



Facts and figures: the EMTER Report



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In brief

- The maritime sector accounts for 14.2% of the EU's CO₂ emissions from transport, behind the road sector, and almost equivalent to the aviation sector. CO₂ emissions from maritime transport have increased annually in the EU since 2015 (except for 2020), amounting to 137.5 million tonnes in 2022, 8.5% more than the previous year.
- Methane (CH₄) emissions from maritime transport have at least doubled between 2018-2023 and constitute 26% of the transport sector's total methane emissions in 2022.
- In terms of air pollution from the maritime sector, Sulphur Oxide (SO_x) emissions in the EU have decreased by about 70% since 2014, largely due to the introduction of Emission Control Areas for SO_x (SECAs) in Northern Europe. The Mediterranean SECA, set to take effect on 1st May 2025, is expected to replicate this success in that region, and North-East Atlantic countries are considering establishing an ECA, potentially by 2027. In contrast, Nitrogen Oxides (NO_x) emissions have risen significantly in 2015-2023, by an average of 10% across the EU. This is despite the North and Baltic Seas being designated as NO_x Emission Control Areas since 2021, which applies only to new ships and has low penetration rates.
- Maritime transport contributes to water pollution through the emission of hazardous substances; primarily oil spills, but also through operational discharges such as grey water and waste from exhaust gas cleaning systems (EGCS). Open-loop EGCS account for 98% of permitted water discharges, with the remaining 2% comprising of grey waters, sewage, bilge water, and closed-loop EGCS. Furthermore, the discharge of grey water has increased by 40% from 2014 to 2023, mainly due to the growth in cruise ship operations.
- Enhanced satellite technology can now detect smaller possible oil spills on the sea's surface than ever before. Most of the 2023 possible incidents detected from space by the CleanSeaNet service covered an area of less than two km².
- New pan-European model data allows for quantitative comparisons of underwater radiated noise (URN) from shipping, revealing high sound pressure level (SPL) values in parts of the English Channel, the Strait of Gibraltar, parts of the Adriatic Sea, the Dardanelles Strait, and some regions in the Baltic Sea. Forecast data suggests that technical and operational mitigation measures could reduce URN by up to 70% between 2030 and 2050.

- Marine litter attributed to fisheries (11.2%) and shipping (1.8%) sources is estimated to be decreasing in the regional seas, reaching half of the values from a decade ago. In addition, there is an increasing amount of data on waste deliveries from ships to EU ports each year. However, challenges remain in tackling plastic pollution, such as the release of pellets from lost containers.
- In 2022, while 13.2% of the global fleet was flagged under an EU Member State, only 7% of recycled end-of-life vessels carried those flags at the time of disposal. This underscores how re-flagging continues to undermine EU efforts for safe and environmentally sound ship recycling.
- Maritime transport impacts biodiversity through activities like port expansions, dredging, and anchoring that affect 27% of Europe's near-shore seabed and lead to physical disturbances or habitat loss. There has also been a notable rise in collision risks of ships with marine wildlife within Natura 2000 protected areas. While the number of non-indigenous species (NIS) keeps increasing, the introduction of invasive alien species (IAS) peaked in 2000-2005 and has since decreased. The International Ballast Water Management Convention entered into force in 2017, and by 2023, 31% of the ships held an International Ballast Water Management Certificate, while 23% had compliant ballast water management systems.
- An increasing number of ships are being equipped with alternative sources of power, indicating a shift towards greener energy solutions. The use of batteries is also increasing, with the fleet using them expected to double in the coming years. While the number of ships using methanol remains low, it is growing, as are the numbers of ships using wind propulsion and hydrogen.
- At least 44 EU ports have already implemented onshore power connections (OPS), with 352 berths having shore-to-ship power supply facilities. However, only a limited number of ships have the necessary equipment to connect to high voltage OPS.

Setting the scene - the EU maritime sector:

The second edition of European Maritime Transport Environmental Report examines the progress made towards achieving Europe's decarbonisation targets and environmental goals, while indicating the most important trends, key challenges, and opportunities in the sustainability transition of the maritime transport sector.

Since the first edition of the report was published in 2021, progress has been made in various domains at EU level, including reducing sulphur emissions from ships, lower levels of recorded marine litter generated by fisheries and shipping, increased reporting of waste deliveries from ships, and a decrease in the number of invasive alien species in European marine ecosystems. However, continued efforts are essential to maintain this momentum and ensure sustained progress toward greening the sector.

At the same time, the EU has updated the climate legislation linked to the maritime sector in the context of the European Green Deal. The 'Fit for 55' package saw the extension of the Emissions Trading System to the maritime transport sector, legislation seeking to increase the uptake of sustainable fuels through the FuelEU Maritime Regulation, the Alternative Fuel Infrastructure Regulation, the Energy Taxation Directive, and the Renewable Energy Directive.



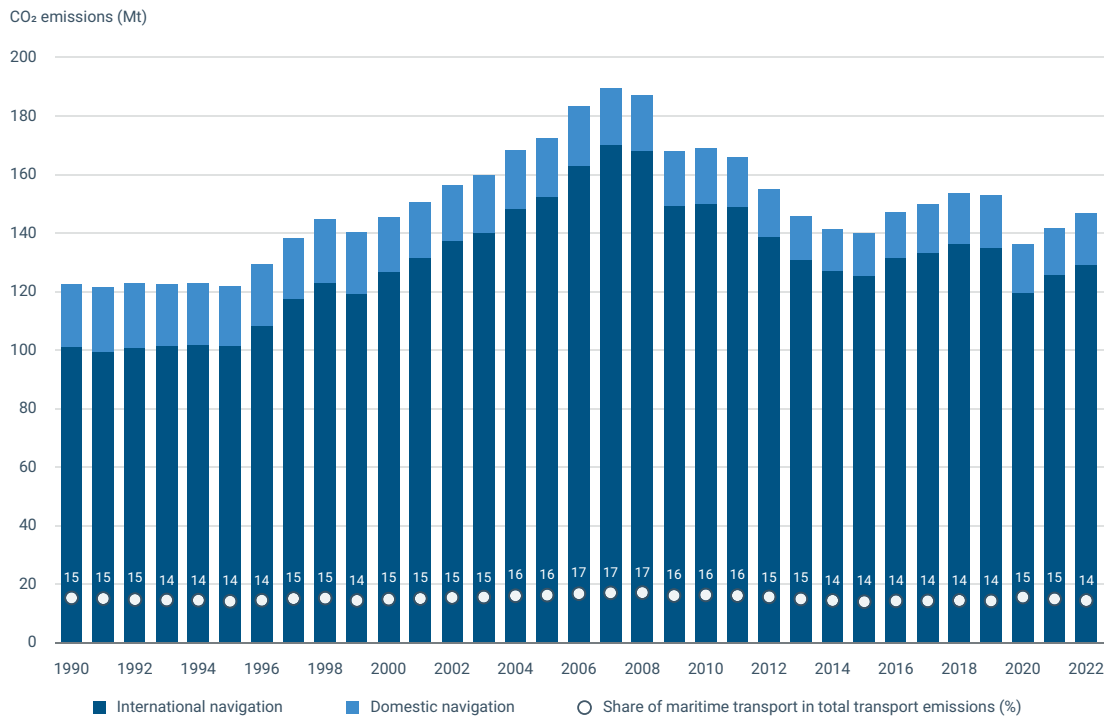
Greenhouse gases

Greenhouse gases (GHG) are the major contributor to global warming and climate change, with carbon dioxide (CO₂) emissions playing a critical role in driving these issues. In the maritime transport sector, these emissions primarily result from the combustion of fossil fuels in a ship's machinery, including main engines, auxiliary engines, and boilers.

CO₂ emissions

Carbon dioxide (CO₂) emissions are the largest type of GHG emissions generated by the maritime transport sector, which accounts for 3-4% of all EU CO₂ emissions, and in 2022 for 14.2% of all CO₂ emissions from the EU transport sector as a whole.

Figure 1 CO₂ emissions from the maritime sector (Mt) and their share in total transport emissions (%) between 1990 and 2022 in EU-27

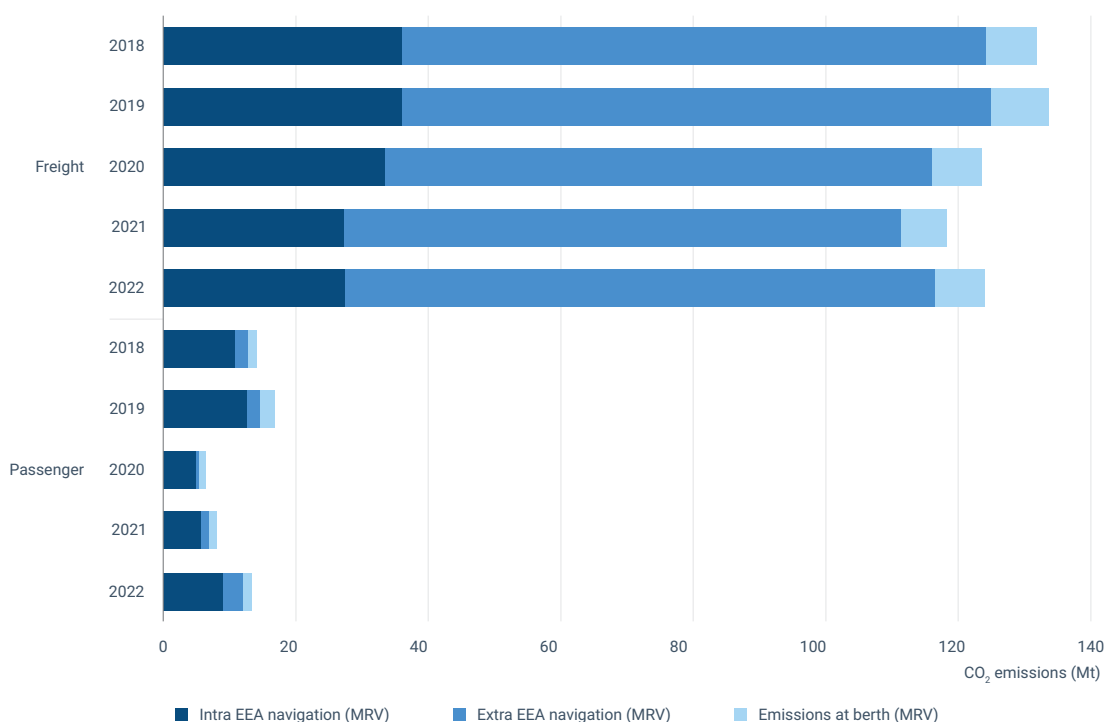


Notes: Mt, million tonnes of carbon dioxide equivalent.

Sources: UNFCCC (EEA, 2022).

In the EU, ships larger than 5,000 gross tonnes and entering or leaving ports in the European Economic Area, report their CO₂ emissions under the EU Maritime Monitoring, Verification, and Reporting (MRV) Regulation. MRV data shows that nearly 13,000 ships emitted 137.5 million tonnes of CO₂ into the atmosphere in 2022, an 8.5% increase from the year before.

Figure 2 Distribution of CO₂ emissions from freight and passenger vessels between 2018 and 2022 in the European Economic Area



Notes: Data from 2021 onwards excludes the UK
Mt, million tonnes of carbon dioxide.

Sources: THETIS-MRV (EMSA, 2024).

Between 2018 and 2022, total MRV-reported CO₂ emissions from freight transport fell by 5.9%, while passenger transport emissions decreased by 5.2% in the same timeframe (with the caveat of the impact of the COVID-19 pandemic, as well as the fact that emissions from 2021 and 2022 do not include UK-related emissions). Overall, 80% of all CO₂ emissions reported in MRV are generated by five ship types: containerships, oil tankers, bulk carriers, chemical tankers, and general cargo ships.

Fishing vessels operating in the EU do not report CO₂ emissions through the MRV system. However, model data estimates suggest that their emissions totalled 3.7 million tonnes in 2023, equivalent to 2% of CO₂ emissions from transport in the EU and 1.3% at global level.

Model data also estimates that average specific emissions of CO₂ per unit of cargo transported (in grammes per tonne-kilometre, g/tkm) generally decreased in Europe between 2015 and 2023, with reductions ranging from -21% to -7%, depending on the ship type. This decline is attributed to a combination of factors, including an increase in the average payload transported during the same period, which significantly offset the absolute rise in CO₂ emissions. Cargo ships and tankers had the lowest yearly specific CO₂ emissions.

During the same timeframe, CO₂ emissions from cruise ships in Europe, measured in kilogrammes per kilometre (kg/km), also saw a slight decrease, despite a 17% increase in distance travelled. However, these ships emitted approximately 11 times more CO₂ than conventional passenger ships in the same region and period. Data on

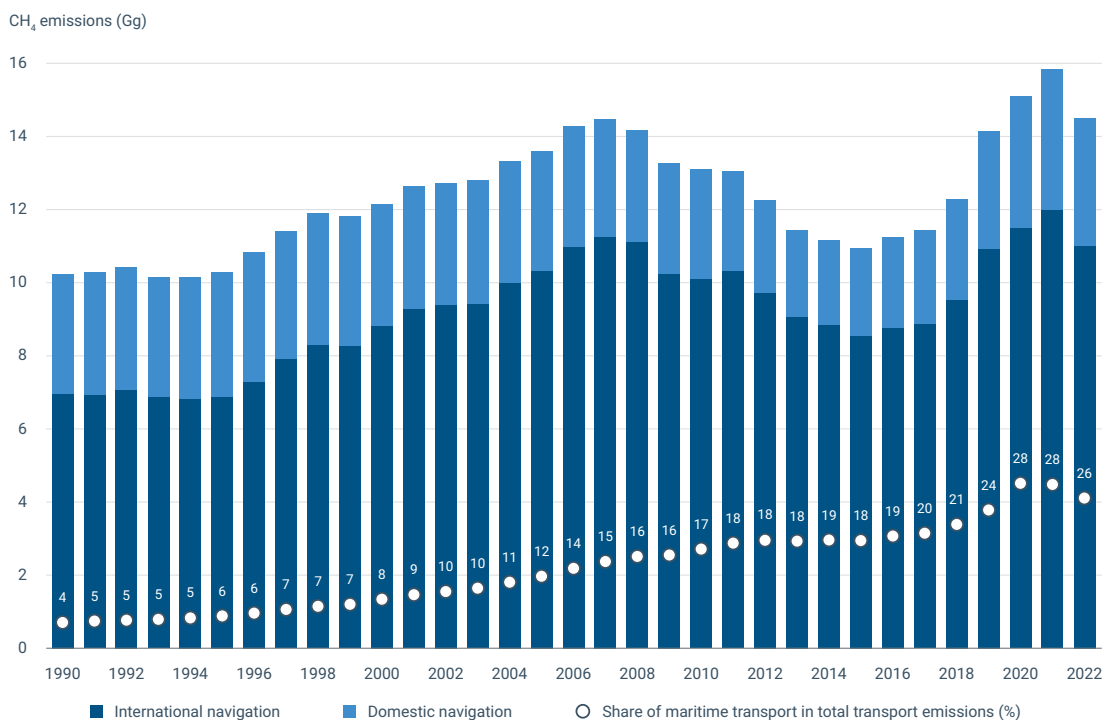
the numbers of passengers transported per ship is not readily available, making it impossible to estimate emissions per passenger-kilometre.

Methane emissions

Methane (CH₄) is a short-lived greenhouse gas that makes a significant contribution to global warming and climate change. It is more effective at trapping heat than CO₂ and, in the presence of solar radiation, reacts with other chemical compounds to form ozone.

Methane emissions from the maritime transport sector have been increasing over time and are now estimated to account for 26% of all methane emissions from the entire EU transport sector. Between 2018 and 2023, methane emissions across EU marine regions may have increased by a factor of between two and five times. This increase may be associated with the growth in the overall number of liquefied natural gas (LNG) powered ships in operation, which generate more methane emissions than conventionally fuelled ships.

Figure 3 CH₄ emissions from the maritime sector (Gg) and their share in total transport emissions (%) between 1990 and 2022 in the EU-27



Notes: Gg, gigagrams of methane.

Sources: UNFCCC (EEA, 2022).

Until 2024, there was no systematic reporting of methane emitted by ships by shipping companies operating in the EU. However, with the inclusion of maritime transport in the EU Emissions Trading System (EU ETS), the scope of the EU-MRV was expanded to include methane emissions. In 2025, the first methane emissions data, based on 2024 reporting, will be published.



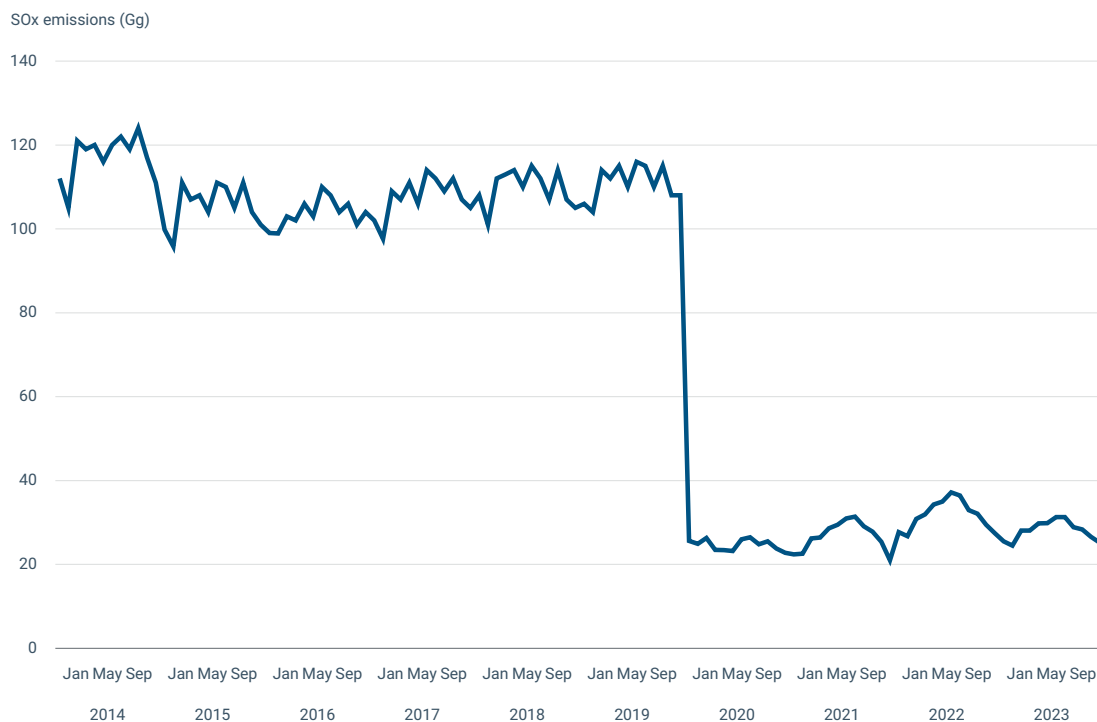
Air pollution

Air pollution emissions pose a threat to human health and the environment. Among other impacts, air pollutants are linked to stratospheric ozone depletion, tropospheric ozone formation, and contribute to acid rain and ecosystem eutrophication. While burning marine fuel, ships generate a range of air pollutants, including sulphur oxides (SOx), nitrogen oxides (NOx), particulate matters (PM, of which SOx and NOx are important precursors), and black carbon, which are significantly higher in areas of heavy maritime traffic.

Sulphur oxide emissions

There has been a clear decrease in the total Sulphur Oxide (SOx) emissions in the EU, where model data for 2023 estimates a reduction of approximately 70% at EU level since 2014.

Figure 4 SOx emissions for EU, 2014-2023

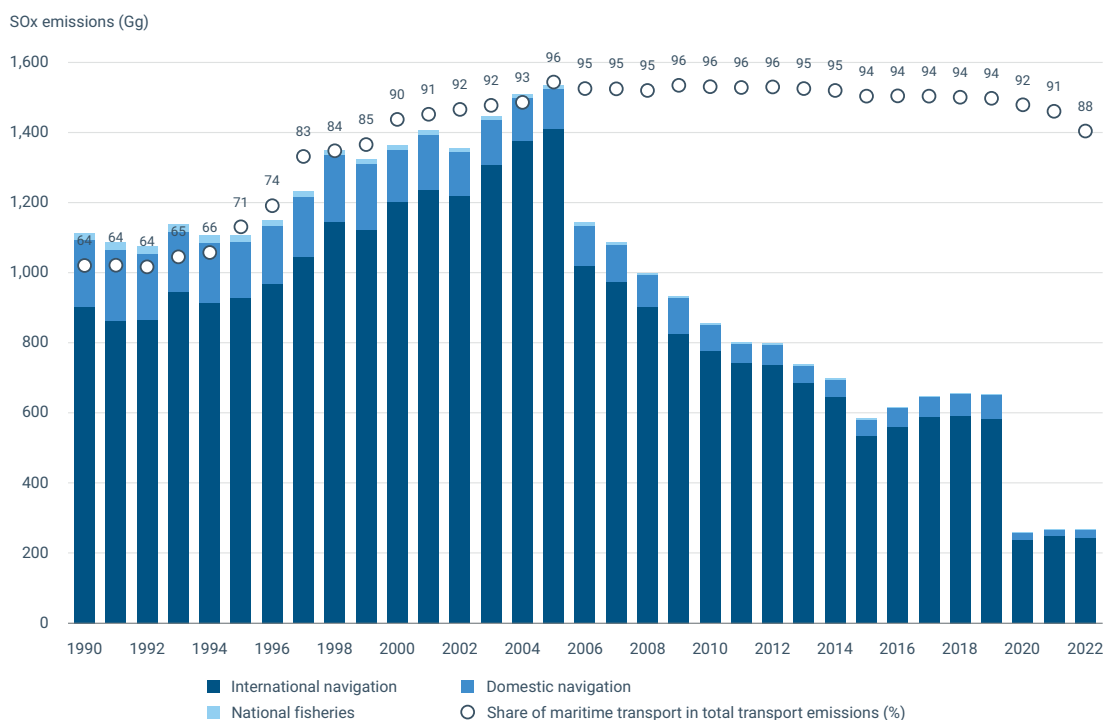


Notes: Gg, gigagrams of sulphur oxides.

Sources: STEAM (FMI/EMSA, 2024).

Shipping is by far the largest contributor to overall transport SOx emissions in the EU. Nevertheless, both the quantity of emissions it produces, and its share, are falling. In 2005, maritime transport was responsible for 97% of all EU SOx emissions, which in absolute terms represented approximately 1,500 gigagrams of SOx. By 2022, the share of emissions generated by the sector had fallen to 88%, corresponding to 267 gigagrams (one gigagram is equal to 1,000 metric tons).

Figure 5 SOx emissions from the maritime sector (Gg) and their share in total transport emissions (%) between 1990 and 2022 in the EU-27



Notes: Gg, gigagrams of sulphur oxides.

Sources: LRTAP (EEA, 2024).

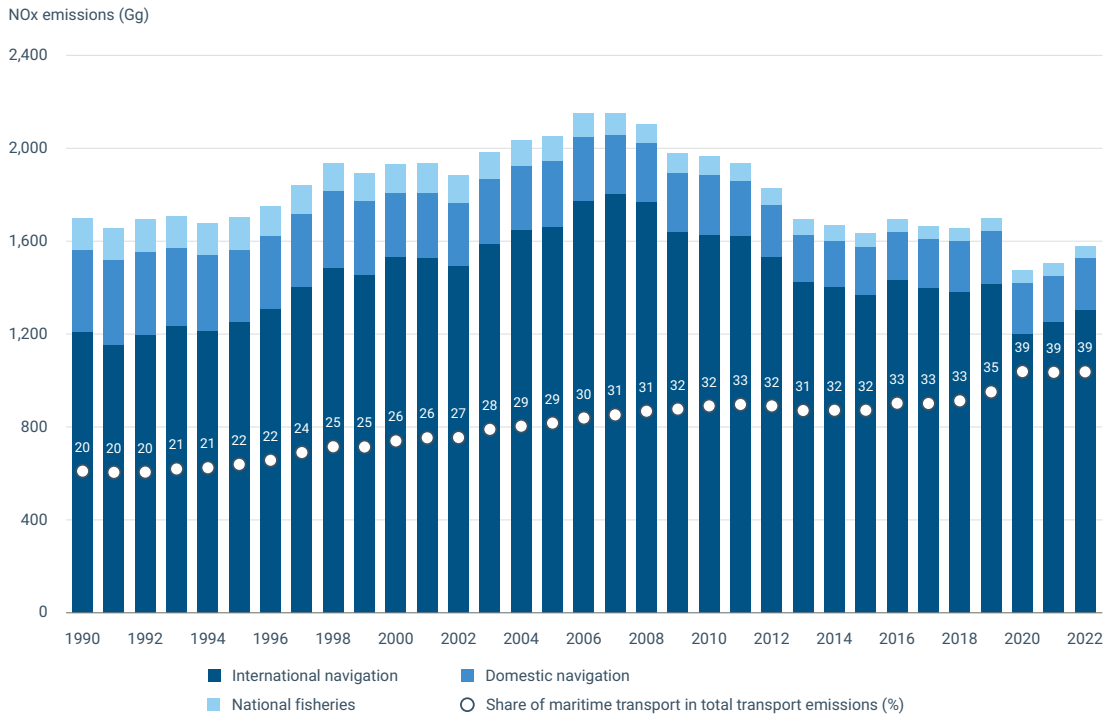
While the entry into force of the global sulphur cap in 2020 made a significant contribution, the large reduction in SOx emissions in the EU is primarily due to the introduction of Emission Control Areas (ECAs) that reduce SOx emissions from ships operating in EU waters (SECA). Starting 1 May 2025, the Mediterranean Sea will become the third SECA in European waters, joining the Baltic Sea and North Sea, which have had SECA designations since the early 2000s. Additionally, North-East Atlantic countries are considering establishing an ECA, potentially by 2027. These measures will bring substantial health and environmental benefits, improving air quality across the EU region.

Nitrogen oxide emissions

Between 2015 and 2023, Nitrogen Oxide (NOx) emissions have risen significantly across the EU by about 10%. In specific areas, the increase was even more pronounced: 33% in the Atlantic, 8% in the Mediterranean, and 32% in the Arctic. Nonetheless, even in currently designated Emission Control Areas (ECAs) in the North and Baltic Seas, NOx emissions remain an important issue, since requirements apply only to new ships. Concerns regarding engines operating at low power loads will be addressed at the International Maritime Organisation (IMO).

Moreover, data reported under the Convention on Long-Range Transboundary Air Pollution (LRTAP) shows that the maritime sector's share of NOx emissions has been growing steadily. In 2022, emissions from this sector accounted for 39% of all NOx emissions from transportation.

Figure 6 NOx emissions from the maritime sector (Gg) and their share in total transport emissions (%) between 1990 and 2022 in the EU-27 and 2022 in the EU-27



Notes: Gg, gigagrams of nitrogen oxides.

Sources: LRTAP (EEA, 2024).

Black carbon emissions

Black carbon (BC) is both an air pollutant and a driver of climate change which is estimated to be responsible for 6.85% of the global warming contribution from shipping. In 2021, BC emissions from shipping made up 17% of the overall BC emissions from the EU transport sector, a figure that has been steadily increasing over time.

Black carbon has a major impact when it precipitates in the Arctic region. It darkens the snow and the ice sheets, thus reducing the amount of light reflected and increasing heat retention. Though still a significant issue, estimates indicate that BC emissions in the Arctic appear to have peaked in 2019, falling from 0.041 gigagrams (Gg) to 0.022 Gg in 2023.



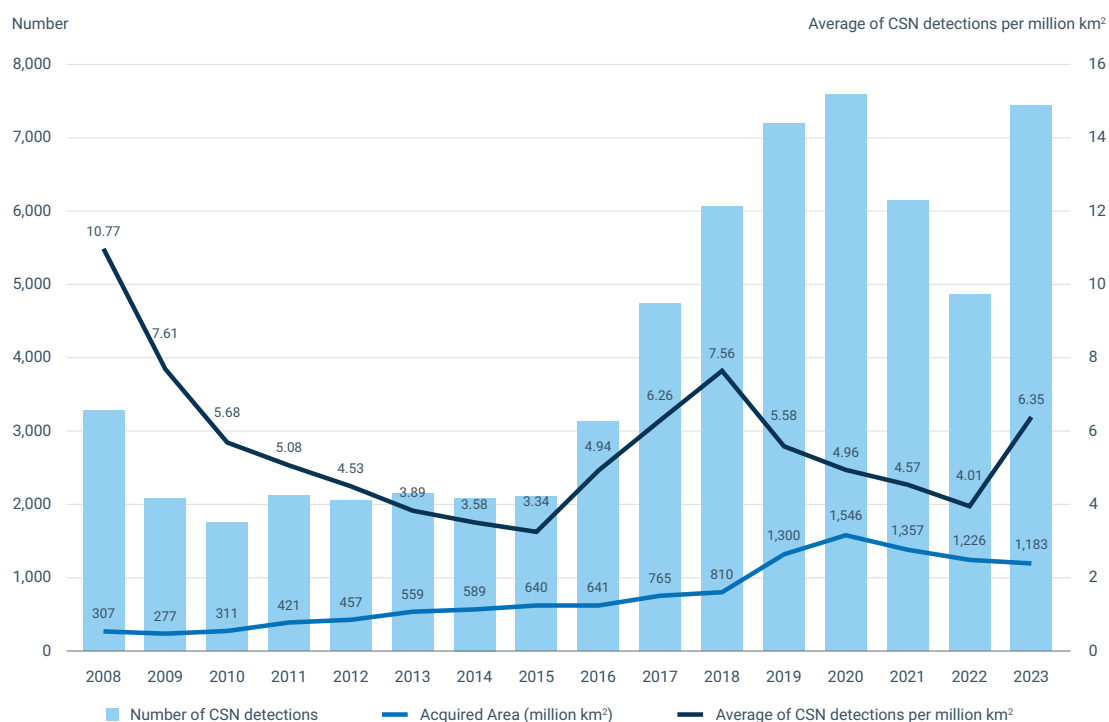
Water pollution

Oil spills

There is a greater detection of possible oil spills in the North Sea and Mediterranean Sea compared to other areas. This is due to high maritime traffic, which increases the likelihood of illegal discharges and accidents.

Although there was a decline in the rate of possible pollution incidents detected by satellite surveillance from 2018 - 2022, in 2023 the average number of possible pollution incident detections by EMSA's CleanSeaNet service increased more than 58% compared to 2022. This increase may be partially due to the improvements in resolution, allowing for better detection of small to medium-sized possible pollution incidents (i.e., possible oil spills with less than 15 km²). Of these, 62% were smaller than 2 km² and 87% smaller than 7 km². This indicates that the more widespread use of higher spatial resolution imagery from commercial satellite missions has enhanced the capability to identify smaller possible spills.

Figure 7 Trend in annual number of possible spills detected by CleanSeaNet and average number of possible spills per million km²



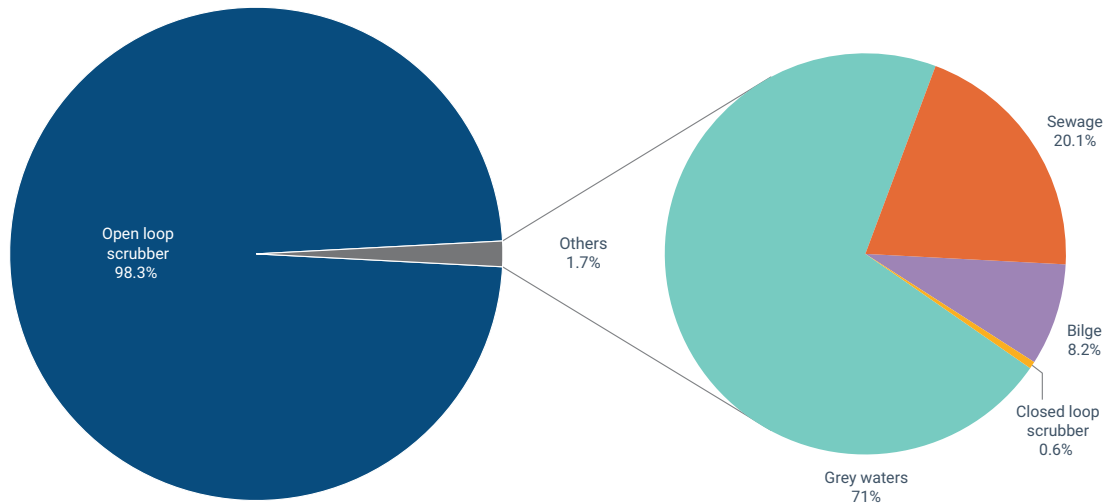
Notes: Acquired area is the number of km² which have been monitored through the acquisition and subsequent analysis of satellite imagery.

Sources: CleanSeaNet (EMSA, 2024).

Discharges and contaminants

Discharges from open-loop exhaust gas cleaning systems (EGCS; scrubbers) account for 98% of water discharges, with the remaining 2% comprising of grey waters, sewage, bilge water, and closed-loop EGCS.

Figure 8 Water discharges composition in European waters in 2023 (left) and a close-up of the composition of discharges excluding open loop scrubbers (right)



Sources: STEAM (FMI/EMSA, 2024).

Since 2020, water discharges from open-loop scrubbers have remained stable in previously established Sulphur Emission Control Areas (SECAs) and increased in the North-East Atlantic Ocean, Black Sea, and Mediterranean Sea. This increase is due to compliance with the EU and IMO sulphur emission regulations which saw a significant increase of the installation of scrubbers given the lower compliance cost for ships.

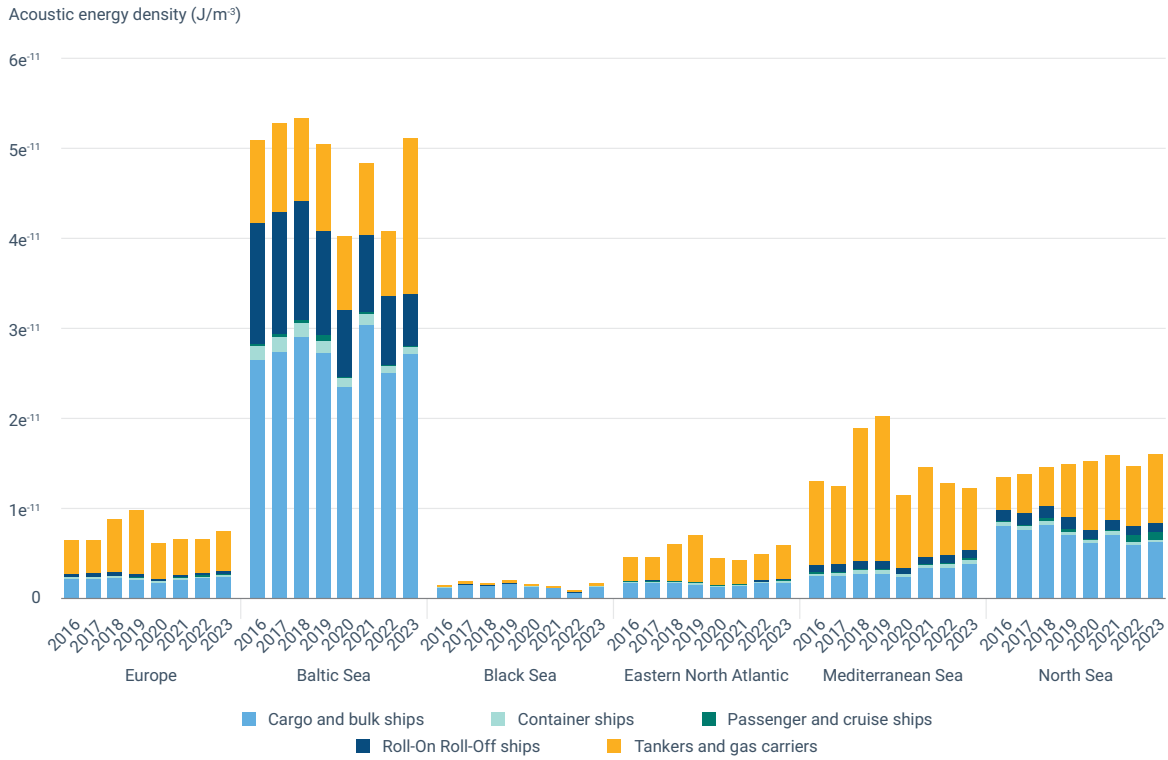
The amount of grey water discharged has increased by 41% between 2014 and 2023, mainly because of the growing number of cruise ships in operation. The highest discharge volumes on the freight side come from tankers, with an increase of 25% since 2014.

Underwater radiated noise

The underwater radiated noise (URN) caused by a ship as it moves through the water is largely generated by the movement of its propeller and the sounds made by its engine and machinery on-board. URN can adversely impact marine species, particularly cetaceans, which use sound for important localisation and communication purposes.

Areas that currently have the highest sound pressure level values in Europe include parts of the English Channel; the Strait of Gibraltar; parts of the Adriatic Sea; the Dardanelles Strait; and some regions in the Baltic Sea. The lowest values are recorded in the northwest part of the North-East Atlantic Ocean, particularly around the Denmark Strait, the Irminger Sea, and the southern part of Mediterranean Sea.

Figure 9 URN sound energy density at 63 Hz (Europe leftmost chart and regional seas) from 2016 to 2023



Source: NAVISON (EMSA, 2024).

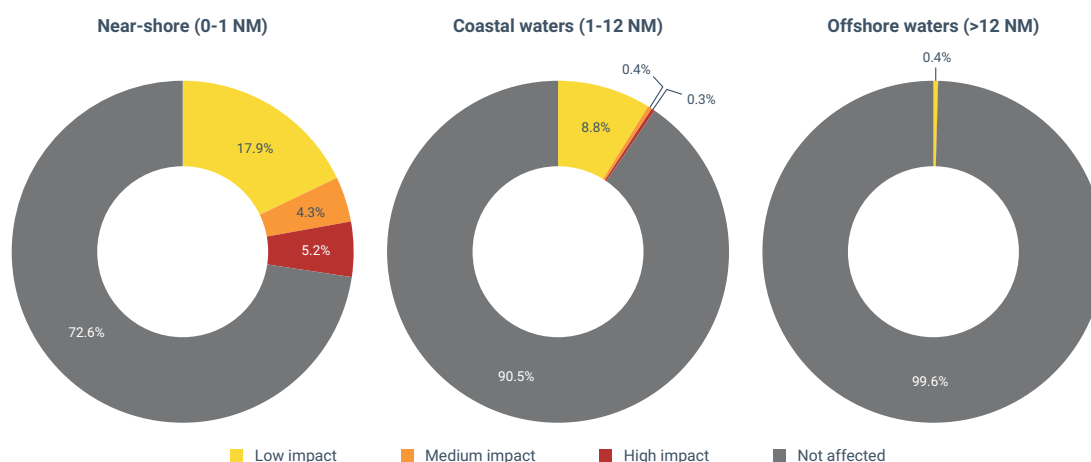
Tankers and cargo ships are primary contributors to URN, particularly at lower frequencies. However, the contribution of specific ship types varies across regions and frequency bands.

Foresight analysis indicates that the implementation of technical and operational URN and greenhouse gas (GHG) mitigation measures may lead to a substantial reduction in URN for all ship types and in all regions by 2050. In specific cases, this reduction could be as much as 70% compared to a business-as-usual scenario.

Marine biodiversity

Approximately 27% of Europe's near-shore seabeds are impacted by maritime transport linked activities such as port expansions, dredging, and anchoring, which lead to physical disturbances and habitat loss, with 5% facing severe effects. Specifically, 4.2% of broad benthic habitats are disturbed solely by maritime transport, while 0.2% of habitats experience loss due to significant seabed changes caused by these activities.

Figure 10 Percentage of physically disturbed seabed in near-shore (0-1NM), coastal (1-12NM) and offshore (>12NM) waters in the regional seas



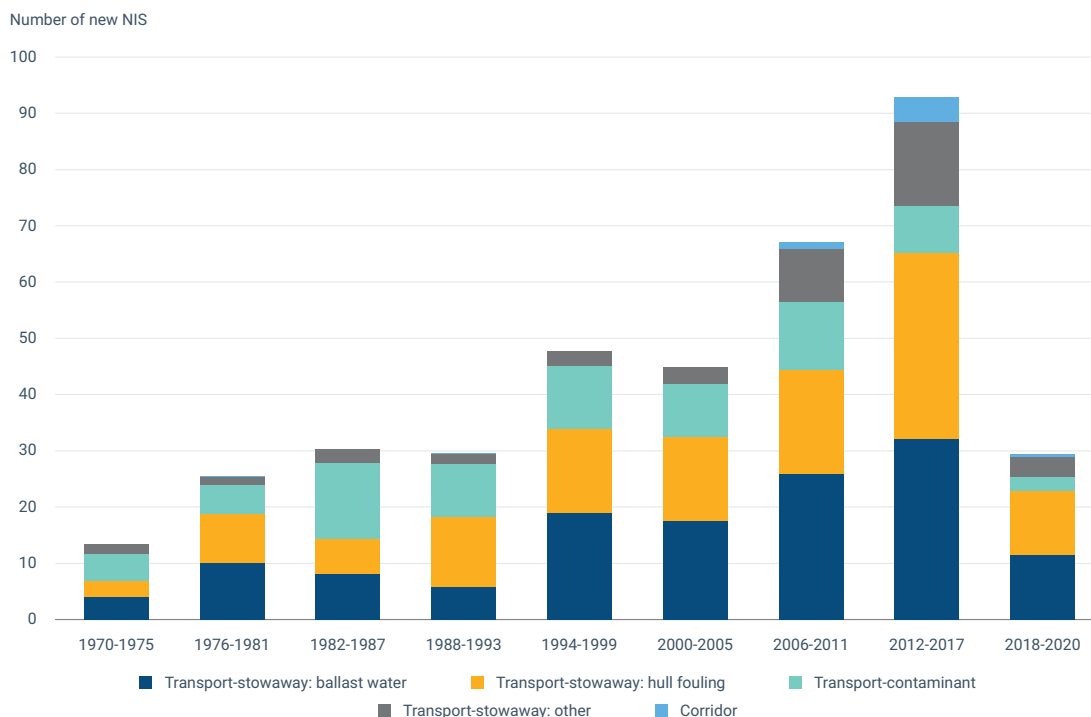
Notes: Only EU Member States' waters are included.

Sources: EEA, 2024 (using EMODnet Digital Bathymetry, MSFD Benthic Broad Habitat Types, EMODNET vessel density, EMODnet Human Activities – Dredging, EEA marine assessment areas buffer zones).

Between 2000 and 2018, there was a 13% increase in port areas in the EU. The expansion was most prominent in the North-East Atlantic Ocean in absolute terms (53 km²) and in the Black Sea in relative terms (17%). The habitat types most impacted by ports and port activity-related pressures are sands and mud in shallow water closest to the shore, which provide homes to various species, including seagrass, microalgae, mangroves, saltmarsh, prawns, bivalves, mud crabs, and fish.

Non-indigenous species (NIS) can be transported from one habitat to another by ships either externally (by clinging to the hulls of vessels, otherwise known as hull fouling) or through ships' tanks (ballast water). When NIS spread aggressively and cause adverse effects, they are classified as Invasive Alien Species (IAS). In 2017, 60% of NIS and 56% of IAS in the marine environment were introduced by shipping activities. While the number of NIS keeps increasing, the introductions of IAS peaked in 2000-2005 and has since decreased. The International Ballast Water Management Convention entered into force in 2017, and by 2023, 31% of ships held an International Ballast Water Management Certificate, while 23% had compliant ballast water management systems.

Figure 11 Number of new non-indigenous species (NIS) in European regional seas introduced by maritime transport, over six-year cycles



Notes: Key to categories: 'ballast water': with ships' ballast waters; 'hull fouling': attached to ships' outer hulls; 'contaminant': carried with another species in a ship; 'Corridor': via man-made shipping canals; 'other': any other ship-related means. The last period is shorter (three years).

Sources: EEA, 2023.

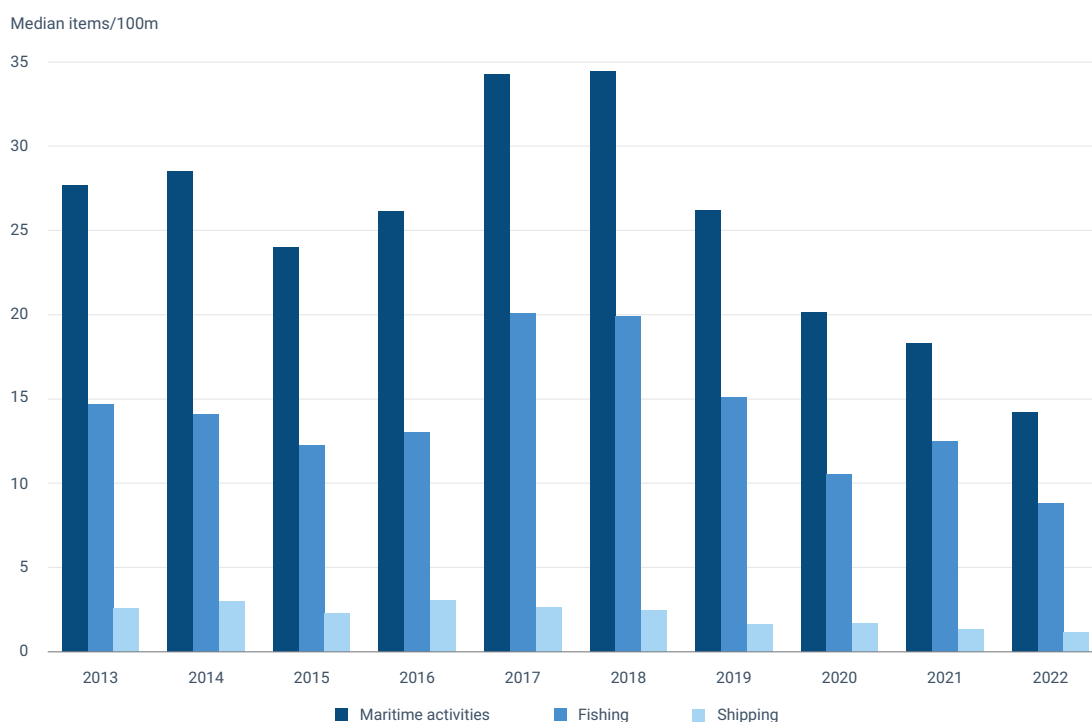
Eastern parts of the Greater North Sea, the south coast of the Bay of Biscay, the Gibraltar region, and parts of the Aegean Sea are hotspots with significant increases in collision risk for whales and turtles.

A decrease in collision risk is noticeable in the western coast of the Iberian Peninsula, partially in the Celtic Seas, the Adriatic Sea, and the Black Sea. There has been a significant increase in collision risk in Natura 2000 areas in all marine subregions between 2017 and 2022.

Marine litter and waste reception at ports

Marine litter from fisheries (11.2%) and shipping (1.8%) were estimated to contribute to more than 20% of the total marine litter. Beach litter attributed to shipping and fisheries was analysed to have been reduced by half within the past decade. Meanwhile, data suggests that the contribution of the shipping sector to annual pellet losses from European industries ranges between 141 and 279 tonnes, mainly from lost containers. These losses can have immediate and long-term impacts, as seen in the CSAV TOCONAO incident in late 2023, where approximately 26 tonnes of plastic pellets were released, causing significant environmental damage, and prompting extensive clean-up efforts along the Galician coastline.

Figure 12 Temporal distribution of litter items likely originating from all maritime activities, shipping and fisheries and mariculture, in European regional seas



Notes: Compiled survey data of EMODnet European beach litter standardised, harmonised, and validated datasets 2001/2022 v2023 and EEA MarineLitterWatch v2023.

Sources: EEA, 2024.

Ports are playing an ever more significant role in the management of waste from ships. In 2023, the largest amounts of waste delivered to port reception facilities were oily waste (855,000 m³) and garbage (488,000 m³), followed by sewage (250,000 m³).

Leading ports such as Rotterdam, Antwerp, and Copenhagen handled the highest volumes of waste, with Rotterdam managing 475,000 m³, Antwerp 210,000 m³, and Copenhagen 132,000 m³.

Supporting the sustainable transition

An EU basket of measures

As part of a set of measures under the European Green Deal, the 'Fit for 55' package extended the EU Emissions Trading System (EU ETS) to maritime transport. Under its provisions, shipping companies will surrender allowances for a portion of their greenhouse gas emissions: 40% of their verified emissions as of 2024, 70% as of 2025, and 100% as of 2026.

In addition, the FuelEU Maritime Regulation stipulates that the yearly average greenhouse gas (GHG) intensity of the energy used on board ships will initially have to be reduced from the 2020 baseline by a minimum of 2% by 2025, 6% by 2030, and afterwards in 5-year steps up to 80% by 2050. To achieve the emission reductions and energy intensity expected by 2030, fossil fuel consumption should be significantly limited.

Furthermore, measures contained in the FuelEU Maritime Regulation enforcing the use of onshore power supply by 2030 are supporting the transition to low-carbon and renewable energy sources, while the Alternative Fuel Infrastructure Regulation ensures the development of infrastructure for alternative fuels as well as the deployment of onshore power supply. The Renewable Energy Directive sets binding targets for the use of renewable energy in the transport sector, including maritime transport, driving innovation in advanced biofuels and renewable fuels of non-biological origin.

At the same time, revenues from the EU ETS are financing the EU's Innovation Fund, which has already supported more than 300 shipping decarbonisation related projects. The Innovation Fund is one of the world's largest funding programmes for the development of innovative low carbon technologies. It focuses on highly innovative clean technologies and big flagship projects with European added value that can bring significant pollutant and GHG emissions reductions.

Alternative fuels

Methanol use as a shipping fuel is rising, with 33 ships currently in operation and 29 on order in 2024. The number of biofuel-powered ships is also expected to grow, although there are limitations in terms of the amount of biomass available as well as its compliance with sustainability criteria. Synthetic fuels, including e-fuels, are considered advantageous 'drop-in' fuels and have been studied as potential medium- and long-term alternatives for marine fuel, while there are currently 112 global projects aiming to produce green and blue ammonia as zero carbon fuels. The number of wind propulsion systems is increasing, with installations on over 30 ships and ongoing retrofits on 26 more. Hydrogen-powered ships include three in operation and five currently on order.

In 2023, the EU maritime sector had 1083 battery-powered ships in operation, with 160 more on order for 2024. At the same time, at least 44 ports have already implemented onshore power supply (OPS) connections, with 352 berths equipped with shore-to-ship power supply facilities. However, only a limited number of ships are currently able to connect to high voltage OPS.

Future challenges

Taken as a whole, the widespread adoption of alternative fuels and sources of power by the maritime transport sector requires substantial investment, both in infrastructure and in training. Estimates suggest that up to 800,000 seafarers may require additional training on new fuels and technologies by the mid-2030s to achieve net-zero GHG emissions from international shipping by 2050. Therefore, there is a pressing need for harmonised international guidelines on seafarer training for ships using alternative energy sources to effectively facilitate this transition.

Rapid advancements in maritime technologies, including alternative fuels and novel power solutions, also introduce new challenges. Some potential alternatives, like ammonia, have associated safety concerns. Equally, it remains uncertain as to whether the production of alternative energy sources can meet the expected demand that will arise in parallel to the decarbonisation strategies of the sector. For example, the projected electrolyser capacity by 2030 could supply hydrogen fuels for 13-19% of the global fleet if sufficient renewable electricity and capacity increases are realised. Green ammonia production needs a three-to-four-fold increase to support the foreseen demand.

Ongoing decarbonisation efforts promote the uptake of cleaner low carbon fuels with no sulphur content. However, some fuel options will still require a pilot fuel for combustion, and others will continue to produce NO_x emissions. Nevertheless, with the appropriate use of technology and regulations both in the EU and in the framework of the International Maritime Organization, these challenges can be overcome.

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