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2023 Report from the European Commission on CO₂ Emissions from Maritime Transport

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1. Introduction

Maritime transport plays an essential role in the EU economy and is one of the most energy-efficient modes of transport. However, it is also a major and growing source of greenhouse gas emissions. This is the fifth annual report on carbon dioxide (CO₂) emissions from ships entering and leaving ports in the European Economic Area (EEA), collected under the EU Regulation on the monitoring, reporting and verification of greenhouse gas emissions from maritime transport adopted in 2015¹ (the EU Maritime MRV Regulation). The Regulation is an essential part of the EU's action to address climate change in the maritime transport sector.

The present report covers the first five compliance cycles (i.e. data collected for 2018-2022) and builds on the previous reports². It allows a comparison of data, as well as an examination of trends in emissions and energy efficiency over the years. This report also analyses the characteristics and energy efficiency of ships, helping to better understand trends in maritime transport CO₂ emissions.

2. Policy development

As part of the package to deliver the European Green Deal, the European Parliament and the Council adopted in 2023 a series of measures to ensure that the maritime transport sector contributes to achieving the EU's climate ambitions:

- the revision of the **EU Emissions Trading System (ETS)**³ has extended the scope of the EU ETS to cover CO₂ emissions from large ships entering EU ports as from 1 January 2024, regardless of the flag they fly;
- the **FuelEU Maritime Regulation**⁴ will ensure that the greenhouse gas intensity of energy used onboard ships gradually decreases over time, and will oblige passenger ships and container ships to use onshore power supply while moored at the quayside in major EU ports as from 2030;

¹ Regulation (EU) 2015/757 of the European Parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC, OJ L 123, 19.5.2015, p. 55.

² Communication C(2020) 3184 final, 2019 Annual Report from the European Commission on CO₂ Emissions from Maritime Transport, https://climate.ec.europa.eu/document/download/676175fd-f8db-40fb-b37a-cc7323c680a2_en?filename=c_2020_3184_en.pdf, Communication C(2021) 6022 final, 2020 Annual Report from the European Commission on CO₂ Emissions from Maritime Transport, [8cd736dc-d508-408c-8cf7-9317048d1ff0_en](https://climate.ec.europa.eu/document/download/8cd736dc-d508-408c-8cf7-9317048d1ff0_en) (europa.eu), Communication C(2022) 5759 final, Third Annual Report from the European Commission on CO₂ Emissions from Maritime Transport (period 2018-2020), https://climate.ec.europa.eu/document/download/06c406a8-df93-4e38-b7ca-9a6929d5bddb_en?filename=c_2022_5759_en.pdf, and Communication C(2023) 1585 final, Fourth Annual Report from the European Commission on CO₂ Emissions from Maritime Transport (period 2018-2021), [01688bd2-e5a5-48cd-97b7-415fb99666fa_en](https://climate.ec.europa.eu/document/download/01688bd2-e5a5-48cd-97b7-415fb99666fa_en) (europa.eu).

³ Through Directive (EU) 2023/959, OJ L 130, 16.5.2023, p. 134, <http://data.europa.eu/eli/dir/2023/959/oj>.

⁴ Regulation (EU) 2023/1805, OJ L 234, 22.9.2023, p. 48, <http://data.europa.eu/eli/reg/2023/1805/oj>.

- the **Regulation on Alternative Fuels Infrastructure**⁵ requires maritime ports welcoming a minimum number of large passenger vessels or container vessels to provide shore-side electricity for such vessels by 2030;
- the revision of the **Renewables Energy Directive**⁶ has introduced more ambitious sector-specific targets in transport, including subtargets for advanced biofuels and renewable fuels of non-biological origin for the sector⁷.

Horizon Europe⁸ is supporting the successful implementation of the policy objectives of the above measures through research and innovation. In this context, the Zero-Emission Waterborne Transport partnership⁹, with a budget of €3.8 bn, was set to demonstrate zero-emission solutions for all main ship types and services before 2030.

Compliance with the new obligations stemming from the extension of the EU ETS to maritime transport and the FuelEU Maritime Regulation will build on the monitoring, reporting and verification system established by the **EU MRV Regulation**, which was revised in May 2023¹⁰. The revision amends the rules, to the extent necessary, to extend the ETS to maritime transport and to include non-CO₂ emissions (methane (CH₄) and nitrous oxide (N₂O)) in the system. The new monitoring and reporting rules will apply from the reporting period 2024 onward.

The Commission is also committed to supporting global action to encourage the decarbonisation of the sector, notably at the International Maritime Organization (IMO), where the EU supported and welcomed the outcome of the revision of the initial IMO greenhouse gas reduction strategy in July 2023, which set the goal of net zero emissions from ships by or around, i.e. close to, 2050.

At the international level the Commission, on behalf of the EU, has further partnered with 23 countries outside of the EU in the Mission Innovation initiative to accelerate clean energy innovation, which includes the Zero-Emission Shipping mission.

3. CO₂ emissions in 2022 as compared with 2021: Russia's full-scale invasion of Ukraine and the post-COVID-19 economic recovery

The monitored voyages for the 2022 reporting year emitted **135.5 million tonnes of CO₂** into the atmosphere. These emissions were **7.1% higher** than those reported in 2021 and 7.9% lower than those reported pre-COVID-19 in 2019 (the 2019 figure did, however, include emissions related to

⁵ Regulation (EU) 2023/1804, OJ L 234, 22.9.2023, p. 1, <http://data.europa.eu/eli/reg/2023/1804/oj>.

⁶ Directive (EU) 2023/2413, OJ L 2023/2413, 31.10.2023, ELI: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202302413.

⁷ The Commission's proposal for a revision of the Directive on energy taxation (Council Directive 2003/96/EC of 27 October 2003) is still being considered by the co-legislators at the time of writing.

⁸ Regulation (EU) 2021/695, OJ L 170, 12.5.2021, <https://eur-lex.europa.eu/eli/reg/2021/695/oj>.

⁹ Commission Decision C(2021) 4113 of 14.6.2021 on the approval and signature of eleven Memoranda of Understanding for Co-programmed European Partnerships for Research and Innovation.

¹⁰ Regulation (EU) 2023/957, OJ L 130, 16.5.2023, p. 105, <http://data.europa.eu/eli/reg/2023/957/oj>.

the United Kingdom ¹¹). The emissions reported for 2022 originated from a fleet of almost 12 800 ships, the highest number registered so far for a single reporting period (6.5% higher than in 2021).

This total increase in CO₂ emissions for the period 2021-2022 hides significant disparities between the different ship types, which reflect the major economic trends that affected the year 2022, and notably the consequences of Russia's full-scale invasion of Ukraine. In 2022, 9 of the 15 ship types reported higher emissions than in 2021.

- By ship-type group, **passenger ships** (+172%), **liquefied natural gas (LNG) carriers** (+59%), and **bulk carriers** (+13%) recorded the highest increases in emissions compared with 2021. These were driven by the increasing number of reporting ships and higher activity levels.
- The increase of emissions from **passenger ships** reflects the rebound (full or partial) of the sector after the COVID-19 years. The increase from LNG carriers reflects the record amount of LNG imported into the EU in 2022.
- The activity of **bulk carriers** was notably affected by the impact of sanctions and geopolitical risks, which affected global shipping trends and increased the distances travelled for many commodities, including energy products.
- Conversely, the most noticeable reduction in CO₂ emissions was recorded by **container ships**, which emitted around 2.9 million tonnes of CO₂ less in 2022 than in 2021 (-7.6%), following a decrease in activity in EU container ship ports, a decrease in the average distance sailed (-3.9%) and a reduction in the average speed of active container ships (-4.7%).
- CO₂ emissions from **oil tankers** were also at their lowest in 2022 since 2018, mainly due to the impact of sanctions.

Most ship types' relative contribution to total reported emissions remained stable overall in 2018-2022, even in the first year of COVID-19 (2020) and in the years following the UK's withdrawal from the EU (2021 and 2022).

Container ships, oil tankers, and bulk carriers were confirmed as the top emitters in 2022.

They were responsible for around 55% of total reported emissions in 2022. Container ships alone were responsible for 28% of the total CO₂ emissions. Two ship types (**passengers ships and LNG carriers**) stand out because they have shown considerable yearly variations over the last three reporting periods.

¹¹ It was not possible to recalculate historical data before 2021 so as to exclude the emissions resulting from the application of the EU Maritime MRV Regulation to the United Kingdom. This is because the legislation does not require shipping companies to report emissions at voyage level. Therefore, throughout this report, the figures presented for the reporting years after 2020 are based on the reported data, which excludes the Regulation's application to the United Kingdom (but only to EEA countries, including the EU-27). By contrast, the reported data for the reporting years 2018, 2019 and 2020 includes the Regulation's application to the United Kingdom, which is accounted for as part of the EEA (the EU-28).

The distribution of the fleet's total CO₂ emissions between the different types of voyages and at berth that was recorded in 2022 was almost the same as in 2021. Voyages starting or ending outside the EEA represented the bulk of the CO₂ emissions (around two thirds). Voyages between two ports in the EEA represented around a quarter of all CO₂ emissions, in line with the share observed in 2021 after the withdrawal of the United Kingdom from the EU. CO₂ emissions occurring when ships are at berth in EEA ports represented around 6% of total emissions. These shares are in line with the volume of inward and outward flows recorded by Eurostat data.

In terms of **fuel consumption**, the monitored ships consumed more than 43 million tonnes of fuel in 2022. Fuel consumption data for 2022 confirmed established trends for 2018-2021 – namely the shift towards light fuel oil, LNG, and diesel oil, which followed the introduction of the 2020 IMO limit on the sulphur content of fuel oil used onboard ships. The composition of the 2022 fuel mix, in comparison with 2021, highlights a decrease (from 26% to 22%) in the share of light fuel oil and an increase in the use of heavy fuel oil (from 48% to 50%). 2022 saw the highest recorded level of LNG consumed by the fleet (around +32% higher than in 2021), fuelled by an increase in the activity of LNG carriers combined with the accelerating uptake of LNG-use by container ships. The consumption of non-fossil bunker fuels remained negligible, as in all previous years.

4. The monitored fleet: shipping routes, speed time and time spent at sea

According to Eurostat data, the total 2022 **volume of inward trade flows** increased by 2.5% and was nearly the same as in 2019. Compared with 2021, the inflow from the United States (East Coast), Egypt, Norway, China, the UK, Brazil, and Canada (East Coast) increased in 2022, while the inflows from Russia (Black Sea and Baltic Sea), Nigeria and Türkiye decreased. The total 2022 volume of outward flows decreased by 1.4% and was nearly the same as in 2019. It was primarily the outflows to China and the UK that decreased in 2022, but total outflows are still dominated by the outward flow to the UK.

MRV data for 2018-2022 highlights the fact that **speed variation** was minor for most ship types. However, it is to be noted that, following an increase in average speed in 2020 and 2021, container ships recorded in 2022 a 4.7% decrease in average speed in comparison with 2021. This was a major driver of the reduction in total emissions for this ship type in 2022 (-7.6% on 2021).

Between 2021 and 2022 the **average time spent at sea** decreased for 6 of the 15 ship types but increased for 8 ship types. Among the ship types that experienced a longer average time at sea in 2022, passenger ships, LNG carriers, and bulk carriers have spent the longest total time at sea since 2018. This indicates that there has been a recovery from the COVID-19 crisis and that the EU's efforts to diversify its energy imports have been at least partially successful.

5. Technical and operational efficiency of the monitored fleet

The graphical analysis of key technical and operational efficiency indicators shows that no significant changes took place in 2018-2022. Furthermore, the completeness and correctness of the reported data, which improved over the period, is confirmed by increasing data correlation

values between key technical and operational efficiency indicators¹² and the size of the ships reporting under the EU Maritime MRV Regulation.

Ships reported a **better energy efficiency design index** in 2022 when cumulated at fleet level (a 5.6% improvement on 2021) and their average size increased by 5.7% compared with 2018-2021.

6. The implementation of the EU Maritime MRV Regulation in 2022

In terms of implementation of the EU Maritime MRV Regulation, the 2022 results confirm the continuing improvement in the quality of data. However, punctuality in data submission decreased after considerable improvements in the first 4 reporting years.

¹² The Energy Efficiency Design Index (EEDI) and the Estimated Index Value (EIV) are assessed for the technical efficiency of ships. The Energy Efficiency Operational Indicator (EEOI) and the Annual Efficiency Ratio (AER) are assessed for their operational efficiency.