

## 【欧州】 【海事】

Maritime Issues - Internal regulation on gas emissions: The impact of FuelEU Maritime Regulation and Directive on ship-source pollution on cleaning up the maritime sector against the backdrop of possible early adoption of e-fuels

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## 【概要 : Summary】

The maritime transport sector provides economic and social benefits to the EU, but it is also responsible for about 3 to 4% of the EU's total CO<sub>2</sub> emissions besides other ship-source pollution. Considering the 2050 net-zero GHG emissions target, the 90% GHG emission reduction target for the EU's transport sector, and the target to reduce ship-source pollution, the FuelEU Maritime Regulation (EU) 2023/1805 has come into full effect on 1 January 2025, and on 5 January 2025, the Directive (EU) 2024/3101 on ship-source pollution entered into force. The new Directive (EU) 2024/3101 incorporates the IMO MARPOL Annexes' international standards into EU law, expanding the scope of ship-source pollution rules to all polluting substances discharged illegally into the sea, including residues of exhaust gas cleaning systems (EGCS). The Directive (EU) 2024/3101 is expected to ultimately help lowering the environmental impact of maritime transport activities on the marine ecosystem.

Furthermore, the FuelEU Maritime Regulation (EU) 2023/1805 obliges commercial vessels of 5,000 gross tonnes and above to gradually decrease their annual average GHG intensity, starting

from -2% in 2025 and to finally reaching -80% in 2050, based on the GHG intensity average in 2020. The Regulation (EU) 2023/1805 also mandates the use of onshore power supply (OPS) from 1 January 2030 onwards in ports covered by the Alternative Fuels Infrastructure Regulation (AFIR), among others.

Considering the general target to make the shipping sector more sustainable, an UCL report assesses the financial risks to the shipping industry due to stricter GHG emission regulations. Another report of UCL/UMAS focuses on the question to what extent e-fuels can be made competitive at an earlier date in the transition towards alternative low emission fuels and technologies. There are concerns that a lack of a clear business case for e-fuels could undermine timely investments and prevent cost reduction. The UCL/UMAS report concludes that an earlier adoption of e-fuels will only happen if policy measures close the TCO gap between e-fuels and the most cost-effective alternative fuel compliance option. This can be achieved by a combination of rewarding direct subsidies to the shipping industry for adopting e-fuels and the introduction of levies and penalties.

【記事 : Article】

## 1. Improving maritime transport's sustainability

With 75% of the EU's external trade being seaborne, maritime transport is vital for the EU's economy and for connecting its islands and peripheral regions (Council of the EU 2024). However, while the maritime sector brings economic and social benefits, it also poses environmental challenges. Nearly all existing and ordered new ships are still fossil-fuelled and use heavy fuel oil, with only 2% of the fleet ready to switch to zero-emission fuels and just one-third of the fleet uses energy-saving technologies, despite their maturity and cost-effectiveness (Fricaudet et al. 2025). The main reason for ships still using heavy fuel oil is that a switch to cleaner fuels like hydrogen, ammonia, and e-fuels remains expensive and that they are limited in availability (Prenghman 2024). Accordingly, maritime transport is responsible for about 3 to 4% of the EU's total CO<sub>2</sub> emissions, or over 124 million tonnes of CO<sub>2</sub> in 2021 (European Commission n.d.a, European Commission 2024). The EU's 2019 European Green Deal target to reach climate-neutrality by 2050 also envisages a 90% reduction of the transport sector's CO<sub>2</sub> emissions. Current efforts in EU policies to decarbonise maritime transport focus on the introduction of low-carbon fuels and zero-emission technologies (EEA 2024). Furthermore, the EU policies on making maritime transport more sustainable also include efforts to reduce ship-source pollution.

To improve the maritime transport sector's sustainability, two new pieces of legislation need to be analysed more closely, the Directive (EU) 2024/3101 on ship-source pollution, amending Directive 2005/35/EC, which entered into force on 5 January 2025, and the FuelEU Maritime Regulation (EU) 2023/1805, which came into full effect on 1 January 2025.

## 2. Directive (EU) 2024/3101 amends Directive 2005/35/EC on ship-source pollution

Based on the relevant IMO's rules and standards set in the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), the new Directive 2024/3101 amends Directive 2005/35/EC on the regulation of penalties for illegal discharges of oil and noxious liquid substances from ships. Directive 2005/35/EC was introduced in the wake of the Erika (1999) and Prestige (2002) oil spills and also transposed the MARPOL international standards in MARPOL Annexes I and II into EU law (COM(2023) 273 final, Council of the EU 2024). Related measures also included the creation of the CleanSeaNet service, an EU-wide oil monitoring system hosted by the European Maritime Safety Agency (EMSA) (SWD(2023) 164 final, Council of the European Union 2023a). However, since those responsible for illegal discharging were not always identified and penalised, and since new MARPOL international standards for ship-source pollution had to be transposed into EU law, a revision of Directive 2005/35/EC had become necessary. The proposal was presented as part of the maritime safety package of 1 June 2023 (European Commission 2023a, see also Antolini 2024).

The new Directive (EU) 2024/3101 aims to prevent any type of illegal discharges into European seas and expands the scope of the legislation to cover all international standards on polluting substances, also including sewage from ships and exhaust removed from the wash water of the exhaust gas cleaning systems (EGCS) defined in Regulation 4 of Annex VI to MARPOL 73/78 (MARPOL Annex IV) (Council of the European Union 2023, Directive (EU) 2024/3101). Moreover, to improve information exchange between Member States and the Commission, EMSA tools and services such as CleanSeaNet, SafeSeaNet and THETIS will be further optimised (European Commission 2023a, 2023b). Accordingly, Directive (EU) 2024/3101 is

expected to lower the environmental impact of maritime transport on the marine ecosystem (Council of the European Union 2024, European Parliament 2024). The EU Member States have 30 months to transpose the Directive's provisions in their national legislation (Directive (EU) 2024/3101, European Parliament 2024).

### 3. FuelEU Maritime Regulation (EU) 2023/1805 for introducing renewable and low carbon fuels in maritime transport

In 2018, the IMO adopted an Initial Strategy for international shipping to reduce average carbon intensity (CO<sub>2</sub> per tonne-mile) by at least 40% by 2030 and by 70% in 2050, while total emissions should be cut by at least 50% by 2050, compared to 2008 (Soone 2024).

To align with these goals, the EU introduced the FuelEU Maritime Regulation (EU) 2023/1805, mandating the gradual uptake of renewable and low-carbon fuels and onshore power supply (OPS). The FuelEU Maritime regulation is the second major EU legislation focusing on the shipping industry's CO<sub>2</sub> emissions, following the EU-ETS for shipping (Regulation (EU) 2023/1805). Regulation (EU) 2023/1805 entered into force on 12 October 2023 and became fully applied from 1 January 2025. It obliges ships exceeding 5,000 gross tonnage, regardless of their flag, to reduce their GHG intensity of their energy consumption on board by increasingly reducing the use of fossil-fuel based marine fuels (European Commission 2025, Commission n.d.b). Companies must monitor their ships' energy used on board during EU related voyages and stays at EU ports. EMSA supports implementation through the THETIS-MRV platform, aiding in reporting and compliance tracking (EMSA n.d., European Commission n.d.b). GHG intensity is set to decrease from -2% in 2025 to -80% by 2050, compared to 2020 levels (Regulation (EU) 2023/1805). The FuelEU Maritime Regulation covers not only CO<sub>2</sub> but also methane and nitrous

oxide emissions over the full lifecycle of the fuels used onboard, on a Well-to-Wake (WtW) basis (European Commission n.d.b).

To achieve its targets, the FuelEU Maritime Regulation takes a goal-based, technology-neutral approach, explicitly including e-fuels and offers operators flexibility in choosing sustainable fuels and technologies to meet reduction targets (Regulation (EU) 2023/1805). To cut air pollution in ports, passenger and container ships must use OPS or zero-emission technologies from 1 January 2030 in AFIR-covered ports and from 1 January 2035 in all EU ports with OPS facilities (European Commission 2025). Compliance involves monitoring and reporting energy usage and GHG emissions, with penalties imposed for non-compliance (Regulation (EU) 2023/1805).

From 1 January 2025, The FuelEU Regulation (EU) 2023/1805 requirements are expected to reduce carbon emissions and air pollution in the EU's maritime sector. By 31 January 2026, companies must submit a FuelEU Report to verifiers to assess compliance with 2025 GHG reduction targets (European Commission 2025).

### 4. UCL/UMAS studies on planning the introduction of future maritime fuels and possible impact of FuelEU Maritime

As the IMO prepares to finalize mid-term measures on GHG emission reductions in maritime transport at key negotiations in February and April 2025, a report by the UCL Energy Institute Shipping and Oceans Research Group, entitled "Supply-side and demand-side stranded asset risks in shipping", highlights financial risks of stranded assets in shipping due to stricter GHG regulations (shippingandoceans 2025a). The report indicates that a global fuel standard with a flexibility mechanism will not significantly promote alternative fuels like e-fuels' adoption in maritime transport before 2040 (Fricaudet et al. 2025, Safety4Sea 2025a). The

maritime transport sector faces supply-side risks from carbon-intensive ships becoming obsolete and demand-side risks from declining fossil fuel use and retrofitting and repurposing ships would reduce the amount of stranded assets but also those measures would come at a cost (Fricaudet et al. 2025). Moreover, the alternative fuels are in short supply in maritime transport, and there is competition from other sectors like aviation, causing a rise of costs for the shipping companies (Tunagur 2025).

Consequently, there exists high uncertainty regarding the future technology mix, which complicates planning for ship owners, although proactive planning remains essential (Fricaudet et al. 2025, Shippingandoceans 2025a).

Another study presented by UCL Energy Institute and UMAS entitled “How the IMO’s mid-term measures might shape shipping’s energy choices and transition to e-fuels” focuses on the extent to which e-fuels can be made competitive early in the transition towards alternative, low emission fuels and technologies in the period 2027–2035 (UCL/UMAS 2025). The UCL/UMAS study expects that a combination of fossil fuels including LNG, biofuels and CCS would be most competitive until up to the year 2036 (Safety4sea 2025a). Thereafter, ammonia dual fuel ships would be the lowest cost solution, albeit operating on blue ammonia until 2044 (UCL/UMAS 2025). The carbon-free, synthetic e-fuels, produced by combining hydrogen, derived from renewable electricity, with carbon dioxide, are considered a promising solution for decarbonizing the shipping industry (Bureau Veritas 2025). However, the e-fuel’s basis, green hydrogen, currently still faces significant challenges in terms of cost, scalability and global availability (Bureau Veritas 2025). Furthermore, ships that were more competitive between 2027 and 2035 would have at least a 25% higher total cost of operation from 2040 onwards (UCL/UMAS 2025). However, a lack of

a clear business case for e-fuels could undermine investment and prevent cost reduction through learning effects and supply chain development. Currently, in fact, shipowners and investors seem to not anticipate a highly ambitious transition to alternative fuels and their investment strategy seems to be based on “watch and wait”, which is a risky strategy, as it could lead to unanticipated losses (Shippingandoceans 2025a). If shipowners order tonnage to maximize competitiveness in a short-term horizon of only 5 years, the sector faces a major risk of technology lock-in and higher transport costs (Safety4sea 2025a).

This also creates a risk that e-fuels will remain scarce and expensive, depriving the sector sight of its long-term transition pathway (UCL/UMAS 2025). The lack of preparation for these investment decisions will have a negative impact on the increase of sustainability in maritime transport (Safety4sea 2025b).

The UCL/UMAS study concludes that only if there are specific and targeted direct subsidies for the use of e-fuels at a level that closes the total cost of ownership (TCO) gap between e-fuels and the lowest-cost compliance option of alternative fuels, coupled with a GHG levy, an early adoption of e-fuels in the period 2027–2035 could be considered and the risk of technology lock-in and higher transport costs could be avoided (Shippingandoceans 2025b, UCL/UMAS 2025).

## 5. Conclusion and considerations

As they tackle different aspects of maritime pollution, the new Directive (EU) 2024/3101 and the FuelEU Maritime Regulation (EU) 2023/1805 are expected to improve the maritime transport’s overall sustainability. While the new Directive (EU) 2024/3101 tackles ship-source pollution including illegal discharges of residues from exhaust gas cleaning systems in the EU, the FuelEU Maritime Regulation (EU) 2023/1805 effectively targets

the reduction of the carbon intensity of ships through increased use of renewable and low-carbon fuels and OPS in ports.

Both laws will require the shipping industry to invest in alternative fuels and new infrastructure. While the industry recognizes the environmental benefits of these measures, it raises concerns over challenges related to increased operational costs and competitive pressures. The mandatory use of alternative fuels is expected to drive up demand, inevitably leading to higher fuel prices and shipping costs, impacting both, the industry and consumers.

The technology-neutral approach in Regulation (EU) 2023/1805 allows flexibility in adopting cleaner alternative fuels and propulsion systems. However, the greening of maritime transport, the transition to renewable and low-carbon fuels and the reduction of ship-source pollution will come at a price.

According to a UCL/UMAS study, only targeted subsidies for alternative fuels like e-fuels, combined with a GHG levy would ensure an early adoption of e-fuels. The reward and levy will work in combination to close the competitiveness gap between e-fuels and other lower cost compliance options. However, neither of the new EU laws provides direct financial subsidies, while the broader EU programs like the Innovation Fund and Horizon Europe support the development of renewable fuels and sustainability with targeted subsidies for projects, potentially also supporting the early adoption of e-fuels. In summary, both pieces of legislation use incentive mechanisms and penalties to ensure compliance with their targets.

While there are challenges in terms of compliance and increased costs due to the need of investing into alternative fuels and infrastructures, the new laws make proactive investment decisions in favour of green maritime technologies and sustainable maritime transport solutions worthwhile.

## References

- Antolini, Andrea (2024): Maritime Transport - Environmental issues: The European Parliament and the Council reach provisional agreement on the revision of directive on ship-source pollution. In: [https://www.jttri.or.jp/topic\\_europe\\_2024Mar-02.pdf](https://www.jttri.or.jp/topic_europe_2024Mar-02.pdf), 27 March 2024, accessed 3 February 2025
- Bureau Veritas (2025): E-fuels. In: <https://marine-offshore.bureauveritas.com/shipping-decarbonization/future-fuels/e-fuels>, 2025, accessed 5 February 2025
- COM(2023) 273 final: Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2005/35/EC on ship-source pollution and on the introduction of penalties, including criminal penalties, for pollution offences. COM(2023) 273 final. In: [https://transport.ec.europa.eu/system/files/2023-06/COM\\_2023\\_273\\_Ship-source\\_pollution.pdf](https://transport.ec.europa.eu/system/files/2023-06/COM_2023_273_Ship-source_pollution.pdf), 1.6.2023, accessed 16 January 2025
- Council of the European Union (2023): Proposal for a Directive of the European Parliament and of the Council amending Directive 2005/35/EC on ship-source pollution and on the introduction of penalties, including criminal penalties, for pollution offences - General approach. In: <https://data.consilium.europa.eu/doc/document/S-T-16107-2023-INIT/en/pdf>, 30 November 2023, accessed 20 February 2024
- Council of the European Union (2024): Maritime safety: Council and Parliament strike a deal to ensure cleaner shipping in the EU. In: <https://www.consilium.europa.eu/en/press/press-releases/2024/02/15/maritime-safety-council-and-parliament-strike-a-deal-to-ensure-cleaner-shipping-in-the-eu/>, 15 February 2024, accessed 3 February 2025
- Directive (EU) 2024/3101: Directive (EU) 2024/3101 of the European Parliament and of the Council of 27 November 2024 amending Directive

2005/35/EC as regards ship-source pollution and on the introduction of administrative penalties for infringements (Text with EEA relevance). PE/91/2024/REV/1. In: OJ L, 2024/3101, [https://eur-lex.europa.eu/eli/dir/2024/3101/oj/eng?utm\\_source=chatgpt.com](https://eur-lex.europa.eu/eli/dir/2024/3101/oj/eng?utm_source=chatgpt.com), 16.12.2024, accessed 23 Jan. 2025

EMSA (n.d.): FuelEU Maritime: full application 1 January 2025. In: <https://emsa.europa.eu/newsroom/latest-news/item/5385-fueleu-maritime-full-application-1-january-2025.html>, no date, accessed 4 February 2025

European Commission (n.d.a): Reducing emissions from the shipping sector. In: [https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector\\_en](https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector_en), no date, accessed 3 February 2025

European Commission (n.d.b): Decarbonising maritime transport - FuelEU Maritime. In: [https://transport.ec.europa.eu/transport-modes/maritime/decarbonising-maritime-transport-fueleu-maritime\\_en](https://transport.ec.europa.eu/transport-modes/maritime/decarbonising-maritime-transport-fueleu-maritime_en), no date, accessed 4 February 2025

European Commission (2023a): Maritime safety: new proposals to support clean and modern shipping. In: [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_23\\_2919](https://ec.europa.eu/commission/presscorner/detail/en/ip_23_2919), 1 June 2023, accessed 17 January 2025

European Commission (2023b): Questions and Answers on Maritime safety: new proposals to support clean and modern shipping. In: [https://ec.europa.eu/commission/presscorner/detail/en/qanda\\_23\\_2920](https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_2920), 1 June 2023, accessed 17 January 2025

European Commission (2024): Climate Action Progress Report 2024. Leading the way: from plans to implementation for a green and competitive Europe. In: <https://climate.ec.europa.eu/document/download/7bd19c68-b179-4f3f-af75->

[4e309ec0646f\\_en?filename=CAPR-report2024-web.pdf](https://eur-lex.europa.eu/eli/dir/2024/3101/oj/eng?utm_source=chatgpt.com), 5 November 2024, accessed 23 Jan. 2025

European Commission, Directorate-General for Mobility and Transport (2025): New EU rules aiming to decarbonise the maritime sector take effect. In: [https://transport.ec.europa.eu/news-events/news/new-eu-rules-aiming-decarbonise-maritime-sector-take-effect-2025-01-10\\_en](https://transport.ec.europa.eu/news-events/news/new-eu-rules-aiming-decarbonise-maritime-sector-take-effect-2025-01-10_en), 10 January 2025, accessed 23 January 2025

EEA (European Environment Agency, EEA) (2024): Greenhouse gas emissions from transport in Europe. In: <https://www.eea.europa.eu/en/analysis/indicator/s/greenhouse-gas-emissions-from-transport>, 31 Oct 2024, accessed 4 February 2025

European Parliament (2023): Ship-source pollution and introduction of penalties. In: Legislative Observatory, 2023/0171(COD) <https://oeil.secure.europarl.europa.eu/oeil/en/document-summary?id=1746043>, 01/06/2023, accessed 3 Feb. 2025

European Parliament (2024): Revision of the Directive 2005/35/EC on ship-source pollution and on the introduction of penalties for infringements. In “A European Green Deal”. In: <https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-the-ship-source-pollution-directive>, 15 Dec. 2024, accessed 4 Feb. 2025

Fricaudet et.al. (Fricaudet, M., Rehmatulla, N. and Smith, T. ) (2025): Supply-side and demand-side stranded asset risks in shipping, In: [https://www.ucl.ac.uk/bartlett/energy/sites/bartlett\\_energy/files/supply-side\\_and\\_demand-side\\_stranded\\_asset\\_risks\\_in\\_shipping.pdf](https://www.ucl.ac.uk/bartlett/energy/sites/bartlett_energy/files/supply-side_and_demand-side_stranded_asset_risks_in_shipping.pdf), London, UK, 23 January 2025, accessed 7 Feb. 2025

Prengman, Peter (2024): Head of international shipping regulator says industry must do more to cut carbon pollution. In: <https://apnews.com/article/international-shipping-greenhouse-gas-emissionsinternational-maritime-organization->



[933147f1bba7f4851134f128b07e6917](https://eur-lex.europa.eu/eli/reg/2023/957), October 9, 2024, accessed 7 February 2025

Regulation (EU) 2023/957: Regulation (EU) 2023/957 amending Regulation (EU) 2015/757 in order to provide for the inclusion of maritime transport activities in the EU Emissions Trading System and for the monitoring, reporting and verification of emissions of additional greenhouse gases and emissions from additional ship types. (Text with EEA relevance). PE/10/2023/REV/1. In: OJ L 130, p. 105-114, <https://eur-lex.europa.eu/eli/reg/2023/957>, 16.5.2023, accessed 17 January 2025

Regulation (EU) 2023/1805: Regulation (EU) 2023/1805 of the European Parliament and of the Council of 13 September 2023 on the use of renewable and low-carbon fuels in maritime transport, and amending Directive 2009/16/EC (Text with EEA relevance). PE/26/2023/INIT. In: OJ L 234, 22.9.2023, p. 48-100, <https://eur-lex.europa.eu/eli/reg/2023/1805>, 22.9.2023, accessed 17 January 2025

Safety4sea (2025a): Study explores IMO's options on e-fuels and energy transition. In: <https://safety4sea.com/study-explores-imos-options-on-e-fuels-and-energy-transition/>, 30 January 2025, accessed 4 February 2025

Safety4sea (2025b): UCL: Shipping should promptly adapt to the energy transition. In: <https://safety4sea.com/ucl-shipping-should-promptly-adapt-to-the-energy-transition/>, 23 January 2025, accessed 5 February 2025

Shippingandoceans (2025a): Existing ships and those on order would produce twice the emissions required under a 1.5° C-aligned carbon budget. In: <https://www.shippingandoceans.com/post/existing-ships-and-those-on-order-would-produce-twice-the-emissions>, 23 Jan 2025, accessed 4 February 2025

Shippingandoceans (2025b): New study shows that only targeted subsidy for e-fuels, coupled with a GHG levy, would ensure e-fuel early adoption. In: <https://www.shippingandoceans.com/post/only-targeted-subsidy-for-e-fuels-coupled-with-a-ghg-levy-would-ensure-e-fuel-early-adoption>,

[targeted-subsidy-for-e-fuels-coupled-with-a-ghg-levy-would-ensure-e-fuel-early-adoption](https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-fuel-eu-maritime), Jan. 29 2025, accessed 7 February 2025

Soone, Jaan: Fuel EU Maritime - Sustainable maritime fuels. In "A European Green Deal". In: Legislative Train Schedule, European Parliament, <https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-fuel-eu-maritime>, 15/12/2024, accessed 4 February 2025

SWD/2023/164 final: COMMISSION STAFF WORKING DOCUMENT EXECUTIVE SUMMARY OF THE IMPACT ASSESSMENT Accompanying the document PROPOSAL FOR A DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2005/35/EC on ship-source pollution and on the introduction of penalties, including criminal penalties, for pollution offences. In: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=SWD:2023:164:FIN>, SWD/2023/164 final, Brussels, 1.6.2023, accessed 17 January 2025

Tunagur, Enes (2025): EU's cleaner marine fuel rules are inflationary, shipbrokers say. In: [https://www.reuters.com/sustainability/climate-energy/eus-cleaner-marine-fuel-rules-are-inflationary-shipbrokers-say-2025-01-06/?utm\\_source=chatgpt.com](https://www.reuters.com/sustainability/climate-energy/eus-cleaner-marine-fuel-rules-are-inflationary-shipbrokers-say-2025-01-06/?utm_source=chatgpt.com), January 6, 2025, accessed 4 February 2025

UCL/UMAS (2025): How the IMO's mid-term measures might shape shipping's energy choices and transition to e-fuels. In: [https://safety4sea.com/wp-content/uploads/2025/01/UCL-UMAS-How-IMO-mid-term-measures-might-shape-shippings-energy-transition-2025\\_01.pdf](https://safety4sea.com/wp-content/uploads/2025/01/UCL-UMAS-How-IMO-mid-term-measures-might-shape-shippings-energy-transition-2025_01.pdf), January 2025, accessed 4 February 2025