Sustainability in numbers

by Dr Jeroen Dierickx, *Founder, iDefossilise*

The maritime industry is under increasing pressure to reduce its environmental impact, particularly concerning greenhouse gas (GHG) emissions. In response, both international and regional regulatory frameworks have been developed to encourage emission reductions and promote sustainable shipping practices. Notably, the maritime industry now faces a transitional challenge in complying with the latest EU rules, as the changes brought by them are posed to make green methanol competitive.

Under the EU's Fit for 55 regulatory package, vessel owners and operators are incentivised to transition to sustainable fuels through significant penalties levied on continued fossil bunker use. For fuel producers, the regulations offer a stable, long-term framework from 2024 to 2050, paving the way for secure investment opportunities in the maritime sector.

A new white paper prepared for the Methanol Institute concludes that the FuelEU Maritime Regulation and the EU Emissions Trading System (EU ETS) will create a level playing field for bio- and e-methanol, making them economically competitive compared to fossil marine fuels.

Regulations

FuelEU Maritime is a cornerstone initiative of the EU aimed at reducing GHG emissions from the maritime sector. This legislative framework sets specific targets and measures to decarbonise shipping and promote cleaner fuels. Its key elements include yearly average (well-to-wake) GHG intensity reduction targets and a 2% sub-target for renewable fuels of non-biological origin (RFNBO) starting in 2034 (with incentives for RFNBO use until then). It also mandates the use of onshore power supply in major European ports.

The EU ETS is a cap-and-trade system that limits the total CO_2 emissions from certain sectors, with shipping included as of this year. The scope of maritime emissions covered by the EU ETS increases from 40% in 2024 to 70% in 2025 and 100% in 2026. Shipping companies must buy emission allowances, each covering one tonne of CO_2 or the equivalent of other potent GHGes, such as methane (CH_4) or nitrous oxide (N_2O). Allowances are auctioned, and companies can trade them in secondary markets.

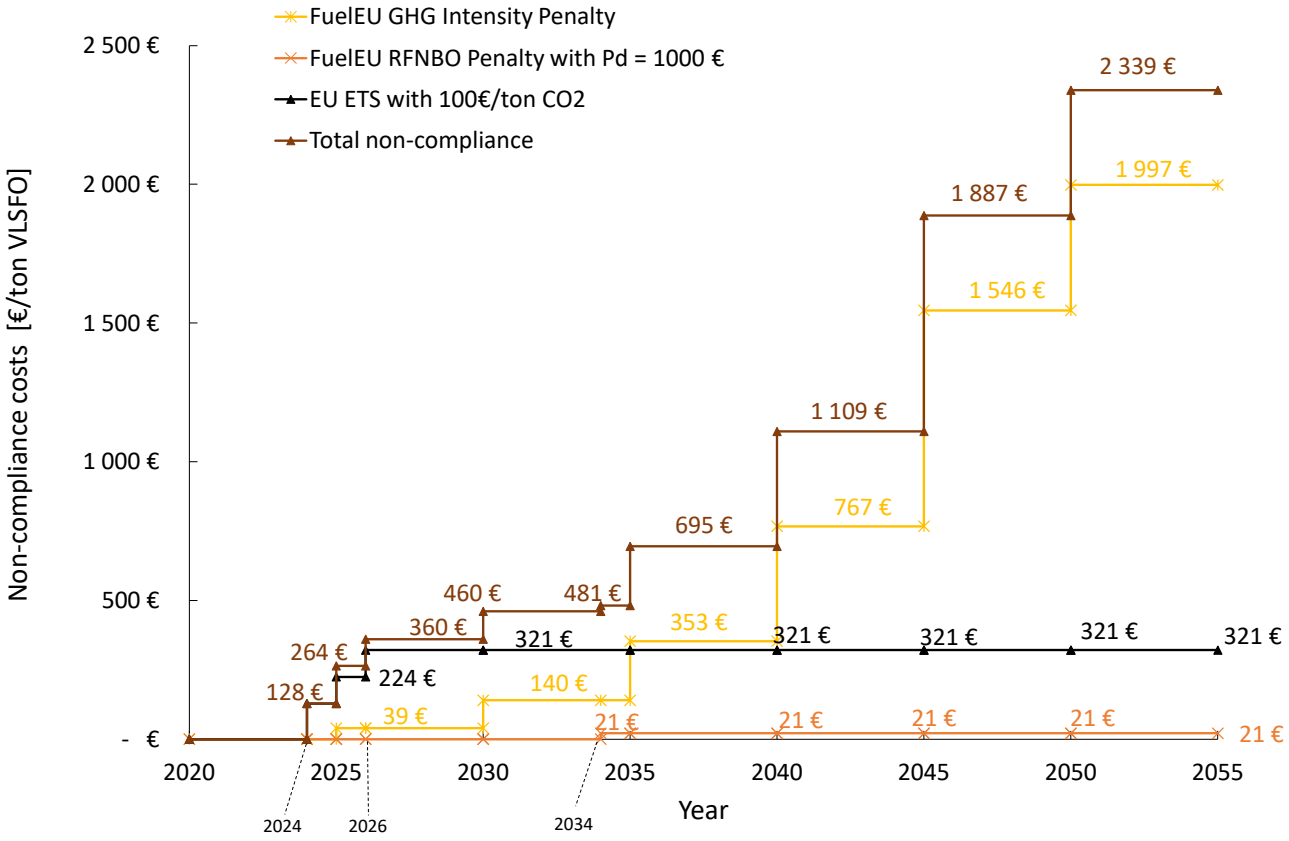
Penalties

The 'stick' for not meeting the FuelEU Maritime GHG intensity reduction targets increases every five years, starting at €39/tonne of very-low sulphur fuel oil (VLSFO) in 2025, rising to €1,997/t/VLSFO after 2050. This increase corresponds with the stricter GHG intensity reduction targets over time. When the cost of an EU emission allowance is €100, the FuelEU Maritime GHG intensity penalty surpasses the EU ETS cost by 2035 – and more than doubles it after 2040.

The penalty for not meeting the RFNBO sub-target was calculated using an assumed price difference of €1,000 between RFNBO and VLSFO, resulting in a penalty of €21/t/VLSFO used. For context, if the price difference between RFNBO and VLSFO were €500 or €2,000, the penalties would be €10 and €42/t/VLSFO, respectively.

The EU ETS is gradually introduced to the maritime sector, covering 40% of emissions this and 70% next year, resulting in costs of €128 and €264/t/VLSFO, accordingly. By 2026, all emissions will be in scope, thus costing €321/t/VLSFO. This cost does not include CH_4 and N_2O emissions, which come into effect in 2026 and add about €5.50/t/VLSFO. For fossil liquefied natural gas (LNG), because of the methane slip, this additional cost can reach €74/t of LNG used.

Fig. 1. Non-compliance costs for using VLSFO under FuelEU Maritime and EU ETS



Compliance using methanol

Given the significant non-compliance costs for the continued use of VLSFO for propulsion, shipping companies are looking at regulatory compliance strategies. While several pathways exist – including the use of bio-fuels, e-fuels, wind propulsion, or pooling of vessels – this section focuses on mitigating non-compliance costs using methanol.

This can be done for individual ships or a pool of vessels, where one sustainable ship

Photo: MPC Container Ships

Fig. 2. Energy shares of VLSFO and bio- or e-methanol in dual-fuel vessel operation to comply with the FuelEU Maritime GHG intensity reduction targets (Pathway 1) – based on the assumptions made in this analysis

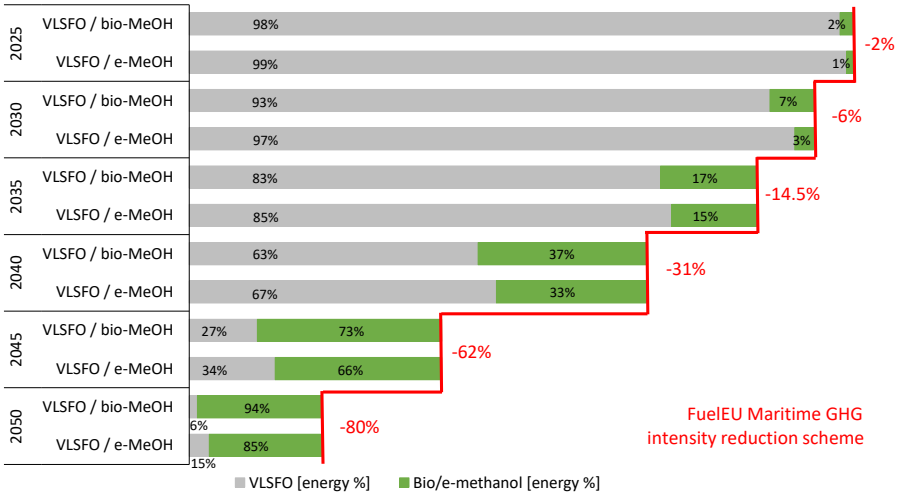


Photo: Stena Proman

offsets the GHG emissions of another group of vessels. In determining the compliance pathway, it is important to note that shipowners are currently favouring dual-fuel internal combustion engine technology with methanol.

While there are several pathways possible to be compliant with FuelEU Maritime, this analysis explores two options for using methanol. Pathway 1 uses, on an annual basis, the average required (and minimum) amount of methanol to be compliant. The results of this pathway can be used for individual vessels or a pool (or, hypothetically, at the EU level, i.e., assuming that sustainable methanol would be the only solution to achieve compliance).

Pathway 2 uses methanol blends, i.e., a mixture of fossil-based and sustainable methanol. Again, the results of this pathway can be used for individual vessels or a pool. This option is interesting to investigate as it allows the existing methanol supply to be used and fossil-based methanol to be gradually replaced by its sustainable version.

The two pathways are analysed as if they were two independent solutions to become compliant with FuelEU Maritime. In reality, they will co-exist and interact with each other, as well as with other compliance solutions.

This analysis focuses on the stringent European regulatory framework for GHG emissions, particularly FuelEU Maritime and the EU ETS. These regulations impose significant penalties for non-compliance, driving the need for alternative fuels. The non-compliance costs for using VLSFO will rise sharply due to regulatory penalties, from €264/t in 2025 to €2,339/t by 2050. This increasing cost supports the shift to alternative fuels like bio-methanol and e-methanol.

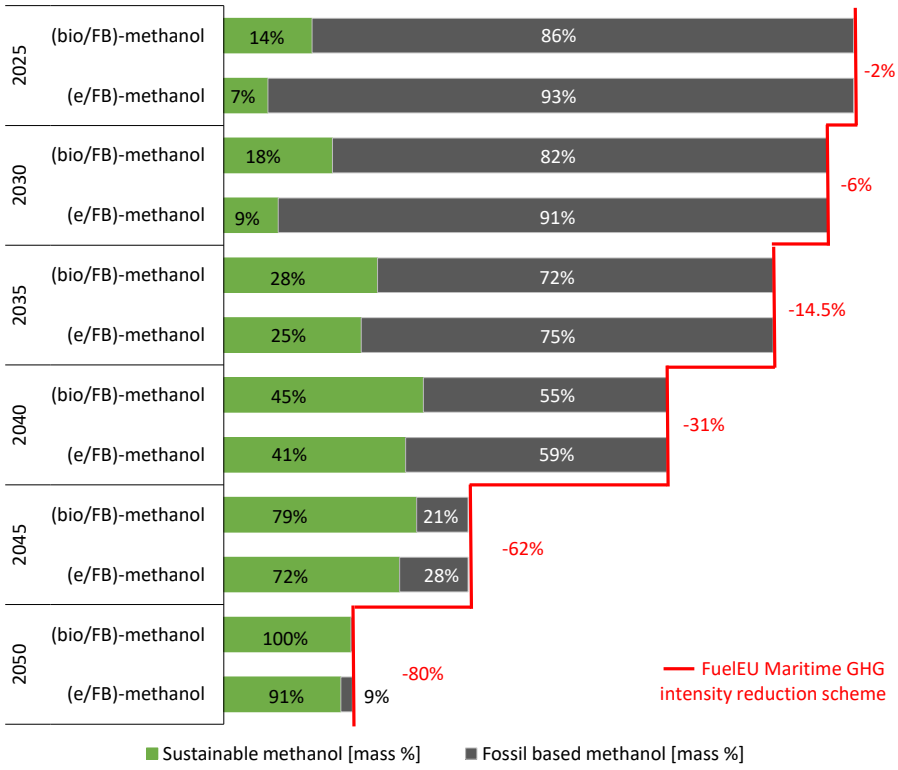
Photo: Hutchison Ports UK

Economic value of bio-methanol and e-methanol

The economic value of methanol is expressed in this analysis as the maximum price of methanol for which the total fuel cost of VLSFO, including non-compliance costs, is equal to the total fuel cost with Pathway 1. For instance, the maximum price for bio-methanol considering only FuelEU Maritime is €936/t in 2030 and €965/t in 2040. By adding the EU ETS to the picture, both maximum prices increase by €120/t.

The reward factor for e-methanol from 2025 to 2034 also significantly impacts its price, making it, for example, €2,405/t in 2030 but dropping to €1,330/t five years later when the reward factor ends. Including the EU ETS results for e-methanol in a maximum price increase of €150/t. It is also concluded that the economic value of sustainable methanol depends on its potential to reduce GHGes: the higher the well-to-wake emission reduction, the greater the economic value under FuelEU Maritime.

Fig. 3. The composition of methanol blends to comply with FuelEU Maritime (Pathway 2) – based on the assumptions made in this analysis



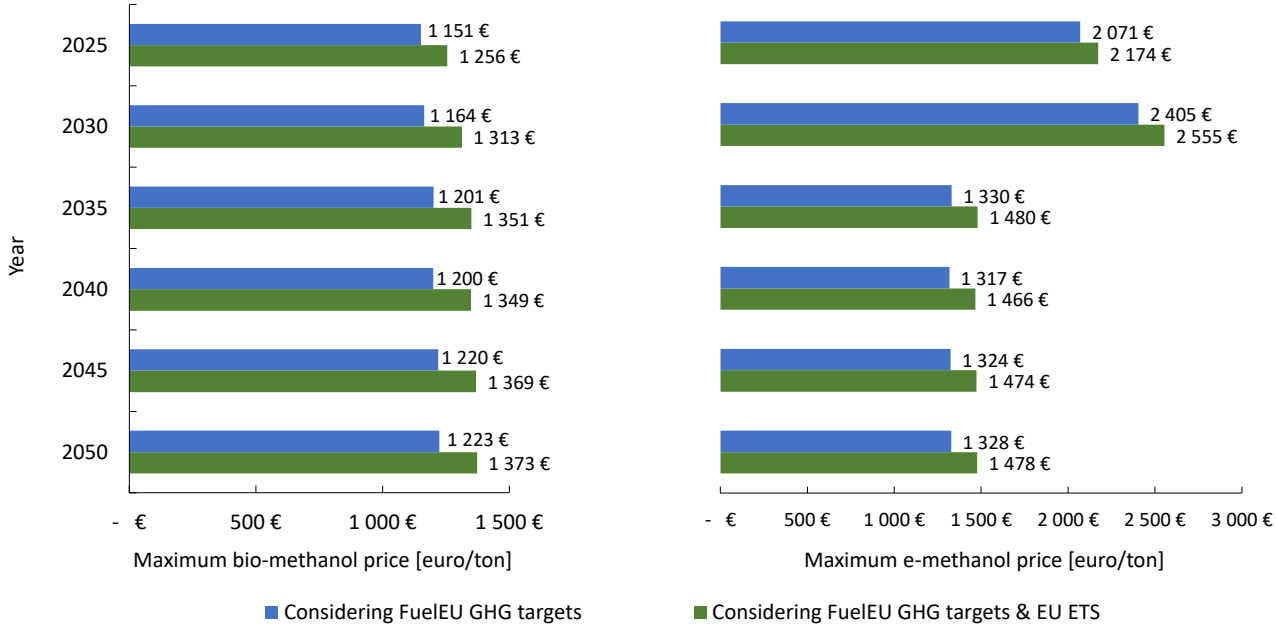
Market incentive for sustainable fuels

FuelEU Maritime and the EU ETS provide strong incentives for the adoption of sustainable fuels in the maritime sector. The non-compliance costs for VLSFO are substantial, making bio- and e-methanol attractive and economically viable alternatives.

With average maximum prices of €959/t for bio-methanol (excl. the EU ETS, from 2025 to 2050) and up to €2,238/t for e-methanol (excl. the EU ETS, from 2025 to 2034), and given that production costs for bio-methanol and e-methanol are typically lower, it is concluded that the regulations enable bio- and e-methanol fuel producers to charge a premium, making investment cases profitable. This suggests that the regulatory frameworks effectively support the transition to sustainable fuels in maritime shipping.

FuelEU Maritime and the EU ETS are creating a level playing field for sustainable fuels like bio- and e-methanol. With significant penalties for using fossil bunkers, owners-operators are incentivised to switch to sustainable methanol. For fuel producers, these regulations provide a stable, long-term framework until mid-century, facilitating secure investment opportunities. □

Fig. 4. Maximum bio-methanol and e-methanol price using Pathway 1 to match with the total price for VLSFO under FuelEU Maritime and EU ETS – based on the assumptions made in this analysis



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