result of the conflict-related disruptions, container shipping demand has shifted towards other European countries such as Denmark, Estonia, Latvia, Lithuania, Romania and Sweden (see Figure 1).[13]

As much as 40% of maritime trade consists of transporting fossil fuels (such as oil, coal and liquefied natural gas, LNG) from points of fuel production to points of fuel consumption.[14] In 2021, the shipping industry transported nearly 2 billion tonnes of crude oil, in addition to more than 1 billion tonnes of coal and 500 million tonnes of LNG.[15] In turn, nearly 100% of maritime shipping vessels relied on fossil fuels for propulsion as of March 2023 (see Figure 2).[16]

By 2050, global fossil fuel demand is projected to decline 80% for coal, 50% for oil, and 25% for natural gas, which could lead to stranded assets for fossil fuel transport in the shipping industry.[17] With a minimum lifespan of 20 years for most vessels, there is a risk that the continued procurement of ships that transport fossil fuels will lead to inefficiencies in shipping fleets.[18]

The average age of the world's container shipping vessels has increased from 10.3 years in 2011 to 13.7 years in 2022; the ageing global fleet is increasing pollution per unit volume.[19] Commercial fleets are ageing as many ship owners are delaying orders for new vessels due to uncertainty about technology trajectories, cost-efficient fuels and carbon pricing.[20]

FIGURE 1. Container shipping fleet deployment of selected countries, by capacity, 2018 to mid-2022

Source: See endnote 13 for this section.

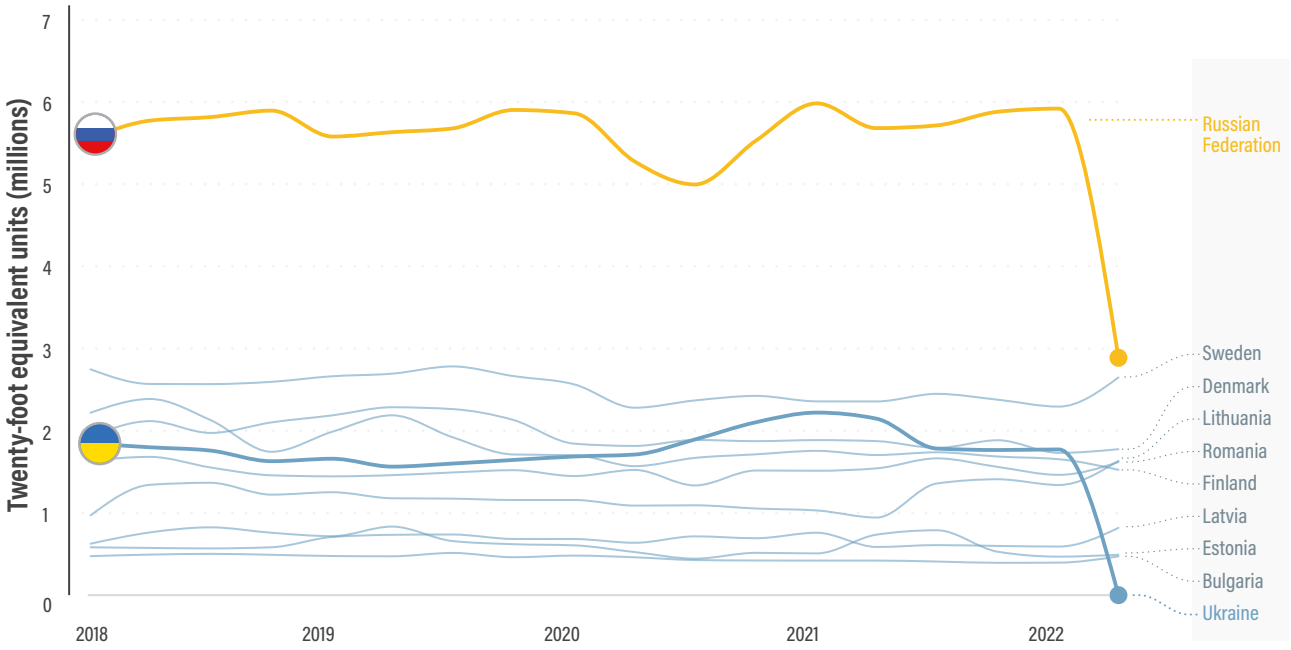


FIGURE 2. Shares of fossil fuels in international shipping and shipping vessel propulsion, as of March 2023

Source: See endnote 16 for this section.

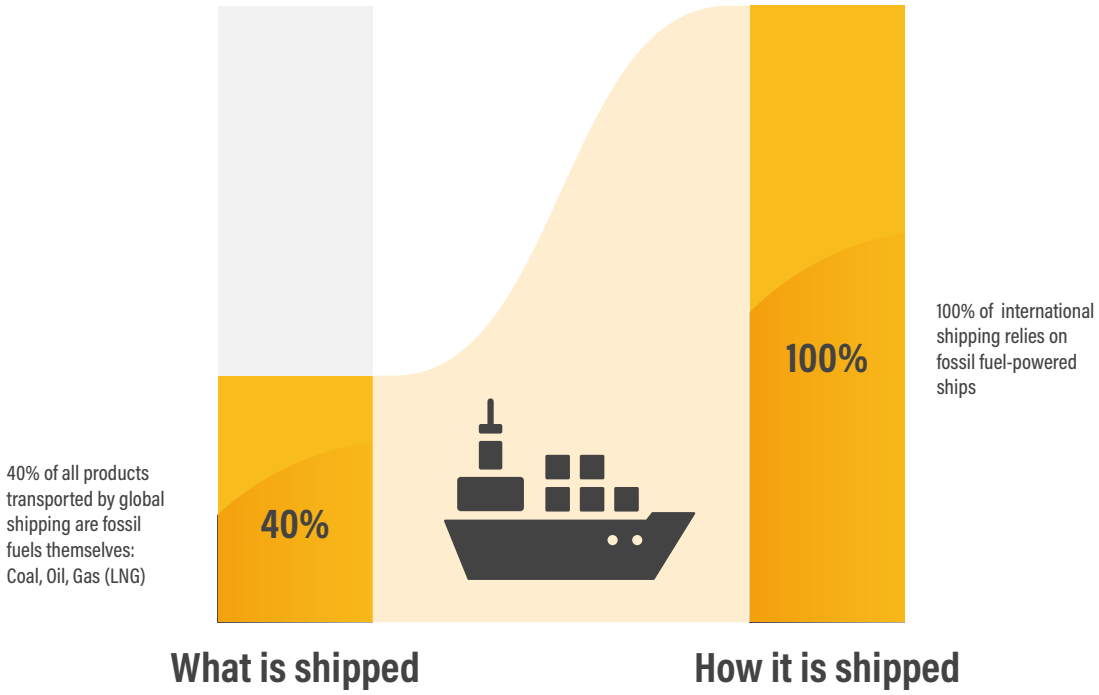
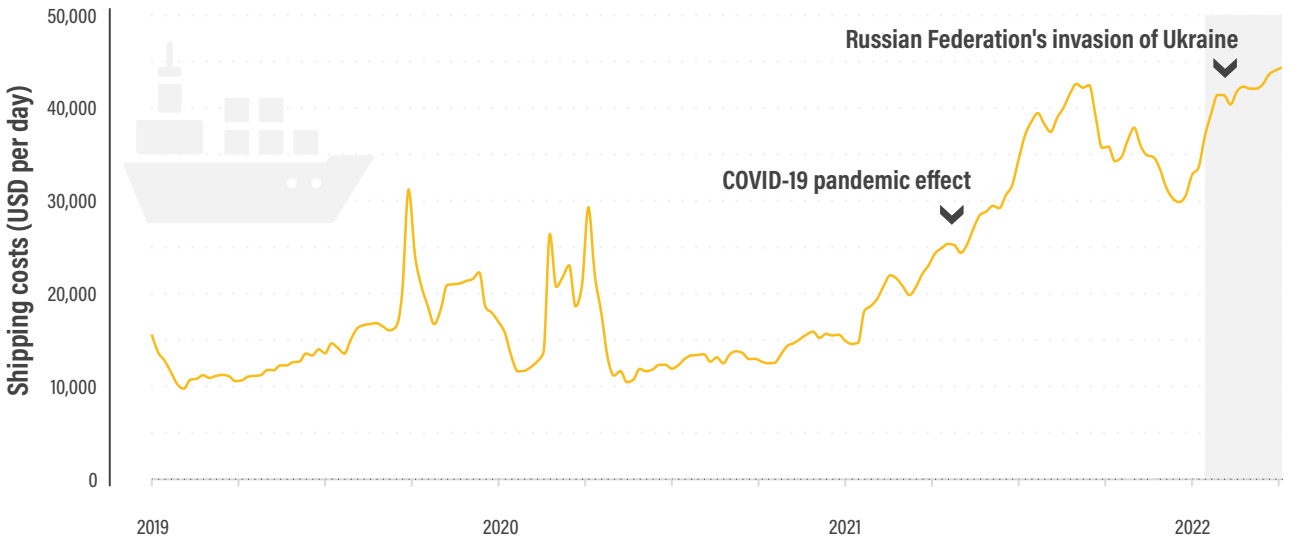


FIGURE 3. Rising costs of shipping, 2019 to mid-2022

Source: See endnote 23 for this section.



In 2021, the global commercial fleet grew less than 3%, the second lowest growth rate since 2005.[21]

Since mid-2020, higher shipping costs have been driven by events such as the COVID-19 pandemic and the Russian invasion of Ukraine. High energy prices are a key contributor to increased maritime shipping costs. The average price of fuel oil increased nearly two-thirds from January to May 2022.[22] The average fuel surcharge by container shipping lines rose nearly 50% during this period (see Figure 3).[23]

As of 2021, advanced biofuels for shipping cost two to three times as much as conventional fuel and thus were not yet widely commercially viable.[24] The annual consumption of diesel fuel in maritime shipping in 2020 was 240 million tonnes oil equivalent (mtoe), whereas the amount of biofuels needed for sector decarbonisation is 220 mtoe.[25]

Inland waterway freight activity in the EU increased 3.3% in 2021, with container ship demand rebounding after several years of volatility.[26] After a period of relative stability from 2011 to 2017, freight transport demand in EU inland waterways has fluctuated since 2017 due to factors including the pandemic and slow economic growth (see Figure 4).[27]

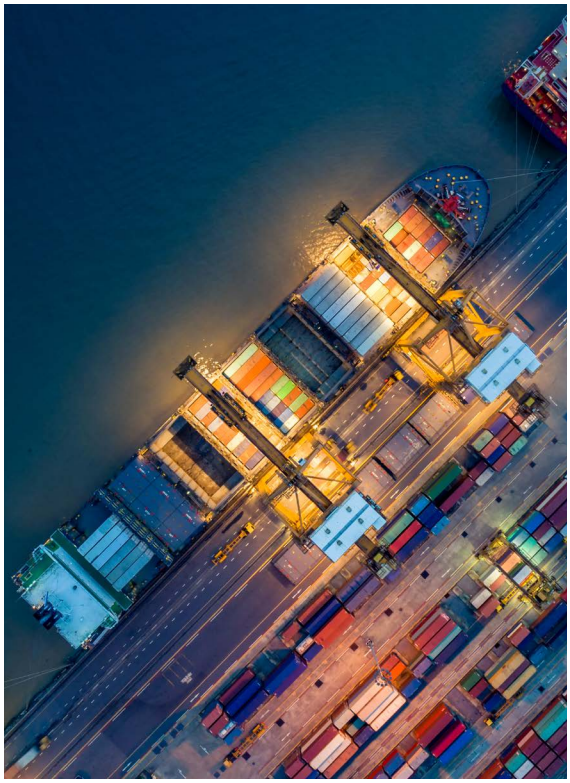
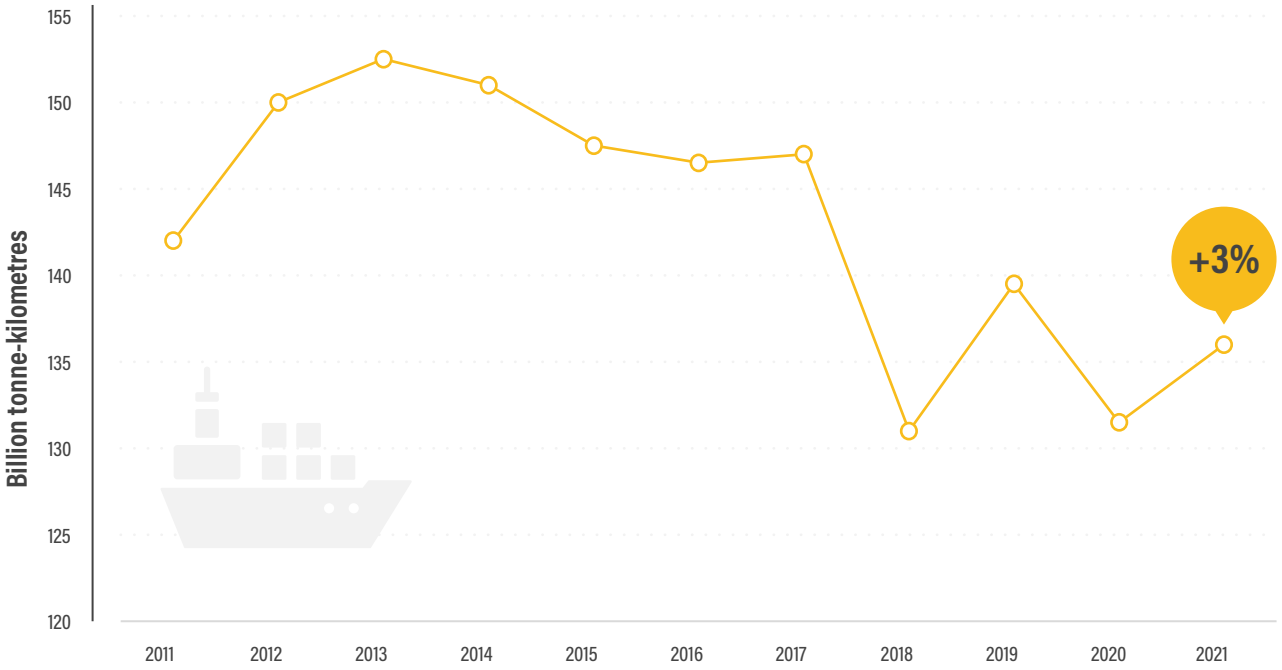


FIGURE 4. Inland waterway freight transport activity in the European Union, 2011-2021

Source: See endnote 27 for this section.



Emission trends

Carbon dioxide (CO_2) emissions from the international shipping sector grew 5% in 2021, reversing a decline in 2020 and returning to 2017 levels.[28] International shipping emissions accounted for around 3% of total energy-related CO_2 emissions in 2021 and were poised to grow further in 2022 (see Figure 5).[29] **CO_2 emissions from the world's maritime shipping fleet grew an estimated 4.7% in 2022 and increased 23.8% overall between 2012 and 2022** (see Figure 6).[30]

Although international shipping has the lowest CO_2 emissions per tonne-kilometre among transport modes, the sector emitted around 700 million tonnes of CO_2 in 2021, a total exceeded by only five countries: China, the United States, India, the Russian Federation and Japan.[31] Global maritime shipping released more emissions than all of Germany in 2021; nevertheless, emissions from international shipping are not included in countries' national emission inventories (*see Policy Developments section*).

Even in a scenario in which measures taken by the International Maritime Organization contribute to lowering emissions, a 15% decline in emissions between 2021 and 2030 is needed to enable the sector to achieve net zero emissions by 2050.[32] Meeting this target would require CO_2 emissions from maritime shipping to remain steady until 2025 (rather than rising, as they are currently) and then to decrease 3% annually until 2030.[33] In 2019, China's coastal shipping sector alone released around 45 million tonnes of CO_2, roughly 4.5% of the country's total transport emissions.[34] Mandatory energy efficiency standards for ships, as well as low-carbon fuel regulations, could support a peaking of emissions from China's domestic coastal shipping by 2040 and a decline by 2060.[35]

In 2019, inland waterway transport produced far fewer CO_2 emissions than road or rail transport while contributing to several of the UN Sustainable Development Goals (SDGs).[36] **Inland waterway transport is responsible for 2% of the global greenhouse gas emissions from transport.**[37] Inland waterway freight transport (or "inland towing") produced 30% fewer emissions than rail freight and nearly 90% fewer emissions than road freight (per tonne-kilometre) in 2019 (see Figure 7).[38] By reducing energy use and shifting freight transport away from agglomerations, inland waterway transport contributes to SDG 3 (health and well-being), SDG 7 (energy), SDG 9 (industry, innovation and infrastructure) and SDG 13 (climate action).[39]

FIGURE 5. Monthly emissions from international shipping, 2019-2022

Source: See endnote 29 for this section.

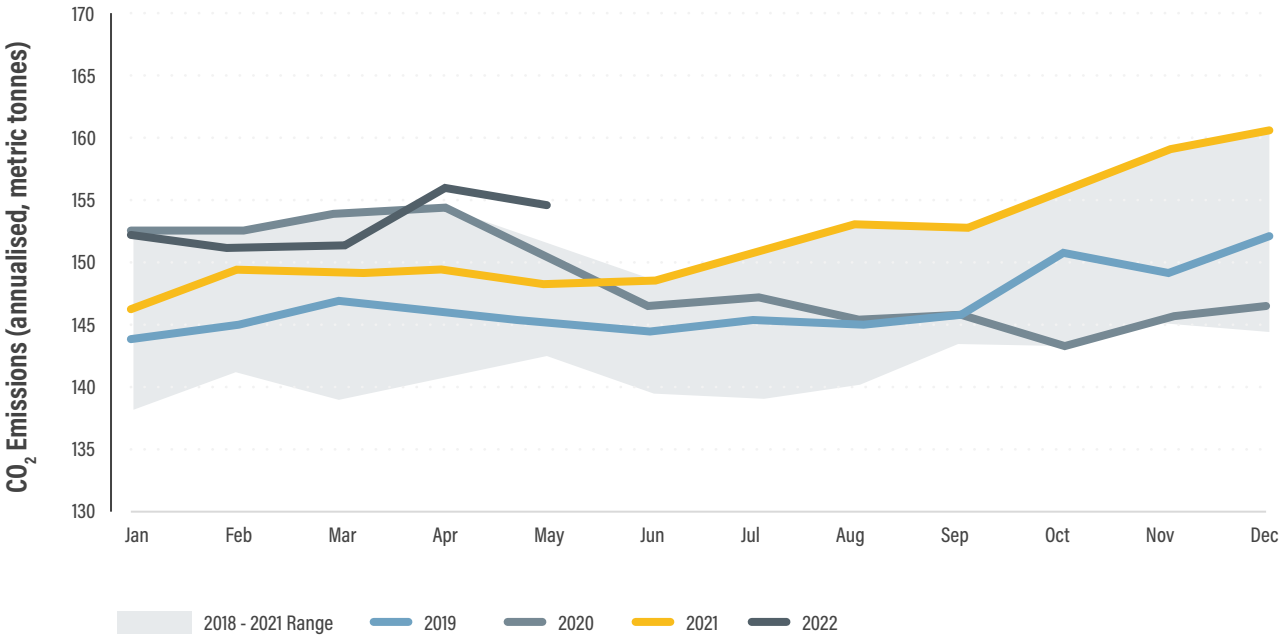


FIGURE 6. CO_2 emissions from the world's commercial shipping fleet, 2012-2022

Source: See endnote 30 for this section.

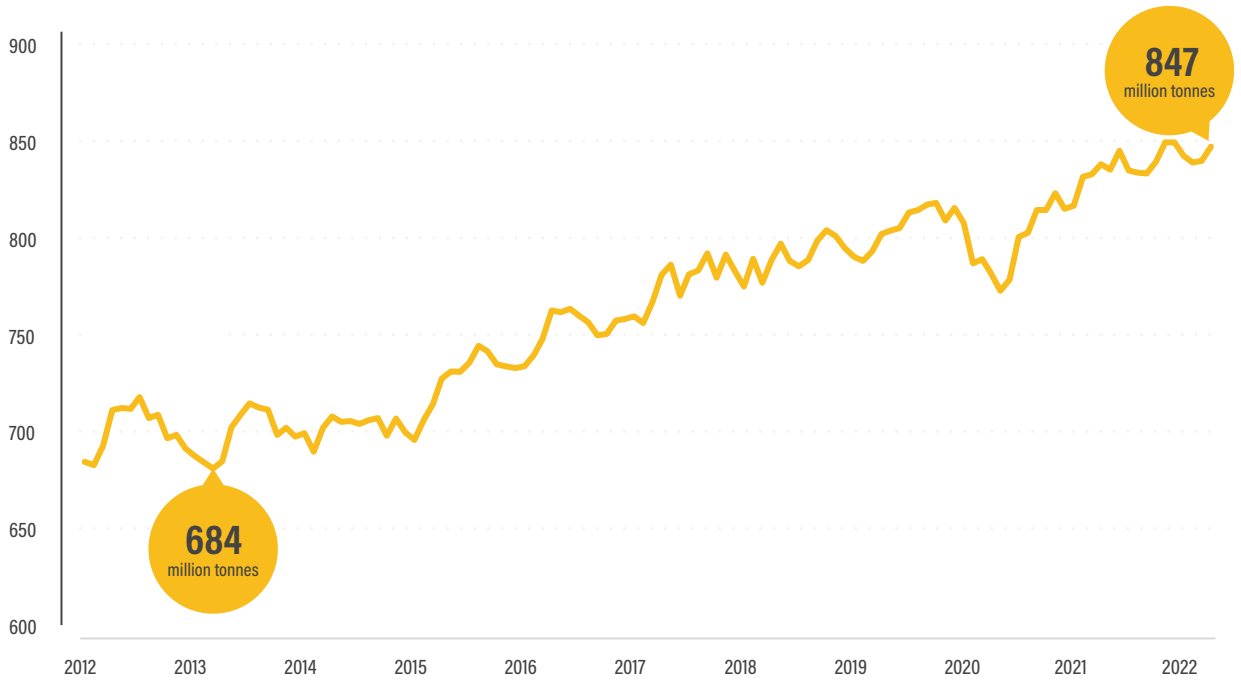
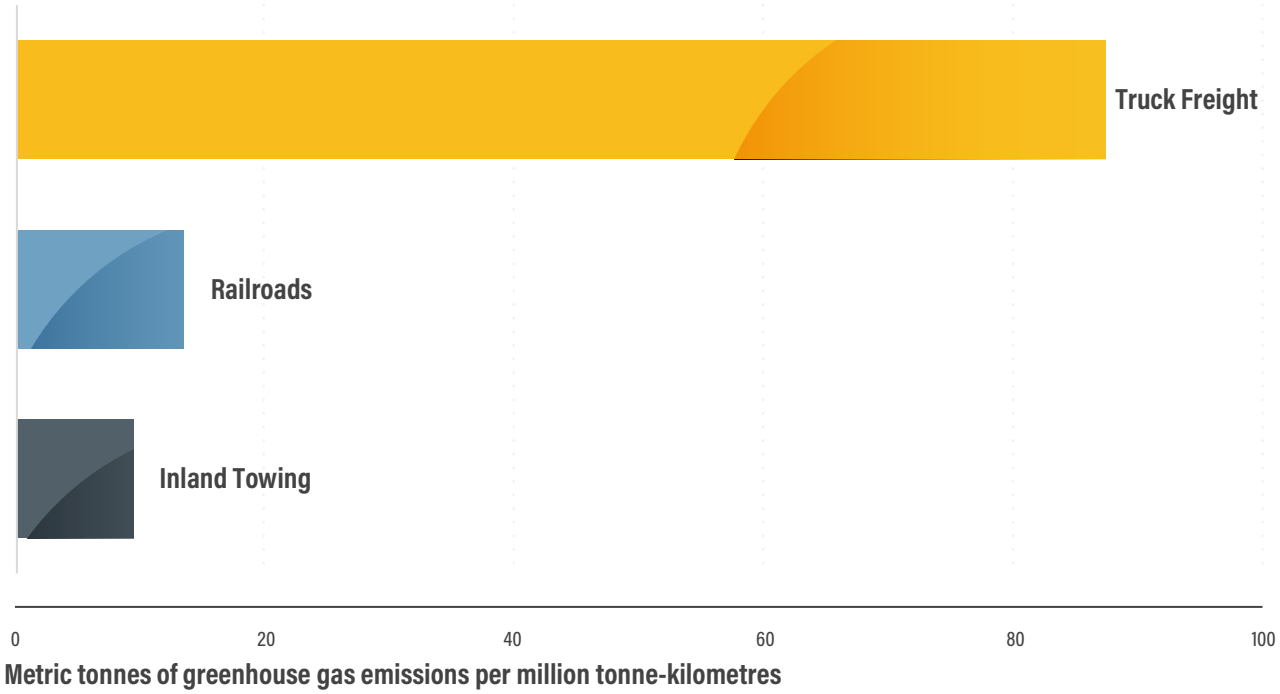


FIGURE 7. Greenhouse gas emissions per million tonne-kilometres, by transport mode, 2019

Source: See endnote 38 for this section.



Roughly 5% of maritime fuels must be zero carbon by 2030 to achieve the targets of the Paris Agreement.[40] **As of 2021, however, biofuels accounted for less than 1% of total shipping energy use.**[41] Oil products supplied more than 99% of the total energy for international shipping in 2021.[42]

- As of March 2022, almost 40% of new vessel procurements worldwide were for ships capable of running on multiple fuels including **LNG, methanol, ammonia** and **electricity**.[43] Scaling up these fuels further will require ports providing adequate fuelling infrastructure.[44]
- Around 50 methanol dual-fuelled vessels were ordered worldwide in 2022, as shipowners anticipate the need to replace ageing fleets.[45] Orders for **methanol**-powered ships are expected to surge.
- **Ammonia** is being developed as a low-carbon shipping fuel, but the threat of unintended consequences is high. Ammonia fuels have low life-cycle energy efficiency and are not easy to transport and use due to their toxicity. If nitrogen releases from ammonia fuels are not well controlled, maritime transport could emit potent nitrous oxide emissions at a micro scale and substantially alter the global nitrogen cycle at a macro scale.[46]

Sails are making a comeback in decarbonisation pledges, with more than 20 commercial ships using "wind-assist" technologies retrofitted to existing vessels as of 2023.[47] Wind propulsion has been a niche solution as shipping companies have failed to bear the full environmental and societal costs of burning fossil fuels.[48]

- The China Merchant Energy Shipping company is operating a super tanker with four large sails that will reduce the ship's average fuel consumption nearly 10%.[49]
- Japanese bulk carrier MOL is operating a wind-assisted ship, and Swedish shipping company Wallenius is building a wind-assisted vessel to cut emissions up to 90%.[50]
- The French start-up Zephyr & Borée has built a wind-assisted vessel that will be used to transport parts of the European Space Agency's Ariane 6 rocket.[51]

Battery-electric propulsion is emerging as a low-emission option for the marine shipping sector, due to its considerable potential for emission reduction.[52] Advantages of battery-electric vessels include improvements in battery energy storage, increasing availability of renewable electricity, and efficiency

advantages over green hydrogen and ammonia. It is imperative to undertake a systematic analysis of the potential of battery-electric ships.

- In 2022, California (USA) imposed new air quality rules on small boats, which can be replaced by battery-operated vessels that are technically and commercially feasible.[53]
- Maersk, the world's largest shipping company by volume, is piloting battery-hybrid propulsion on a container ship operating between East Asia and West Africa.[54]
- An electric 80-metre container ship was expected to begin operation in Norway in the early 2020s, and similar projects were under way in Denmark, Japan and Sweden.[55]

A global carbon price on maritime shipping would create further incentives to accelerate development of biofuels, wind propulsion and battery-electric vessels.[56] A global carbon pricing regime could build on lessons learned from the EU's Emissions Trading Scheme, which includes international shipping emissions.

Policy developments

An IMO submission at the 2022 UN Climate Change Conference in Sharm el-Sheikh, Egypt (COP 27) suggests increased ambition towards mitigating emissions, with the Energy Efficiency Existing Ship Index and the Carbon Intensity Indicator entering into force in 2023.[57] The Carbon Intensity Indicator looks at the CO_2 emissions of a ship per unit of nominal transport work, while the Energy Efficiency Existing Ship Index examines the CO_2 emissions per cargo tonne and kilometre compared to a baseline, which is decided by ship design.[58] These indicators will allow the shipping industry to assess progress towards a target to reduce carbon intensity (measured as CO_2 emissions per transport work) 40% by 2030, although this falls short of demonstrating aggregate reductions.[59]

In June 2023, the IMO adopted a revised strategy to reduce greenhouse gas emissions from international shipping to at least 70% below 2008 levels by 2040, and striving for 80%.[60] **This is a major improvement from the IMO's initial 2018 strategy, which aimed at a 50% reduction by 2050.**[61] The 2023 IMO greenhouse gas strategy aims to:

- review and strengthen the energy efficiency of ships, to reduce their carbon intensity;
- reduce CO_2 emissions at least 40% by 2030, compared to 2008 levels;
- increase the uptake of zero or near-zero greenhouse gas emission technologies, fuels and/or energy sources by at least 5% and striving for 10% of international shipping's energy use by 2030;
- peak greenhouse gas emissions from international shipping as soon as possible and reach net zero emissions by or close to 2050.[62]

Indicative checkpoints towards net zero emissions include reducing total annual greenhouse gas emissions from international shipping 20-30% by 2030 and 70-80% by 2040, compared to 2008 levels.[63] **Overall, the revised IMO strategy raises the level of ambition for emission mitigation and is estimated to place the international shipping sector well within the carbon budget required to align with a scenario of keeping global temperature rise below 2°C compared to pre-industrial levels. However, the strategy remains insufficient to support the carbon budget in a scenario of keeping global temperature rise below 1.5°C.**[64]

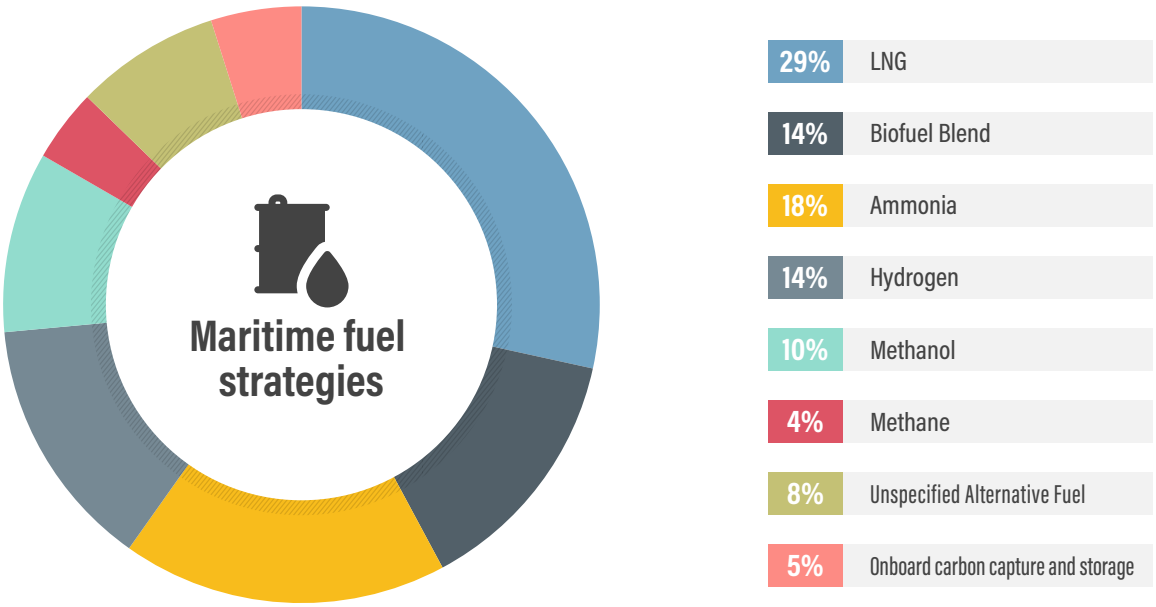
The revised IMO strategy does not directly enforce a carbon price for maritime shipping despite earlier IMO working group meetings giving hope for such an economic levy, which was seen as a breakthrough by many Parties to the Paris Agreement.[65] After more than a decade of contention, countries seemed to have agreed on the need to put a price on maritime shipping emissions at the IMO working group meeting in May 2022. The industry's trade association had previously supported a levy of USD 2 per tonne of fuel to fund research on clean shipping technology, translating to a carbon price of just USD 0.64.[66] The revised strategy features the possibility of a carbon price as a potential mid-term measure for reducing greenhouse gas emissions.[67]

- Major economies have previously resisted carbon tax proposals. At the 2022 meeting, however, EU countries and the United States shifted to support carbon pricing, with first-time backing for the measure by the Bahamas, New Zealand and the United Kingdom.[68]
- The Marshall Islands and Solomon Islands have proposed a carbon price of USD 100 per tonne on shipping fuels.[69]
- Maersk, the world's largest container shipping company, has proposed a price of USD 150 per tonne to accelerate use of low-carbon fuels.[70]

As of 2022, only 35% of major maritime shipping companies had set a target for net zero emissions by 2050 and/or had committed to the 2018 IMO target of a 50% emission reduction by 2050.[71] **A third of commitments by firms had identified a fuel strategy, with LNG being the most common conventional fuel and ammonia the most common alternative fuel.**[72] Companies with pledges have higher levels of reported emissions disclosure and related decarbonisation actions (see Figure 8).[73]

FIGURE 8. Proportion of fuel strategies in industry commitments on maritime shipping decarbonisation, as of 2022

Source: See endnote 73 for this section.



During 2021 and 2022, a varied group of ports, cities, cargo owners, and shipping companies and manufacturers issued commitments and calls for decarbonising the sector by 2050 and making zero-emission vessels widespread by 2030.[74]

- Cargo Owners for Zero Emission Vessels, a group of retailers including Amazon, Ikea, and Unilever, have committed to shipping products solely on zero-emission vessels by 2040 and have urged policy makers to fully decarbonise shipping by 2050.[75]
- The ports of Los Angeles and Shanghai, along with C40 Cities, announced a partnership in January 2022 to create the first "green shipping corridor" between China and the United States.[76]

For domestic maritime transport (coastal and inland shipping), very few efforts are in place to support a shift from road freight to inland waterways. As part of the European Green Deal, there is a proposal to cut transport emissions 90% by 2050, with plans to increase connectivity and to shift more passengers and freight away from road transport to rail and inland waterways (*see Section 2.3 Europe Regional Overview*).[77] This proposal should help boost the share of inland waterways in total freight transport, which declined between 2011 and 2021 in 11 of the 17 EU Member States for which this transport mode is applicable.[78]

The Maritime Just Transition Task Force of the UN Framework Convention on Climate Change was established at COP 26 in 2021 to facilitate a decarbonised shipping industry, followed by the launch of the Just Transition Work Programme at COP 27 in 2022.[79] At COP 26, more than 20 nations signed on to the **Clydebank Declaration**, publicly pledging to demonstrate the viability of green shipping corridors by 2025.[80] **Maritime shipping has been identified as one of the "hard-to-abate" sectors targeted under the Mitigation Work Programme adopted in 2022.**[81]

Emissions from international shipping continue to be outside the scope of countries' Nationally Determined Contributions (NDCs) towards reducing emissions, due to a lack of clarity in the Paris Agreement.[82] Some experts call for a two-tiered approach to tackling emissions in the maritime transport sector that merges collective action through the IMO and individual commitments in countries' NDCs.[83] Nevertheless, 22 of the second-generation NDCs submitted

by countries as of the end of 2022 featured mitigation actions related to maritime transport, mostly the NDCs of island countries such as Cabo Verde, Kiribati, Maldives, Micronesia, Samoa, Solomon Islands and Sri Lanka.[84]

- Cabo Verde intends to support a shift to low-carbon international maritime trade, with ships being powered by sails or solar or other low-carbon fuels.[85]
- China aims to increase the share of railways and waterways in freight activity and to expand its use of zero-emission vessels.[86]
- Micronesia intends to update vessels to increase ship efficiency, embed renewable energy as a power source and add more vessels for response operations.[87]
- The updated NDC of Kiribati includes a comprehensive package of activities, such as the development of a national maritime action plan, low-carbon container ships and biofuel blending.[88]

With additional cost pressures deriving from the Russian Federation's invasion of Ukraine, and despite the new IMO targets, there is a strong risk that shipping decarbonisation will slip further down the policy agenda. The Russian invasion poses novel challenges to decarbonisation of the shipping industry, which requires additional financial, technical and policy support for widespread implementation of low-carbon measures.[89]

3.8 SHIPPING

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