BetterSea

DECARB COMPLIANCE LIBRARY

FuelEU Maritime Compliance Insights

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CHAPTER ONE

FuelEU Maritime 101

FuelEU Maritime Compliance Timeline

In this chapter, we break down the key dates and requirements for FuelEU Maritime to help you stay on track with the FuelEU compliance timeline.

Monitoring Plan Submission

Deadline: 31 August 2024

The ISM company must submit a monitoring plan for each vessel. The monitoring plan must outline the chosen method for monitoring and reporting emissions. In case a ship is subject to FuelEU Maritime after 31 August 2024, a monitoring plan must be submitted to the verifier no later than two months after the first port call at a port falling under the regulation's scope.

Recording Data

Period: 1 January to 31 December 2025

Throughout the operational year of 2025, companies are required to record EU MRV (Monitoring, Reporting, and Verification) data in line with the submitted monitoring plan. This includes but is not limited to detailed documentation of fuel usage, emissions, and distance traveled for each vessel.

Data Submission

Deadline: 31 January 2026

The recorded EU MRV data for the operational year must be submitted to the verifier by the end of January 2026. Note that if a ship changes the ISM company throughout the operational year, the transferring company must submit the partial data to the verifier who must verify the data and record it in the FuelEU database within one month.

Data Verification

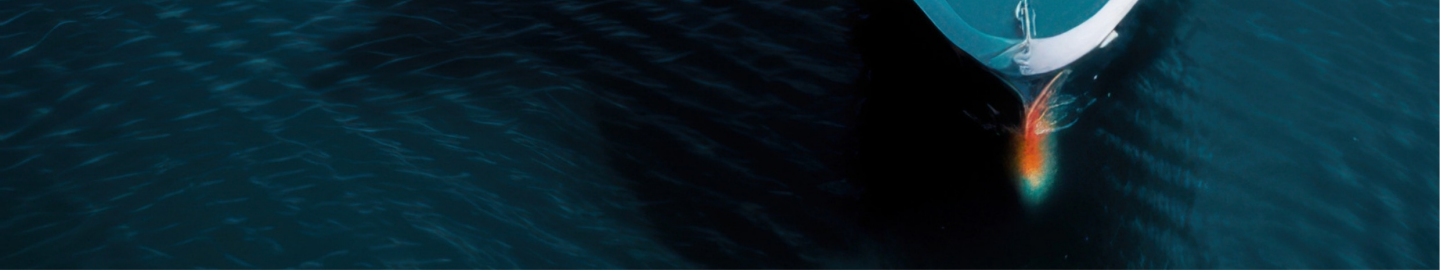
Deadline: 31 March 2026

By the end of March 2026, the verifier must complete the verification process and report the results to the company. The verified data will then be recorded in the FuelEU database. This data includes but is not limited to the ship's compliance balance and GHG intensity.

Compliance Mechanism Reporting

Deadline: 30 April 2026

After receiving approval from the verifier, companies must report their utilization of compliance mechanisms such as banking, borrowing, or pooling in the FuelEU database by the end of April 2026. Effective use of these mechanisms can provide flexibility and cost savings while ensuring compliance with FuelEU regulations.



Compliance Penalty Notification

Date: 1 June 2026

On this date, responsible authorities (the administering state) will inform companies of any applicable penalties that must be paid.

Penalty Payment and Document of Compliance (DoC) Issuance

Deadline: 30 June 2026

By the end of June 2026, any outstanding penalties must be paid, and a Document of Compliance (DoC) is issued.

Why is it Important to keep on track with FuelEU and closely follow the FuelEU Maritime compliance timeline?

Compliance with FuelEU regulations is not just a regulatory requirement but also a commercial risk. The penalties for non-compliance can be enormous (see previous case study), the commercial as well as legal alignment of stakeholders is demanding, and choosing the most cost-effective compliance option is not straight forward.

Responsibility under FuelEU Maritime

Who is responsible under the FuelEU Maritime regulation?

The ISM (International Safety Management Code) company i.e. DoC (Document of Compliance) holder is responsible for ensuring compliance with the FuelEU Maritime Regulation. This does not depend on whether the DoC holder is a ship owner, charterer, or ship manager. It places a significant responsibility on the DoC holder to manage and oversee compliance with the regulation's requirements.

Differences from EU ETS?

Under the EU Emissions Trading System (EU ETS), an implementing act shifted the responsibility from the DoC holder to the ship owner. This change was made to acknowledge the inability of ship managers to influence the technical and operational setup of ships exposed to the regulation.

Will the same happen for FuelEU?

In contrast to EU ETS, the FuelEU regulation legally doesn't allow for a similar implementing act. This means that, unlike the EU ETS, the DoC holder will remain responsible under FuelEU.

Challenges

The DoC holder, in most cases the technical manager of the ship, has no direct power over the fuel choice or the technical setup of the vessel as the ship owner or operator typically determines it. This lack of control complicates the DoC holder's ability to ensure compliance with FuelEU requirements while at the same time exposing him/her to extensive financial risks.

At the same time, it raises the question of surplus ownership. While the DoC holder is responsible, the operator bears the increased fuel costs of bunkering alternative fuels and is interested in owning the monetary benefit (the surplus).

Both the regulatory responsibility as well as the surplus ownership require amendments of charter party agreements and further contractual agreements, especially when choosing pooling as a mean of compliance.

Regulatory Context

The relevant portion of the FuelEU Maritime Regulation regarding responsibility is in Article 3(13):

"Company means the shipowner or any other organization or person such as the manager or the bareboat charterer, which has assumed the responsibility for the operation of the ship from the shipowner and has agreed to take over all the duties and responsibilities imposed by the International Management Code for the Safe Operation of Ships and for Pollution Prevention"

For more detailed information, refer to the full text of the FuelEU Maritime Regulation (EU) 2023/1805 on the EUR-Lex website.

FuelEU Maritime Banking

For which of the below vessels would you consider FuelEU Maritime banking as a smart means of compliance with FuelEU?

- ❑ HFO vessel
- ❑ MeOH vessel
- ❑ Dual-fuel LNG vessel
- ❑ Bio30 vessel

What is FuelEU Maritime Banking in Compliance?

Banking in the context of FuelEU compliance refers to the process by which a vessel that has achieved a compliance surplus (i.e., its greenhouse gas (GHG) intensity or RFNBO (Renewable Fuels of Non-Biological Origin) sub target performance is better than required) can carry over this surplus to offset future deficits. This mechanism allows vessels to store their compliance surplus for future use, effectively smoothing out the compliance process over multiple years.

FuelEU Maritime banking is particularly useful for vessels facing varying operational conditions or fuel availability over time, providing a flexible strategy to maintain compliance with evolving regulations. However, it's essential to note that banking is vessel-specific; the surplus generated by one vessel can only be used by that same vessel in subsequent reporting periods.

The correct answers

When it comes to banking, it’s crucial to remember that banking is only allowed for the same vessel.

Dual-fuel LNG Vessel: These vessels can accrue a compliance surplus during the period from 2025 to 2030. This surplus can be banked and used when these vessels become non-compliant from 2030 onwards.

Bio30 Vessel: A Bio30 vessel, which runs on a blend of biofuels and traditional fuels, can generate a surplus. This surplus can be banked and used in future years when the vessel might be running on more conventional fuels like HFO due to e.g. fuel availability, thus ensuring compliance in those years.

Why Not the Other Vessels?

HFO Vessel: HFO vessels do not generate a surplus under FuelEU and therefore cannot benefit from banking, as it is only allowed for the same vessel.

MeOH Vessel: While a MeOH vessel (methanol-fueled) generates a surplus, it is not as advantageous for banking because it will maintain a compliance surplus for years to come and has as such no option to utilize the banked surplus for its own compliance needs. Planning for compliance in the far future, such as around 2040 to 2050, is not advisable due to potential changes in fuel infrastructure and availability.

Regulatory Context

The relevant portion of the FuelEU Maritime Regulation regarding banking is detailed in Article 20:

"On the basis of the calculations undertaken in accordance with Article 16(4), where the ship has, for the reporting period, a compliance surplus on its GHG intensity as referred to in Article 4(2) or, if applicable, on the RFNBO subtarget as referred to in Article 5(3), the company may bank it to the same ship’s compliance balance for the following reporting period. The company shall record the banking of the compliance surplus to the following reporting period in the FuelEU database subject to approval by its verifier. The company may no longer bank the compliance surplus once the FuelEU document of compliance has been issued."

FuelEU Maritime GHG Intensity & Mitigation

When it comes to FuelEU Maritime compliance, which of the following mitigation options is favorable?

- ❑ Technical vessel improvements
- ❑ Wind-assisted technologies
- ❑ HFO fuel

General Overview: Understanding the FuelEU Maritime GHG intensity.

The FuelEU Maritime Regulation (EU) 2023/1805 outlines the calculation of greenhouse gas (GHG) intensity for ships in Article 4. The FuelEU Maritime GHG intensity is the ratio of total GHG emissions to total energy used by a ship.

Formula

Total GHG emissions / Total energy used

Components

Total GHG emissions: Includes all well-to-wake (WtW) GHG emissions by different fuel types consumed onboard. The emissions are calculated by multiplying the energy consumption of a specific fuel type with its respective emission factor.

Total energy used: Considers all energy types consumed during the reporting period.

Here is why wind-assisted technologies are the correct answer

When considering FuelEU compliance, the intensity indicator (GHG intensity) is crucial. Here's why wind-assisted technologies are the favorable option:

Wind-Assisted Technologies: Wind-assisted propulsion systems (WAPSs) significantly reduce fuel consumption and GHG emissions. Ships with WAPSs benefit from a Wind Reward Factor under FuelEU, reducing their GHG intensity. For example, a vessel with a factor of 0.97 can achieve compliance while still using fossil fuels between 2025 and 2030.

Why Not the Other Options?

Technical Vessel Improvements: Technical improvements, such as waste heat recovery systems, enhance energy efficiency by reducing both the numerator and denominator of the GHG intensity formula, resulting in minimal to no impact on the GHG intensity. While these improvements lower the remedial penalty by reducing non-compliant energy consumption, they do not significantly improve compliance under FuelEU.

HFO Fuel: Heavy Fuel Oil (HFO) has a high emission factor, resulting in an intensity figure that exceeds the regulatory threshold, making it unsuitable for improving compliance.

Regulatory Context

The relevant portion of the FuelEU Maritime Regulation regarding wind-assisted technologies is in Article 9:

"For the purposes of calculating the attained annual average GHG intensity as referred to in Article 4(1), the energy savings achieved through wind propulsion technology shall be taken into account. The Commission shall adopt implementing acts specifying the verification procedure and the methodology to calculate the energy savings from wind propulsion technology."

FuelEU Maritime Pooling: Rules, Examples, and Opportunities

Pooling is one of the compliance mechanisms under the FuelEU Maritime Regulation and offers an advantageous but new compliance option. By redistributing compliance surpluses and deficits within a defined group (pool) of vessels, pooling can optimize compliance costs and even create financial opportunities. However, as a new approach, it comes with specific rules and challenges that require careful consideration.

Let's completely disassemble the pooling mechanism and its intricacies, challenges, and opportunities.

What is FuelEU Maritime Pooling and What Are the Rules?

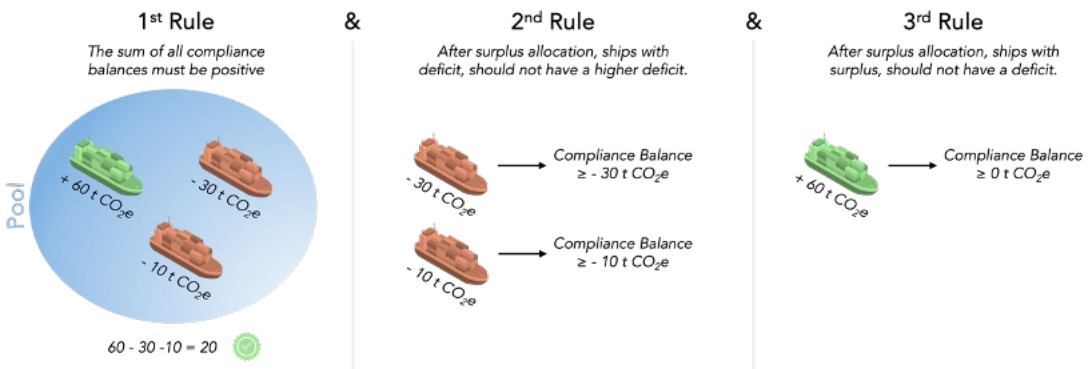
Under FuelEU Maritime, every ship gets an individual compliance balance based on its GHG intensity and the applicable regulatory limit. If the compliance balance is negative, the ship is non-compliant and has a so-called deficit. On the contrary, if the ship's compliance balance is positive, the ship is over-compliant and has a so-called surplus.

Pooling allows vessels to share their compliance balances—redistributing surpluses and deficits—with each other in a group of vessels (pools). A simple example, a vessel with a surplus of 100 t CO2e could form a pool with a vessel with a deficit of 90 t CO2e, making both vessels compliant. The formation of pools can be done internally (with ships of one company) or externally (with ships of several companies).

The FuelEU Maritime Regulation includes a set of rules that define a valid pool in Article 21(4):

"A pool is valid only if the total pooled compliance is positive, if ships which had a compliance deficit as calculated in accordance with Article 16(4) do not have a higher compliance deficit after the allocation of the pooled compliance, and if ships which had a compliance surplus as calculated in accordance with Article 16(4) do not have a compliance deficit after the allocation of the pooled compliance."

Image 1 below illustrates the three rules defined by the FuelEU Maritime Regulation based on a set of three sample ships.



It is important to note that these rules are not exclusive, but must all be fulfilled for a pool to be valid.

Further, Article 21(4) alludes to an allocation of surplus or broader compliance balance between the vessels participating in the pool. The FuelEU Maritime Regulation does not define a standardized procedure for the allocation of compliance balances but instead allows the participating companies to decide the individual allocation to each ship as long as it outlines the mentioned rules. Recording of such allocation shall take place in the FuelEU Database according to Article 21(8).

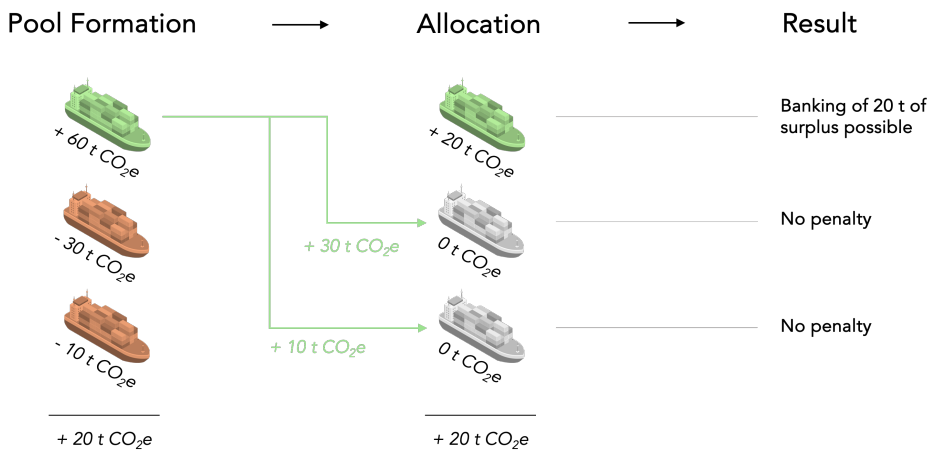
"By 30 April of the verification period, the selected verifier shall record in the FuelEU database the definitive composition of the pool and allocation of the total pool compliance balance to each individual ship."

For further details on the FuelEU timeline, please see Chapter 1.

FuelEU Maritime Pooling Examples: Scenarios and Strategies

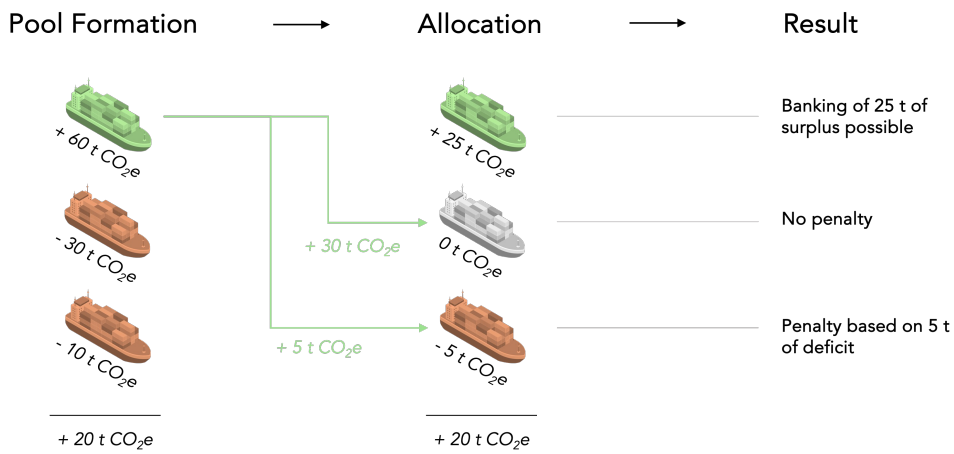
Pooling offers flexibility in how to allocate compliance balances across the participating vessels, allowing for many different cases, among others, the ones outlined below:

Example 1: The Straightforward Approach



The allocation of surplus is straightforward in Image 2. The surplus ship shares sufficient surplus with the other two to make them compliant. Therefore, the deficit ships do not face any compliance penalties for the corresponding compliance year. An additional 20 t of surplus remains on the surplus ship and can be banked for future compliance periods.

Example 2: Compliance Penalty Reduction



The surplus ship again shares surplus, but based on the chosen allocation, only the first deficit ship received sufficient surplus to be compliant with the FuelEU Maritime Regulation. The second deficit ship remains with a deficit of 5 t. Resultantly, the surplus ship can bank 25 t of surplus, whereas the second deficit ship faces a penalty for the remaining 5 t.

"By 30 April of the verification period, the selected verifier shall record in the FuelEU database the definitive composition of the pool and allocation of the total pool compliance balance to each individual ship."

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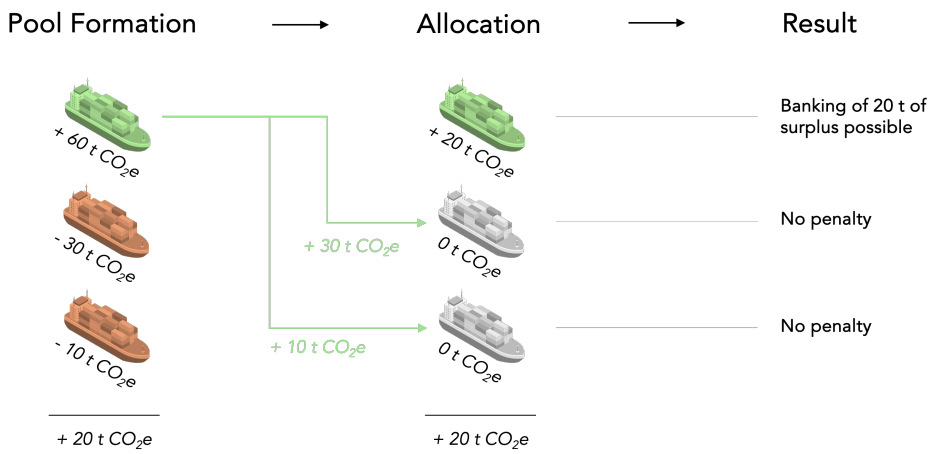

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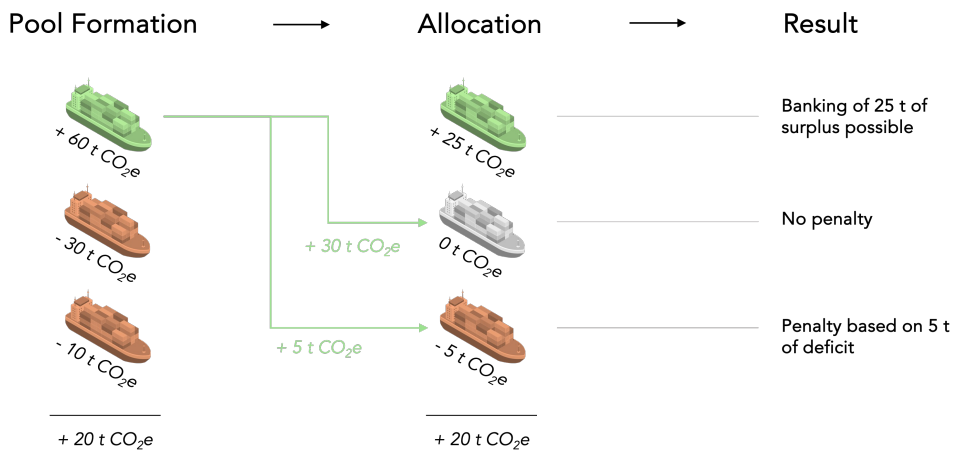

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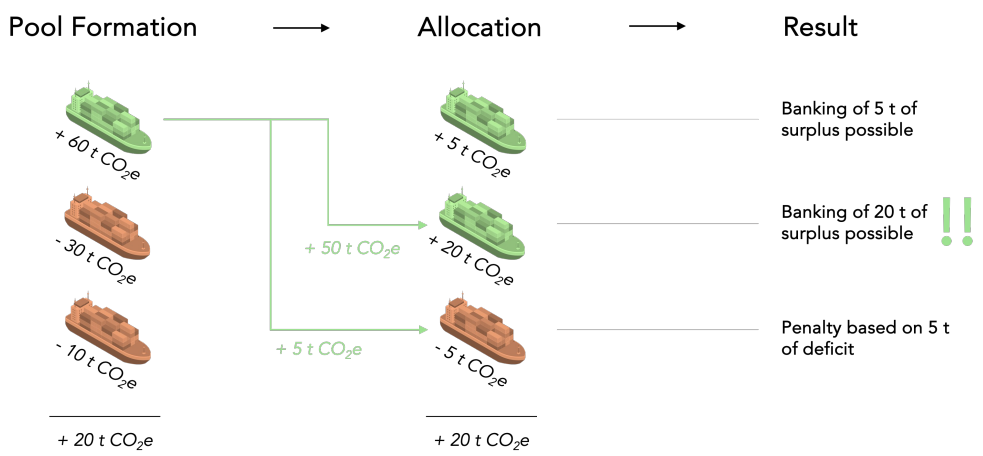
In line with Article 21(4), the second example also represents a valid pooling scenario. It predominantly applies to two use cases: (a) the surplus generated for an internal pool is not sufficient, no surplus trading was done, but the compliance costs shall be reduced to a minimum, or (b) the surplus bought for external pooling is not sufficient to make all deficit ships compliant.

Example 3: Prepare for the Future with Surplus Trading



While initially counterintuitive to Article 20(1) of the FuelEU Maritime Regulation, the third example also represents a valid pooling scenario. An insufficient amount of surplus has been allocated to the second deficit ship, leaving it with a penalty for 5 t of deficit, but, in contrast, more surplus than deficit has been allocated to the first deficit ship, ultimately making it over-compliant. As a result, the previous deficit ship is in surplus after pooling and is allowed to bank 20 t of surplus for future compliance periods. This raises several commercial thought experiments:

- Companies in deficit that bought more surplus than needed do not lose the surplus but can trade or use it in the future.
- A banked surplus can be traded even in subsequent compliance years, providing long-term financial opportunities.
- By leveraging pooling, both deficit and surplus vessels can intentionally generate (more) excess surplus, bank it, and trade it on marketplaces like **BetterSea's FuelEU Marketplace** in later years when the price might be higher.

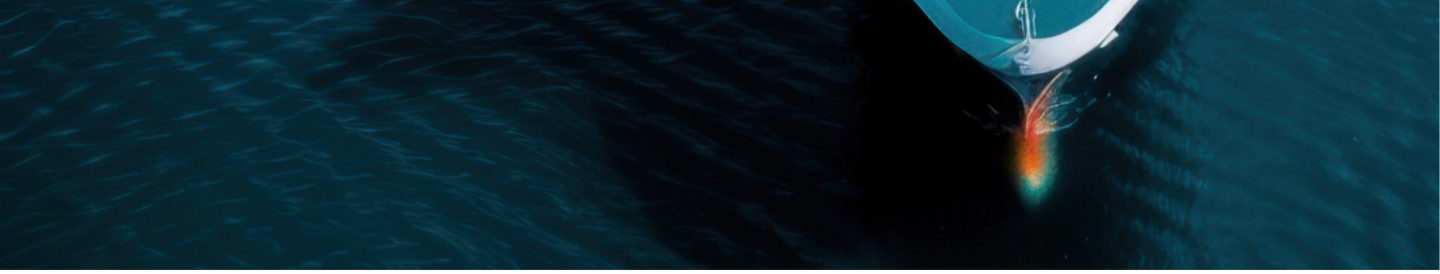
Note that the same is not applicable for borrowing. Ships that have borrowed compliance in the same compliance period are not allowed to pool.

Open Questions and Regulatory Considerations

While the above already outlines clear rules for pooling and a fruitful ground for surplus trading, there are still a few open regulatory questions, including:

Additional Checks

Article 17(1) of the FuelEU Maritime Regulation states that competent authorities of administering states can check the data used for compliance purposes for the previous two compliance periods.



"At any time, the competent authority of the administering State in respect of a company may, for any of its ships, conduct, in relation to the two previous reporting periods, additional checks of any of the following: (…)"

This must be handled cautiously, especially with respect to pooling. In a worst-case scenario, the administering state finds an issue for 2025 data in 2027. This could potentially influence all ships involved in pooling with the misreporting ships in 2025 or 2026 and all ships involved in pooling in 2026 with the other pool participants from 2025.

A solution could be to restrict the implications of misreporting to the involved ship only and keep the compliance status of all the other potentially involved ships as is. This would remove post-verification alignment issues and any commercial and legal implications for ships not at fault. Another option could be to leave it to all involved stakeholders to reallocate compliance balances for 2025 and 2026. Share your view in the comments below!

Banked Surplus & Non-EU Scope

As explained in other chapters, the generated compliance surplus has monetary value. Banking under FuelEU Maritime does not have a time limitation such that some compliance strategies may involve banking of surplus for a future in which the previously surplus-generating ships become non-compliant. Others might have received some unexpected excess surplus through external pooling for which banking is the only option.

If such vessels end up not trading in Europe for the next years or even the remaining lifetime and, therefore, do not fall under the scope of FuelEU Maritime, the monetary value attached to the banked surplus is lost. Based on the regulatory text, it is possible to grant such vessels allowance to trade and pool the banked surplus even though they are not trading in Europe.

Understanding FuelEU Maritime Borrowing: Risks and Strategies

The FuelEU Maritime Regulation introduces several compliance mechanisms. These help companies meet their greenhouse gas (GHG) intensity targets. One notable mechanism is borrowing, which allows ships to offset a compliance deficit by using surplus from the following reporting period. This approach may seem straightforward, but it comes with strict limitations, risks, and long-term implications.

In this chapter, we explore how borrowing works, when it is allowable, and why companies need to assess its potential impact thoroughly.

How Borrowing Works Under FuelEU Maritime

Borrowing, as defined in Article 20(2) of the FuelEU Maritime Regulation, allows a ship to compensate for a compliance deficit. This is done by utilizing an "Advance Compliance Surplus" from the following year.

"On the basis of the calculations undertaken in accordance with Article 16(4), if a ship has a compliance deficit for the reporting period, the company may borrow an advance compliance surplus of the corresponding amount from the subsequent reporting period. The advance compliance surplus must then be added to the ship's compliance balance for the reporting period. However, 1.1 times the surplus must be subtracted from the same ship's compliance balance in the next reporting period. The advance compliance surplus may not be borrowed: a) for an amount exceeding by more than 2% the limit set out in Article 4(2), multiplied by the ship's energy consumption as calculated according to Annex I; b) for two consecutive reporting periods."

While borrowing offers short-term relief, it is not an unlimited option. The regulation imposes significant constraints, including:

- Borrowing is limited to a maximum of 2% exceeding the GHG intensity limit in the reporting period. This calculation is multiplied by the ship's energy consumption.
- Any borrowed surplus must be repaid in the following year with a 10% penalty.
- A ship may not borrow for two consecutive reporting periods.
- It is only possible to borrow if the Compliance Balance of the ship within the reporting period is negative but within the 2% threshold.
- Ships that borrow in a given year cannot participate in pooling during the same verification period.

An important note is that the GHG intensity target applied to borrowing is based on the reporting year rather than the next year's target. This means that if the regulatory target tightens the following year, the borrowed surplus is still calculated on the previous year's requirement. For instance, if a ship borrows from the 2030 compliance balance for the 2029 reporting period, the GHG intensity limit will be based on the 2029 (2% reduction) instead of the 2030 (6% reduction).

The Risks of Borrowing Under FuelEU Maritime

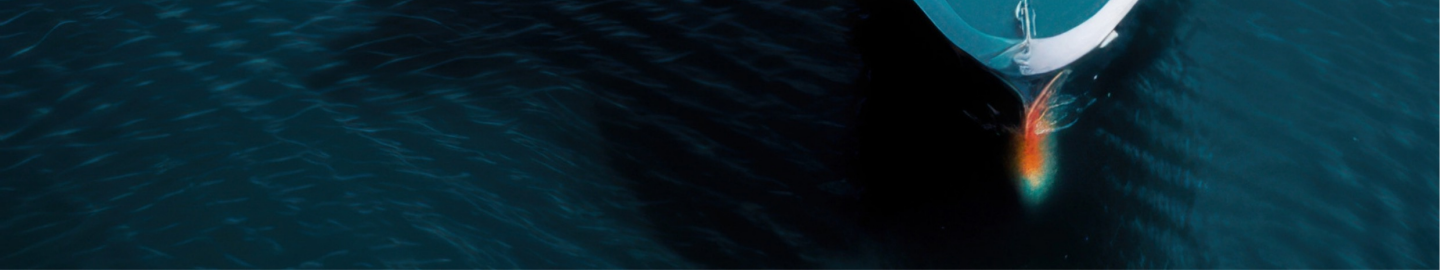
While borrowing provides some flexibility, it carries multiple risks that companies must manage effectively.

Financial Risks and Compliance Liability

Borrowing effectively shifts compliance obligations to the following year. This arrangement can create financial and operational risks. The 10% penalty further complicates matters since it leads to an accumulating deficit. This accumulation can make future compliance more expensive and challenging.

Regulatory Restrictions and Strategic Limitations

When a ship borrows, it locks itself out of pooling for the same verification period. Pooling becomes an option only for the next verification period. Additionally, ships that have borrowed cannot borrow again the following year. This restriction could leave companies in a difficult position if compliance balances do not improve, compelling them to pay FuelEU penalties.



Long-Term Compliance Strategy Implications

Borrowing should not be treated as a default compliance option. It is best utilized as a last resort. Companies that lean heavily on borrowing risk losing flexibility in the ensuing year. They will have fewer compliance mechanisms available to them.

Comparing Borrowing to Other Compliance Mechanisms

Borrowing is just one of the compliance mechanisms available under FuelEU Maritime. It is crucial to explore how it compares to other options.

Compliance Option	Pros	Cons
Borrowing	Short-term relief, suitable for data changes or unforeseen events.	10% aggravation, prevents pooling.
Pooling	Cost-effective, allows for long-term planning, surplus can be banked.	Requires legal and financial framework, search for pooling partner, depends on surplus market.
Alternative Fuels & Tech	EU ETS cost reductions, may qualify for RFNBO incentives.	Higher OPEX, eventually high CAPEX, depends on

While borrowing can efficiently fill short-term compliance gaps, long-term strategies should also consider pooling, alternative fuels, or other applicable technologies.

Implications for Charter Agreements and Compliance Contracts

Because borrowing influences compliance liabilities over multiple years, it's essential for charter agreements to clearly specify decision rights regarding borrowing. This clarity is particularly significant in time charters.

Short-Term Time Charters (<1 Year)

The ISM company retains full compliance responsibility, meaning the shipowner must decide whether to borrow.

Long-Term Time Charters (≥1 Year)

The charterer gains decision-making authority regarding compliance strategies, including borrowing. Charterers must ensure that they do not inherit borrowing restrictions from previous periods.

In all scenarios, contracts should explicitly outline who bears responsibility for repaying the borrowed surplus and managing the associated penalties. Beyond charter contracts, shipping companies also need to consider potential borrowing during previous periods when engaging in buying and selling transactions.

Conclusion: Borrowing as a Strategic Compliance Tool

Borrowing under FuelEU Maritime can be a valuable yet risky compliance tool. It is best used to bridge gaps in compliance and should be chosen only when no better alternatives exist. In many circumstances, pooling or using alternative fuels may yield better outcomes than resorting to borrowing. Even in cases of unexpected events or compliance gaps, relying on a streamlined pooling process can save companies from incurring the additional 10% penalty.

Navigating the Geographic Scope of FuelEU Maritime: Which Voyages Are Covered and How Much Counts?

With FuelEU Maritime now in full swing, understanding which parts of energy consumed counts on which voyage—and how much—towards your compliance balance can make or break your most cost-effective compliance strategy. The regulation applies to all vessels above 5,000 GT calling EU/EEA ports, but the percentage of energy considered under FuelEU differs dramatically depending on the voyage profile.

This chapter breaks it down in detail: we look beyond the usual intra-EU vs international distinction and explore how FuelEU handles ports in outermost regions, voyages to small islands, exemptions under public service obligations, and much more.

Understanding the FuelEU Maritime Scope: More Complex Than Expected

FuelEU Maritime defines the energy scope in Article 2(1) based on four primary voyage types:

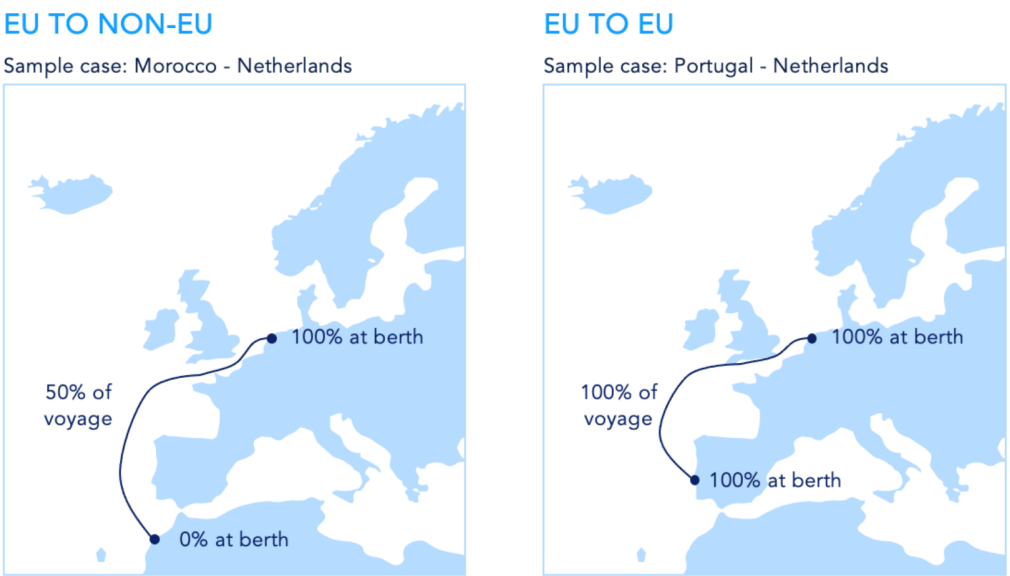
- 100% of energy used while at berth in any EU/EEA port.
- 100% of energy used on voyages between EU/EEA ports (Intra-EU voyages).
- 50% of energy used on voyages to/from Outermost Regions (OMRs) of EU Member States.
- 50% of energy used on voyages between EU/EEA ports and third countries (Extra-EU voyages).

But it doesn't stop there. Several geographical and operational exceptions reshape how the scope is applied—some of them permanent, others temporary until 2029 or 2030.

What Counts Where? The Voyage Scope Illustrated

Each voyage category is treated differently in terms of how much of its energy use is accounted for under FuelEU:

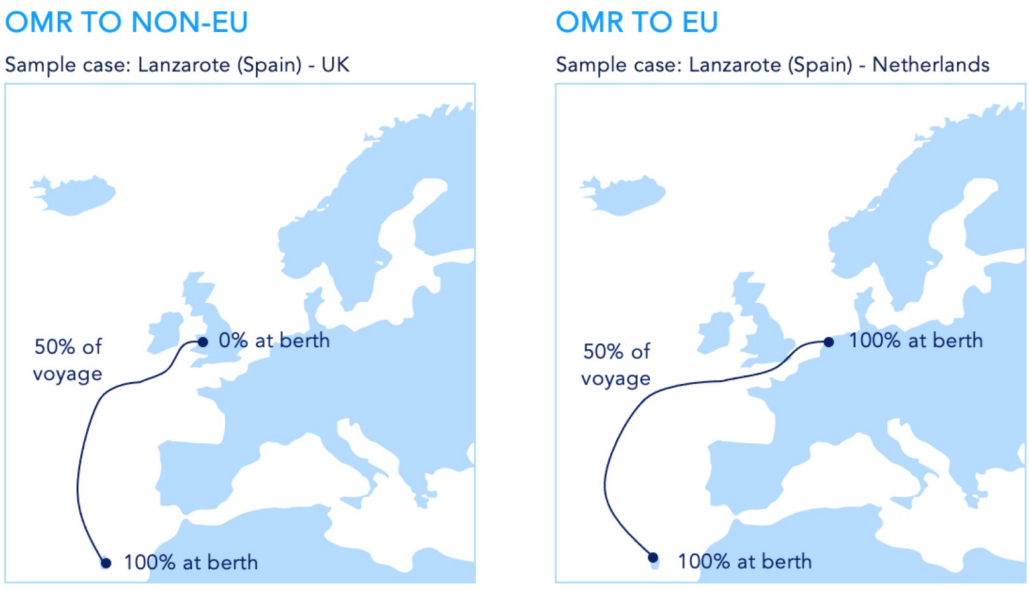
- Intra-EU voyages carry full (100%) inclusion (see Figure 1).
- International or Extra-EU voyages are only counted as 50% (see Figure 1).
- OMRs trigger a 50% scope.
- Low-populated island routes and some public service connections may be exempt altogether from FuelEU until 2029.



Special Geographies: Islands, Territories, and Public Routes

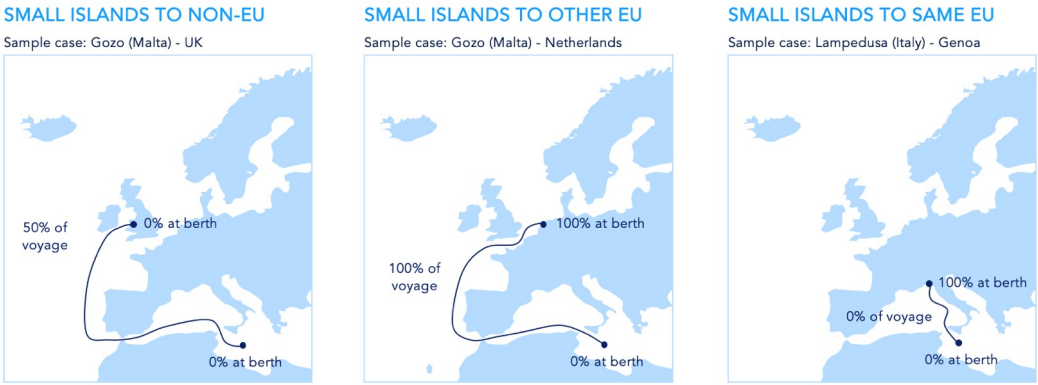
Outermost Regions (OMRs)

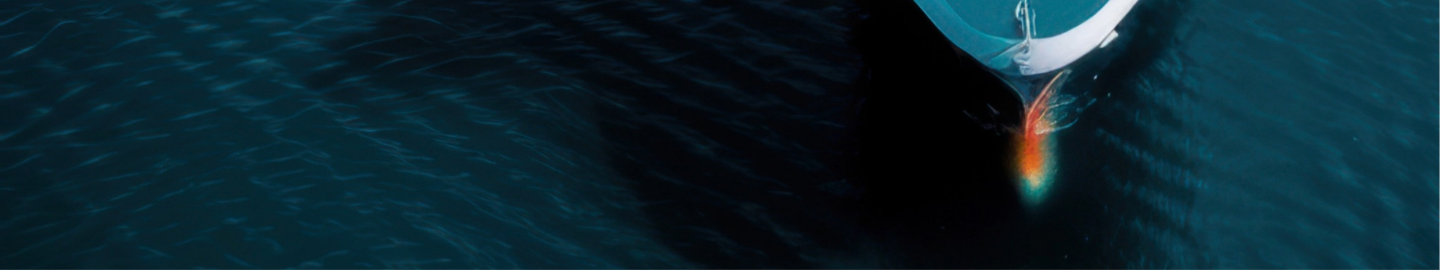
Although part of the EU, OMRs enjoy special status. Voyages to or from these areas, whether to EU or non-EU ports, only contribute 50% of their energy to your compliance balance—despite being “intra-EU.” Three member states currently have Outermost Regions: Spain (Canary Islands), Portugal (Madeira, Azores), and France (Guadeloupe, French Guyana, Martinique, Mayotte, Saint Martin, Reunion). Note that by 2031, EU ETS will handle this exposure differently than FuelEU Maritime. FuelEU Maritime further allows for exemptions of voyages between OMRs currently requested by the same three member states.



Low Populated or Small Islands (<200,000 residents)

FuelEU Maritime grants temporary exemptions for passenger ships (other than cruise ships) serving small islands within the same Member State until end 2029. On these routes, 0% of energy is counted until 2029. This includes both intra-island voyages and island-to-mainland connections, subject to notification by Member States, which has been requested by eight member states so far (Finland, Greece, Croatia, Italy, Malta, Portugal, and Spain). Again, this differs from EU ETS, while EU ETS exempts both ports until the end of 2030, FuelEU only exempts the port of the low-populated island until 2029.





Public Service Obligations (PSO)

PSOs or contracts under EU cabotage rules may also exempt island services, especially where no land borders exist. These exemptions are also temporary (until 2029) but significantly reduce compliance exposure for many domestic ferry routes. Again, EU ETS and FuelEU differ in the exemption end date as EU ETS allows exemption until end of 2030.

Non-Port Stops and Transhipment Exemptions

FuelEU applies only to recognized ports of call—meaning a stop must involve cargo operations or passenger disembarkation. Exempted stops include:

- Refueling-only stops
- Repairs or dry-docking
- Emergency stops or assistance
- Adverse weather sheltering
- Transshipment ports (Tanger Med, East Port Said are expected as per the current draft)

However, even when a stop is exempt, energy used on the segment may still fall under FuelEU if either the previous or next stop is a qualifying port of call. For example, if a vessel performs cargo operations in Singapore and Rotterdam but has a bunker (refueling-only) stop on the Cap Verdes, the energy falling under the scope is still 50% of the voyage between Rotterdam and Singapore.

Compliance Implications: Why the Scope Matters

Understanding how much of a voyage's energy is counted under FuelEU is not just a technicality—it directly affects:

- Your compliance balance and potential deficits
- Surplus generation potential
- Alternative fuel strategy
- Banking decisions

For example, a vessel trading primarily between mainland EU and outermost regions may generate less compliance surplus—even if using the same fuels—than one trading between core EU ports. Similarly, passenger ferries on exempt island routes may avoid any compliance exposure altogether. It becomes particularly essential when combined with the fuel/energy allocation allowed under FuelEU Maritime and explained in Chapter 4.2. Note, that this allocation exercise can not only help when allocating alternative fuels but also when allocating fossil fuels with different emission factors (e.g., HFO vs MDO) to decrease compliance penalties.

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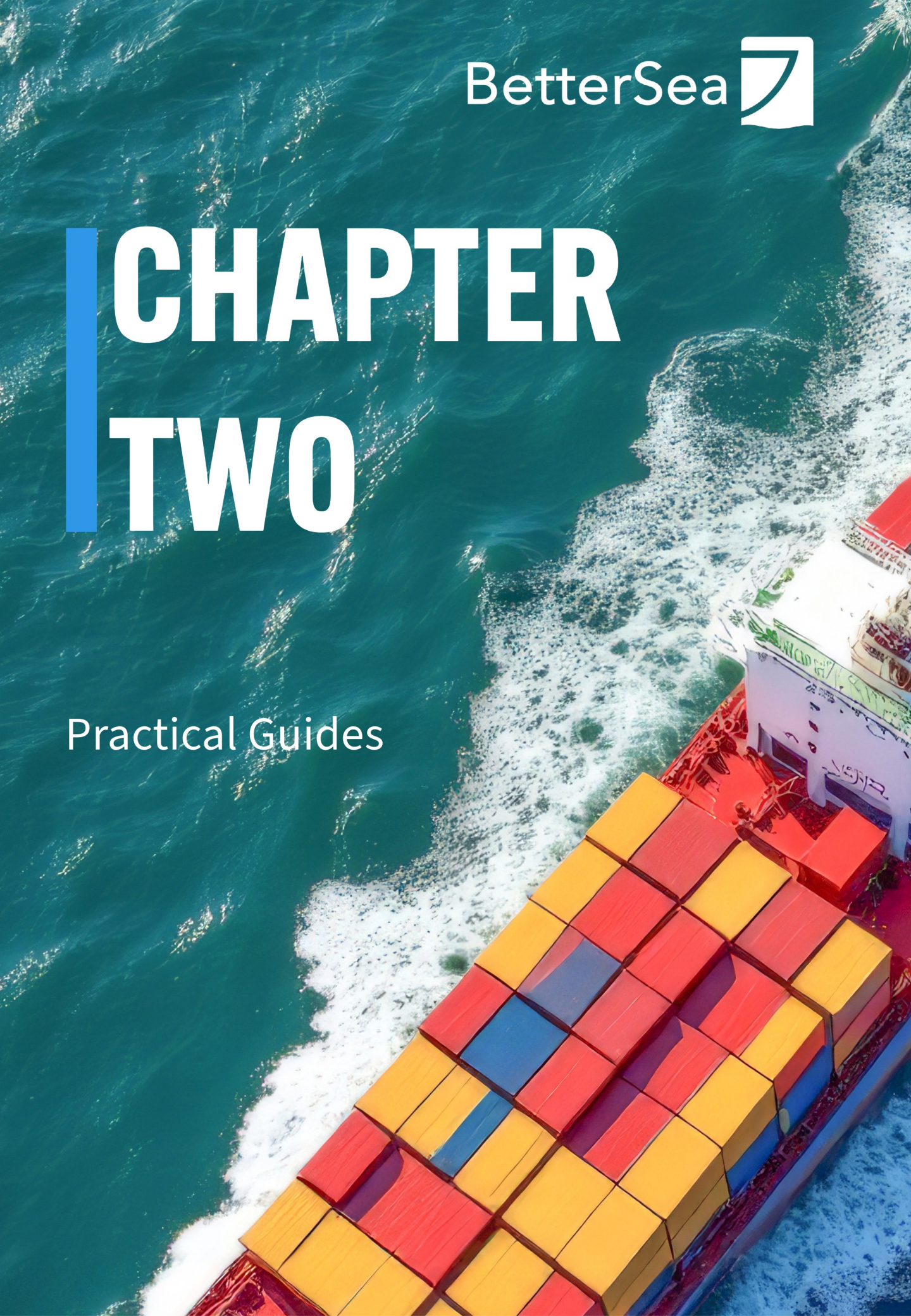
CHAPTER TWO

Practical Guides



FuelEU Maritime: Finding the Right Emission Factor

Most essential for compliance with FuelEU Maritime is the emission factor used to determine the GHG intensity. The emission factor under FuelEU Maritime measures a fuel's lifecycle emissions (well-to-wake), which are expressed in grams of CO_2 equivalent per megajoule (g CO_2e/MJ). This chapter sheds light on where to find a fuel's emission factor and how it is derived:

Where to find a fuel's emission factor for calculations under FuelEU Maritime?

FuelEU Maritime is the first EU regulation for shipping considering not only tank-to-wake emissions, those occurring when combusting fuel onboard, but also well-to-tank emissions, caused by, for example, the production of the fuel. This required the definition of well-to-wake emissions for maritime fuels, a new set of emission factors. When calculating the penalties under FuelEU Maritime, the use of the right emission factors determines correctness.

The regulation provides default emission factors for the most commonly used fuels such as HFO or LFO under Annex II.

Less common fuel types, including biofuels, are not defined in the above-mentioned Annex II. The document instead refers to the EU's Renewable Energy Directive (RED). Compliance of fuels with this regulation is proven by the International Sustainability & Carbon Certification (ISCC) and documented on a fuel's Proof of Sustainability (PoS). The corresponding emission factor not mentioned in Annex II of the FuelEU Maritime regulation can, therefore, be found under Section 3 of its PoS document.

What does the Proof of Sustainability (PoS) document include?

The PoS document has three different sections beyond mentioning the supplier and recipient, those are:

1. General Information
2. Sustainability criteria
3. Greenhouse Gas Information

The section 'Greenhouse Gas Information' outlines both the well-to-wake emission factor as well as the emission factors for the underlying steps of the lifecycle. Those are:

Emissions from the extraction or cultivation of raw materials e_{ec}

These are the emissions associated with the cultivation or extraction of raw materials. It includes greenhouse gases from the application of fertilizers, energy for machinery, and irrigation. Field-level data such as fertilizer use and diesel consumption must be accounted for, along with emissions from the production of chemicals used in cultivation.

Emissions from carbon stock change caused by land-use change e_l

If there has been a change in land use (e.g., forest to farmland) after a specific cutoff date, emissions from the carbon stock change must be included. This is annualized over a 20-year period, using carbon stock calculations that compare the former and current land use.

Emissions from processing e_p

Processing emissions include energy used for converting raw materials into fuels, such as electricity and heat consumption, and the production of intermediate goods. For example, emissions from the generation of steam or other energy sources in production facilities need to be included.

Emissions from transport and distribution e_{td}

Emissions related to the transportation and distribution of raw materials and final products are calculated based on fuel use and distance traveled. This also includes emissions from storage.

Emissions from use of fuel e_u

These emissions occur during the use phase of the fuel. In the case of renewable fuels, this typically refers to emissions from burning the fuel. This is subtracted from the total emissions to provide net emissions.

Emission saving from soil carbon accumulation e_{sca}

Emission savings from improved agricultural management, such as better tillage practices or improved crop rotation, may further reduce the emissions attributed to the cultivation phase.

Emission savings from CO_2 capture and replacement e_{ccr}

This refers to the CO_2 captured from processes, which replaces fossil-derived CO_2 in other industries. This results in a net emission reduction.

Emission savings from CO_2 capture and geological storage e_{ccs}

Emissions can be reduced by capturing and storing carbon, such as in biofuel production where CO_2 is sequestered instead of released.

Emission savings from excess electricity e_{ee}

Occurring excess electricity can be fed into the grid and replace fossil-based electricity resulting in emission savings.

To derive the resulting emission factor, each fuel supply chain participant needs to provide the relevant intermediate emission factors together with a sustainability certification that outlines which option was chosen to come up with the corresponding values. Options include:

- The use of total default values
- The use of disaggregated default values
- The use of actual values
- Combination of the above

A final verification of the values by an auditor marks the end of creating a fuel's PoS.

Challenges of the Proof of Sustainability under FuelEU Maritime

Considering the amount of reporting stakeholders, one of the main challenges with emission factors for biofuels under FuelEU Maritime is the timely delivery of the proof of sustainability, which can take up to three months. During this time, the shipping company can only work with an estimate that might change with the delivery of the PoS, resulting not only in a changed emission factor but also a compliance penalty or surplus value.

Default vs. Actual Values

Beyond the PoS, it is noteworthy that the FuelEU Maritime regulation allows for both default values and actual values to be used under specific circumstances when reporting the fuel's emission factor. The regulation allows the use of actual values derived from either direct measurements or laboratory testing according to applicable international standards for all emission factors except well-to-tank emission factors from fossil fuels and tank-to-wake CO_2 emission factors from fossil fuels.

The well-to-wake performance of renewable and low-carbon maritime fuels should be established using default or actual and certified emission factors covering the well-to-tank and tank-to-wake emissions. For the purpose of this Regulation, only default well-to-tank emission factors and default tank-to-wake CO_2 emission factors for fossil fuels should be used.

For more detailed information, refer to the full text of the FuelEU Maritime Regulation (EU) 2023/1805 on the EUR-Lex website.

Conclusion

FuelEU Maritime, its compliance and penalty, strongly rely on the correct usage of emission factors. Shipping companies can use default factors but also actual values are possible for specific types and circumstances. Getting an understanding of where to find the right emission factor and the available options is crucial for the most optimal compliance with FuelEU Maritime.

Guide:
How to Calculate GHG Intensity under FuelEU Maritime

Following up on the previous chapter, in this chapter we'll focus on the practical application of emission factors, calculating the greenhouse gas (GHG) intensity of a ship under the FuelEU Maritime regulation. We provide a guide on how to correctly calculate the GHG intensity based on an example with a containership using heavy fuel oil (HFO).

What is GHG Intensity?

Under FuelEU Maritime, the GHG intensity is the ratio of total greenhouse gas emissions (in grams of CO_2e) to the total energy consumed by the ship (in MJ). This value, expressed in g CO_2e/MJ, is the metric used to determine compliance with FuelEU Maritime.

Example: Calculating GHG Intensity under FuelEU Maritime for a Containership in 2025

In this example, we will calculate the GHG intensity of a containership with 7,000 tonnes of annual HFO consumption (in scope) under FuelEU Maritime in 2025 (using AR4 Global Warming Potentials).

Step 1: Identify Calculation Parameters

Before diving into the calculation, we need to gather the relevant data:

Annual fuel consumption: 7,000 tonnes of HFO.

1	2	3	4	5	6	7	8	9
			WtT	TtW				
Fuel Class	Pathway name	LCV [MJ/g]	$CO_{2eq\ WtT}$ [gCO2eq/MJ]	Fuel Consumer Unit Class	$C_{f\ CO_2}$ [gCO2/gFuel]	$C_{f\ CH_4}$ [gCH_4/gFuel]	$C_{f\ N_2O}$ [gN_2O/gFuel]	C_{slip} As % of the mass of the fuel used by the engine
Fossil	HFO ISO 8217 Grades RME to RMK	0,0405	13,5	ALL ICEs	3,114	0,00005	0,00018	-
	LFO ISO 8217 Grades RMA to RMD	0,041	13,2	ALL ICEs	3,151	0,00005	0,00018	-
	MDO MGO ISO 8217 Grades DMX to DMB	0,0427	14,4	ALL ICEs	3,206	0,00005	0,00018	-

Image 1: A snippet of the Emission Factors provided in Annex II of the FuelEU Regulation

HFO's Emission Factors:

- The default well-to-tank (WtT) emission factor for HFO is 13.5 g CO_2e/MJ.
- Tank-to-wake (TtW) CO_2: 3.114 g CO_2/g fuel.
- Tank-to-wake (TtW) CH_4: 0.00005 g CH_4/g fuel.
- Tank-to-wake (TtW) N_2O: 0.00018 g N_2O/g fuel.

The values are according to Annex II of the regulation, as shown in Image 1.

Global Warming Potential (GWP):

- GWP CO_2: 1.
- GWP CH_4: 25.
- GWP N_2O: 298.

The values are according to AR4 as per FuelEU Maritime.

Step 2: Calculate Well-to-Wake (WtW) Emission Factor

Based on the above-identified parameters, the GHG intensity can be calculated. The first step is the calculation of the corresponding well-to-wake emission factor, for which it is mandatory to first determine the tank-to-wake emission factor for HFO based on AR4 GWPs:

$$EF_{TtW,HFO} = C_{f\,CO_2} \cdot GWP_{CO_2} + C_{f\,CH_4} \cdot GWP_{CH_4} + C_{f\,N_2O} \cdot GWP_{N_2O}$$

$$EF_{TtW,HFO} = 3.114 \cdot 1 + 0.00005 \cdot 25 + 0.00018 \cdot 298 = 3.16889 \left[\frac{\text{g } CO_2\text{e}}{\text{g fuel}}\right]$$

From here, the well-to-wake emission factor can be calculated by adding the well-to-tank and the tank-to-wake part:

$$EF_{WtW,HFO} = EF_{WtT,HFO} + EF_{TtW,HFO}$$

$$EF_{WtW,HFO} = 13.5 + \frac{3.16889}{0.0405} = 91.744 \left[\frac{\text{g } CO_2\text{e}}{\text{MJ}}\right]$$

Note that the calculated tank-to-wake factor must be divided by the LCV to have the same unit.

Step 3: Calculate Energy Content of HFO

The next step is to calculate the total energy content of the 7,000 tonnes HFO consumed. The Lower Calorific Value (LCV) of HFO is 0.0405 MJ/g fuel (see Annex II image above). With that, the total energy used by the ship can be calculated to:

$$E_{total} = m_{HFO} \cdot LCV_{HFO}$$

$$E_{total} = 7{,}000 \cdot 10^9 \cdot 0.0405 = 2.835 \cdot 10^{11}\ [\text{MJ}]$$

Step 4: Calculate Total Emissions

Next, we calculate the total greenhouse gas emissions using the well-to-wake (WtW) emission factor and the fuel consumption:

$$CO_2e_{total} = EF_{WtW,HFO} \cdot E_{total}$$

$$CO_2e_{total} = 91.744 \cdot 2.835 \cdot 10^{11} = 2.60095 \cdot 10^{13}\ [\text{g } CO_2\text{e}]$$

Step 5: Calculate GHG Intensity

Finally, we calculate the GHG intensity by dividing the total emissions by the total energy used onboard.

$$GHG\ Intensity = \frac{CO_2e_{total}}{E_{total}} = 91.744\ \left[\frac{\text{g } CO_2\text{e}}{\text{MJ}}\right]$$

It can be noticed, that in the case of just one fuel type the GHG intensity equals the well-to-wake emission factor of the fuel type.

Note on AR4 vs. AR5 GWP Values

While the above calculation uses AR4 Global Warming Potentials (GWPs) as per the current regulatory text, it is important to note that the European Maritime Safety Agency (EMSA) has indicated that the regulation will shift to AR5 GWPs before January 2025. This means the GWP values for CH_4 and N2O will change to 28 and 265 respectively, affecting the well-to-wake emission factor:

$$EF_{WtW,HFO,AR5} = 91.601\ \left[\frac{\text{g } CO_2\text{e}}{\text{MJ}}\right]$$

Conclusion

The GHG intensity of the containership consuming 7,000 tonnes of HFO annually under FuelEU Maritime in 2025 is 91.744 g CO_2e/MJ based on AR4 values. The fuel consumption did not affect the resulting GHG intensity as the ship only consumed one fuel type.

Shipping companies should remain prepared for any adjustments in their emission factor calculations, as regulatory updates will incorporate AR5 GWPs.

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Guide:
How to Calculate FuelEU Maritime Penalties

Following up on the previous chapter, we're providing a guide on how to calculate the FuelEU Maritime penalties. We will go through each required step.

General Overview of FuelEU Maritime Regulation

The FuelEU Maritime Regulation aims to reduce the maritime sector's greenhouse gas (GHG) emissions, targeting a 6% reduction by 2030 and 80% by 2050. The regulation mandates stricter emissions reporting and compliance with GHG intensity limits for ships operating to/from or within the EU, promoting the use of cleaner fuels and innovative technologies to drive sustainability.

The Compliance Penalty

The FuelEU Maritime Regulation includes a strict compliance penalty that is applied if the target GHG intensity is not met. The penalty costs have cautiously been chosen to ensure that a strategy of just paying the penalty is commercially not attractive.

"Without prejudice to the possibility of complying through the flexibility and pooling provisions, ships that do not meet the limits on the yearly average GHG intensity of the energy used on board should be subject to a penalty that has dissuasive effect, is proportionate to the extent of the non-compliance and removes any economic advantage of non-compliance, thus preserving a level playing field in the sector (the 'FuelEU penalty'). The FuelEU penalty should be based on the amount and cost of renewable and low-carbon fuels that the ships should have used to meet the requirements of this Regulation." as per FuelEU Maritime Regulation (EU) 2023/1805.

The penalty is set at 2400€ per ton of VLSFO equivalent exceeding the limit, but what does that mean for a vessel in total?

How to calculate FuelEU Maritime Penalties?

Step 1: Calculate the GHG intensity

Required data:

- Fuel consumption per fuel type (in g fuel)
- Tank-to-Wake (TtW) emission factor per fuel type (in g CO_2e / MJ)
- Well-to-Tank (WtT) emission factor per fuel type (in g CO_2e / MJ)
- Lower calorific value (LCV) per fuel type (in MJ / g fuel)
- Electricity consumption (in MJ)

The lower calorific value can be found in Annex II of the FuelEU Maritime Regulation (EU) 2023/1805, the emission factors can be found in the same Annex or the fuel's Proof of Sustainability (PoS).

Equation:

$$GHG\ Intensity_{actual} = \frac{m_{fuel} \cdot LCV_{fuel} \cdot (EF_{WtT} + EF_{TtW})}{m_{fuel} \cdot LCV_{fuel} + E_{electricity}}$$

Note: For LNG, RFNBOs, ice class, or wind propulsion, please consult the FuelEU Maritime Regulation (EU) 2023/1805 for more details.

Step 2: Calculate the Compliance Balance

Required data:

- Actual GHG intensity (in g CO_2e / MJ)
- Target GHG intensity (in g CO_2e / MJ)
- Fuel consumption per fuel type (in g fuel)
- Lower calorific value (LCV) per fuel type (in MJ / g fuel)
- Electricity consumption (in MJ)

The lower calorific value can be found in Annex II of the FuelEU Maritime Regulation (EU) 2023/1805, the actual GHG intensity has been calculated under Step 1, and the target GHG intensity is 89.34 g CO_2e / MJ as per Article 4(2) of the FuelEU Maritime Regulation (EU) 2023/1805.

Equation:

$$CB = (GHG\ Intensity_{target} - GHG\ Intensity_{actual}) \cdot (m_{fuel} \cdot LCV_{fuel} + E_{electricity})$$

Step 3: Calculate the Compliance Penalty

Required data:

- Actual GHG intensity (in g CO_2e / MJ)
- Compliance balance (in g CO_2e)

The actual GHG intensity has been calculated under Step 1, the compliance balance has been calculated under Step 2.

Equation:

$$Penalty = \frac{|CB| \cdot 2400€}{GHG\ Intensity_{actual} \cdot 41{,}000}$$

This step-wise approach helps calculate the FuelEU Maritime penalties and breaks down the complex equations in a simpler manner. Note that the above has been simplified to exclude the use of LNG, RFNBOs, wind propulsion, or an ice class. In case any of the above is relevant, please refer to the annexes of the FuelEU Maritime Regulation (EU) 2023/1805 for further information.

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Step-By-Step to Successful FuelEU Maritime Compliance

The upcoming FuelEU Maritime regulation goes beyond just data recording and reporting. It requires an overarching multi-faceted approach to achieve and maintain compliance. Multiple maritime stakeholders must manage responsibilities, assess compliance status, and carefully plan their compliance actions throughout the year.

In this chapter, we break down step-by-step what is required to master compliance with the upcoming FuelEU Maritime Regulation successfully.

Align Stakeholder Responsibilities

While the ISM company is ultimately responsible for compliance with FuelEU, it is expected that individual contractual agreements will pass on responsibility for achieving compliance to other parties. Define with your respective counterparties (owners, charterers, and/or managers) how to handle GHG intensity tracking, reporting, and surplus management. Special emphasis must be laid on the compliance mechanisms, most importantly on the ownership of surplus as it is critical for external/internal pooling and banking.

Assess and Track Compliance Status

Regularly assess each vessel's and the fleet's GHG intensity relative to the FuelEU targets to ensure end-of-year compliance. Make use of simulation tools to project how your compliance status may evolve throughout the year, considering factors like fuel changes, voyage patterns, and price data.

Develop a Compliance Strategy

Define a strategy based on your fleet's projected end-of-year compliance status. If your fleet will have a deficit (non-compliance), decide whether to:

- Pay the penalty.
- Purchase alternative fuels.
- Borrow from the following year's compliance balance.
- Buy surplus by entering an external pool.

If your fleet will have a surplus (over-compliance), decide whether to:

- Bank the surplus for future use.
- Use it for internal pooling within your fleet.
- Sell the surplus to other companies.

Option: Source Alternative Fuels

Consider the technical capabilities of your vessels, their routes, the corresponding alternative fuel availability, and the correct fuel certification for eligibility under FuelEU. To prevent extra costs, calculate the exact amount of alternative fuel needed by considering the intricacies of the FuelEU regulation, especially the fuel allocation across different voyages.

Option: Manage External Pooling and Surplus Trading

External pools are both particularly appealing as they save compliance costs for non-compliant companies and allow for additional revenues for over-compliant companies, but must also be looked at with caution. To ensure risk-managed, trustworthy, and reliable external pooling, several key points must be considered:

- **KYC and Partner Selection**: Ensure thorough Know Your Customer (KYC) processes and select reliable partners.

- **Data Accuracy**: Request pre-validated data when trading before the annual data verification to reduce the risk of non-delivery.
- **Contractual Agreement:** Set up contracts that cautiously define price, amount, timelines, responsibilities, and most importantly risk management (e.g. reimbursement structure in case of non-delivery).
- **Control over sold surplus:** Make sure to maintain control over sold surplus not allowing buyers to further sell surplus to other companies to prevent stakeholder chaos and contractual confusion.

Report and Verify Compliance Data and Mechanisms

Ensure that all relevant (EU MRV) data, including surplus and deficit calculations, is submitted to a verifier on time. Make sure to also report compliance mechanisms, including the use of surpluses, deficits, and penalties, as required by FuelEU Maritime regulations.

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to book a call on how BetterSea can help you handle compliance end-to-end

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CHAPTER THREE

Intricacies

Ice Class & FuelEU Maritime: Navigating Compliance in Harsh Conditions

As the maritime industry adapts to the upcoming FuelEU Maritime regulation, one area that presents unique challenges is the compliance of ships with ice class. These are essential for maintaining global trade routes that pass through colder climates. The ships are designed to handle harsh sea ice conditions, but their unique operational needs and technical characteristics also mean higher energy consumption, complicating their efforts to meet the regulation's greenhouse gas (GHG) intensity targets.

To ensure that this regulation does not unfairly burden ice-class ships, the FuelEU Maritime regulation supports such ships and offers specific exemptions. In this chapter, we explore these exemptions in more detail and outline how this is different from the current EU ETS. For more information on the alignment of different ice classes, please follow the HELCOM recommendation 25/7.

FuelEU Maritime Exemptions for Add. Energy Consumption of Ice Class and Sailing in Ice

Under the FuelEU Maritime regulation, some provisions allow companies operating ice-class ships to exclude additional energy consumption due to the technical characteristics of the ship and navigation in ice conditions from their compliance balance.

Technical Characteristics of Ice-Class Ships: According to Article 8(3)(n) and Annex V of the regulation, companies may request to exclude additional energy used due to the ship's ice class from the compliance balance. This provision applies specifically to ships with ice classes IA or IA Super.

Sailing in Ice Conditions: Article 3(23) defines "sailing in ice conditions" as the navigation of an ice-class ship in areas within the ice edge. The regulation permits companies to exclude the energy used during such voyages from their compliance balance. To do so, companies must provide detailed information on the vessel's ice class, the distance traveled in ice conditions, and the fuel consumed during these voyages.

Note, that EU ETS does not allow for the inclusion of the second bullet point, sailing in ice conditions, but only considers the higher energy consumption due to the physical difference of ice-class ships.

How to Calculate Adjusted Energy for Ice-Class Ships

The process of adjusting for additional energy consumption is detailed in Annex V of the regulation:

- **Additional Energy Due to Ice Class:** For ships with ice class IA or IA Super, the additional energy consumption due to their technical characteristics is calculated as a percentage (5%) of the total energy used on all voyages (excluding additional energy due to sailing in ice conditions).
- **Additional Energy Due to Ice Conditions:** For ships navigating through ice and ice class IC, IB, IA, or IA Super, the additional energy consumption is calculated by subtracting the energy used for open-water voyages and the adjusted energy for ice voyages from the total energy used.
- **Total Additional Ice Energy:** The total additional energy due to ice is the sum of both the technical and operational energy (as per above) for ice-class ships, which is then allocated to the different fuel types used during the year.

Please find the exact formulas for calculating ice class exemptions in Annex V of the FuelEU Maritime regulation.

Reporting Requirements and Verification

To benefit from these exemptions, companies must ensure that they provide accurate and verifiable data, as outlined in Article 15(1)(g-h). This includes information on the ship's ice class, the distance traveled in ice conditions, and the corresponding fuel consumption. This data collection is not known from EU ETS and therefore must be established.

Next Steps for Ice-Class Ships

Responsible entities for ice-class ships need to prepare for the documentation requirements outlined in the regulation and should stay informed about any updates of the regulation as this provision is valid only until **December 31, 2034.**

Key Considerations for Drafting Charter Clauses under FuelEU Maritime

The Baltic and International Maritime Council (BIMCO), one of the world's largest international shipping associations representing ship owners, is actively working on draft clauses for time charter parties to help maritime stakeholders navigate FuelEU Maritime. In this chapter, we share our thoughts on key considerations for FuelEU charter clauses and also touch upon implications on SHIPMAN agreements.

Key Considerations for FuelEU Maritime Charter Clauses:

Flexibility in Fuel Procurement: It's important to build flexibility for charterers to supply fuels that meet the vessel's greenhouse gas (GHG) intensity targets. Clauses should allow charterers to choose the combination of fuels and energy that aligns with their decarbonization strategies while ensuring that these choices are compatible with the vessel's technical capabilities. Otherwise, the owner's imposed mitigation strategy might not align with the charterers' already ensured fuel supply and vessel operations.

Regular Reviews and Updates: Given future FuelEU reviews, charter clauses should include provisions for regular updates. This ensures that the contracts remain aligned with any changes to the FuelEU Maritime Regulation and continue to protect the interests of all parties involved.

Managing Surplus and Deficit Scenarios: A critical aspect of FuelEU compliance is how to handle the scenarios where a vessel either exceeds (surplus) or falls short (deficit) of its GHG intensity targets. Charter clauses should include clear provisions for managing surpluses and deficits, including options for banking, borrowing, or pooling. In this respect, it is essential to address how the value of any surplus will be determined, for which the charterer will be compensated, especially considering the potential volatility in trading markets. If this is not sufficiently done, charterers and owners will not be able to agree on the value resulting in corresponding disputes.

Time Charters less than a Full Compliance Year: It is likely (and advised) that charter clauses will allow passing on the ability to pool from owner to charterer. If the charter period is less than the compliance year, it must be ensured that a vessel is only pooled in one pool per compliance year. Therefore, the ability to pool shall preferably not be passed on to more than one charterer to avoid a complex stakeholder landscape requiring complex reimbursement and control mechanisms.

The Impact of FuelEU Maritime on SHIPMAN Contracts

The introduction of the FuelEU Maritime Regulation will further have implications for SHIPMAN contracts, which govern the relationship between ship owners and ship managers. A few initial thoughts below:

Risk Management and Liability: SHIPMAN contracts should clearly define the ship manager's liability for non-compliance with the FuelEU Maritime Regulation. This is essential to protect both ship owners and managers from potential disputes.

Collaboration with Charterers: Given the flexibility charterers may receive to supply alternative fuels, ship managers will need to work closely with them to ensure appropriate technical facilities and crewing. SHIPMAN contracts may include provisions to facilitate this collaboration.

Regular Reviews and Updates: Just as the BIMCO FuelEU clauses include provisions for regular reviews, SHIPMAN contracts should incorporate mechanisms for periodic assessments to ensure compliance with evolving regulations.

Conclusion:

The FuelEU Maritime Regulation requires updated contracts, influencing not only charter parties but also ship management agreements. By updating these contracts to reflect the new compliance landscape, stakeholders must be aware of financial risks while ensuring alignment with their own decarbonization strategies.

RFNBOs under FuelEU Maritime

Which of the following is considered an RFNBO under the FuelEU?

- ❑ e-Methanol
- ❑ HFO/Biofuel blend
- ❑ Bio-LNG
- ❑ Blue Ammonia

General Overview: Understanding RFNBOs and Their Incentives

Renewable Fuels of Non-Biological Origin (RFNBOs) are synthetic fuels produced from renewable electricity and carbon captured directly from the air. Here's a concise overview of RFNBOs and how they are incentivized under the FuelEU Maritime Regulation:

Definition & Compliance

RFNBOs must satisfy the definition in the Renewable Energy Directive (RED) II Article 2(36). They must achieve at least 70% GHG emissions reduction compared to the RED comparator. Compliance with renewable hydrogen criteria, including rules on sourcing renewable electricity, is required as per RED III Article 27(6).

Incentives for RFNBOs

Multiplier Effect: Until the end of 2033, energy from RFNBOs counts twice in GHG intensity calculations.

Sub-target: A minimum use target of 2% RFNBOs of the total yearly energy use by ships applies from 2034 if the share of reported RFNBOs used by ships is less than 1% by 2031.

These measures support the uptake of RFNBOs, signaling shipping companies and fuel suppliers to invest in these sustainable fuels despite their higher production costs compared to conventional fuels.

Here is why e-Methanol is the only RFNBO in the list

E-methanol is considered green methanol, produced using renewable energy and captured carbon dioxide, making it an RFNBO under FuelEU. It complies with the criteria for renewable hydrogen and its derivatives according to RED.

Why Not the Other Options?

HFO/Biofuel blend: Not considered an RFNBO due to its biological origins. However, it can help reduce GHG intensity under FuelEU if it meets the sustainability criteria set out in RED II Article 29.

Bio-LNG: Similarly, Bio-LNG is not an RFNBO because of its biological origin but can aid in reducing GHG intensity if it meets the necessary sustainability criteria.

Blue Ammonia: Produced from natural gas with carbon capture and storage, Blue Ammonia is a low-carbon fuel (LCF) and not an RFNBO.

Regulatory Context

The relevant portion of the FuelEU Maritime Regulation regarding RFNBOs is in Article 5.1 and onwards:

"For the calculation of the GHG intensity of the energy used on board by a ship, from 1 January 2025 to 31 December 2033 a multiplier of '2' can be used to reward the ship for the use of RFNBO. The methodology for this calculation is set out in Annex I."

The Role of Ports under FuelEU Maritime

General Overview: The Role of Ports under FuelEU Maritime

Under FuelEU Maritime, ports play a vital role in promoting cleaner maritime fuel options. They provide essential infrastructure, enforce regulations, and can offer incentives to help the shipping industry adopt alternative fuels.

By improving efficiency, using sustainable technologies, and working with various stakeholders, ports drive significant changes towards maritime decarbonization.

How FuelEU Maritime Regulates Ships in European Ports

The FuelEU Maritime regulation outlines the requirement for containerships and passenger ships to connect to the onshore power supply (OPS) while moored ar berth for a period exceeding 2 hours. Note that zero emission technologies can exempt the respective ships from the requirement. The requirement is following a timeline that allows both ships and ports to implement the technology needed for OPS:

From 1 January 2030, the above mentioned is required in ports covered by Article 9 of Regulation (EU) 2023/1804

From 1 January 2035, this is extended to ports not covered by the mentioned regulations but equipped with OPS.

Between 2030 and 2035, member states can decide to impose the usage of OPS in ports not covered by the regulation but equipped with OPS when communicated to the Commission a year earlier. Further, member states may decide to extend the requirement of OPS usage to ships at anchorage.

How the EU secures Onshore Power Supply (OPS) in European Ports

While FuelEU Maritime sets the OPS requirements for ships, the Commission also ensured the availability of the necessary infrastructure by Regulation (EU) 2023/1804. As of the regulatory text, Trans-European Transport Network (TEN-T) core and comprehensive ports must take the necessary measures to provide at least 90% of quayside energy through OPS by 31 December 2029 to containerships, high-speed passenger crafts, and passenger ships above 5,000 GT.

Background information: TEN-T (Trans-European Transport Network) Ports & Onshore Power Supply (OPS)

These ports are a key part of the EU's initiative to create an integrated and efficient transport network across Europe. They are strategically selected for their critical role in facilitating international trade and transport, and they are divided into two main categories:

Core Network Ports

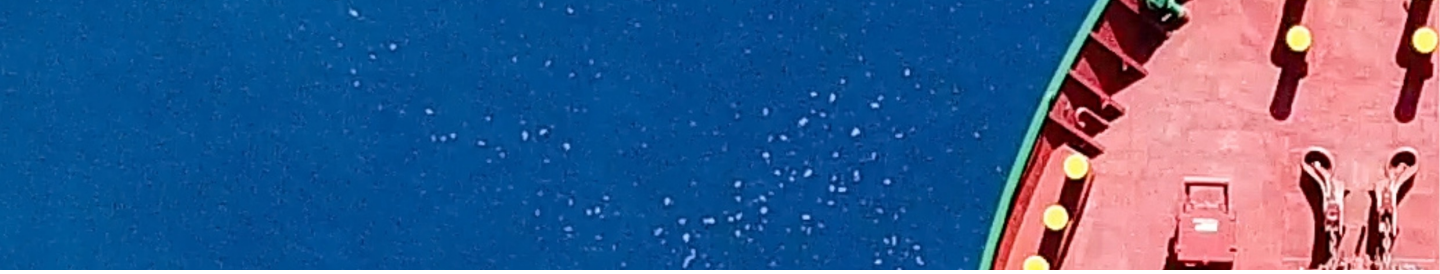
These are the most significant ports within the TEN-T network. They handle large volumes of cargo and passenger traffic and are prioritized for EU funding and development. Core network ports are essential for the smooth functioning of the entire European transport system.

Comprehensive Network Ports

These ports complement the core network by enhancing regional and national connectivity. While they handle less traffic compared to core network ports, they still play a vital role in the transport network and receive support for infrastructure improvements.

What is Onshore Power Supply (OPS)?

Onshore Power Supply, also known as cold ironing or shore-side electricity, allows ships to plug into the local power grid while docked, instead of running their auxiliary engines on fossil fuels. This significantly reduces emissions of air pollutants and greenhouse gasses, improving air quality and contributing to climate goals.



Regulatory Context

The relevant portion of the FuelEU Maritime Regulation regarding OPS is in Article 6(1) and onwards:

"From 1 January 2030, a ship moored at the quayside in a port of call which is covered by Article 9 of Regulation (EU) 2023/1804 and which is under the jurisdiction of a Member State shall connect to OPS and use it for all its electrical power demand at berth."

For more detailed information, refer to the full text of the FuelEU Maritime Regulation (EU) 2023/1805 on the EUR-Lex website.

The relevant portion of the regulation on the deployment of alternative fuel infrastructure regarding OPS is in Article 9(1) and onwards:

"Member States shall ensure that a minimum shore-side electricity supply for seagoing container ships and seagoing passenger ships is provided in TEN-T maritime ports."

For more detailed information, refer to the full text of the Regulation (EU) 2023/1804 on the EUR-Lex website.

In summary, both regulations work together to not only ensure emission reduction at sea but also at berth through the application of OPS, an essential enabler for comprehensive maritime decarbonization. On top, OPS helps to reduce air emissions and related health impacts, especially in port cities.

A FuelEU Maritime Controversial: The Rising Tide of LNG and the Complexities of Boil-Off Gas Management

With Maersk's recent change of heart in its decarbonization strategy, diversifying its fuel portfolio including previously criticized liquified natural gas (LNG), the fuel takes center stage demanding a closer look at its role under FuelEU Maritime regulation. The fuel brings the critical challenge of managing boil-off gas (BOG) within the regulation's framework.

What is Boil-Off Gas and how is it accounted for under FuelEU?

Boil-off gas is the vaporized LNG that naturally occurs as the liquid fuel warms up during storage in a ship's cryogenic tanks. This gas needs to be managed carefully to prevent pressure buildup within the tanks.

The different ways of managing boil-off gas ultimately define how it is accounted for in calculating the GHG intensity under FuelEU:

BOG as Fuel: If the BOG is utilized as fuel in the ship's engines, the resulting emissions are included in the GHG intensity calculation as part of the energy consumed. This is a straightforward scenario where BOG contributes to the total GHG emissions. The use of BOG as fuel is common, especially in LNG carriers.

BOG Reliquefication: If the BOG is reliquefied, the energy consumed in this process contributes to the overall energy use and indirectly affects the GHG intensity. The emissions associated with the energy used for reliquefication are factored into the GHG intensity calculation, albeit as an indirect contribution.

BOG Venting: Venting BOG is the most concerning scenario. When BOG is released into the atmosphere without being burned, it contributes directly to methane emissions. Under the FuelEU Maritime regulation, the 'lost fuel' is used with the default emission factor and corresponding methane slip percentage to calculate the related emissions but the direct emission of unburnt methane is not at all accounted for.

The Challenge of Boil-Off Gas and Onshore Power Supply

The occurrence of boil-off gas presents a significant operational challenge—especially when ships are connected to onshore power supply (OPS). With engines shut down, the typical use of BOG as fuel is interrupted, forcing companies to consider either reliquefication (using OPS) or venting. The latter results in significant methane emissions that are not accounted for under FuelEU.

The reliance on OPS, mandated by FuelEU Maritime for container and passenger ships by 2030, adds another layer of complexity. The integration of OPS is intended to reduce emissions in port areas by shifting the energy burden to the local electricity grid. However, without a clear strategy for managing BOG during these periods, the very environmental benefits that OPS is designed to achieve are undermined.

A Controversial Trade-Off: Are We Truly Reducing Emissions?

This scenario presents a controversial trade-off. On one hand, OPS represents a step forward in reducing emissions at berth, particularly in densely populated port cities. On the other hand, the potential increase in emissions from improperly managed BOG during these periods could offset these gains while not even quantified.

Will the shift to LNG, combined with OPS requirements, truly result in lower overall emissions? Or are we simply shifting the burden, trading one environmental challenge for another? This debate is far from settled!

FuelEU Maritime Pooling: Comparing Marketplaces and Super Pools

As shipping companies work on their strategies for compliance with FuelEU Maritime, they are considering different models for trading compliance surpluses and pooling. Two primary options arose: marketplaces, driven by all individual marketplace participants, and super pools, structured around centralized management by a single provider.

In this chapter, we look at the key categories for consideration and the main differences between these models, focusing on structure, transparency, and participant autonomy. By understanding these contrasts, companies can make informed decisions about the best fit for their compliance strategy.

Pooling Structure and Flexibility

Open Marketplace: An open marketplace supports independent participation for both surplus and deficit companies. Each entity maintains control over its participation, with options to join various pools based on their compliance needs. This open structure supports a participant-driven pooling experience, offering flexibility and independence in navigating compliance with FuelEU Maritime.

Super Pool: The super pool is typically a closed, centralized structure managed by one provider who aggregates and manages surplus on behalf of all participants. This centralization limits participant-driven decisions, as users must rely on the provider to structure and operate the pool. This model may appeal to companies seeking an all-in-one option, but it offers strongly limited flexibility for participants to independently navigate their compliance strategies due to its centrally controlled setup.

Financial and Transactional Transparency

Open Marketplace: In an open marketplace, transactions take place with full transparency on pricing and verified data. Each participant manages their own costs with a clear and transparent view of surplus pricing, often supplemented by streamlined financial setups for added security. This transparency gives participants direct control over their compliance budget.

Super Pool: In a super pool, the provider often manages and invoices participants based on aggregate balances and monthly adjustments. While this approach can simplify budgeting, the lack of visibility into granular costs can lead to blurred pricing where participants rely on the provider's calculations rather than on itemized, participant-specific invoices. Further, the participants gain no transparency on the surplus market value as pricing is centrally controlled by a single provider.

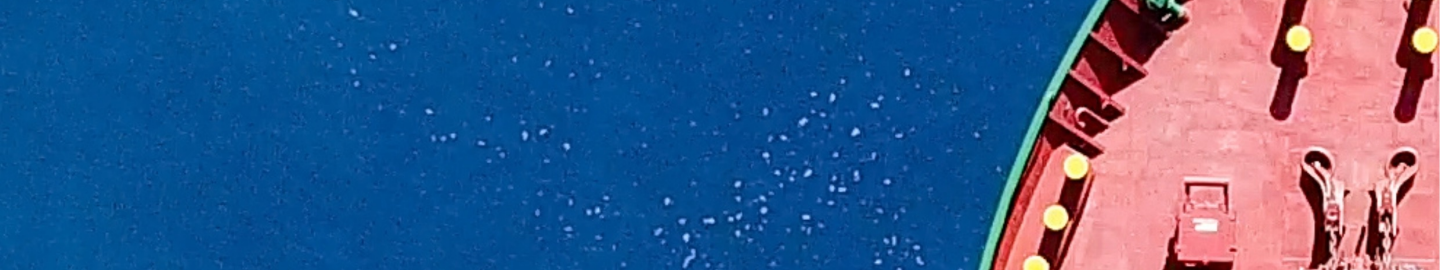
Risk Management and Liability

Open Marketplace: With an open marketplace, risk management is built into the model through participant-individual streamlined financial and risk mechanisms, allowing participants to understand their share of liabilities and financial risks. By structuring liability on a per-participant basis, the model distributes risk proportionally across contributors, enhancing transparency in risk allocation. A marketplace's exposure to a large number of surplus generators and deficit holders forming several pools independently also allows for a faster speed of reaction and a higher probability of resolution if risk is identified.

Super Pool: In contrast, a super pool typically assigns full compliance responsibility to the provider, introducing a "trust me" element where participants rely heavily on the provider's assurances for managing risks. This structure may appeal to those looking for an all-inclusive service, but it can also mean that participants have limited control over compliance monitoring, realignment, and cost transparency, which some may see as an increased risk.

Operational Autonomy for Participants

Open Marketplace: Participants in an open marketplace can enter pools independently, making it easier to choose participation based on operational and compliance needs. This autonomy allows companies to customize their approach to FuelEU compliance, aligning pool involvement with their specific goals.



Super Pool: The super pool model is largely provider-controlled, meaning that decisions about pool membership, surplus generation, and other operational aspects are centralized or undergo a complex multistakeholder alignment. Participants in this model may find their operational freedom restricted, limiting the scope for independent decision-making.

Surplus Management and Monetization Potential

Open Marketplace: Surplus management in an open marketplace is participant-driven, empowering companies to actively trade surpluses in a transparent environment. This allows for the best surplus pricing as the surplus value is transparent and competitive. It further gives participants direct control over trading decisions and profits.

Super Pool: In the super pool model, surpluses are managed centrally by the provider. While this approach can simplify compliance for participants, it offers an increased risk of lower monetization or higher costs as surplus control is retained by the pooling provider.

Key Takeaways of Comparing Marketplaces and Super Pools as Options for FuelEU Maritime Pooling

While both models aim to support FuelEU Maritime compliance, they differ significantly in structure, transparency, and participant autonomy. The super pool model offers a managed, centralized service, which may appeal to companies seeking simplicity, but it requires a high level of trust in the provider's management. Conversely, an open marketplace offers a transparent and flexible environment that gives participants greater control over their compliance and operational decisions. Ultimately, when comparing marketplaces and super pools as options for FuelEU Maritime pooling, the choice between these models depends on your company's compliance strategy, risk tolerance, and desire for operational autonomy.

Selling and Buying Ships Under FuelEU Maritime: Challenges and Compliance

Selling or buying ships under FuelEU Maritime introduces challenges for both buyers and sellers. The regulation adds complexity to the process, from managing compliance balances to ensuring compliance responsibility between both parties. This chapter explores the regulatory requirements for ship sales, highlights potential risks, and includes a practical example.

Regulatory Requirements for Selling and Buying Ships under FuelEU Maritime

The FuelEU Maritime Regulation provides specific guidance on compliance obligations when a ship changes ownership or, to be precise, ISM (International Safety Management) company during a reporting period. Further, it clearly defines in Article 15(4)(c) that the company responsible for the ship on the 31st December of the respective reporting period is responsible for compliance under FuelEU Maritime, independent from any comparison regarding the length of responsibility within the reporting period.

Obligations of the ISM company selling the ship

The ISM company that sells or transfers responsibility for the ship to another party must report the data relevant under FuelEU Maritime (defined under Article 15(1)) to its verifier, this is stated in Article 15(4)(a):

"the transferring company shall notify to the verifier the information referred to in paragraph 1 of this Article for the time during which it had responsibility for the operation of the ship"

Obligations of the verifier of the ISM company selling the ship:

The verifier is obliged to verify the reported data and, afterward, forward it to the FuelEU database no later than 1 month after the sale, this is stated in Article 15(4)(b):

"as close as practical to the day of completion of the transfer and no later than one month thereafter, the information referred to in point (a) shall be verified and recorded in the FuelEU database in accordance with Article 16 by the verifier that performed verification activities for the ship under the transferring company"

Note that the delay in access to verified data poses a risk for the buyer as the procurement process might only rely on the non-verified data provided by the seller. This may lead to disputes or unexpected liabilities if the ship is later found to be non-compliant.

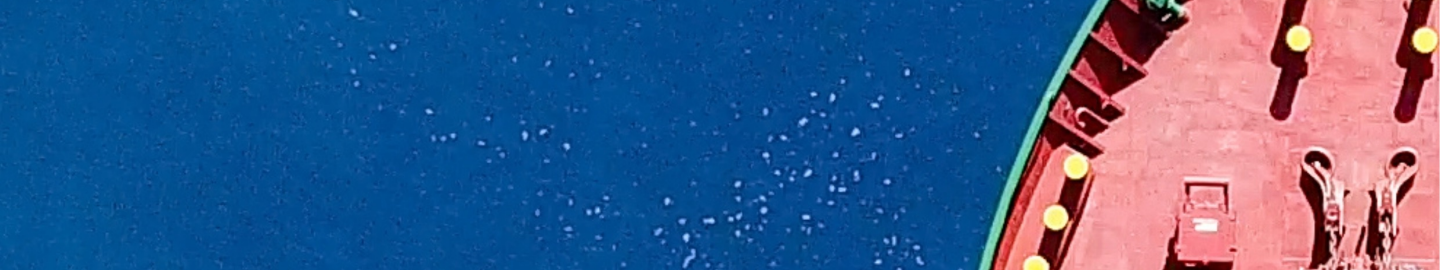
Obligations of the ISM company buying the ship:

The ISM company that buys the ship must update the ship's monitoring plan after the takeover as per Article 9(2)(a).

Key Considerations for Buyers and Sellers

For Sellers:

- Ensure timely submission of compliance data up to the sale date to your verifier
- Clarify compliance responsibilities in the sales contract
- Clarify surplus ownership in the sales contract



For Buyers:

- Receive access to compliance data (preferably validated, at best verified) **before** purchase
- Address potential liabilities related to prior non-compliance in the sales contract
- Clarify surplus ownership in the sales contract and potential existing pooling obligations
- Clarify any banked or borrowed surplus from previous compliance periods

Practical Example: Compliance Post-Sale

To illustrate these challenges, let's consider a scenario where a ship is sold after four months of a reporting period under FuelEU Maritime. The seller must calculate and report its compliance balance, and the buyer must determine the steps to ensure compliance for the remainder of the year.

Required Pre-Sale Details for Assessment:

- Fuel consumption Pre-Sale: 3,000 t HFO
- Reporting Period Pre-Sale: 4 months
- Banked compliance surplus: 0 g CO2e
- Borrowed compliance surplus: 0 g CO2e
- GHG Intensity Pre-Sale: 91.601 g CO2e/MJ
- Compliance Balance Pre-Sale: -275,100,300.00 g CO2e
- Biofuel required for compliance Pre-Sale: 125.98 t

Note that the above values have been calculated with BetterSea's free online FuelEU Maritime Calculator & Strategizer.

The buyer purchases a ship that is currently non-compliant with the FuelEU Maritime Regulation. Based on the pre-sale performance, the buyer must make their own forecasts to estimate the end-of-year (EOY) compliance status. Assuming the buyer would forecast that the vessel operates on 4,000 t HFO and 1,500 MDO, the end-of-year values would be:

- Projected EOY GHG Intensity: 91.422 g CO2e/MJ
- Projected EOY Compliance Balance: -724,858,260.00 g CO2e
- Projected EOY Biofuel required for compliance: 331.94 t

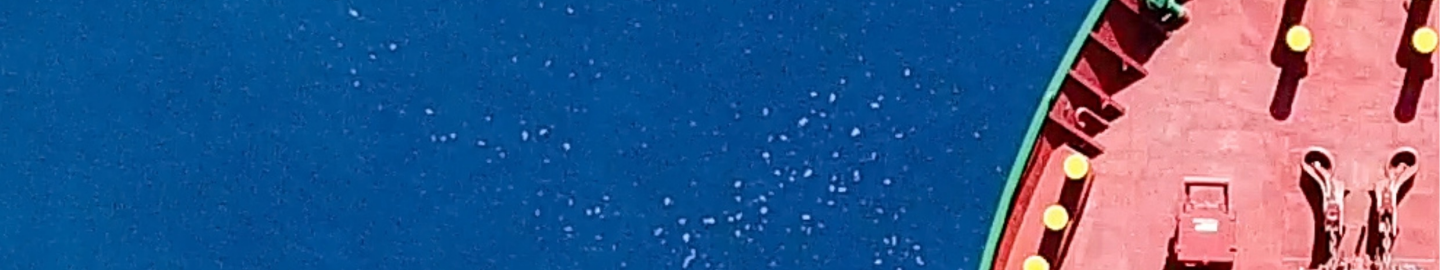
The ship will generate a deficit, leaving the buyer with three main options for compliance: (a) paying the penalty, (b) bunkering alternative fuel, or (c) pooling. Omitting option (a) due to its commercial implications, the buyer is left with (b) and (c). In both cases, several questions and considerations must be made:

For alternative fuel:

- Does the vessel have the technical ability to bunker a certain alternative fuel?
- Is FuelEU-compliant alternative fuel accessible on the vessel's future route?
- If so, how do I price the current deficit in the purchase?

For pooling:

- Who has the pooling rights for the vessel?
- Is the vessel already part of a pooling agreement for the current compliance period?
- If so, how do I price the current deficit in the purchase?



Key Takeaways

Due Diligence: Buyers should request detailed compliance data before finalizing the purchase, including at least the data points provided in the above example case. Verified or, at minimum, validated data is to be preferred.

Contractual Terms: To prevent disputes, sales contracts should address surplus ownership, compliance responsibilities, and liabilities.

Pooling: Buyers must have visibility into potentially existing pooling commitments and ensure contractual provisions regarding pooling rights.

Conclusion

Ship sales under FuelEU Maritime introduce complexities that require careful coordination among buyers, sellers, and verifiers. Compliance data visibility specific to FuelEU Maritime throughout the full reporting year across different responsible entities and stakeholders is key to making the right decisions, maintaining compliance, and preventing surprises at the end of the year.

Chartering Setups Under FuelEU Maritime: Responsibilities, Risks, and Charter Periods

The FuelEU Maritime Regulation introduces additional complexity in both charters as well as SHIPMAN contracts. With BIMCO's recently published FuelEU Maritime Clause for Time Charter Parties and the approaching end of 2024, the industry is now facing discussions and negotiations for exactly these clauses. This not only elevates the actuality of the regulation's legal framework but also the internal strategies for compliance that are strongly influenced by those considerations.

This chapter dives into different charter setups and periods under the newly released BIMCO clause and explores the impacts on compliance strategies, the division of responsibilities, and the operational challenges.

Key Chartering Setups and Their Implications Under FuelEU

The maritime industry came up with many different charter setups. While these are highly individual, the following three categories shall help generalize their implications under FuelEU Maritime. It is assumed below that the owner (even if not ISM company) has to manage compliance as per the agreement in the corresponding SHIPMAN contract, for which the BIMCO draft is expected in the upcoming weeks.

Voyage Charters

Under a voyage charter, the owner charters out the vessel under pre-agreed terms (e.g., route or cargo) for a particular voyage. The owner keeps responsibility for the fuel supplier and other operational responsibilities. The status of the ISM company is not transferred to the charterer.

Legal Considerations: The owner is fully responsible for compliance. Charterers may face an additional surcharge.

Bareboat Charters

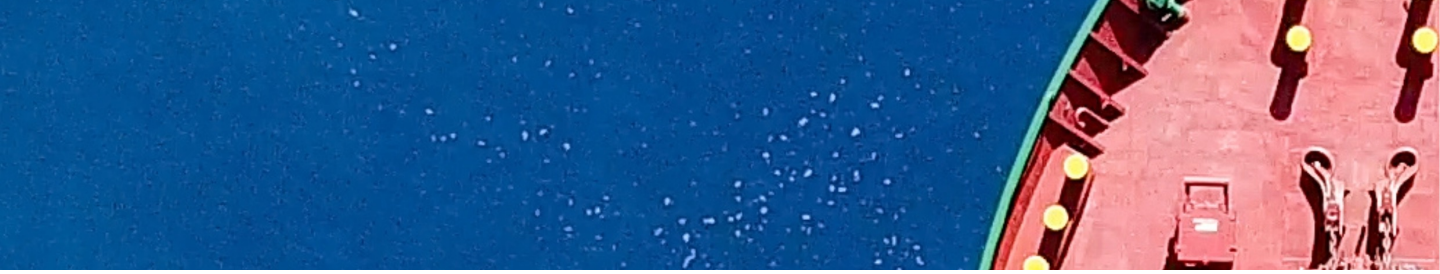
Under a bareboat charter, the owner transfers full operational and technical responsibility to the charterer for a long period. Typically, the status of the ISM company does not remain with the owner.

Legal Considerations: This may be treated as a long-term time charter in which the charterer receives decision power over the FuelEU compliance options.

Time Charters

Under a time charter, the owner charters out the vessel to an operator who takes over the operational responsibility of the vessel for a set period, it is a time-bound agreement. It is often further distinguished between short-term and long-term time charters. Charterers typically assume responsibility for supplying fuel to the vessel, but in almost no cases assume the status of an ISM company.

Legal Considerations: Charterers may receive decision power over FuelEU compliance options depending on the length of the time charter. The exact responsibilities and risks are explained in more detail in the next chapter.



Pooling Considerations for Various Chartering Setups

Depending on the chartering setups, pooling comes with different benefits and risks:

	Status	Risks
Time Charters	Depending on the charter period, charterers may be able to trade surplus.	Pooling rights for charter periods shorter than the full compliance year or spanning across incomplete compliance years must be handled carefully.
Voyage Charters	Owners retain control over surplus allocation and trading.	Charterers will have no influence over pooling but might be exposed to a FuelEU surcharge. The definition of compliance cost in this surcharge is crucial.
Bareboat Charters	Charterers will likely be able to trade surplus.	Alignment with ISM company (if not transferred to charterer)

Time Charters and Chartering Periods under FuelEU Maritime

The BIMCO FuelEU Maritime Clause highlights the importance of charter period length in determining how responsibilities for compliance actions are allocated. The charter period length is a crucial aspect to consider in the FuelEU charter clauses. Again, it can be distinguished between three categories that differ based on their coverage of a Reporting Period, defined by BIMCO as:

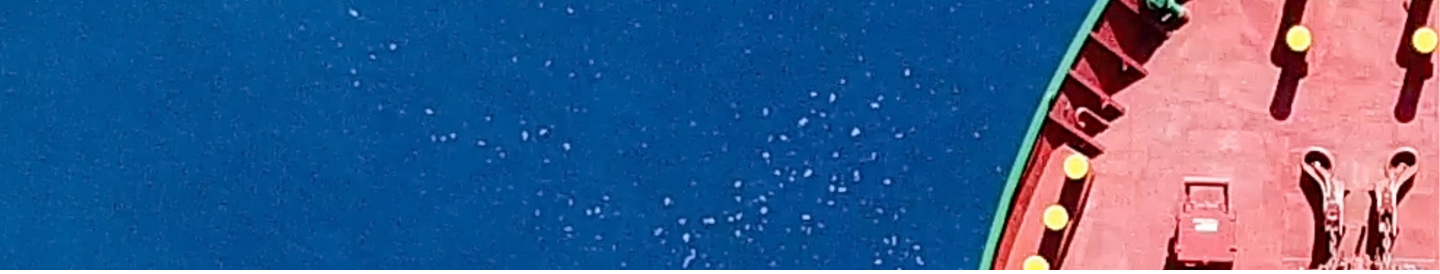
"Reporting Period" means a period from 1 January to 31 December of the year during which information referred to in FuelEU Maritime is monitored and recorded.

Long-Term Time Charters (Minimum One Reporting Period)

For simplicity, this case assumes the coverage of full (minimum one) reporting periods. As per the BIMCO clause, the charterer receives decision power over the trading or banking of surplus. The transfer of decision power is reasonable, considering the charterer's influence over the vessel's compliance status in this particular reporting period, and allows the charterer to choose the most cost-effective compliance option.

(i) If the Charter Period covers a complete Reporting Period, the Charterers shall have the right to instruct the Owners to bank or pool any Compliance Balance in accordance with FuelEU Maritime. (…)

This also creates an inheritance risk for charterers if the vessel paid penalties or borrowed compliance balance in the previous reporting period, especially considering the multipliers applied under FuelEU Maritime for such cases.



If the long-term charter spans across a minimum of two consecutive reporting periods, the charterer is further empowered to decide upon borrowing compliance balances.

(j) If the Charter Period covers at least two consecutive Reporting Periods, the Charterers shall have the right to instruct the Owners to borrow from the following Reporting Period provided the following Reporting Period falls entirely within the Charter Period. (…)

Long-Term Time Charters (Non-Integer Reporting Periods)

This refers to a specific but common case in which the long-term time charter spans across full (minimum one) reporting periods but also 'non-full' reporting periods. A practical example is a vessel that is taken over by a new charter party on a 3-year charter contract in May.

It would be reasonable to transfer decision power over FuelEU compliance options to the charterer as outlined above but bears the risk of assigning two charterers with the same abilities during one reporting period (the final and initial one). This is especially complicated for pooling as the pooling rights might potentially be shared across multiple stakeholders for overlapping periods, which is not recommended. Further, borrowing compliance surpluses from future periods may be restricted if the following reporting period falls outside the charter duration.

BIMCO's clause does not provide clear guidance on such cases, but the previously cited (i) points towards the implementation of a 'transition period' during which the owner remains with the decision power over compliance options for the reporting periods with two long-term time charters. It would be handled similarly to short-term time charters.

Again, inheritance of compliance status from previous charter periods bears a risk for all parties involved both owners and charterers, and must be paid particular attention to in such transition periods.

Short-Term Time Charters (Less Than One Reporting Period)

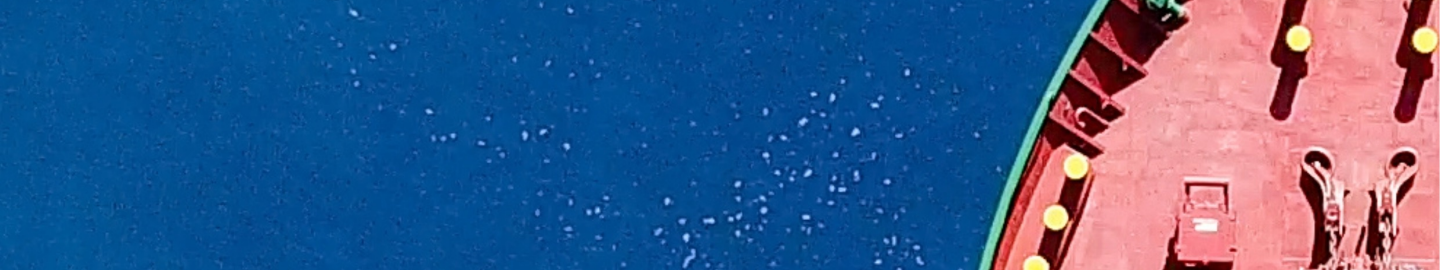
Any time charter with a duration of less than one full reporting period falls under this category. The charterer does not receive any decision power upon FuelEU compliance options such as pooling. Instead, the owner is required to report the vessel's compliance balance on a per month or per voyage level and is entitled to a surcharge.

(d) Within the first fifteen (15) days [of each month/after each Voyage] and upon redelivery, the Owners shall notify the Charterers in writing of the aggregated Compliance Balance of the Vessel incurred during the Charter Period in the then current Reporting Period. If the aggregated Compliance Balance has a negative value, the Owners shall provide to the Charterers the calculation and independently validated information used in the calculation of a surcharge equal to the FuelEU Penalty expected for that previous month or that Voyage (whichever applies) and upon redelivery (the Surcharge). (…)*

The explanatory notes further outline information regarding the surcharge itself:

The surcharge(s) represents the owners' exposure to payment of the FuelEU penalty and should follow the aggregated compliance balance since both elements are dynamic.

This may be seen as critical by the charterer as the owner may also decide to pool the vessel at a lower cost than the actual FuelEU penalty, which alludes to a general problem of any FuelEU charter clause, the definition of compliance costs.



The Definition of Costs and Benefits Under FuelEU Maritime

All stakeholder interactions that include reimbursement for either created deficit or surplus will face the question of pricing. As explained in other chapters, the main available options for compliance for FuelEU can be categorized as (a) paying the penalty, (b) pooling, and (c) alternative fuels. When considering a reimbursement, the main question is how to price any of these options.

Paying the penalty is straightforward. The FuelEU Maritime regulation sets the penalty at 2400 €/t VLSFOe. Alternative fuels can also be considered somewhat straightforward, although their pricing is not as clear as fossil fuels. Options could be to include a UCOME index in the clause. Lastly, the value of the surplus and, as such, the price for pooling remains hard to assess but might be the cheapest option for compliance.

Especially, in cases in which a surplus is created during a charter period, the reimbursement for such a surplus and its value will be hard to define. BIMCO's clause left this open in (m):

*(m) ***If the aggregated Compliance Balance incurred during the Charter Period for any Reporting Period is positive, the Owners will pay the Charterers a sum equal to [insert currency and amount] per tonne of CO2 equivalent of positive Compliance Balance (remaining after any banking and/or pooling) up to a maximum of [insert currency and amount] within [X**] days after 30 June of the corresponding Verification Period or upon redelivery (whichever is earlier).*

Key Considerations for Chartering Under FuelEU Maritime

Chartering under FuelEU Maritime requires alignment and consideration of several key aspects, whether companies decide to use BIMCO's clause or draft their versions.

Pre-Charter Compliance Balance: Validated FuelEU compliance balances must be shared when chartering a vessel from 2025 onwards. Pricing of previous deficits or surpluses must be considered.

Compliance Balance during Chartering: Owners must provide the vessel's compliance balance with a pre-defined frequency, e.g. per voyage or month. Note, that timely reporting might be influenced by delay in delivery of the fuel's Proof of Sustainability (PoS), which can take up to 90 days.

Previous Compliance Periods: Chosen compliance options in previous reporting periods might influence compliance in the current reporting period. First and foremost, borrowing and penalties and their related multiplier effects.

Reimbursement: In charter setups in which reimbursement between the parties is reasonable, the exact value of reimbursement both for deficit as well as surcharge cases must be defined, considering all potential compliance options and scenarios.

Pooling, Banking, and Borrowing Rights: It is crucial to outline the ownership of surplus or deficit and as such the right to pool for a minimum of one full reporting period. Particular emphasis must be laid on the above-described 'transition periods.' Further, the right to bank and borrow must be assigned. Note that in the event of a transfer of rights, the banked surplus remains with the vessel rather than the responsible party of a specific period.

Charter contracts under FuelEU Maritime introduce complexities that require careful coordination among counterparties. Compliance data visibility specific to FuelEU Maritime throughout the full reporting period and beyond across different responsible entities and stakeholders is key to making the right decisions, maintaining compliance, staying ahead of reimbursements, and managing rights.

The Complex Web of FuelEU Stakeholders & the Underlying Legal Framework

The implementation of the FuelEU Maritime Regulation has introduced compliance mechanisms that connect legal, operational, and financial responsibilities. These changes affect ship owners, charterers, and ship managers while opening the door to even more players, such as fuel suppliers and EUA traders. In this chapter, we explore the complex, evolving, and dynamic web of FuelEU stakeholders and discuss the opportunities and challenges ahead.

Stage 1: The ISM Company is at the Heart of Compliance

The ISM company is the entity officially recognized by the regulatory authorities as being responsible for compliance with FuelEU Maritime. This has been repeatedly criticized. The ISM company, most often the ship manager, is not responsible for supplying fuel to the ship and has, therefore, no option to influence the ship's emissions. Yet, if a vessel's compliance balance is negative, the ISM company is responsible for ensuring that penalties are paid. The ISM company's role places it at the center of risk management under FuelEU.

Considering that ship managers who have ISM company status are not able to influence a ship's compliance status, the liability is shared or passed on to the ship owner. The underlying legal document is the SHIPMAN contract.

Stage 2: Interdependence between Ship Manager and Ship Owner

BIMCO has published the SHIPMAN 2024 FuelEU Clause, which mandates the ship owner to be financially liable for penalties and compliance costs. This creates a relationship of interdependence:

Managers' Duties:
- Prepare and submit monitoring plans.
- Oversee compliance balance tracking and reporting.
- Notify owners of penalties or surpluses.

Owners' Duties:
- Provide necessary data (e.g., Bunker Delivery Notes, Proof of Sustainability).
- Cover compliance costs, including penalties and management fees.
- Provide security for potential penalties, which the managers may call upon in case of disputes.

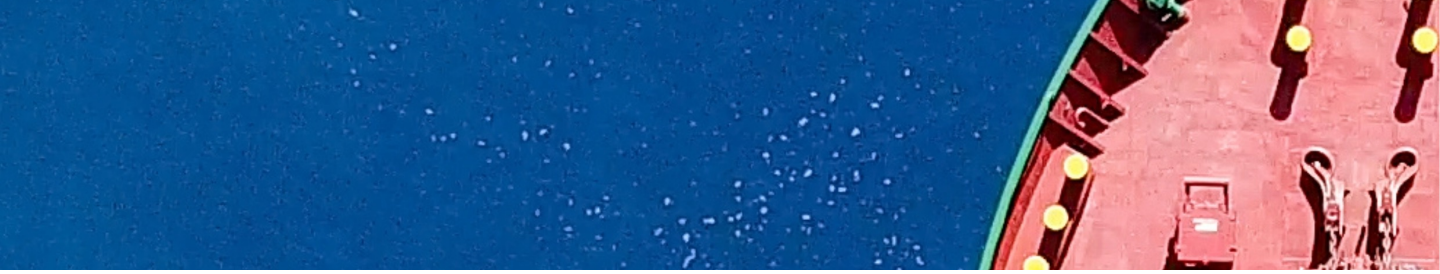
Stage 3: Charterers and the Importance of Timeframes

Often (in time charter arrangements), the fuel-supplying entity is the charterer rather than the owner, creating the need for an additional cascade of responsibilities and duties. BIMCO recently published the FuelEU Maritime Clause for Time Charter Parties which introduced a set of responsibilities based on the charter period:

Short-Term Time Charters (<1 Year):
- Charterers supply fuel but have no direct control over surplus trading or pooling.
- They are liable for surcharges if the vessel accrues a deficit.

Long-Term Time Charters (≥1 Year):
- Charterers gain control over compliance strategies, including banking, pooling, and borrowing compliance balances.
- They remain liable for surcharges if the vessel accrues a deficit.

Note that special cases where charters start or end mid-year pose challenges for pooling rights and compliance responsibilities. Find out more about FuelEU Clauses for Time Charter Parties in the previous subchapter.



Stage 4: Fuel Suppliers and EUA Traders are Expanding Roles in Compliance Markets

The complex stakeholder chain is further accentuated by the appearance of fuel suppliers and EUA traders expanding their roles to play a pivotal role in the FuelEU compliance market. There is no standardized or widely recognized legal framework on how to include these stakeholders in the complex FuelEU web. Instead, a number of different approaches can be observed in the industry:

Broker Role in Surplus Trading: Acting as intermediaries between surplus-generating vessels and deficit holders in pooling and trading, executing trades on behalf of clients without any ownership or responsibility.

Compliance Ownership: Some suppliers and traders are assuming responsibility for surplus trading and pooling by taking ownership of the surplus, often also referred to as pooling rights. Note that responsibility for pooling and surplus trading does not necessarily equal compliance responsibility.

Strategic Agreements: Some fuel suppliers offer strategic collaborations with ship owners and charterers to formalize surplus allocation, compliance liability, and pricing mechanisms. Often offered as tailored solutions for surplus management and market participation while also taking compliance responsibility.

Stage 5: The Quintessence of Surplus Trading, the Pooling Agreement.

After the complex web of FuelEU stakeholders has identified and defined the responsible party eligible to trade surplus and pool, the remaining document to close the legal framework of FuelEU is the Pooling Agreement. This agreement is required if several responsible entities agree on a surplus trade and, as such, a pool. At its core, the agreement defines the liabilities between the pool participants and addresses potential financial and compliance risks

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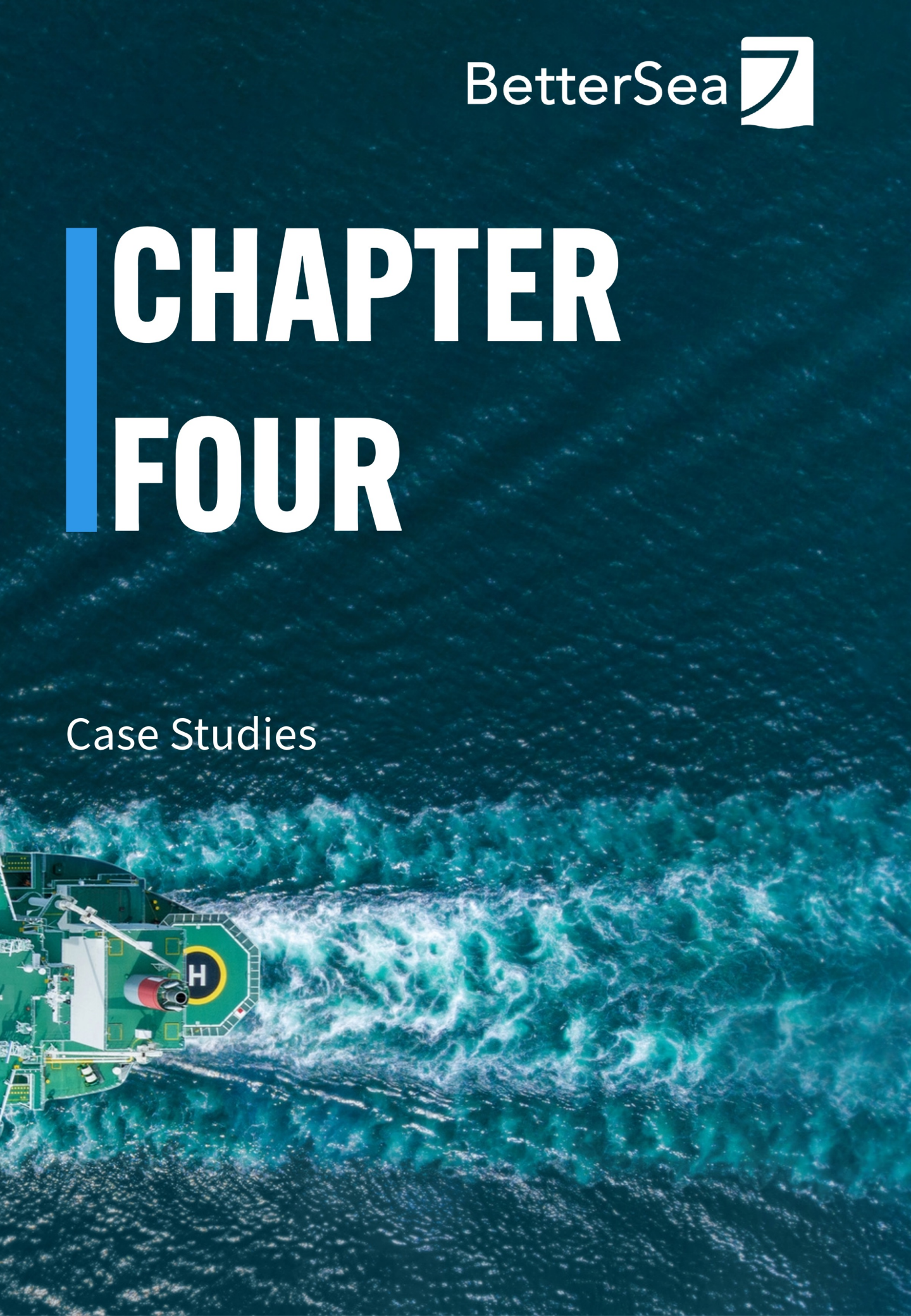
CHAPTER FOUR

Case Studies



Case Study:
FuelEU Maritime Penalty for a 15k TEU Containership

In this chapter, we're exploring a case study to illustrate the impact of FuelEU Maritime penalties using a 15,000 TEU containership as an example.

General Overview of FuelEU Maritime Regulation

The FuelEU Maritime Regulation aims to reduce the maritime sector's greenhouse gas (GHG) emissions, targeting a 6% reduction by 2030 and 80% by 2050. The regulation mandates stricter emissions reporting and compliance with GHG intensity limits for ships operating to/from or within the EU, promoting the use of cleaner fuels and innovative technologies to drive sustainability.

Case Study: FuelEU Maritime Penalty for a 15,000 TEU Containership

We will calculate the penalty for a 15,000 TEU containership under the FuelEU Maritime Regulation to provide insights into the financial implications of non-compliance.

Main data

- **Capacity:** 15,000 TEU
- **Annual Fuel Consumption:** 15,000 tonnes
- **Annual Fuel Consumption in Regulatory Scope:** 10,000 tonnes
- **Fuel Mix:**
    - Heavy Fuel Oil (HFO): 55%
    - Light Fuel Oil (LFO): 40%
    - Marine Diesel Oil (MDO): 5%
- **Emission Factors and Lower Calorific Values:** As per FuelEU Maritime Regulation (EU) 2023/1805 and IPCC AR5

Guide on how to calculate the FuelEU Maritime Penalty

1. **Fuel Consumption Distribution:** Source the consumption per fuel type in tonnes
2. **Total CO_2e Emissions:** Calculate by multiplying each fuel type's consumption by its respective emission factor
3. **Total Energy Used:** Calculate by multiplying each fuel type's consumption by its lower calorific value as per FuelEU Maritime Regulation (EU) 2023/1805
4. **GHG Intensity:** Calculate by dividing total CO_2e emissions by total energy used
5. **Excess GHG Intensity:** Calculate the difference between actual GHG intensity and the regulatory target.
6. **Penalty Calculation:** Calculate based on the excess GHG intensity and the penalty rate (2,400 € per equivalent metric ton of VLSFO).

Results

In this case, the GHG intensity is higher than the regulatory target (between 2025 and 2030: 2% less than the reference value of 91.16 CO_2e/MJ).

Penalty: 540,000 €

The Impact of the FuelEU Maritime Penalty: Comparison with the Annual Fuel Costs

To understand the penalty's impact, let's compare it with the annual fuel costs using current market prices.

Market prices:

- Heavy Fuel Oil (HFO): 580 €/t
- Light Fuel Oil (LFO): 670 €/t
- Marine Diesel Oil (MDO): 880 €/t

Results

In this case, the annual fuel costs faced by the vessel equal 6,300,000 €. Therefore, the FuelEU Maritime Penalty amounts to 9% of the annual fuel costs in 2025.

Key Takeaways

Even a slight excess in GHG intensity can result in significant penalties, around 9% of annual fuel costs for our example vessel. Investing in alternative fuels, carbon capture, and wind propulsion is crucial to avoid such penalties and ensure regulatory compliance. Alternatively, pooling represents a cost-effective option for compliance with FuelEU Maritime.

This case study demonstrates the importance of meeting FuelEU GHG intensity targets and the impact of non-compliance. By understanding the financial implications, shipping companies can better prepare and adopt necessary measures to ensure compliance, avoiding substantial penalties.

Click here

for our free online FuelEU Maritime Calculator & Strategizer

Case Study:
Fuel Allocation on International Voyages under FuelEU Maritime

In this chapter, we're exploring a case study to illustrate the impact of the fuel allocation mechanism under the FuelEU Maritime.

General Overview of FuelEU Maritime Regulation

The FuelEU Maritime Regulation aims to reduce the maritime sector's greenhouse gas (GHG) emissions, targeting a 6% reduction by 2030 and 80% by 2050. The regulation mandates stricter emissions reporting and compliance with GHG intensity limits for ships operating to/from or within the EU, promoting the use of cleaner fuels and innovative technologies to drive sustainability.

The Geographical Scope

All ships that call an EU/EEA port are exposed to the FuelEU Maritime Regulation irrespective of their company's origin or flag state. A difference is made between intra-EU voyages, voyages to/from outermost regions, and voyages to/from the EU (international voyages):

- Intra-EU voyages: 100% of the energy used is subject to the regulation
- Voyages to/from outermost regions: 50% of the energy used is subject to the regulation
- International voyages: 50% of the energy used is subject to the regulation

Note, that the FuelEU Maritime regulation further uses the concept of transshipment ports similar to the EU ETS. Stops in transshipment ports do not count as port calls.

The Fuel Allocation on non-EU to/from EU voyages

While the fuel (energy) allocation on all intra-EU voyages is straightforward, 100% of the energy used onboard must be accounted for, the allocation on international voyages provides flexibility in the form of an allocation mechanism.

The allocation mechanism, or the flexibility in allocating renewable and low-carbon fuels to international voyages, stems from the fact that the GHG intensity is calculated using the total energy used per reporting period (annually). This allows for what can be called a fuel allocation optimization ensuring that the maximum amount (50%) of renewable and low-carbon fuels is allocated to the scope of the FuelEU Maritime regulation. Further details can be found under Question A.1 in the official FuelEU FAQ.

Case Study A: Fuel Allocation for Lower 50% Renewable or Low-carbon Fuel

The below illustrates a simple example of an international voyage with a 70/30 fossil/biofuel blend:

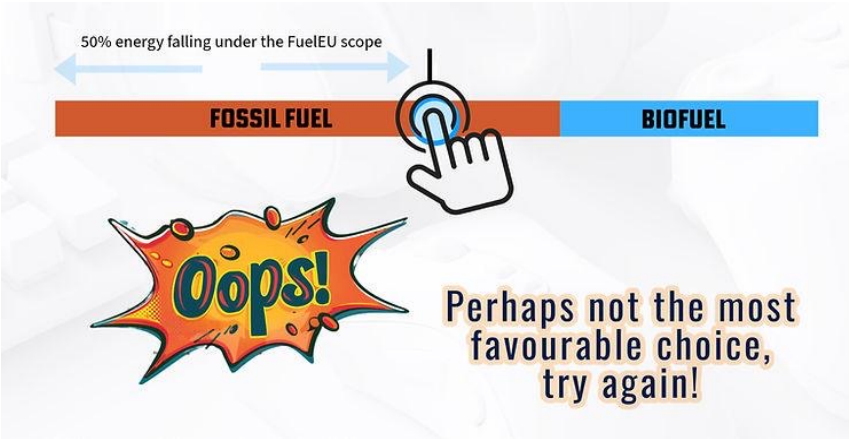


Image 2: Case Study A – Allocation Trial 1

In Image 2, the fuel allocation is not optimal. As chosen, the energy content in scope would be 50% fossil fuel, despite having used 30% biofuel on the international voyage. The resulting GHG intensity for this voyage would be above the limit and the penalty would amount to about 15,000 €.

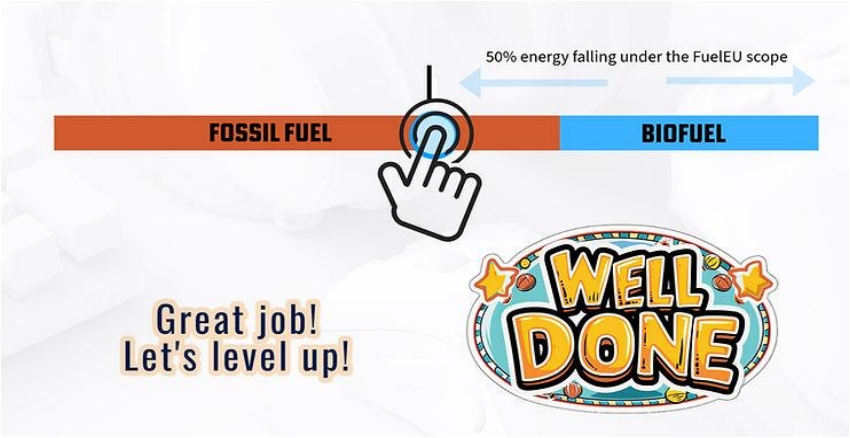


Image 3: Case Study A – Allocation Trial 3

In Image 3, the fuel allocation is optimal. The energy content in the scope includes the maximum amount of lower emission fuel resulting in 20% fossil and 30% biofuel in scope for the respective international voyage. The resulting GHG intensity for this voyage would be way below the limit, no penalty payment would be required, and the resulting surplus could potentially be monetized for about 85,000 €.

Case Study B: Fuel Allocation for Above 50% Renewable or Low-carbon Fuel

The below illustrates a simple example of an international voyage with a 40/60 fossil/biofuel blend:

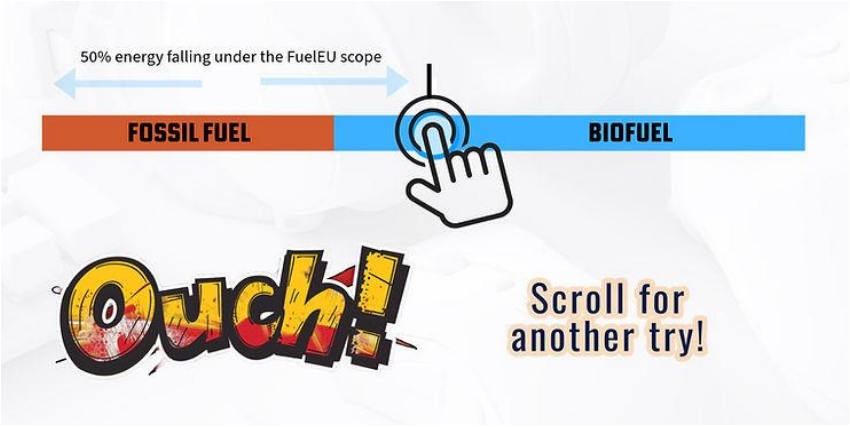


Image 4: Case Study B – Allocation Trial 1

In above Image 4, the fuel allocation is not optimal. As chosen, the energy content in scope would be 40% fossil fuel and 10% biofuel, despite having used 60% biofuel on the international voyage. The resulting GHG intensity for this voyage would be below the limit and the resulting surplus could potentially be monetized for about 15,000 €.

Image 5: Case Study B – Allocation Trial 2

In Image 5, the fuel allocation is optimal. The energy content in the scope includes the maximum amount of lower emission fuel resulting in 50% biofuel in scope for the respective international voyage. The resulting GHG intensity for this voyage would be way below the limit, and the resulting surplus could potentially be monetized for about 360,000 €.

Since the GHG intensity is calculated using the total energy used per reporting period (annually), the allocation can further be improved. As only 50% of the 60% biofuel has been used, the remaining 10% can be added to a future voyage with less than 50% of renewable or low-carbon fuel within the same reporting period.

Further Benefits of the Flexibility in Fuel Allocation on International Voyages under FuelEU Maritime

The previous case studies clearly outlined the benefits of the fuel allocation mechanism for the GHG intensity and respectively the penalty and potential surplus earnings related to compliance with the FuelEU Maritime regulation. Another reason for this flexibility and additional benefit might arise in the future. As other countries are currently discussing a similar regional regulation, international voyages between two similar regional regulations might be exposed to different penalties. The allocation mechanism allows to account for the renewable and low-carbon fuels in the regulation that is preferential from a financial perspective. This ultimately incentivizes the shipping companies consuming such fuels by improving their business cases.

RFNBO Incentive under FuelEU Maritime: A Critical Case Study

In this chapter, we're taking the example of one of the case studies to assess the incentive for RFNBOs under FuelEU Maritime.

General Overview: RFNBO Incentive under FuelEU Maritime

The FuelEU Maritime regulation is clear when it comes to incentivizing RFNBOs:

"In order to create a clear and predictable legal framework and thereby encourage the early market development and deployment of the most sustainable and innovative fuel technologies with growth potential to meet future needs, a dedicated incentive for renewable fuels of non-biological origin (RFNBO) is necessary." as per FuelEU Maritime Regulation (EU) 2023/1805.

Until 2033, FuelEU Maritime aims to foster the uptake of RFNBOs through a reward factor (RWD). This reward factor is essentially a multiplier that enables counting the energy of RFNBOs twice. If the incentive doesn't result in the intended effect, defined as a share of reported RFNBOs equal to or larger than 1% by 2031, then a 2% RFNBO subtarget shall apply by 2034.

In Practice: How does FuelEU Maritime incentivize RFNBOs?

The regulation's annexes help understand how the reward factor incentivizes RFNBOs. As a reminder, the compliance balance is the essential variable under FuelEU that defines whether a ship has a surplus or deficit. The surplus makes it eligible for banking and/or pooling, the larger the better.

The first step to reveal a ship's surplus is to calculate its GHG intensity as defined under Annex I. Here the GHG emissions are divided by the energy used onboard. The reward factor (RWD) that incentivizes the use of RFNBOs under FuelEU Maritime is represented by a multiplier of 2 in the denominator, essentially counting the energy related to RFNBOs twice and as such reducing the GHG intensity of the ship.

ENERGY CALCULATION FOR DETERMINING THE GHG INTENSITY (ANNEX I)

$$\sum_i^{n\ fuel} M_i \times LCV_i \times RWD_i + \sum_k^c E_k$$

RFNBO MULTIPLIER

The second step is the actual calculation of the compliance balance as defined under Annex IV. Here the difference between a ship's GHG intensity and the regulation's GHG intensity limit is multiplied by the ship's energy used onboard to determine the compliance balance. Unfortunately, the reward factor is not included in this formula despite the regulation's intent to incentivize RFNBOs.

ENERGY CALCULATION FOR DETERMINING THE COMPLIANCE BALANCE (ANNEX IV)

$$(GHGIE_{target} - GHGIE_{actual}) \times \left[\sum_i^{nfuel} M_i \times LCV_i + \sum_k^c E_k\right]$$

NO RFNBO MULTIPLIER

The regulation's omittance of the reward factor when calculating the compliance balance has a significant impact on the degree with which RFNBOs are incentivized, especially as the compliance balance is the ultimate number defining the surplus that can for example be monetized through pooling.

Case Study: RFNBO Incentive for a 15,000 TEU Containership

In a previous chapter, we calculated the FuelEU penalty for a 15,000 TEU containership. The same assumptions shall be used to determine the impact of the missing reward factor for RFNBOs when calculating the sample ship's compliance balance. Instead of the previously chosen fossil fuel mix, it is assumed that the ship consumes an RFNBO at a well-to-wake (WtW) greenhouse gas (GHG) emission factor 70% less than the one of heavy fuel oil (HFO).

Case I: Calculation as per regulation

If calculated according to Annex I and Annex IV as of today, the sample ship has the following values:

- **GHG intensity:** 13.74 g CO_2e / MJ
- **Compliance Balance:** 30 billion t CO_2e
- **Number of equal ships to pool:** 36
- **Add. revenue through pooling:** 3.3M EUR

Case II: Including the reward factor in the compliance balance calculation

Instead of following the compliance balance calculation as per Annex IV (see above), this case includes the reward factor when determining the sample ship's compliance balance. The formula has therefore been changed as per below:

Ensuring a comprehensive application of the reward factor throughout the regulation has an immense effect on the intended RFNBO incentive.

- **GHG intensity:** 13.74 g CO_2e / MJ
- **Compliance Balance:** 60 billion t CO_2e
- **Number of equal ships to pool:** 72
- **Add. revenue through pooling:** 6.6M EUR

Key Takeaways

The FuelEU Maritime regulation undoubtedly outlines the reasoning behind incentivizing RFNBOs and the intended effect:

"However, the production costs of RFNBO are currently much higher than the market price of conventional fuel and are expected to retain such higher costs in the mid-term. Therefore, this Regulation should provide for a combination of measures to ensure the support for the uptake of sustainable RFNBO (...)" as per FuelEU Maritime Regulation (EU) 2023/1805.

The regulation aims to reward decarbonization leaders by significantly reducing their higher OPEX costs due to the early adoption of RFNBOs. The case study shows that this has not been achieved to the extent it could have been possible when consistently applying the reward factor throughout the calculation.

Case Study: Penalty vs. Biofuel vs. FuelEU Pooling – What's the Best Compliance Option?

As the FuelEU Maritime regulation takes effect, companies must choose between paying the penalty, switching to biofuels, or pooling surplus from over-compliant ships. Each option has significant financial implications. In this chapter, we present a case study comparing real-world costs for a non-compliant vessel, helping companies identify the most cost-effective strategy.

Evaluating FuelEU Maritime Compliance Costs

Scenario Overview

A sample containership consumes 10,000 tonnes of HFO within the FuelEU scope. Given its fossil fuel usage, the ship incurs a compliance deficit of 975 t CO_2e in 2025. The operator faces three choices to comply:

1. Pay the FuelEU Penalty (€2,400 per tonne of VLSFOe or €640 per tonne of CO_2e).
2. Switch to Bio30 (30% biofuel blend) at an additional €209 per tonne compared to VLSFO (ARA price difference, HBE incentivized as per Feb 7)
3. Purchase surplus from another ship at a price of €250 per tonne of CO_2e surplus.

Each method has different cost implications and strategic benefits, as shown in the breakdown below.

Option 1: Paying the FuelEU Penalty

Under FuelEU Maritime, ships failing to comply must pay a fixed penalty of €2,400 per tonne of VLSFOe (equal to €640 per tonne CO_2e)*.

$$€_{Penalty} = 975\ t\ CO_2e \cdot 640\ \frac{€}{t\ CO_2e} = 624{,}000\ €$$

While simple, this is the most expensive option. Additionally, if the vessel remains non-compliant for consecutive years, penalties are further penalized exponentially, creating a growing financial burden.

Option 2: Switching to Bio30

Switching to a 30% biofuel blend (Bio30)** reduces the vessel's emissions to meet compliance with FuelEU Maritime.

$$€_{Bio} = 1{,}485\ t_{Bio30} \cdot 209\ \frac{€}{t_{Bio30}} = 310{,}365\ €$$

Biofuels provide a regulatory-compliant pathway by reducing emissions at the source. However, they come at a premium price, may have supply constraints depending on market availability, and technical challenges as described below:

Delayed Proof of Sustainability (PoS): The exact emission reductions achieved with biofuels are often uncertain at the time of bunkering. The PoS, which defines the emission factor of the fuel, is typically delivered after bunkering, sometimes significantly later. This delay can complicate compliance reporting and strategy planning.

Cashew Nutshell Liquid (CNSL) Biofuels: Recent reports have highlighted significant engine problems associated with biofuels derived from cashew nutshell liquid. Ships operating in Singapore and Rotterdam experienced issues such as clogged filters, injector failures, fuel sludging, and turbocharger corrosion after using CNSL-based biofuels.

**Simplified unit conversion **The analysis assumes an emission reduction for biofuel of 65% compared to 94 g/MJ (as per RED II) and a LCV of 37200 ***Surplus value estimated to be 250 €/t CO2e (Disclaimer: This is an assumption)*

Option 3: Pooling

Pooling allows companies to purchase surplus from vessels with over-compliance, achieving compliance on the deficit ships at a significantly lower cost***.

$$€_{Pooling} = 975\ t\ CO_2e \cdot 250\ \frac{€}{t\ CO_2e} = 243{,}750\ €$$

Pooling emerges as the most cost-effective option, with compliance costs significantly lower than both penalties and biofuel. Moreover, pooling offers additional flexibility:

- Companies can purchase only what they need or buy extra surplus for future banking.
- Even tramp shipping companies, operating with uncertainty, can secure surplus now and bank it for future use.
- Early purchases guarantee lower prices before market demand increases.

Comparing the FuelEU Compliance Costs: The Best Choice

Pooling offers the lowest compliance cost while maintaining flexibility, making it the best option for most shipping companies. Note that EU ETS savings are not considered, check Chapter 4.6 if you want to find out how EU ETS changes the business case.

	Total Cost	Savings vs. Penalty	Pros	Cons
Pay Penalty	624,000 €	-	No operational changes	Most expensive option, increases for consecutive non-compliance
Biofuel	310,365 €	313,635 € (50%)	Direct emission reduction	Supply constraints, technical challenges
External Pooling	243,750 €	380,250 € (61%)	Most cost-effective option, highly flexible, no operational changes	Requires legal and financial framework

Why Trade Early?

Pooling is not just the cheapest option—it also provides strategic advantages:

- Locks in lower prices before demand increases later in the year.
- Prevents FuelEU penalty multipliers, avoiding long-term cost escalation.
- Allows banking of surplus, providing compliance security for future years.
- Tramp shipping companies can secure compliance early despite uncertain schedules.

Conclusion: FuelEU Pooling is the Smartest Compliance Strategy

- Penalty payments are the most expensive option, offering no long-term benefit.
- Biofuels reduce emissions but are supply-dependent.
- Pooling surplus provides the lowest-cost, most flexible compliance solution.

With surplus trading, FuelEU com.liance is no longer just about meeting regulations—it's about making the smartest financial decision.

Case Study: The Business Case for e-LNG under FuelEU Maritime: A High-Value Compliance Opportunity?

Throughout recent years, and especially last year, LNG has emerged as a widely used transition fuel, offering lower CO2 emissions compared to other fossil fuels. As described previously, under the FuelEU Maritime Regulation, LNG vessels are at an advantage over other fossil fuel ships due to their lower greenhouse gas intensity.

Looking beyond fossil LNG, bio-LNG is already a common surplus generator under FuelEU, especially seen as the enabler of some of the super pools offered on the market. However, the real game-changer is e-LNG. Produced using renewable electricity and captured CO2, e-LNG is classified as a Renewable Fuel of Non-Biological Origin (RFNBO) under the FuelEU Maritime Regulation. The fuel, therefore, classifies for the RFNBO multiplier: its energy content counts twice in the FuelEU GHG intensity calculation, significantly improving the compliance balance of an e-LNG-fueled vessel.

Given this multiplier effect, ships using e-LNG can generate impressive compliance surpluses, which could be banked for future use or sold on the FuelEU surplus market, turning compliance into a revenue-generating opportunity. But what does this mean in practice? How does e-LNG compare to fossil LNG, and when does it become a financially viable choice? This chapter shall answer these questions.

Case Study: A Sample Fossil LNG-Powered Vessel and Its Compliance Data

To explore the impact of e-LNG, let's take a typical fossil LNG-fueled containership and analyze its compliance performance under FuelEU Maritime. First, we establish a baseline using conventional fossil LNG before comparing the results with e-LNG.

Baseline Case: Fossil LNG Usage

For a vessel running on fossil LNG, compliance is determined by its fuel consumption and the applicable emission factor.

- Annual fuel consumption: 10,000 tonnes of LNG
- Engine type: LNG Diesel (dual fuel slow speed)
- Emission factor (Well-to-Wake, fossil LNG): 76.08 gCO2e/MJ
- Compliance balance (Surplus): 6,508 t CO2e
- Potential surplus earnings (250 €/tCO2e*): 1,627,000 €

Using standard assumptions, the sample vessel generates a significant surplus of 6,508 t CO2e and additional revenue of 1,6M €, based on a conservative surplus value.

e-LNG under FuelEU Maritime: The High-Value Surplus Generator

With the introduction of e-LNG, a synthetic, renewable alternative to fossil LNG, compliance opportunities further improve. Since e-LNG is classified as an RFNBO, it benefits from a multiplier effect under FuelEU, effectively reducing the vessel's reported GHG intensity.

The most important advantage of e-LNG is that it requires no modifications to existing LNG-fueled ships, meaning shipowners can switch seamlessly without investing in costly retrofits.

Case Study: The Same Vessel Using e-LNG

Now, let's assume the vessel replaces 3,000 t of fossil with e-LNG.

- Annual fossil LNG consumption: 7,000 tonnes
- Annual e-LNG consumption: 3,000 tonnes
- Engine type: LNG Diesel (dual fuel slow speed)

- Emission factor (Well-to-Wake, fossil LNG): 76.08 gCO2e/MJ
- Emission factor (Well-to-Wake, e-LNG): 11.38 gCO2e/MJ
- Compliance balance (Surplus): 22,460 t CO2e
- Potential surplus earnings (250 €/tCO2e*): 5,615,000 €

With e-LNG, the ship increases its potential revenue on the FuelEU surplus market by more than 300%, amounting to 5,615,000 €.

Sensitivity Analysis

Sensitivity Analysis I: When Does a 70/30 LNG Mix Become a Good Business Case?

Generating surplus and increasing surplus revenue is only one side of the story; the increase in fuel price and OPEX costs another. The key question for shipping companies is: At what price point does e-LNG become more attractive than fossil LNG under the new regulatory framework of FuelEU?

To evaluate this, we compare different pricing scenarios of our sample case.

- Baseline LNG price: 905 € per tonnes (Titan weekly in ARA, Feb 14)
- Expected e-LNG price: 2,800 € per tonnes (Supplier estimate)
- Sample LNG mix price: 1,473.50 € per tonnes
- Impact of surplus trading on fossil LNG price: -162.70 €/t fossil LNG
- Impact of surplus trading on sample LNG mix price: -561.50 €/t LNG mix
- Break-even price for sample LNG mix: 1,303.80 € per tonnes

The above values showcase the power of the FuelEU Maritime Regulation, its pooling mechanism, and the RFNBO multiplier. With the 70/30 fossil/e-LNG mix, today's conservative supplier estimate of 2,800 € per tonnes for e-LNG is almost as financially attractive as using fossil LNG. If the price falls to 2,235 € per tonnes e-LNG, the 70/30 sample case reaches a break-even point at which the LNG mix is as cheap as fossil LNG.

Sensitivity Analysis II: When Does e-LNG Become a Good Business Case?

But what if we would fully switch to e-LNG? What would be the price requirement for e-LNG in that example? To evaluate this, we assume 100% e-LNG compared to our initial fossil LNG sample case:

- Annual e-LNG consumption: 10,000 tonnes
- Engine type: LNG Diesel (dual fuel slow speed)
- Emission factor (Well-to-Wake, e-LNG): 11.38 gCO2e/MJ
- Compliance balance (Surplus): 41,070 t CO2e
- Potential surplus earnings (250 €/tCO2e*): 10,267,500 €

With 100% e-LNG, the ship doubles its potential revenue on the FuelEU surplus market compared to the 70/30 case, amounting to 10,267,500 €. How would such a case influence the break-even price for e-LNG? To evaluate this, we again compare the different pricing scenarios:

- Baseline LNG price: 905 € per tonnes (Titan weekly in ARA, Feb 14)
- Expected e-LNG price: 2,800 € per tonnes (Supplier estimate)
- Impact of surplus trading on fossil LNG price: -162.70 €/t fossil LNG
- Impact of surplus trading on e-LNG price: -1,026.75 €/t LNG mix

- Break-even price for e-LNG: 1,769.05 € per tonnes

When compared 1:1, the break-even price at which e-LNG would result in the same OPEX costs as fossil LNG is 1,769.05 € per tonnes. Note that EU ETS is not considered in this analysis but further improves the cost-effectiveness of e-LNG.

Sensitivity Analysis III: How Does Surplus Value Influence e-LNG's Business Case?

The above sensitivity analyses are based on a conservative surplus value of 250 €/t CO2e. Since the market is dynamic, it is worthwhile to study a higher value scenario (400 €/t CO2e):

- Potential surplus earnings (fossil LNG, 400 €/tCO2e): 2,603,200 €
- Potential surplus earnings (e-LNG, 400 €/tCO2e): 16,428,000 €

Now, these figures change the impact of surplus trading as depicted below:

- Baseline LNG price: 905 € per tonnes (Titan weekly in ARA, Feb 14)
- Expected e-LNG price: 2,800 € per tonnes (Supplier estimate)
- Impact of surplus trading on fossil LNG price: -260.32 €/t fossil LNG
- Impact of surplus trading on e-LNG price: -1,642.80 €/t LNG mix
- Break-even price for e-LNG: 2,287.48 € per tonnes

When compared 1:1, the break-even price at which e-LNG would result in the same OPEX costs as fossil LNG at an increased surplus value of 400 €/t CO2e is 2,287.48 € per tonnes.

Challenges and Uncertainties of e-LNG Adoption

While e-LNG presents an interesting way forward, there are some challenges to consider:

Production and Scalability: The availability of e-LNG remains limited, with production still ramping up.

Pricing Volatility: e-LNG is still significantly more expensive than fossil LNG, and pricing structures vary depending on production methods and location.

FuelEU Surplus Market: The surplus market development is crucial to improving the price attractiveness of e-LNG. Shipping companies may decide to provide pooling rights to e-LNG suppliers in return for cheaper e-LNG to reduce exposure to market risks

Conclusion: Is e-LNG the Next Big FuelEU Play?

With FuelEU Maritime multipliers, surplus trading opportunities, and seamless compatibility with LNG-powered vessels, e-LNG presents a compelling compliance strategy. The financial case for e-LNG depends on its price relative to fossil LNG, but the potential for surplus generation and trading makes it an attractive option for forward-thinking shipping companies.

The FuelEU compliance market is evolving rapidly, and e-LNG represents a high-value compliance and emission reduction strategy for those looking to turn regulatory obligations and sustainability targets into financial opportunities.

If you are interested in purchasing e-LNG, reach out to us via email — info@bettersea.tech!

**The surplus value is estimated to be 250 €/tCO2e (Disclaimer: This is an assumption)*

Case Study: How Does EU ETS Influence the Business Cases of e-LNG, Biofuel, and FuelEU Maritime Pooling?

The previous two subchapters touched upon different business cases for compliance with FuelEU Maritime, namely biofuel vs pooling and e-LNG. The case studies consider compliance costs under FuelEU Maritime in isolation. For shipping companies, however, maritime decarbonisation compliance costs do not only consist of those relevant to FuelEU Maritime but also EU ETS.

As a reminder, EU ETS is an EU regulation that puts a price on each tonne of CO2 emitted in its scope. Started in 2024, it was introduced with a phase-in period currently (in 2025) covering 70% of CO2 emissions falling under the scope. The main difference when it comes to business cases is EU ETS's focus on tank-to-wake CO2 emissions in contrast to FuelEU's focus on well-to-wake GHG emissions.

This chapter shall discuss the influence of EU ETS on the previous business cases and question whether and when they would be viable from a comprehensive regulatory perspective.

The Previous Case Study in Subchapter 4.4: The Best Compliance Option for FuelEU and EU ETS

Reminder: The Baseline

A sample containership consumes 10,000 tonnes of HFO within the FuelEU scope. Given its fossil fuel usage, the ship incurs a compliance deficit of 975 t CO2e in 2025 and 1,547,658.00 € in EU ETS compliance costs (considering an EUA price of 71,00 €). The operator faces three choices to comply:

- Pay the FuelEU Penalty (€2,400 per tonne of VLSFOe or €640 per tonne of CO2e).
- Switch to Bio30 (30% biofuel blend) at an additional €209 per tonne compared to VLSFO (ARA price difference, HBE incentivized as per Feb 7)
- Purchase surplus from another ship at a price of €250 per tonne of CO2e surplus***.

Each method has different cost implications and strategic benefits, as shown in the breakdown below.

Option 1: Paying the FuelEU Penalty and EU ETS Costs

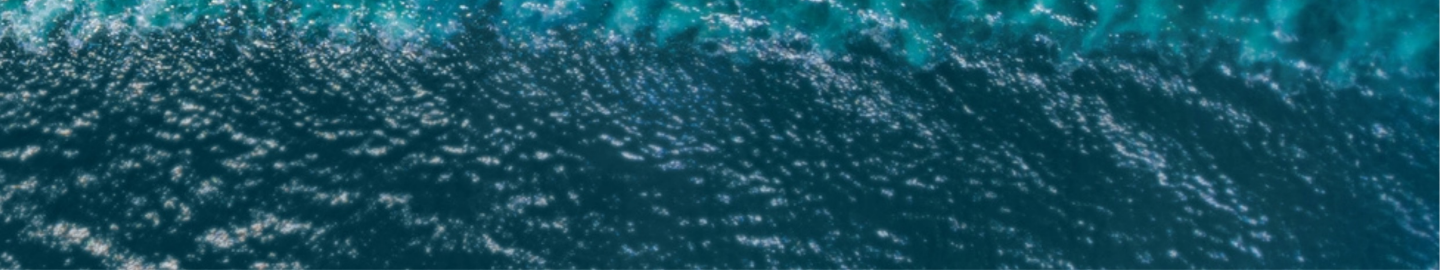
Under FuelEU Maritime, ships failing to comply must pay a fixed penalty of €2,400 per tonne of VLSFOe (equal to €640 per tonne CO2e)*. While simple, this is the most expensive option. Additionally, if the vessel remains non-compliant for consecutive years, penalties are further penalized exponentially, creating a growing financial burden.

- FuelEU Penalty: 624,000 €
- EU ETS Costs: 1,547,658 € (in 2025)
- Total Compliance Costs: 2,171,658 €

Option 2: Switching to Bio30

Switching to a 30% biofuel blend (Bio30)** to reach a compliance balance of 0 reduces the vessel's emissions to meet compliance with FuelEU Maritime. At the same time, it also reduces the EU ETS costs as the tank-to-wake CO2 emission factor for biofuels under EU ETS is 0. Note, that biofuels provide a regulatory-compliant pathway by reducing emissions at the source. However, they come at a premium price and may have supply constraints depending on market availability, and technical challenges. The use of Bio30 would result in:

- FuelEU Compliance Costs: 310,365 €
- EU ETS Costs: 1,478,787 € (in 2025)
- Total Compliance Costs: 1,789,152 €



Option 3: Pooling

Pooling allows companies to purchase surplus from vessels with over-compliance, achieving compliance on the deficit ships at a significantly lower cost***. Pooling does not reduce EU ETS costs. Therefore, the total compliance costs amount to:

- FuelEU Compliance Costs: 243,750 €
- EU ETS Costs: 1,547,658 € (in 2025)
- Total Compliance Costs: 1,791,408 €

Comparing the FuelEU and EU ETS Compliance Costs

In contrast to subchapter 4.4 only considering FuelEU Maritime, Pooling is not significantly cheaper than using biofuel for compliance with FuelEU Maritime and EU ETS. The comprehensive consideration of compliance costs including the EU ETS creates a level playing field between both options and underlines the importance of combining all relevant compliance costs when creating a strategy. A sensitivity analysis is further helpful as several components, EUA price, surplus value, and biofuel price are volatile.

The Previous Case Study in Subchapter 4.5: When Does e-LNG Become a Good Business Case Considering EU ETS and FuelEU Maritime?

The case study in subchapter 4.5 explored the viability of e-LNG as a FuelEU compliance but also a general maritime decarbonization option focusing on the commercialization options provided through FuelEU pooling. The sentiment of the case study was that e-LNG is a cheaper fuel option compared to fossil LNG at a fuel price of 2,287.48 € per tonne when the surplus value is assumed to be 400.00 €/tCO2e and at a fuel price of 1,769.05 € per tonne when the surplus value is 250.00 €/tCO2e*.

The emission factors applicable for calculating compliance costs under EU ETS are fundamentally differnet from those relevant to FuelEU Maritime due to the regulations focus on tank-to-wake CO2 emissions (in 2025). Further, just as under FuelEU Maritime, e-LNG is considered a Renewable Fuel of Non-Biological Origin (RFNBO) and as such has an emission factor of 0 under EU ETS. Resultantly, all EU ETS related compliance costs vanish when fully switching to e-LNG. The numbers below show the impact of this on the e-LNG business case.

Reminder: The Baseline Fossil LNG Case

For a vessel running on fossil LNG, compliance is determined by its fuel consumption and the applicable emission factor.

- Annual fuel consumption: 10,000 tonnes of LNG
- Engine type: LNG Diesel (dual fuel slow speed)
- Emission factor (Well-to-Wake, fossil LNG): 76.08 gCO2e/MJ
- Emission factor (Tank-to-Wake, fossil LNG): 2.75 gCO2e/g
- EUA Price: 71.00 € (Feb 20th 2025)
- Compliance balance (Surplus): 6,508 t CO2e
- Potential surplus earnings (250 €/tCO2e)***: 1,627,000 €
- EU ETS Costs (no phase-in): 1,952,500 €

Using standard assumptions, the sample vessel generates a significant surplus of 6,508 t CO2e and additional revenue of 1,6M €, based on a conservative surplus value, but still incurs EU ETS costs summing up to 1,952,500 €.

The e-LNG Business Case Considering EU ETS and FuelEU Maritime

But what if we would fully switch to e-LNG? To evaluate this, we assume 100% e-LNG compared to our initial fossil LNG sample case:

- Annual e-LNG consumption: 10,000 tonnes
- Engine type: LNG Diesel (dual fuel slow speed)
- Emission factor (Well-to-Wake, e-LNG): 11.38 gCO2e/MJ
- Emission factor (Tank-to-Wake, fossil LNG): 0.00 gCO2e/g (under EU ETS)
- EUA Price: 71.00 € (Feb 20th 2025)
- Compliance balance (Surplus): 41,070 t CO2e
- Potential surplus earnings (250 €/tCO2e)***: 10,267,500 €
- EU ETS Costs: 0.00 €

With 100% e-LNG, the ship significantly increases its potential revenue on the FuelEU surplus market, amounting to 10,267,500 €. At the same time, it reduces its EU ETS costs to 0. Now, how would that influence the break-even price for e-LNG?

- Baseline LNG price: 905 € per tonne (Titan weekly in ARA, Feb 14)
- Expected e-LNG price: 2,800 € per tonne (Supplier estimate)
- Impact of surplus trading and EU ETS on fossil LNG price: +32.55 €/t fossil LNG
- Impact of surplus trading and EU ETS on e-LNG price: -1,222.00 €/t LNG mix
- Break-even price for e-LNG: 2,159.55 € per tonne

When compared 1:1, the break-even price at which e-LNG would result in the same OPEX costs as fossil LNG is 2,159.55 € per tonne. This is roughly 30% higher compared to the business case just considering FuelEU Maritime (1,769.05 €).

Sensitivity Analysis: How Does Surplus Value Influence e-LNG's Business Case?

The above analysis is based on a conservative surplus value of 250 €/t CO2e. Since the market is dynamic, it is worthwhile to study a higher-value scenario (400 €/t CO2e)* with steady EU ETS price.

- Potential surplus earnings (fossil LNG, 400 €/tCO2e)***: 2,603,200 €
- Potential surplus earnings (e-LNG, 400 €/tCO2e)***: 16,428,000 €

Now, these figures change the impact of surplus trading as depicted below:

- Baseline LNG price: 905 € per tonne (Titan weekly in ARA, Feb 14)
- Expected e-LNG price: 2,800 € per tonne (Supplier estimate)
- Impact of surplus trading and EU ETS on fossil LNG price: +65.07 €/t fossil LNG
- Impact of surplus trading and EU ETS on e-LNG price: -1,838.05 €/t e-LNG
- Break-even price for e-LNG: 2,808.12 € per tonne

The break-even price at which e-LNG would result in the same OPEX costs as fossil LNG at an increased surplus value of 400 €/t CO2e is 2,808.12 € per tonne. This is about equal than today's supplier estimate used for e-LNG in this calculation. The previous subchapter only focused on the compliance cost benefits under FuelEU Maritime and did not show a business case for e-LNG already today, whereas the inclusion of EU ETS costs shifts this picture in favor of e-LNG.

If you are interested in purchasing e-LNG, reach out to us via email — info@bettersea.tech!

Conclusion: The Power of a Comprehensive Compliance Strategy Considering FuelEU Maritime and EU ETS

The outcome of both case studies changes when considering not only FuelEU Maritime but also EU ETS. This underlines the importance of a comprehensive compliance strategy. Looking at each of the regulations in isolation may lead to less accurate conclusions. Further, the volatility of several variables including but not limited to biofuel premium, surplus value, and EUA price enhances the need for a thorough analysis and a continuous update of the best strategy.

**Simplified unit conversion *The analysis assumes an emission reduction for biofuel of 65% compared to 94 g/MJ (as per RED II) and a LCV of 37200 ***Surplus value estimated to be 250 €/t CO2e or 400 €/t CO2e (Disclaimer: This is an assumption)*

Case Study:
FuelEU Surplus Value Versus Biofuel Premium

With the introduction of FuelEU Maritime following the famous EU ETS, shipping companies must make strategic decisions about meeting their compliance obligations at the lowest cost. Two of the most prominent pathways are:

- **Using biofuels** to reduce a vessel's greenhouse gas (GHG) intensity.
- **Purchasing surplus** and pooling to offset compliance deficits at a lower cost.

But when is one option better than the other? Using real biofuel market data, we provide a FuelEU surplus value threshold for a sample case that may help shipping companies decide whether to buy biofuel or surplus.

Key Calculation: When Does The FuelEU Surplus Value Become More Expensive Than The Biofuel Premium?

Reminder: The Baseline

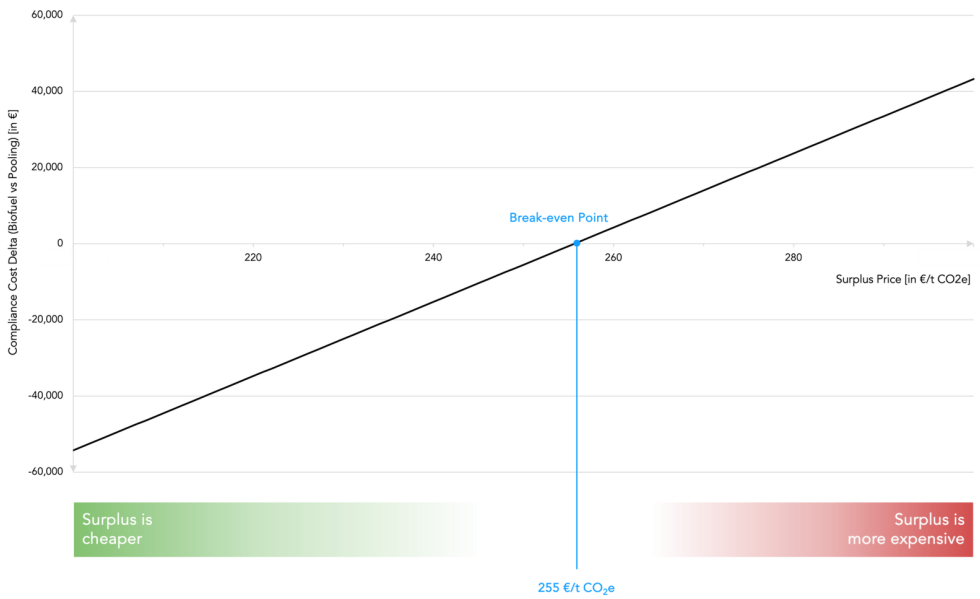
A sample containership consumes 10,000 tonnes of HFO within the FuelEU scope. Given its fossil fuel usage, the ship incurs a compliance deficit of 975 t CO2e in 2025 and 1,510,601.40 € in EU ETS compliance costs (considering an EUA price of 69.30 € as per EEX data from February 28th). The shipping company can decide to buy surplus and pool externally or bunker biofuel. For our analysis, we have used the below fuel price assumptions based on S&P Global data from February 28th:

- 542.50 €/t VLSFOe (0.5%S VLSFO in Rotterdam)
- 755.86 €/t VLSFOe (Bio30 Fame in Rotterdam)

The above results in a biofuel premium of 213.36 €/t VLSFOe. This value has been used as the underlying assumption for the case study.

The Results: Surplus is More Expensive at Prices Higher Than 255€

Based on the above-described sample case, the following data has been calculated to enable the comparison between pooling costs and biofuel costs.



Case Study:
FuelEU Surplus Value Versus Biofuel Premium

- EU ETS costs (with biofuel usage): 1,443,380 €
- Fuel cost premium: 316,484 €

The graph depicts the interplay between the assumed biofuel premium and the surplus value. The intersection with the x-axis resembles the turning point at which surplus becomes more expensive than biofuel considering this sample case.

Our sample case shows that purchasing surplus and pooling remains the most cost-effective option until the surplus price exceeds about 255 €/tCO_2e.

- If the surplus price is at or below about 255 €/tCO_2e, then purchasing surplus is the cheapest way to comply.
- If the surplus price exceeds 255 €/tCO_2e, then bunkering biofuel becomes a better option in terms of cost.

Note that this is based on our sample case and its underlying assumptions.

Beyond Cost: When Pooling or Biofuel Might Not Be an Option

While our sample case provides a financial break-even point, real-world decision-making is often more complex. Several operational and strategic factors can influence whether a company chooses pooling or biofuel bunkering.

Biofuel Availability and Pricing Vary by Region

The biofuel premium in our analysis is based on Rotterdam pricing, but:

- Biofuels at certain locations may have much higher premiums. Check prices for different locations, for example, here.
- Smaller ports or remote bunkering locations may not have access to sustainable biofuels like Bio30 blends, forcing operators to rely on conventional fuels.

For ships with fixed operational routes, biofuel availability can be a make-or-break factor in deciding whether it's a viable compliance strategy.

Internal Company Strategy & Fleet Constraints

While biofuels are a promising compliance solution, some companies may intentionally exclude them from their strategy for several reasons, for example, due to recent technical problems with CSNL biofuels, or long-term fuel stability.

Conclusion: Balancing Cost, Availability, and Strategy

The surplus price and biofuel premium are surely one of the key factors when making compliance decisions under FuelEU and EU ETS. However, companies must evaluate several additional factors including but not limited to:

- Biofuel availability at bunker locations
- Technical considerations
- Accesibility of external pooling options

**The analysis assumes an emission reduction for biofuel of 65% compared to 94 g/MJ (as per RED II) and an LCV of 37200*
(Disclaimer: This case study is based on assumptions if not otherwise stated)

Should an LNG Ship Bank or Trade Surplus Under FuelEU Maritime?

With the FuelEU Maritime Regulation now in effect, LNG-powered vessels are in a unique position. Their lower greenhouse gas (GHG) intensity compared to conventional marine fuels provides an opportunity to generate compliance surpluses at no extra OPEX. But can an LNG vessel rely solely on banking surpluses to stay compliant in the long run? And more importantly, should it?

This chapter explores whether LNG ships can "bank their way" through FuelEU Maritime compliance and if not, whether they should bank or trade surplus.

LNG and the Banking Mechanism Under FuelEU Maritime

FuelEU Maritime allows compliant vessels to bank compliance surpluses—excess reductions in GHG intensity compared to the regulatory target. These banked surpluses can be used in future years to offset any potential deficits, offering an attractive compliance buffer.

LNG-powered ships, due to their lower GHG intensity than other fuels like HFO or MDO, are projected to generate surpluses in the early years of FuelEU. But as regulatory targets become stricter, the question arises: How long can these vessels profit from banked surpluses before they become non-compliant and should they just sell the surplus each year or bank?

Case Study Assumptions

In order to investigate this question, we have to make a few assumptions and create a number of different case studies. For all case studies, we take the usual sample ships with an annual in-scope consumption of 10,000 t LNG. Further, we assume a vessel lifetime of 25 years.

Regarding the surplus value, two scenarios have been used (a) a stable surplus in which the value is constant at 250 €/t CO2e and (b) a dynamic surplus increasing by 10 €/t CO2e with a starting value of 250 €/t CO2e. All values have been calculated using our free, online FuelEU Calculator following the latest regulatory info with WtT values based on AR5 from 2025 and TtW values based on AR4 in 2024 and AR5 from 2025 onwards.

The LNG Newbuild: Bank or Trade?

For the case study of an LNG newbuild, we have assumed the use of an LNG Diesel (dual fuel slow speed). This is the best option with the lowest GHG intensity out of all LNG versions resulting in over-compliance all the way till 2039. Given the assumed lifetime of 25 years, the vessel will be scrapped in 2050. The study distinguishes between a Sell & Buy strategy, buying and selling surplus every year based on what is needed/generated, and a Bank & Buy strategy, banking surplus as long as possible and then buying once all banked surplus is used.

	Sell & Buy	Bank & Buy
Total Costs	25,597,000€	25,597,000€

Table 1: Total FuelEU Maritime compliance costs of an LNG newbuild between 2025 and 2050 in the stable surplus scenario comparing the sell & buy strategy and the bank & buy strategy.

With a stable surplus value, there is no cost difference between the sell & buy and the bank & buy strategy as the costs of non-compliance at the end or throughout is not of relevance. This is different under the dynamic surplus scenario with a steadily increasing surplus value as depicted in Table 2.

	Sell & Buy	Bank & Buy
Total Costs	57,807,000€	49,457,000€

Table 2: Total FuelEU Maritime compliance costs of an LNG newbuild between 2025 and 2050 in the dynamic surplus scenario comparing the sell & buy strategy and the bank & buy strategy.

The bank & buy strategy saves about 8.5 million € over the 25-year lifespan of the vessel compared to the sell & buy strategy because the sell & buy strategy makes the vessel profit from over-compliance in early years during which the surplus value is lower in the assumed dynamic surplus scenario, whereas the bank & buy strategy derives value from the surplus only when the vessel becomes non-compliant and the cost of surplus on the market increased.

Therefore, it is recommendable for new LNG ship owners to bank surplus instead of selling it immediately if the long-term strategy assumes increasing surplus values.

The Existing LNG Ship: Bank or Trade?

Not all of the LNG vessels in the global fleet are newbuilds with the most beneficial engine type. The following case study looks at existing LNG ships with an age of 10 and 15 years and considers other (not all) possible engine types, resulting in the following cases:

- Stable Surplus, LNG Diesel (dual fuel slow speed), 10 years old
- Stable Surplus, LNG Otto (dual fuel slow speed), 10 years old
- Stable Surplus, LNG Otto (LBSI), 10 years old
- Stable Surplus, LNG Diesel (dual fuel slow speed), 15 years old
- Stable Surplus, LNG Otto (dual fuel slow speed), 15 years old
- Stable Surplus, LNG Otto (LBSI), 15 years old

The study did not consider LNG Otto (dual fuel medium speed) as vessels with this engine type will anyway be non-compliant by 2026 latest.

LNG Diesel (dual fuel slow speed)

	Stable Surplus			*Dynamic Surplus*	
	Sell & Buy	Bank & Buy		Sell & Buy	Bank & Buy
Total Profit	13,469,000€	13,469,000€	Total Profit	15,320,000€	21,550,000€

LNG Otto (dual fuel slow speed)

	Stable Surplus			*Dynamic Surplus*	
	Sell & Buy	Bank & Buy		Sell & Buy	Bank & Buy
Total Costs	1,551,000€	1,551,000€	Total Costs	4,239,000€	2,481,000€

LNG (LBSI)

	Stable Surplus			*Dynamic Surplus*	
	Sell & Buy	Bank & Buy		Sell & Buy	Bank & Buy
Total Costs	10,563,000€	10,563,000€	Total Costs	15,975,000€	15,856,000€

Table 3: Total FuelEU Maritime compliance costs or profits of a 10-year-old LNG ship between 2025 and 2040 in a dynamic and stable surplus scenario comparing the sell & buy strategy and the bank & buy strategy.

The results in Table 3 depict a similar result as in the newbuild study. With a stable surplus value, both strategies result in the same costs/profits, whereas in the dynamic scenario with an increasing surplus the bank & buy strategy always wins. Note that the 10-year-old LNG Diesel (dual fuel slow speed vessel) does not incur any costs as its first non-compliance year is 2040 and therefore previous banked or sold surpluses outweigh the occurring non-compliance. This is not the case for LNG Otto (dual fuel slow speed) and LNG (LBSI) turning non-compliant in 2035 and 2030 respectively. How do the values change for a 15-year-old vessel?

LNG Diesel (dual fuel slow speed)

	Stable Surplus			*Dynamic Surplus*	
	Sell & Buy	**Bank & Buy**		**Sell & Buy**	**Bank & Buy**
Total Profit	14,203,000€	14,203,000€	**Total Profit**	16,583,000€	19,884,000€

LNG Otto (dual fuel slow speed)

	Stable Surplus			*Dynamic Surplus*	
	Sell & Buy	**Bank & Buy**		**Sell & Buy**	**Bank & Buy**
Total Profit	3,912,000€	3,912,000€	**Total Profit**	4,212,000€	5,477,000€

LNG (LBSI)

	Stable Surplus			*Dynamic Surplus*	
	Sell & Buy	**Bank & Buy**		**Sell & Buy**	**Bank & Buy**
Total Costs	2,263,000€	2,263,000€	**Total Costs**	3,211,000€	3,092,000€

Table 4: Total FuelEU Maritime compliance costs or profits of a 15-year-old LNG ship between 2025 and 2035 in a dynamic and stable surplus scenario comparing the sell & buy strategy and the bank & buy strategy.

The above Table 4 outlines the same result. The Bank & Buy strategy performs better with a dynamic surplus increasing in price over the FuelEU-relevant period. It also shows that the LNG Otto (dual fuel slow speed) ship has the potential to make profits, in contrast to the 2025 to 2040 timeline, as it only becomes non-compliant in 2035. Further, the LNG Diesel (dual fuel slow speed) vessel is able to make higher profits as it is not facing any under-compliance at all compared to the period till 2040. In this context, note that the analysis assumes that if the banked surplus is not used until the period end it still has the value of the last year's surplus multiplied with the banked surplus amount.

Conclusion: Should LNG Ships Bank or Trade FuelEU Surplus?

Under the assumption that the surplus value in the future either remains stable or increases, there is no numerical argument for selling LNG-based surplus. Instead banking proves to be the better option in the long run. If one would assume that the surplus value will decrease with time, the opposite is true.

Beyond numerical arguments, commercial arguments such as charter party agreements may be of relevance. Banking as a long-term strategy mainly becomes relevant to the ship owner rather than the charterer, unless the charter party agreement beneficially sets the value of banked surplus upon redelivery. Similar to charter arrangements, LNG vessels with banked surplus that are to be sold or purchased carry an additional commercial value which must be considered in S&P considerations.

In any case, it is remarkable that under the current regulatory scheme of the FuelEU Maritime Regulation, a LNG Diesel (dual fuel slow speed) ship solely operating on fossil LNG only turns under-compliant in 2040, and with applied banking strategy, only incurs compliance penalties in 2045. Twenty years after the start of the FuelEU Maritime Regulation with its goal to "(...) to increase the share of renewable and low-carbon fuels in the fuel mix of international maritime transport (...)." Nonetheless, for now, LNG remains one of the strongest compliance solutions.

The Impact of Onshore Power Supply on EU ETS and FuelEU Maritime

As the maritime industry tackles FuelEU Maritime and EU ETS, the business case for Onshore Power Supply (OPS)—also known as shore power or cold ironing—is becoming increasingly interesting for shipping companies. By allowing vessels to reduce their fuel consumption while at berth and draw power from the local electricity grid, OPS reduces at-berth emissions, and can help save FuelEU Maritime penalties and EU ETS costs.

This chapter dives into what OPS is, whether it is of relevance under FuelEU Maritime and EU ETS, and analyses the financial impact of using it.

What is Onshore Power Supply?

OPS is a solution that enables ships to connect to the port's electrical grid at berth, allowing them to shut down or at least reduce their onboard auxiliary engines. The solution reduces fuel consumption, greenhouse gas (GHG) emissions, and air pollutants such as NOx, SOx, and particulates at berth, leading to improved air quality in port cities and reduced GHG emissions from ships.

Historically, OPS requires significant infrastructure investment on land to enable the grid's ability to supply shore power to the ship. Many ports worldwide, particularly in Europe, the US, and China, are already investing in shore power infrastructure. Air pollution is a key driver for such investments, underlined by, for example, California's Clean Air Act, for the ports and adjacent cities, whereas GHG emission reduction is the main driver for shipping, exposed to EU ETS and FuelEU Maritime.

Onshore Power Supply under FuelEU Maritime and EU ETS

As part of the FuelEU Maritime Regulation, container and passenger ships have to use OPS in European ports covered by Regulation (EU) 2023/1804 from January 1, 2030 onwards. After an initial phase-in, the requirement is extended to even more ports by January 1, 2035. Exemptions are given to ships in ports without OPS or relevant technical and other emergencies. Beyond the regulatory requirement, the use of Onshore Power Supply is also one of the possible compliance options, able to reduce the penalty or even create a surplus.

EU ETS does not come with a regulatory requirement to use OPS, but it allows shipping companies to reduce their compliance cost exposure through Onshore Power Supply. Since EU ETS only considers tank-to-wake (TtW) emissions, OPS is accounted for with 0 emissions.

Case Study: How Much Can a Vessel Save by Using OPS in 2025?

Similar to previous case studies, we use the usual sample ship with an annual fuel consumption exposure under EU ETS and FuelEU Maritime of 10,000t HFO.

Baseline Scenario (no OPS):

- Fuel Consumption: 10,000 t HFO
- GHG Intensity: 91.74420 g CO2e/MJ
- EUA Price: 70.00 € (Assumption)
- HFO Price: 497.00 € (Ship & Bunker, VLSFO in Rotterdam, 16.03.2025)
- FuelEU Penalty: 622,000 €
- EU ETS Costs (2025): 1,525,860 €
- Fuel Costs: 4,970,000 €

In the baseline scenario, the sample ship faces total annual compliance costs of 2,147,860 € and total OPEX (fuel & compliance) of 7,117,860 €.

OPS Scenario (10% of overall fuel consumption replaced by OPS):

- Fuel (incl. port) Consumption: 10,000 t HFO
- Port Consumption (replaced by Electricity): 1,000 t HFO
- Generator energy efficiency: 50%
- Electricity Consumption (OPS): 5,625,000 kWh
- GHG Intensity: 89.3368 g CO2e/MJ
- Electricity Price: 0.070 €/kWh (Netherlands, 16.03.2025)
- EUA Price: 70.00 € (Assumption)
- HFO Price: 497.00 € (Ship & Bunker, VLSFO in Rotterdam, 16.03.2025)
- Surplus Value: 250 € (Assumption)
- Potential Surplus Earnings: 232,893 €
- FuelEU Penalty: 0 €
- EU ETS Costs (2025): 1,373,274 €
- Fuel Costs: 4,866,750 €

In the OPS scenario, the sample ship faces EU ETS costs of 1,373,274 €, but no FuelEU Maritime penalty, instead it can monetize the created surplus adding 232,893 € additional income. With slightly reduced fuel costs (4,866,750 €) compared to the baseline scenario (4,970,000 €) and the surplus earnings, the overall OPEX reduced from 7,117,860 € to 6,007,131 €. Therefore, OPS is able to save 1.1M € annually.

Conclusion: Should You Consider OPS For Your Fleet?

The above case study presents OPS as an attractive option for compliance with FuelEU Maritime and outlines its potential for overall compliance costs and OPEX reductions. However, its cost savings potential strongly relies on the availability of OPS in the corresponding port. Interested in utilising Onshore Power Supply to save money onboard your vessels? Inquire about our partner's system at info@bettersea.tech

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CHAPTER FIVE

Outlook & Opportunities

Navigating Compliance & Capitalizing on Opportunities: Fuel Suppliers under FuelEU Maritime

This chapter looks ahead and focuses on the challenges and opportunities for fuel suppliers under FuelEU Maritime. We'll explore the key obstacles suppliers may face, such as the need for certification and reporting, as well as the strategies that can help you turn these challenges into opportunities.

Infrastructure and Investment Challenges

FuelEU Maritime's mission of increasing the uptake of alternative fuels in shipping requires significant investments in infrastructure for producing and supplying renewable and low-carbon fuels, particularly Renewable Fuels of Non-Biological Origin (RFNBOs). The regulation emphasizes a well-to-wake approach, meaning suppliers must track and report emissions across the fuels' entire upstream—from production to bunkering.

Compliance and Reporting Complexities

Fuel suppliers are required to rigorously document and report the GHG intensity of the fuels they provide. This involves maintaining records throughout the supply chain and ensuring that all relevant data is verified by an accredited third party. For the non-fossil fuels, this means that:

RFNBOs must satisfy the definition in Article 2(36) of Directive 2018/2001, showcase at least 70% GHG emissions reduction against the Renewable Energy Directive (RED), and comply with the renewable electricity sourcing rules as per Article 27(6) of Directive 2018/2001. Please also note the additionality requirements for sourcing renewable electricity as per Delegated Act 2023/1184.

Biofuels must meet the criteria in Article 29(2 to 7) of Directive 2018/2001 and satisfy the minimum GHG emission savings as per Article 29(10) of Directive 2018/2001. Please note that all fuels from food or feed crops are not allowed under FuelEU Maritime except those under Annex IX of the Delegated Act 2024/1405.

Other fuels eligible for compliance are recycled carbon fuels (RCFs) as per Article 2(35) of Directive 2018/2001 and low-carbon fuels (LCFs) as per Article 2(13) of Directive 2024/1788.

The complexity increases when suppliers are involved in the production of mixed fuels or biofuel blends, as each component must be certified and tracked under schemes like the Mass Balance approach within the RED framework (refer to Article 30 of Directive 2018/2001)

The **Mass Balance** system allows for the mixing of sustainable and conventional fuels, with the sustainability characteristics of the inputs being traced and attributed to outputs proportionally. This is particularly important when suppliers need to demonstrate the renewable content and sustainability of the fuels they provide to comply with FuelEU Maritime's requirements.

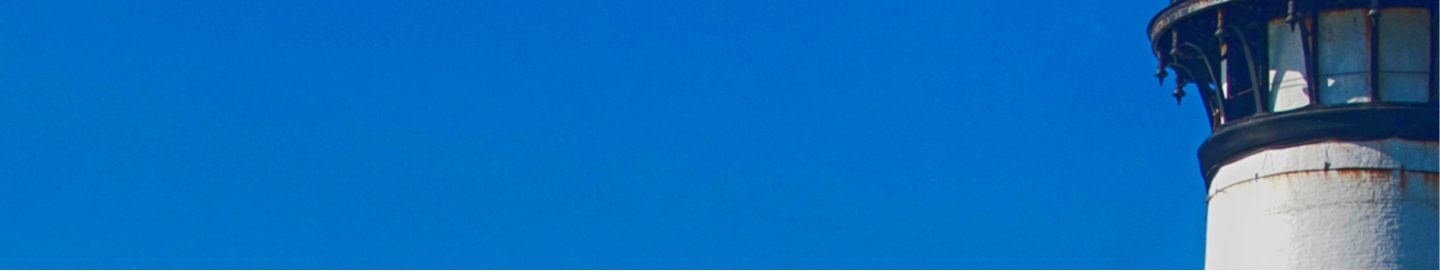
Reporting and certifications are essential for ensuring that the fuels supplied are compliant with the regulation and can be confidently used by shipping companies seeking to meet their GHG intensity target under FuelEU Maritime. The fuel suppliers' document stating adherence to the above-mentioned criteria and certification schemes is ultimately the so-called Proof of Sustainability (PoS).

Leveraging Flexibility Mechanisms and Innovative Strategies

Under the FuelEU Maritime regulation, the ISM company, in most cases the ship manager, is responsible for a ship's compliance. This entity also 'owns' any compliance surplus generated by the ship, which can be traded or banked for future use, if not otherwise stated in contractual agreements between the different stakeholders.

The latter-mentioned contractual arrangements, however, can create new opportunities for fuel suppliers:

Subsidized Fuel Provision: A fuel supplier may agree to provide a more expensive, yet highly compliant fuel to the shipping company on a long-term offtake agreement at a subsidized price. In exchange, the fuel supplier retains ownership of any compliance surplus generated by the ship throughout the agreement.



Trading Surplus on a Marketplace: The fuel supplier can then trade this surplus on a compliance marketplace, like BetterSea's FuelEU Marketplace, where it can be pooled with other ships to optimize compliance. This allows the supplier to recover the subsidies provided and potentially profit, by taking on the risk associated with fluctuating market prices.

These mechanisms offer a unique, new way for fuel suppliers to participate in the emerging compliance trading landscape, beyond merely supplying fuel. By owning and trading compliance surpluses, suppliers can provide shipping companies with planning security, de-risking their investments through subsidized long-term offtake agreements, while potentially increasing revenues through trading the surplus smartly throughout the compliance year.

Strategic Steps Forward for Fuel Suppliers Under FuelEU Maritime

To capitalize on these opportunities, fuel suppliers should consider the following strategies:

Invest in Certification: Ensure all fuels are certified under recognized schemes to meet the stringent requirements of FuelEU Maritime.

Innovate Contractually: Explore new contractual arrangements that allow you to own and trade compliance surpluses, improving the price attractiveness of your fuels and potentially adding a new revenue stream to your business.

FuelEU Maritime & The Future of Carbon Markets in Shipping

With more and more decarbonisation regulations, the shipping industry is seeing a growing influence from carbon pricing mechanisms. The FuelEU Maritime regulation is the EU's most recent way of tackling shipping emissions, but it's not the only one. Regulatory carbon markets, such as the existing EU Emissions Trading System (EU ETS), and other globally or regionally discussed systems are setting the stage for a future where carbon costs will shape maritime. In this chapter, we explore how FuelEU Maritime interacts with existing carbon markets, the rise of other regional and global initiatives, carbon pricing's potential for commercially viable decarbonisation, and what this means for shipping companies.

Understanding Carbon Pricing in Shipping

Carbon pricing refers to mechanisms that put a cost on carbon emissions, typically in the form of either a carbon tax or emissions trading systems (ETS). In regulatory carbon markets, governments set limits on total emissions and allow companies to trade allowances for emissions within those limits, incentivizing emissions reductions.

The EU ETS is a prime example of a regulatory carbon market extended to shipping. From this year, shipping companies operating to/from or within the EU must buy allowances for their CO_2 emissions, covering 50% of international and 100% of intra-EU voyages.

FuelEU Maritime vs. EU ETS: What's the Difference?

While FuelEU Maritime and EU ETS aim to reduce emissions, they differ in approach:

FuelEU Maritime focuses on reducing the GHG intensity of fuels used by ships, requiring companies to meet emissions targets through alternative fuels and with the help of compliance mechanisms like banking, borrowing, and pooling. The latter opens up a regulation-specific carbon market, where pooling can be performed B2B, between companies.

On the other hand, EU ETS is a cap-and-trade system, where companies must purchase allowances/credits for each ton of CO_2 emitted. The EU caps the amount of allowances in the market, creating an artificial or regulatory market.

Global Carbon Pricing and Markets: Emerging Trends

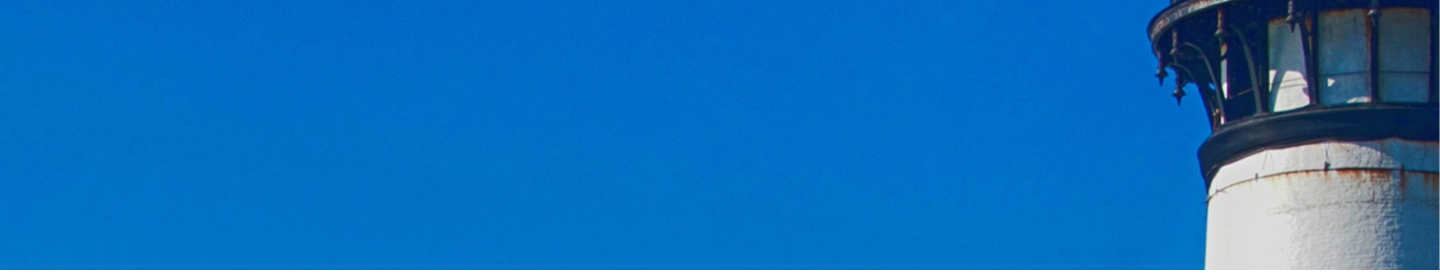
The push for decarbonization is not confined to the EU. Across the globe, regulatory frameworks are emerging. Turkey is set to launch its own ETS, Japan, and the UK are considering national ETS schemes, while China and the US are debating carbon taxes. The US Clean Shipping Act closely resembles the EU's FuelEU Maritime.

At the IMO, international efforts are underway to create a global system through mechanisms like a carbon levy and/or a fuel standard. These mechanisms fall under candidate mid-term measures of the IMO which will be discussed further at the upcoming Marine Environment Protection Committee (MEPC) 82 at the end of September this year.

One notable IMO proposal is the World Shipping Council's (WSC) Green Balance Mechanism (GBM), a mid-term measure aimed at creating a global pricing system for GHG emissions. Under this system, fuels are grouped into zones based on their emissions. Ships using cleaner fuels receive financial benefits and ships using fossil fuels face penalties. WSC's approach centers around a fee vs allocation principle based on a global fuel standard to equal out the increased fuel costs of cleaner fuels.

Selling Low-Carbon Shipping Solutions: Mass Balancing and Book & Claim

Another angle relevant for shipping when it comes to carbon markets is offering low-carbon transport solutions. Here, methods like mass balancing and book & claim are becoming crucial when offering sustainable logistics options to customers and can especially help make decarbonisation commercially viable.



In mass balancing, low-carbon fuels such as bio-LNG are blended with conventional fuels. While the physical fuel used to transport customers' cargo might be conventional, the sustainability attributes of the biofuel portion are tracked and attributed to the customers' cargo. This allows shipping companies to offer services where a proportion of the fuel used is certified as lower carbon, even if the customer receives conventional fuel. Mass balancing is already widely accepted under frameworks like the Global Logistics Emissions Council (GLEC) Framework.

The book & claim system decouples the physical asset from the sustainability benefits. Under this system, companies can buy certificates representing the carbon reductions achieved through the use of low-carbon fuels. These certificates can be claimed by customers, allowing them to demonstrate a reduction in their carbon footprint, regardless of the specific fuel used in their shipment. Although book & claim is not accepted under all frameworks, it is widely used in voluntary carbon markets.

Preparing for the Future: FuelEU Maritime and Carbon Markets in Shipping

As regulatory and voluntary carbon markets continue to grow, shipping companies must be proactive in aligning their decarbonisation strategies:

- **Invest in Alternative Fuels**: Reducing emissions and GHG intensity through fuels like bio-LNG, methanol, and ammonia is essential.
- **Global Regulatory Affairs:** As more countries adopt decarbonisation regulations with economic impact, companies should track international developments, beyond the EU.
- **FuelEU Surplus Trading:** The creation of compliance marketplaces—such as BetterSea's FuelEU Marketplace—enables the trade of FuelEU surpluses. Companies with excess compliance surpluses can sell them, gaining additional revenue, and providing cost savings for companies struggling to meet emissions targets.
- **Low-carbon products:** By participating in voluntary carbon markets, companies can monetize their decarbonisation efforts by offering low-carbon transport solutions.

A Note on Additionality in Carbon Accounting

When selling low-carbon products, one key concept to consider is additionality. This principle requires that the carbon savings attributed to a product must represent an actual, additional reduction in emissions beyond what would have occurred without the intervention. Companies need to be cautious about how they account for carbon savings, particularly when using mechanisms like mass balancing and book & claim.

For example, biofuels used to comply with FuelEU Maritime may raise questions about whether the same carbon savings can be double-counted when offering low-carbon products to customers. Ensuring that the emissions reductions used for compliance are not also sold as low-carbon benefits in a different market can be essential for maintaining transparency and credibility. Companies should closely monitor their claims to avoid overstating the environmental impact of their actions.

Conclusion

Carbon pricing, whether through FuelEU Maritime, EU ETS, or upcoming global measures, will fundamentally alter the economics of shipping. Companies that act early, align with these frameworks and explore new technologies that will not only reduce emissions but also unlock new market opportunities.

Why Early Trading in FuelEU Surplus Markets is a Smart Move

With the compliance year 2025 in full swing, shipping companies must decide whether to secure surplus early or wait for further market developments. While some might opt to observe how pricing evolves, early movers stand to benefit from lower costs without compromising on flexibility or compliance security.

This chapter explores the key advantages of early trading, drawing from real-world FuelEU compliance scenarios and demonstrating how even tramp shipping operators, with unpredictable schedules, can leverage early trading to their advantage.

The Case for Early FuelEU Surplus Trading: Securing a Competitive Edge

A key question many companies ask us is: Why should I buy surplus now if I don't yet know my exact compliance needs? The answer lies in both, cost optimization and long-term flexibility..

Locking in Lower Prices Before Demand Rises

The current FuelEU Maritime compliance market is still in its early stages, meaning that the first surplus transactions will play a major role in defining benchmark prices. With an approaching compliance deadline by the end of 2025/early 2026, demand for surplus will increase, naturally driving up prices significantly.

By acting early, companies can secure surplus at more favorable rates, rather than risking higher costs closer to the deadline. While waiting may seem like a safe bet, price trends suggest that early action is the smarter financial strategy.

Banking Surplus: A Hedge Against Future Costs

One of the most underappreciated features of FuelEU Maritime is the ability to bank surplus indefinitely. Unlike compliance deficits, which must be addressed within each reporting year, surplus does not expire, meaning that companies can buy more than they need today and store it for future compliance periods.

This means that early trades are not just about 2025 compliance, they are also a long-term financial planning tool.

Pooling Scenario Recap: Why Banking is an Advantage

In Chapter 1.5 on FuelEU pooling, we explored an interesting scenario where a deficit ship in a pool not only covered its compliance shortfall but also ended up in surplus, enabling it to bank additional compliance balance for future years.

This strategic move created a long-term cost buffer, allowing the ship to:

- Mitigate future compliance risks in years when alternative fuel costs might rise.
- Take advantage of potential surplus price increases, selling it at a later stage when market demand grows.

This same principle applies to early surplus trading. By purchasing a bit more than needed, companies can reduce their compliance costs by trading early without needing to fear operational changes during the compliance year.

Why Even Tramp Shipping Should Consider Early Surplus Trading

One common hesitation among shipping companies, especially those in tramp shipping, is the inability to accurately forecast FuelEU exposure due to operational unpredictability. Unlike liner shipping, tramp operations are subject to fluctuating routes, cargo availability, and market-driven scheduling adjustments. However, this uncertainty does not mean that early trading isn't beneficial.

Why Tramp Shipping Companies Should Act Now

FuelEU exposure may be unclear, but surplus can be banked indefinitely,-allowing tramp shipping companies to buy surplus amounts with an additional risk margin. The market risk is minimized by locking in lower surplus costs today rather than facing potentially higher prices when last-minute purchases become necessary.

Take a Look at 2028: IMO Net-Zero Framework: Impact on Different Fuel Types and Costs

The FuelEU Maritime Regulation has been a hot topic in the EU for more than a year. But as of MEPC83, the International Maritime Organization (IMO) has followed suit and has finalized its Net-Zero Framework, as amendment to MARPOL Annex VI. This new framework is a major step towards maritime decarbonisation, with a compliance mechanism that closely mirrors the FuelEU Maritime Regulation — but on a worldwide scale.

In this chapter, we explain the basic elements of the IMO Net-Zero Framework and analyze its commercial implications, with a focus on compliance cost projections for key fuel types over time.

A Quick Overview: The IMO Net-Zero Framework

The IMO's Net-Zero Framework will apply to all ships of 5,000 GT and above. The regulation's first reporting year will start in 2028. Like FuelEU, it introduces a GHG fuel intensity standard, with ships needing to progressively reduce their attained annual GHG fuel intensity (GFI) measured in gCO_2eq/MJ.

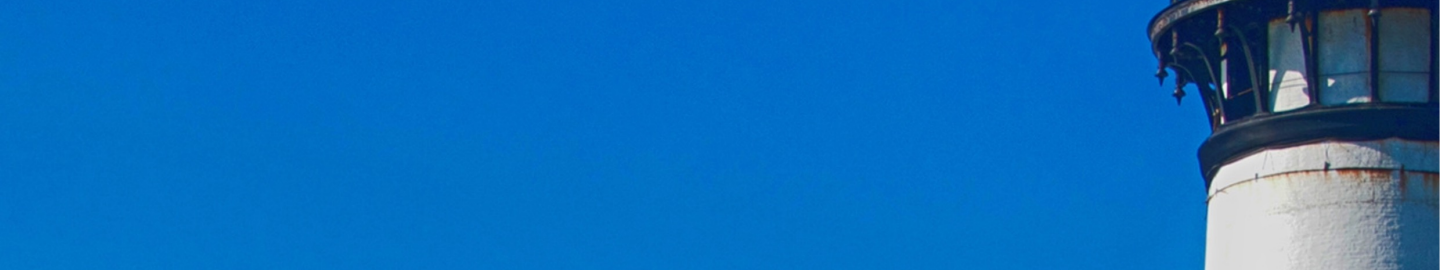
Unlike FuelEU Maritime, the regulation introduces a dual-tier target:

- Base Target: A less ambitious target
- Direct Compliance Target: A stricter target

Failure to comply with the Direct Compliance Target target results in a Tier 1 deficit which can be offset by Tier 1 Remedial Units (RU) priced at 100 USD/t CO_2eq, while failure to comply with the Base Target results in a Tier 1 deficit and a Tier 2 deficit. The latter is to be covered by Tier 2 RUs priced at 380 USD/t CO_2eq in addition to the mentioned Tier 1 RUs or, alternatively, by Surplus Units (SU), resembling FuelEU pooling, produced by ships falling below the Direct Compliance Target. The price of RUs is subject to review for the period from 2031 onwards.

Here are the relevant reduction targets until 2035, considering a reference value of 93.3 gCO_2eq/MJ:

Year	Base Target	Direct Compliance Target
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	21.2%	34.2%
2034	25.6%	38.6%
2035	30.0%	43.0%



The Influence of IMO and EU Regulation on Fuel Costs

Similar to FuelEU, ships that are exposed to penalties (RUs) will have increased OPEX costs defined by the burnt fuel type, while ships performing better than the ambitious Direct Compliance Target will have the chance to monetize their efforts through SUs or, to maintain comparability with FuelEU, pooling. Therefore, the new clarity around all applicable maritime decarbonisation regulations allows for a comprehensive review of the change in fuel costs going forward.

Table 2 shows the expected increase in fuel costs per fuel type in 2028, the first reporting year of the new IMO Net-Zero Framework.

BetterSea	HFO	LFO	MDO/MGO	$LNG_{Otto\ MS}$	$LNG_{Otto\ SS}$	$LNG_{Diesel\ SS}$	LNG_{LBSI}	LPG_{Butane}	$LPG_{Propane}$	$Bio100_{65\%}$	$Bio100_{80\%}$	Bio24	Bio30
$GHG_{WTW,EU}$ *[gCO_2e/MJ]*	91.60123	91.25122	90.63185	91.02538	83.83410	76.12916	88.45707	74.73696	74.08478	32.90000	14.10000	77.51293	73.99086
$GHG_{WTW,IMO}$ *[gCO_2e/MJ]*	95.48408	90.87233	93.93185	94.78916	85.33134	77.18711	90.06025	75.17637	73.65529	32.90000	14.10000	80.46390	76.70886
FuelEU Penalty	+66.81	+57.40	+40.72	+60.78	-	-	-	-	-	-	-	-	-
FuelEU Surplus	-	-	-	-	-77.00	-184.82	-12.31	-191.40	-199.95	-598.34	-797.66	-133.81	-172.80
EU ETS Costs	+216.36	+218.89	+222.65	+243.57	+219.42	+193.54	+234.95	+210.61	+208.56	-	-	-	-
IMO RU1 Costs	+48.76	+49.97	+51.79	+58.22	+37.88	-	+58.22	-	-	-	-	+11.94	-
IMO RU2 Costs	+90.37	+20.42	+70.81	+95.23	-	-	+8.98	-	-	-	-	-	-
IMO SU	-	-	-	-	-	-3.45	-	-29.47	-49.93	-472.20	-671.52	-	-8.18
$Total_{EU}$ *[US$/t fuel]*	**422.30**	**346.68**	**385.96**	**457.81**	**180.30**	**5.28**	**289.83**	**-10.26**	**-41.32**	**-1070.55**	**-1469.18**	**-121.87**	**-180.98**
$Total_{non\text{-}EU}$ *[US$/t fuel]*	**139.13**	**70.39**	**122.60**	**153.45**	**37.88**	**-3.45**	**67.20**	**-29.47**	**-49.93**	**-472.20**	**-671.52**	**11.94**	**-8.18**

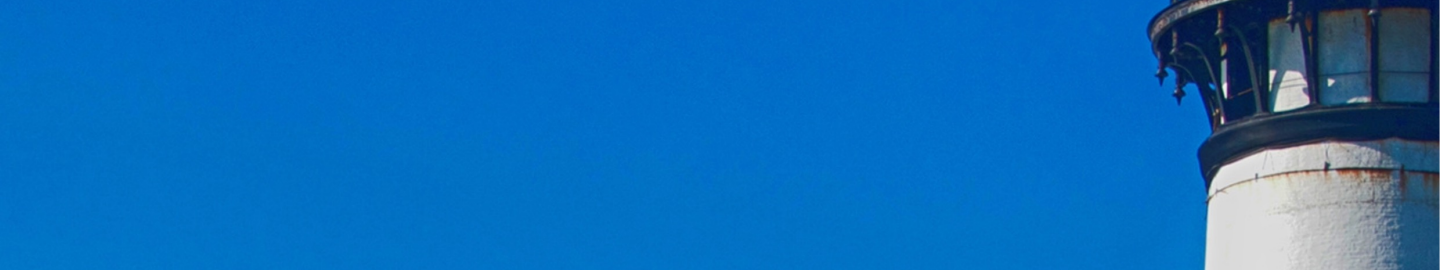
Table 2: Effect of IMO and EU regulations on fuel costs per fuel type in 2028

In the first year, the common maritime fuels (HFO, LFO, and MDO/MGO) experience a higher OPEX increase as under FuelEU Maritime. LNG-powered vessels, however, are less incentivized under IMO than FuelEU. Only LNG with Diesel slow speed engines collects surplus under both regulatory frameworks. The remaining three LNG-based engine types face an IMO penalty (RU) but a FuelEU surplus (except for LNG Otto medium speed). The remaining fuel types all achieve surplus under both IMO and FuelEU Maritime in 2028. Only Bio24, dependent on the emission reduction of the bio content, may be at risk of penalties under IMO.

The picture already changes dramatically in 2030, as depicted in Table 3.

BetterSea	HFO	LFO	MDO/MGO	$LNG_{Otto\ MS}$	$LNG_{Otto\ SS}$	$LNG_{Diesel\ SS}$	LNG_{LBSI}	LPG_{Butane}	$LPG_{Propane}$	$Bio100_{65\%}$	$Bio100_{80\%}$	Bio24	Bio30
GHG_{WTW} *[gCO_2e/MJ]*	91.60123	91.25122	90.63185	91.02538	83.83410	76.12916	88.45707	74.73696	74.08478	32.90000	14.10000	77.51293	73.99086
$GHG_{WTW,IMO}$ *[gCO_2e/MJ]*	95.48408	90.87233	93.93185	94.78916	85.33134	77.18711	90.06025	75.17637	73.65529	32.90000	14.10000	80.46390	76.70886
FuelEU Penalty	+174.40	+166.73	+155.36	+192.04	-	-	+102.48	-	-	-	-	-	-
FuelEU Surplus	-	-	-	-	-25.98	-133.80	-	-143.60	-152.15	-559.68	-759.00	-92.54	-131.74
EU ETS Costs	+216.36	+218.89	+222.65	+243.57	+219.42	+193.54	+234.95	+210.61	+208.56	-	-	-	-
IMO RU1 Costs	+48.76	+49.97	+51.79	+58.22	+55.80	+16.70	+58.22	+6.72	-	-	-	+26.68	+11.80
IMO RU2 Costs	+147.38	+78.85	+131.36	+163.31	-	-	+77.05	-	-	-	-	-	-
IMO SU	-	-	-	-	-	-	-	-	-0.68	-432.64	-631.95	-	-
$Total_{EU}$ *[US$/t fuel]*	**586.89**	**514.44**	**561.16**	**657.13**	**249.24**	**76.45**	**472.70**	**73.73**	**55.73**	**-992.32**	**-1390.95**	**-65.87**	**-119.94**
$Total_{non\text{-}EU}$ *[US$/t fuel]*	**196.14**	**128.82**	**183.15**	**221.52**	**55.80**	**16.70**	**135.27**	**6.72**	**-0.68**	**-432.64**	**-631.95**	**26.68**	**11.80**

Table 3: Effect of IMO and EU regulations on fuel costs per fuel type in 2030



Although, the fossil-based LNG Otto and Diesel slow speed as well as both LPG options still result in surplus under FuelEU, all four are penalized under the IMO framework, facing exposure to IMO Tier 1 RUs. The same holds true for the assumed Bio24 and Bio30 options in this study. Only the Bio100 fuels with 65 and 80% emission reduction compared to RED II generate surplus under both schemes.

Table 4 shows that this statement is still valid for 2035.

BetterSea	HFO	LFO	MDO/MGO	$LNG_{Otto\ MS}$	$LNG_{Otto\ SS}$	$LNG_{Diesel\ SS}$	LNG_{LBSI}	LPG_{Butane}	$LPG_{Propane}$	$Bio100_{65\%}$	$Bio100_{80\%}$	Bio24	Bio30
GHG_{WTW} *[gCO_2e/MJ]*	91.60123	91.25122	90.63185	91.02538	83.83410	76.12916	88.45707	74.73696	74.08478	32.90000	14.10000	77.51293	73.99086
$GHG_{WTW,IMO}$ *[gCO_2e/MJ]*	95.48408	90.87233	93.93185	94.78916	85.33134	77.18711	90.06025	75.17637	73.65529	32.90000	14.10000	80.46390	76.70886
FuelEU Penalty	+403.01	+399.06	+398.97	+470.95	+230.29	-	+389.49	-	-	-	-	-	-
FuelEU Surplus	-	-	-	-	-	-25.37	-	-42.02	-50.57	-477.53	-676.85	-4.85	-44.49
EU ETS Costs	+216.36	+218.89	+222.65	+243.57	+219.42	+193.54	+234.95	+210.61	+208.56	-	-	-	-
IMO RU1 Costs	+48.76	+49.97	+51.79	+58.22	+58.22	+58.22	+58.22	+55.43	+56.16	-	-	+47.89	+47.67
IMO RU2 Costs	+460.94	+400.20	+464.42	+537.70	+365.19	+216.64	+451.44	+171.34	+146.83	-	-	+227.34	+170.23
IMO SU	-	-	-	-	-	-	-	-	-	-215.02	-414.34	-	-
$Total_{EU}$ *[US$/t fuel]*	**1129.07**	**1068.12**	**1137.83**	**1310.44**	**873.12**	**443.04**	**1134.10**	**395.36**	**360.98**	**-692.55**	**-1091.19**	**270.38**	**173.41**
$Total_{non\text{-}EU}$ *[US$/t fuel]*	**509.70**	**450.18**	**516.21**	**595.92**	**423.41**	**274.86**	**509.66**	**226.77**	**202.98**	**-215.02**	**-414.34**	**275.23**	**217.90**

Table 4: Effect of IMO and EU regulations on fuel costs per fuel type in 2035

Despite FuelEU Maritime's consistent surplus rewards for LNG Diesel slow speed and LPG, IMO's framework penalizes all three, leaving Bio100 as the only option for compliance. When combined with the fact that IMO's regulation only allows banking for 2 years, in contrast to the indefinite banking option under FuelEU, it can be stated that IMO's framework is significantly more strict when it comes to LNG-powered vessels, requiring an earlier shift to bio-LNG or e-LNG.

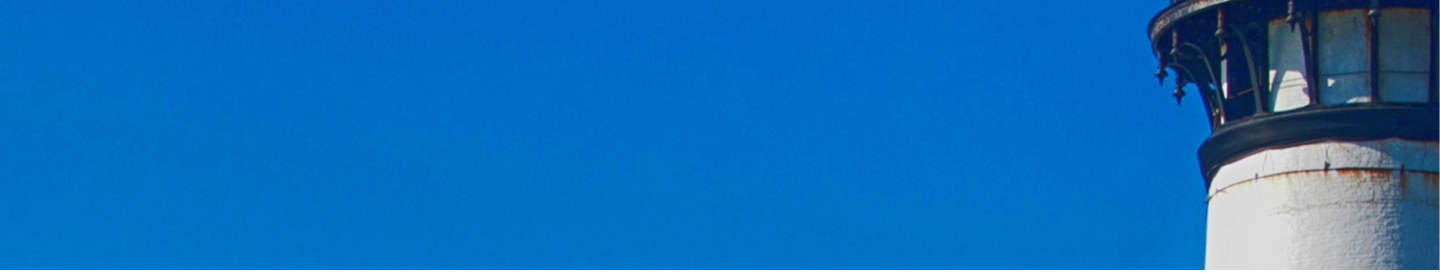
What This Means for Your Commercial Strategy

The introduction of a global fuel standard with a trading mechanism (via surplus units) adds to the existing FuelEU Maritime pooling scheme and underlines that maritime decarbonisation is not merely a luxury of the big shipping companies anymore but a key commercial driver:

- Ships running on traditional HFO or VLSFO will face recurring deficits. The use of fuels like HFO hardly makes financial sense going forward. A ton of HFO may cost about 852 USD in 2028, about 1,017 USD in 2030, and 1,559 USD in 2035.
- LNG remains a transition fuel, but the benefits under FuelEU have been significantly decreased by the introduction of IMO's Net-Zero Framework.
- Dependent on market developments, e-fuels and biofuels may become cost-neutral or even cost-negative when including rewards and surplus trading under the IMO framework and FuelEU Maritime.

Conclusion: Awareness & Action

This framework sends a strong signal: ships with poor GHG performance will pay — either directly or through traded surplus. The right preparation is key to navigating the current and upcoming regulations and maintaining commercial operability:



- Review fuel strategies, even for ships operating outside the EU.
- Model your GHG intensity under the IMO and FuelEU standards to estimate future deficits or surpluses.
- Start engaging in surplus markets (like BetterSea's FuelEU Marketplace) to learn how to navigate the new market reality and ultimately secure lower compliance costs.

We'll be tracking the development of the IMO Net-Zero Framework and building tools to help you manage global compliance across both FuelEU and IMO regulations (if necessary). Stay tuned — surplus markets just got even more serious and BetterSea is providing the standard framework the maritime industry trusts.

Imprint

Other FuelEU Maritime Resources

FuelEU Maritime Calculator & Strategizer

BetterSea's free online FuelEU Maritime Calculator & Strategizer allows you to not only calculate penalties but also to find the most cost-effective way to comply through surplus and biofuel cost analysis.

Start calculating & planning for free here!

FuelEU Maritime Pooling Platform

BetterSea's end-to-end FuelEU Maritime Pooling Platform provides a marketplace for FuelEU surplus trading and streamlines the full compliance process.

Get access to our FuelEU Maritime Pooling Platform here!

Other BetterSea Resources

Monday Newsletter

BetterSea's weekly Monday Newsletter sheds light on the recent developments in maritime decarbonization and regulation through case studies, controversies, guides, and expert opinions.

Subscribe in the bottom of the linked page!

Wavemakers Podcast

Don't miss the private coffee chats with the real changemakers steering the maritime industry towards a sustainable future. BetterSea's very own Gordana Ilic has in-depth discussions on maritime regulations, innovation, and best practices with representatives from among others Hapag-Lloyd, Pacific International Lines, and Swire Shipping.

Subscribe to our Youtube channel here!

More Maritime Decarb Nibbles

BetterSea's LinkedIn page posts short and simple maritime decarbonization and regulation content every day, from 1-minute Tuesday Tutorials to Tech Thursdays. Free knowledge sharing just a few clicks away.

Follow BetterSea on LinkedIn here!

Interested in BetterSea's other commercial products?

BetterSea provides a suite of solutions to tackle the main maritime decarbonization problems from the bespoken FuelEU Maritime regulation to primary Scope 3 emission data.

Book a call with us to learn more here!

Schroer, M. & Ilic, G. (2025). Decarb Compliance Library: FuelEU Maritime Compliance Insights. *BetterSea LDA*.