Shipping decarbonisation policy overview: FuelEU maritime, ETS and IMO NZF

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Introduction

Wood Mackenzie

The IMO has taken a major step by approving the first global carbon pricing mechanism for shipping, but formal adoption is not yet guaranteed

Legislative framework on marine transport emissions

EU Emission Trading System (ETS)

- **Cap-and-trade** mechanism based on an emission allowances market
- **Tank-to-Wake** direct emissions
- Flag-neutral and route-based
- Exemptions for **biofuels** and **RFNBO**

Active from 2024 – fully phased in from 2028

FuelEU Maritime initiative (FEUM)

- **Penalties** on GHG intensity for each ton of fuel consumed above limits
- **Well-to-Wake** emissions
- Flag-neutral and route-based
- Incentives and targets for **RFNBO**

Active from 2025 – limits on GHG intensity fold every 5 years

IMO net-zero framework (NZF)

- **Global standard** for fuels emission
- **Two-tier GHG** pricing mechanism
- **Well-to-Wake** emissions
- Includes rewards for zero and near-zero GHG emissions fuels (ZNZs)

Adoption vote in October 2025 – expected entry into force in 2027

Source: Wood Mackenzie, IMO, European Commission

FuelEU maritime and ETS

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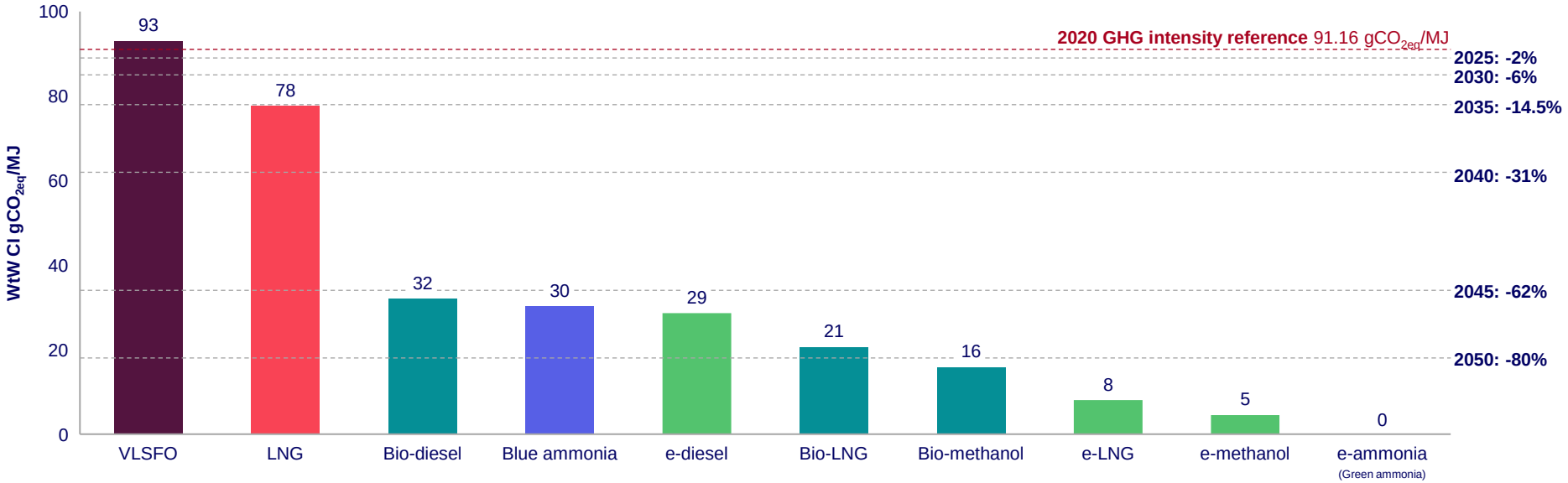
FuelEU maritime sets ambitious target of -80% GHG emission intensity by 2050 to the marine sector

GHG emission intensity covers the full well-to-wake emissions cycle, incentivizing biofuels and e-fuels adoption

GHG emission default factors vs FuelEU maritime CI targets



Assumptions: Well-to-Wake emissions based on the European Commission default factors. LNG slippage assuming LNG Diesel engine (0.2% CH_4 loss).

Source: Wood Mackenzie, European Commission

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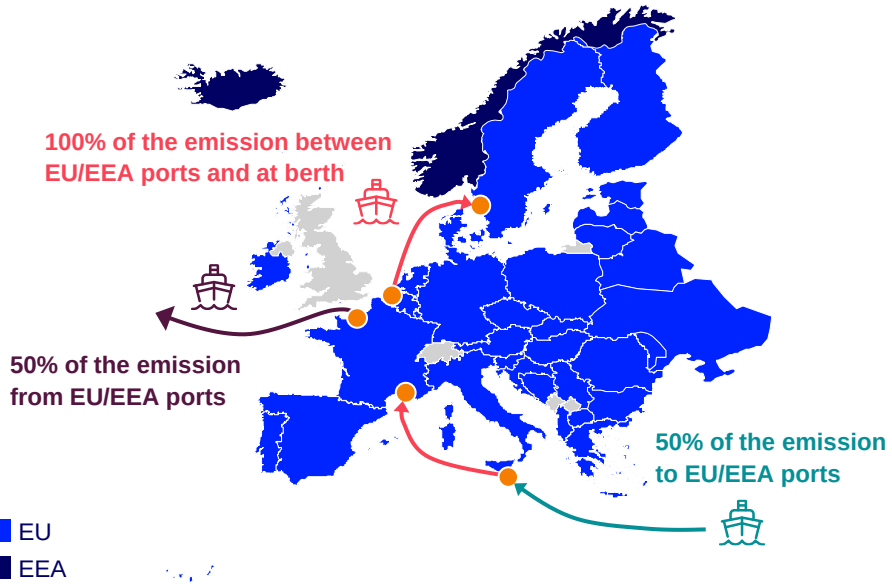
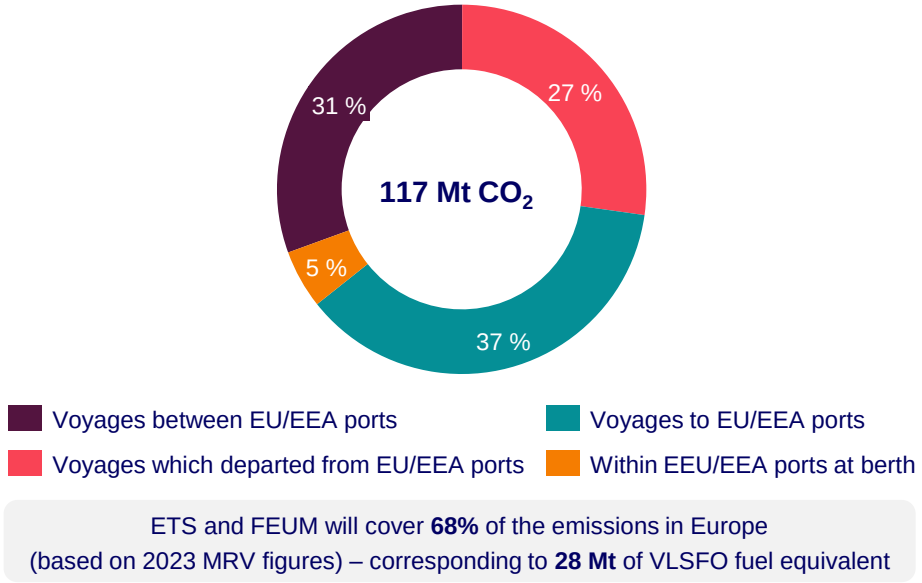
Emissions from all vessels operating within European ports will be subject to FEUM and ETS

FEUM and ETS geographical scope



Source: Wood Mackenzie, European Commission, EU MRV

Shipping-related CO2 emissions, EU 2023



ETS and FEUM will cover **68%** of the emissions in Europe
(based on 2023 MRV figures) – corresponding to **28 Mt** of VLSFO fuel equivalent

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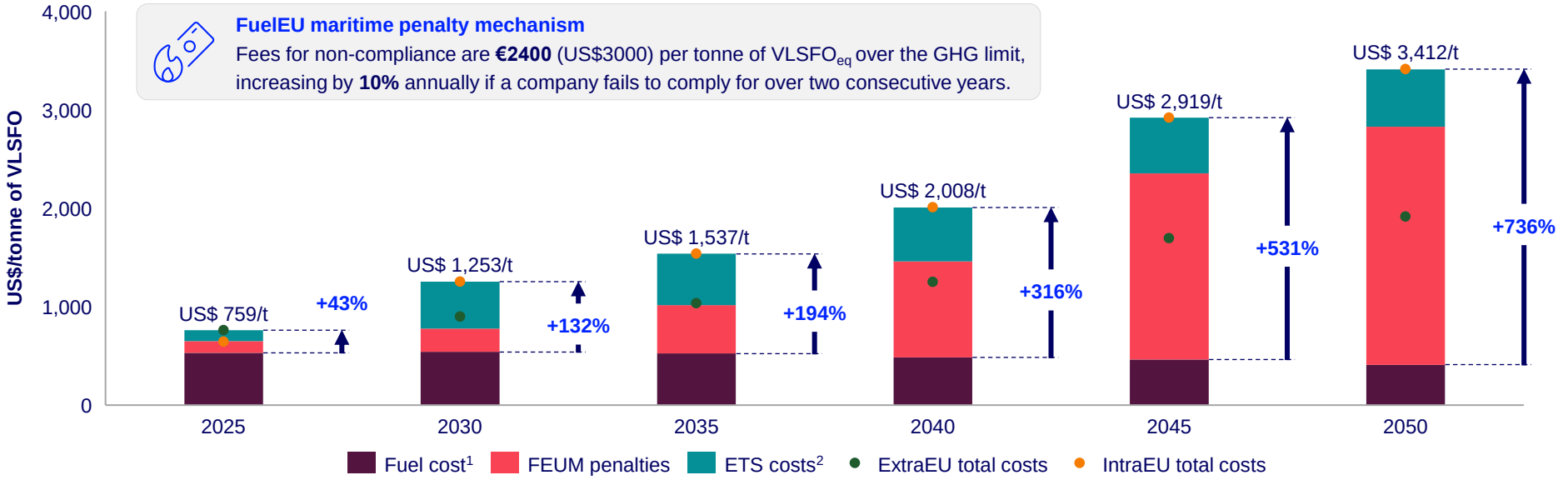
Pay-to-comply is an option in the near term, but the impact on costs will not be negligible

Fuel costs and ETS/FEUM penalties for VLSFO vessels operating within EU ports



Source: Wood Mackenzie, 1) Lens upstream 2) Lens carbon

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The pooling mechanism allows shipowners to gradually reduce emissions while keeping part of the conventional fleet operational

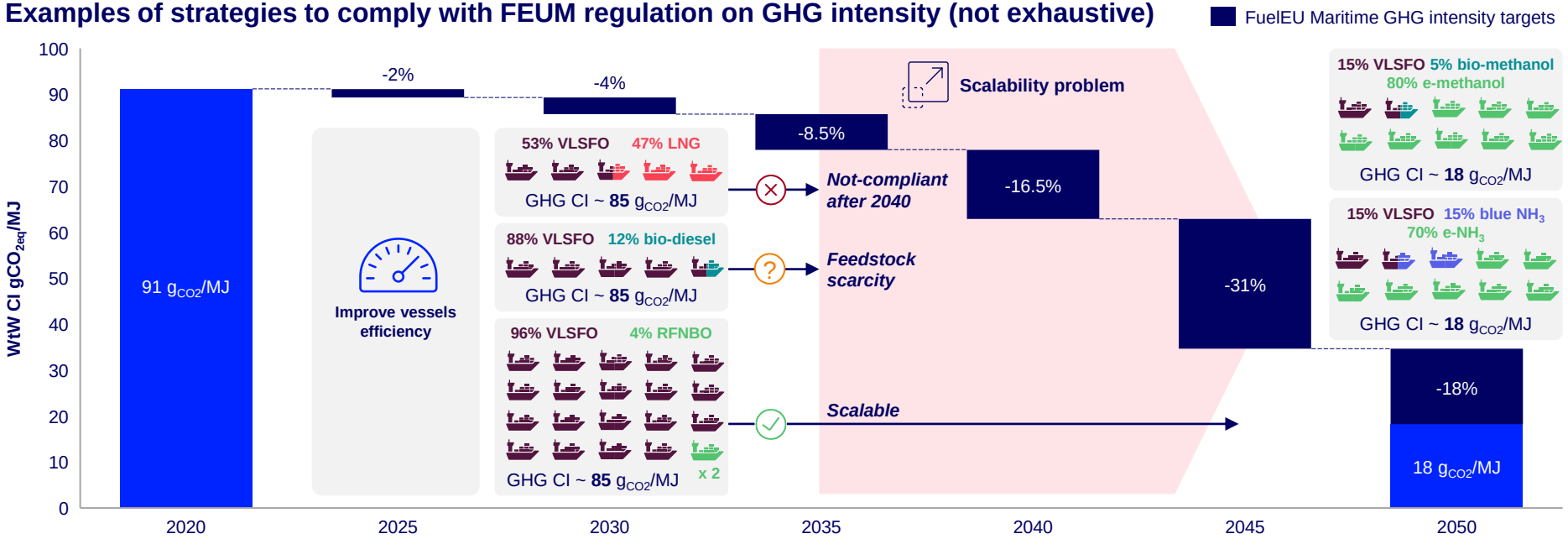
Mechanisms available to comply with FEUM regulation

Source: Wood Mackenzie

The scalability of supply will be crucial to comply with the 56% CI reduction between 2035 and 2045

RFNBOs are currently the main option to meet the -80% GHG CI 2050 goal

Examples of strategies to comply with FEUM regulation on GHG intensity (not exhaustive)



Source: Wood Mackenzie

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IMO Net-zero framework

What do we know

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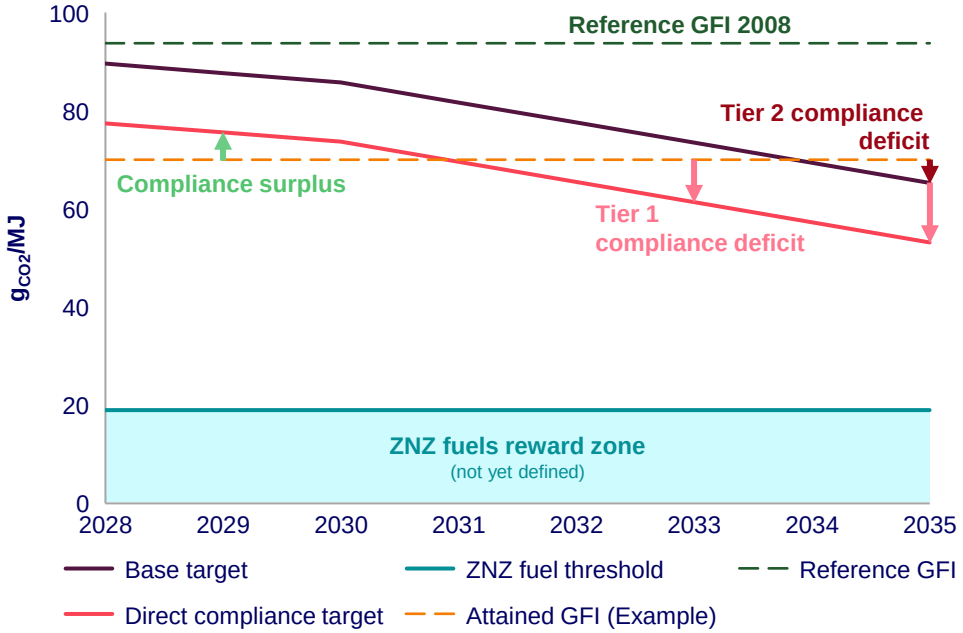
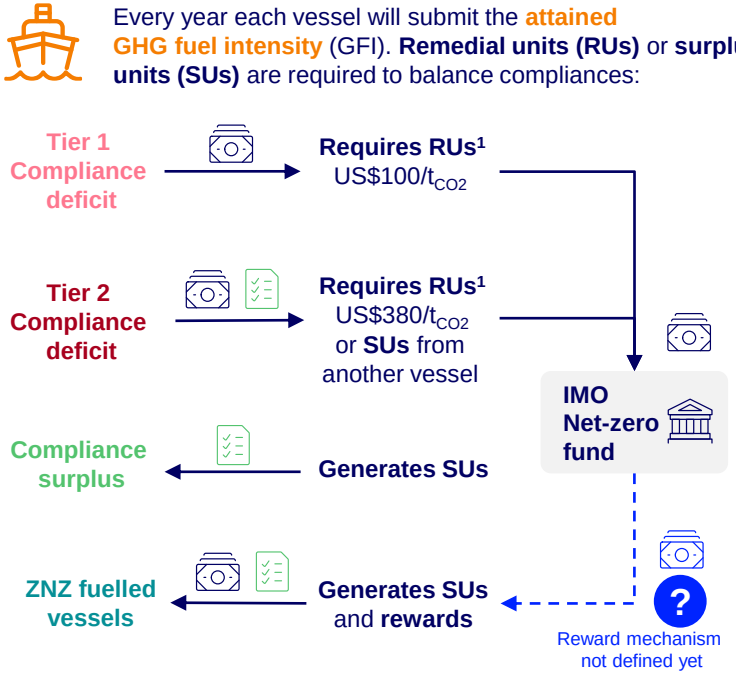
The emissions pricing system is based on a vessel's GHG fuel intensity, with a two-tier mechanism which penalises emissions above targets

Over-compliant vessels will be able to market and transfer their surplus units

IMO Net-Zero Framework GFI targets



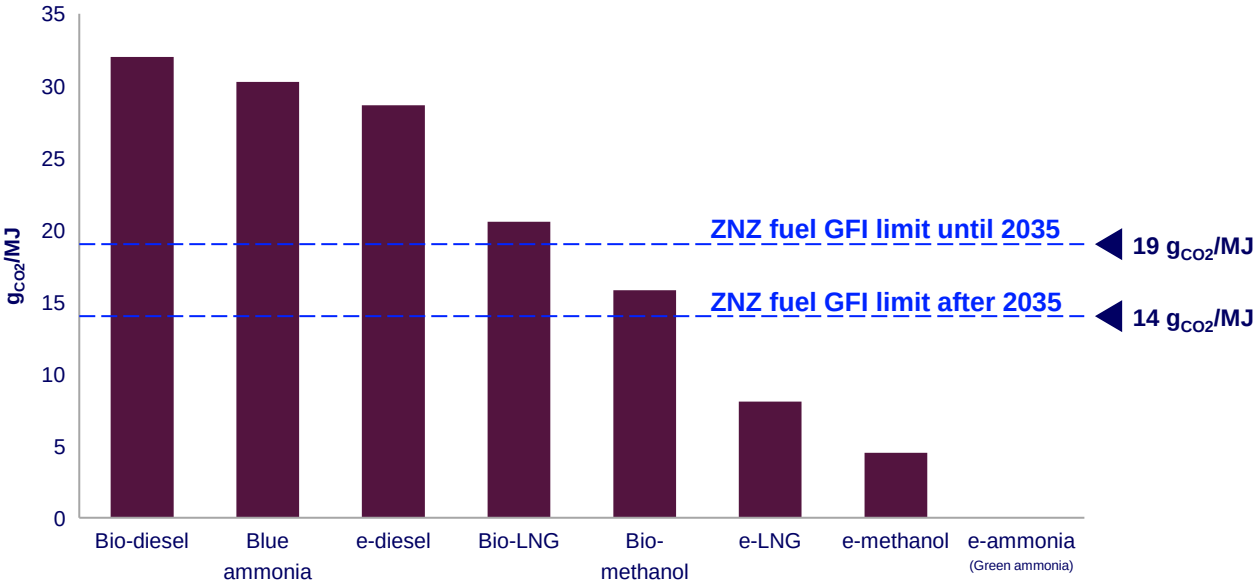
IMO compliance mechanism overview



Notes: (1) Remedial units' price will be revised in 2030
Source: Wood Mackenzie, IMO

Yet-to-be-defined guidance on low-carbon fuels adds risk to the ability of market participants to comply in a timely manner

Comparison: ZNZ fuels GFI limits vs EU default emission factors



Assumptions: Well-to-Wake emissions based on the European Commission default factors. LNG slippage assuming LNG Diesel engine (0.2% CH_4 loss).

Source: Wood Mackenzie, European Commission, IMO

ZNZ fuels related uncertainties

LCA guidelines

The IMO has not published default GFI factors, used for assessing alternative fuels' true emissions reduction potential.

Reward mechanism

The Committee is expected to define a reward mechanism for zero near-zero (ZNZ) fuels not later than March 2027.

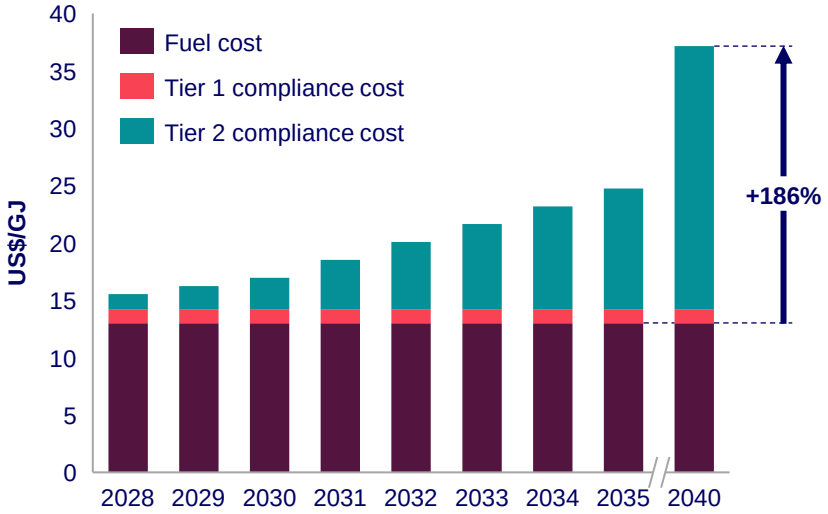
IMO net-zero funding

The specifics of how the IMO Net-Zero Fund will be disbursed have not been determined.

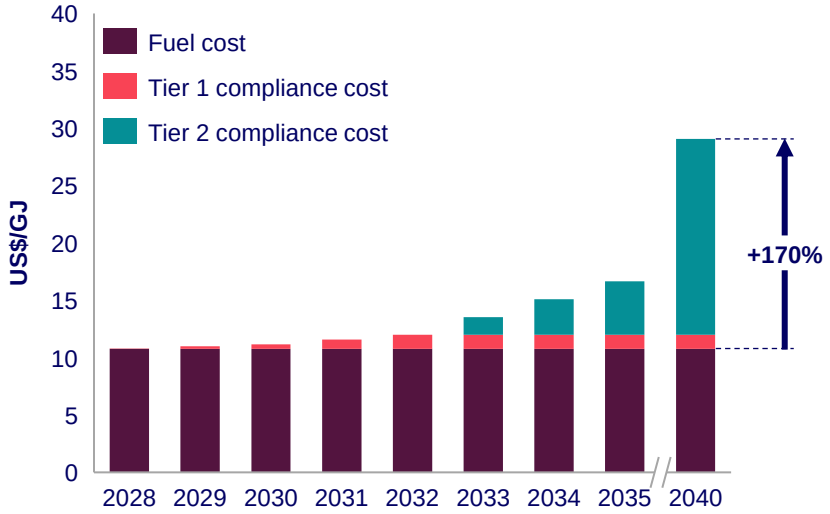
Uncertainty around how collected revenues will be used between support for ZNZ fuels and just energy transition (JET).

The lower GHG fuel-intensity of LNG offers an advantage over VLSFO, but the penalties for LNG rise quickly from 2033, when the tier-two compliance begins

VLSFO fuel costs + remedial units cost



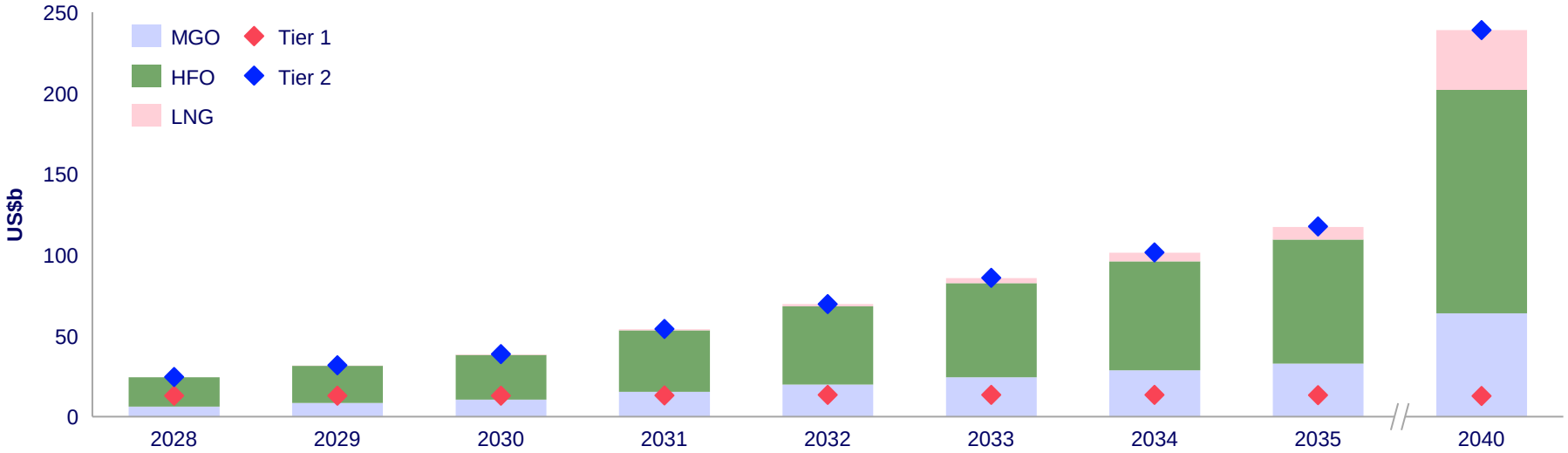
LNG fuel costs + remedial units cost



Assumptions: GFI used based on EU emission default factors: VLSFO = 92.0 g_{CO2}/MJ, LNG = 77.6 g_{CO2}/MJ; price assumptions: VLSFO = US$ 540/t, LNG = US$10/mmbtu

Heavy fuel oil users expected to be the main source of revenue for the fund through tier 2 units, if shipping company take the pay-to-comply route

Potential revenue generated from IMO emission pricing[1]



Notes: (1) Assumes outlook for bunker fuels with limited low-carbon technologies adoption (pre-IMO). (2) Assumes revenue from penalties is used for ZNZ-fuels reward, distributed among low-carbon fuels according to Wood Mackenzie low-carbon bunkers outlook for 2030. Rewarded amount per unit based on VLSFO breakeven costs.

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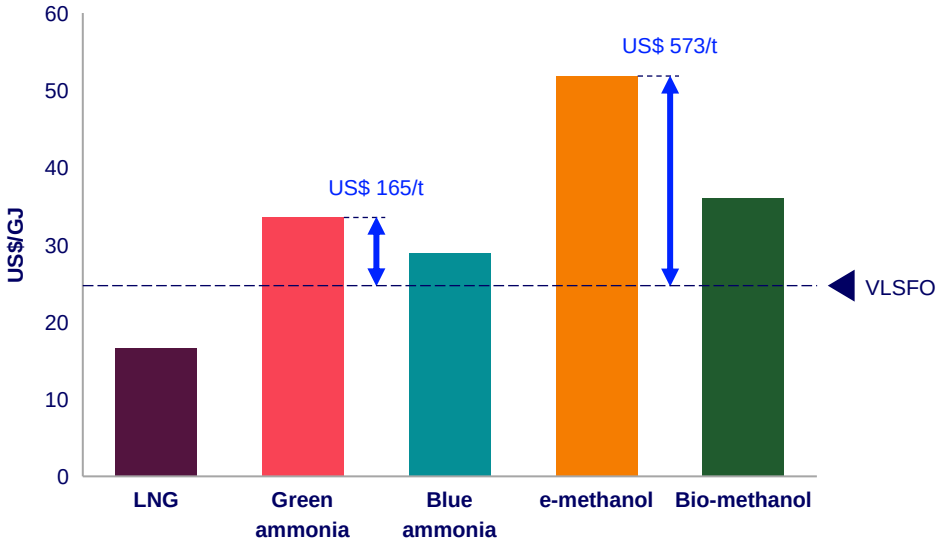
Sources: Wood Mackenzie, Lens Hydrogen

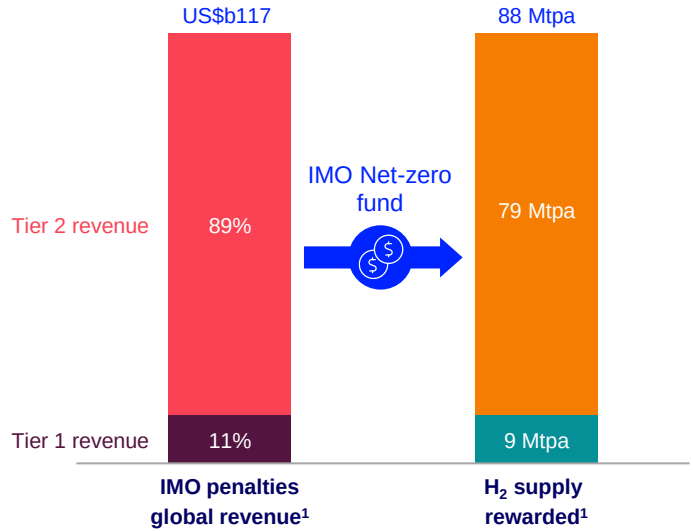
Current carbon pricing limits VLSFO displacement, but revenue redistribution via the IMO net-zero fund offers significant upside for hydrogen derivatives

IMO-NZF adjusted shipping fuel costs, 2035



Notes: GHG fuel intensity based on EU emission default factors;
Price assumptions: e-ammonia = US$1000/t, Blue ammonia = US$700/t, Biomethanol = US$1000/t, e-methanol = USD$1400/t, VLSFO = US$ 540/t, LNG = US$10/mmbtu; Remedial units (T1) = US$100/tCO2; Remedial units (T2) = US$380/tCO2; Surplus units = US$380/tCO2

Potential support towards hydrogen-based fuel, 2035



Notes: (1) Based on current outlook on bunker fuels demand, not including effect of IMO regulation. (2) Assumes all revenue from penalties directed towards closing the price gap with hydrogen-based fuels (e-ammonia, e-methanol). The reward system will be available for fuels that demonstrate a carbon intensity below 15 gCO2/MJ

Wood Mackenzie

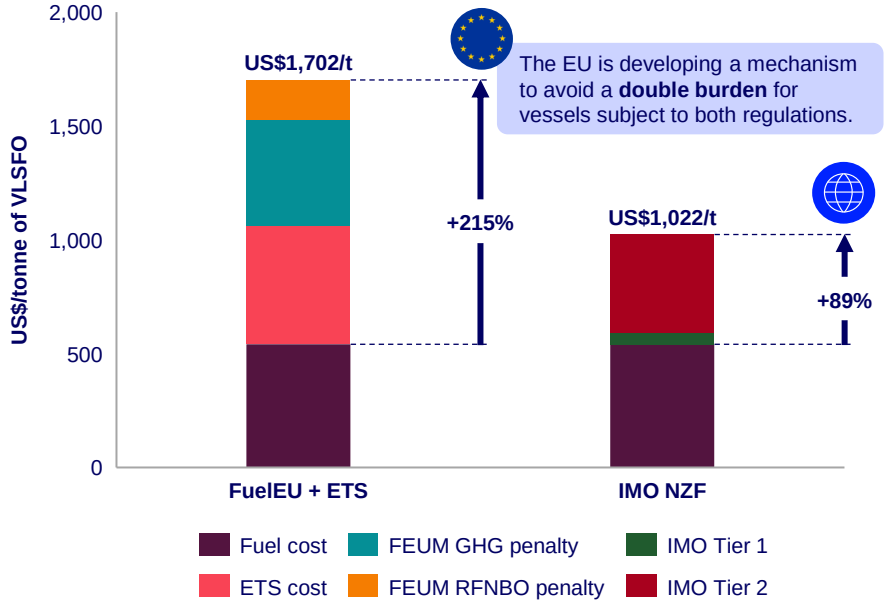
Sources: Wood Mackenzie Lens Hydrogen

Despite IMO's more ambitious GHG targets, the Net-Zero Framework will be less effective than the EU's maritime policies due to weaker carbon pricing

Global shipping emission policy summary

	ETS	FuelEU maritime	IMO NZF
Framework	Carbon Levy	GHG fuel intensity system	GHG fuel intensity system
Emissions scope	**Tank-to-Wake** (~107 $MtCO_2$)	**Well-to-Wake** (~127 $MtCO_2$)	**Well-to-Wake** (~1024 $MtCO_2$)
GHG reduction target	-	-15% (2035) -30% (2040) -80% (2050)	-30% (2035) -65% (2040)
Penalties	Based on the **ETS market**	**Non-compliant emissions:** US$750/$t_{CO2}$[1]	**Non-compliant emissions:** Tier 1: US$100/$t_{CO2}$ Tier 2: US$380/$t_{CO2}$
Low-carbon fuels incentives	Exceptions for RFNBO and biofuels	RNFBO multipliers (until 2034)	**IMO Net-Zero fund**: penalties revenue will reward low-emission fuels

VLSFO emission pricing comparison[2], 2035



Notes: (1) FuelEU penalties based on VLFSO emission equivalent. (2) VLSFO emission calculated using EU WtW default factor 93 gCO2/MJ FuelEU penalties based on Intra-EU voyages. Assumes 100% VLSFO/HFO based fuel mix and RFNBO sub-target.
Source: Wood Mackenzie, IMO, European Commission, Lens Upstream, Lens carbon, Wood Mackenzie Liquid Renewables Fuels Service

Q&A

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London, UK

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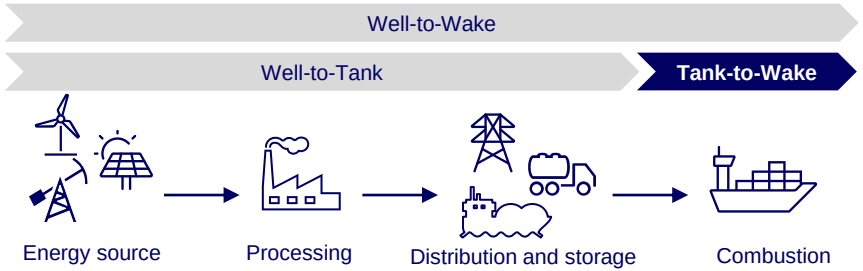
EU marine ETS begins the phase-in period, initial coverage includes 40% of the CO_2 emissions from cargo and passenger vessels above 5,000 gross tonnes

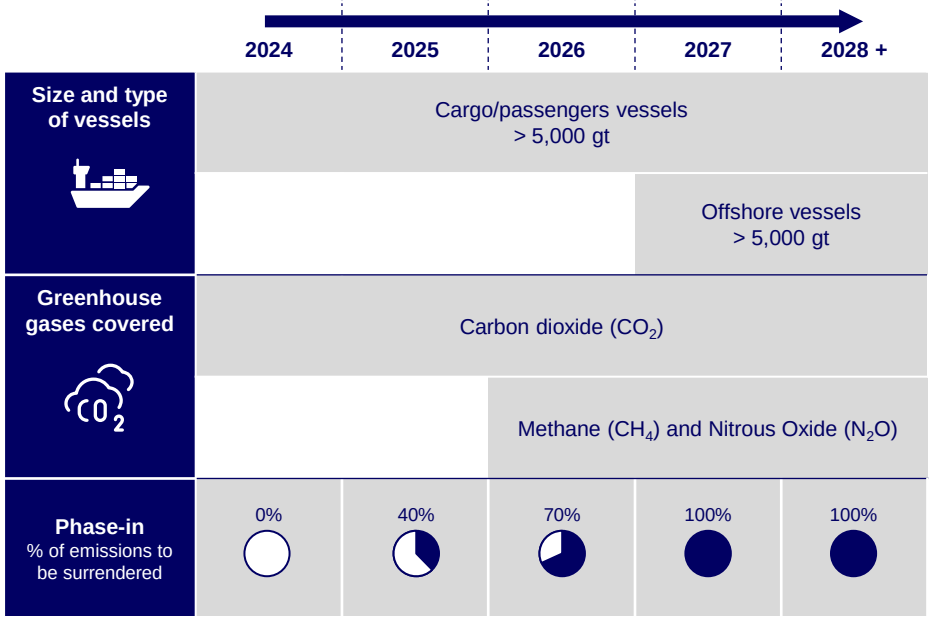
1 ETS for the marine sector overview

- From 2024 all the shipping companies operating in the EU will have to surrender emissions allowances under the EU emissions Trading Scheme Directive (ETS).
- **Emissions from maritime transport are now included in the overall ETS cap**, which indicates the maximum amount of GHG gases permitted under the cap-and-trade scheme.
- The scope of ships and GHG covered under the ETS will be extended during a phasing in period which will end in 2028.
- **The system is flag-neutral and route-based**, covering 100% of the TtW (Tank-to-Wake) emissions from ships performing voyages within EU/EEA member states. Ships voyaging between non-EU/EEA states and EU/EEA member states will have to surrender allowances for 50% of the emissions.

Emissions scope



ETS phase-in period



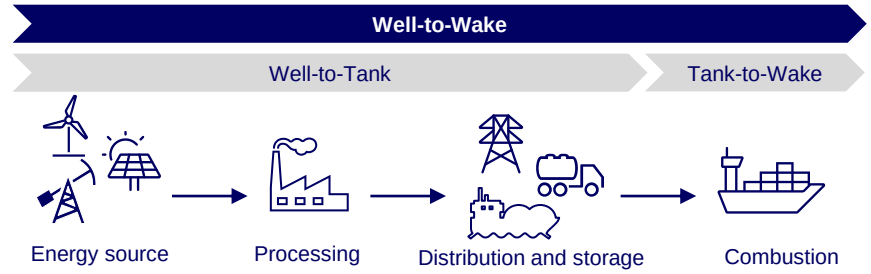
Source: Wood Mackenzie, European Commission

The FuelEU Maritime initiative aims to deliver an 80% decrease of the shipping sector's GHG intensity by 2050

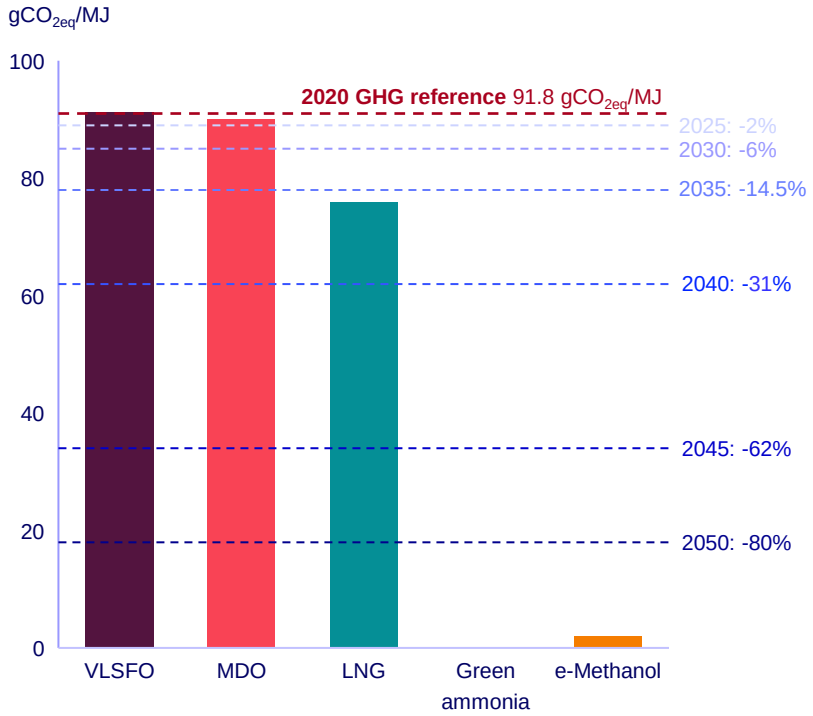
2 FuelEU Maritime (FEUM) regulation overview

- From 2025 the FuelEU maritime regulation will impose a limit to the GHG intensity of the energy used on board by ships above 5000 gt.
- GHG intensity limits are defined by a reduction factor applied to the average GHG intensity registered in 2020. **Reduction factor increases progressively every 5 years**, from -2% in 2025 to -80% in 2050.
- The regulation applies to the average WtW (Well-to-Wake) GHG intensity of fleets operating within European ports (EU and EEA). Only 50% of the energy intensity of ships operating between a European and non-European port will be covered.
- The penalty for an GHG intensity above the limit is **€2400 for each tonne of $VLSFO_{eq}$ consumed in excess**. A pooling mechanism allows fleets to reduce the average GHG intensity by including low GHG fuels in the fuel mix.
- The regulation includes a RFNBO penalty from 2034, if a sub-target of 1% of RFNBO is not included in the fuel mix by 2031.

Emissions scope



FEUM GHG intensity timeline



Source: Wood Mackenzie, European Commission

The IMO net-zero framework will cover the emissions from all vessels above 5,000 gross tonnage operating internationally

The reward system for low-carbon fuels and other key aspects are yet to be defined

IMO Net-zero Framework summary

Goal	Reducing emission from international shipping by 30% in 2035 respect to 2008 levels[1]
When	If approved, measures will come into force in **March 2027**
Scope	• **Well-to-wake emissions** of vessels above 5000 gross tonnes (gt) • Exception for ships trading solely domestically
Mechanism	• Two sets of annual targets for the vessel's GHG fuel intensity (GFI) reduction: a **base target** (tier 2) and a stricter **direct compliance target** (tier 1). • Every year, each vessel will have a **compliance balance** based on the difference between the attained GFI and the GFI reduction targets • Remedial units (**RUs**) or surplus units (**SUs**) need to be purchased from the IMO or transferred between vessels to close the balances
Penalties	Remedial units required to balance compliances will cost from **US$100/$t_{CO2}$** (tier 1) to **US$380/t_{CO2}** (tier 2). Remedial units price will be revised after 2030.
Revenue	Part of the revenue will go towards the **IMO Net-Zero Fund** for the development of low-carbon technologies and reward the use of **zero or near-zero (ZNZ) fuelled vessels.** The other part will be used to contribute to " just and equitable transition" (JET), for national energy transition programs and climate protection.
What is still missing	• GFI reduction targets after 2035 • Undefined reward system for ZNZ fuels • Remedial units price set only until 2030 • Lifecycle assessment (LCA) guidelines have not been decided

GHG fuel intensity reduction targets

Year	Base target (Tier 2)	Direct compliance target (Tier 1)
2028	**4.0%**	**17.0%**
2029	**6.0%**	**19.0%**
2030	**8.0%**	**21.0%**
2031	**12.4%**	**25.4%**
2032	**16.8%**	**29.8%**
2033	**21.1%**	**34.2%**
2034	**25.6%**	**38.6%**
2035	**30.0%**	**43.0%**
2036-2040	**To be determined by Jan 2032**	
2040	**65%**	**78%** (assumed)

Notes: (1) 93.8 gCO_2/MJ (global average 2008)
Source: Wood Mackenzie, IMO