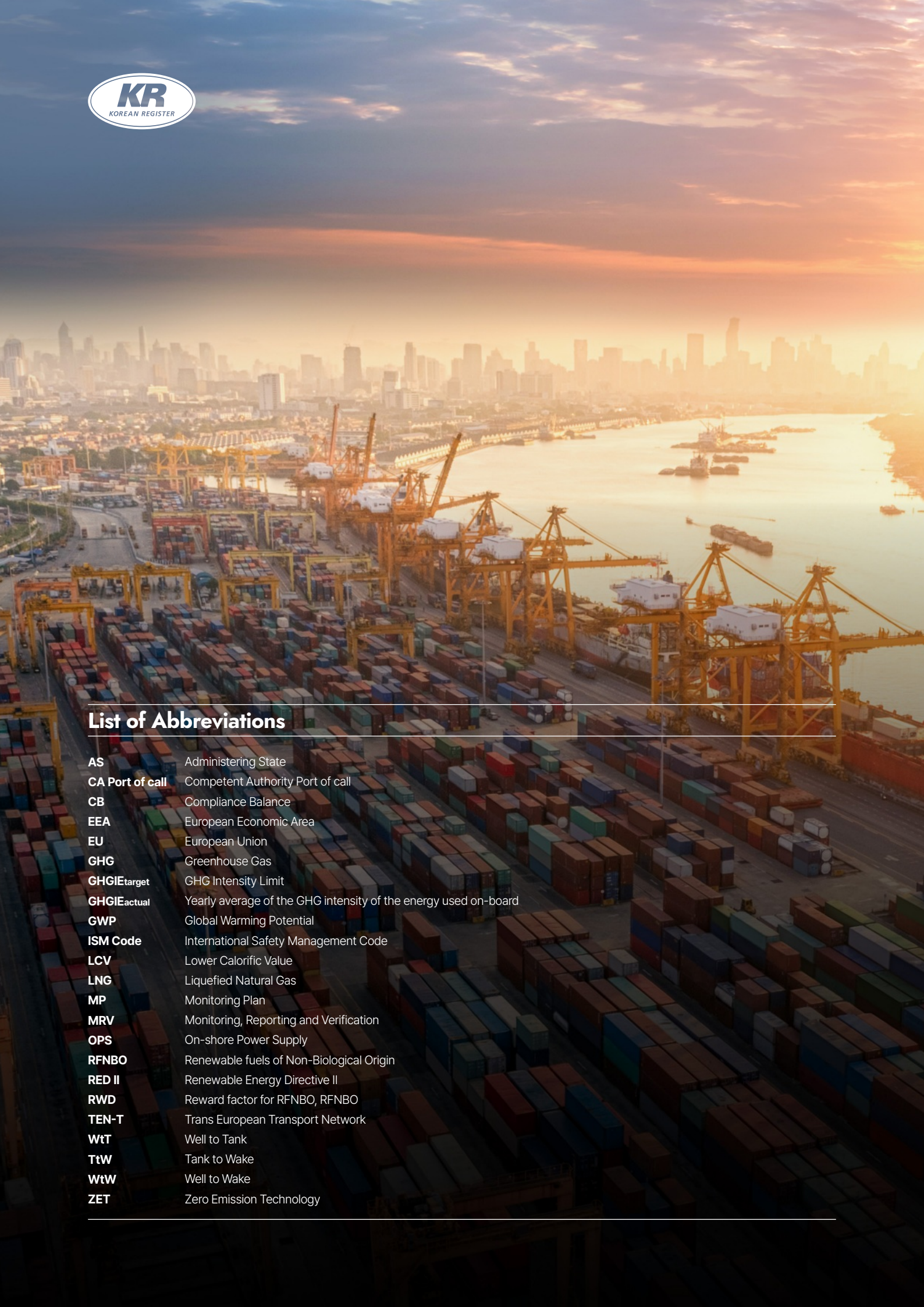
KR
KOREAN REGISTER

Providing the Best Service,
Creating a Better World

FuelEU Maritime Guidelines



List of Abbreviations

AS	Administering State
CA Port of call	Competent Authority Port of call
CB	Compliance Balance
EEA	European Economic Area
EU	European Union
GHG	Greenhouse Gas
$GHGIE_{target}$	GHG Intensity Limit
$GHGIE_{actual}$	Yearly average of the GHG intensity of the energy used on-board
GWP	Global Warming Potential
ISM Code	International Safety Management Code
LCV	Lower Calorific Value
LNG	Liquefied Natural Gas
MP	Monitoring Plan
MRV	Monitoring, Reporting and Verification
OPS	On-shore Power Supply
RFNBO	Renewable fuels of Non-Biological Origin
RED II	Renewable Energy Directive II
RWD	Reward factor for RFNBO, RFNBO
TEN-T	Trans European Transport Network
WtT	Well to Tank
TtW	Tank to Wake
WtW	Well to Wake
ZET	Zero Emission Technology

Providing the Best Service,
Creating a Better World

Contents

A. FuelEU Maritime ROADMAP

| 2025 | First FuelEU monitoring year
| 2026 | First FuelEU verification year

MP Submission & Assessment | **Reporting period** | **Verification period** | **Flexibility Mechanism period** | **Verified Compliance Balance by verifier** | **Penalty Period** (Ensured from AS*)

2024 31 Aug | **2025** | **2026** By 31 Mar | By 30 Apr | 1 May | 1 June | By 30 June

FuelEU Database

FuelEU MP Submit to verifier

Company → Verifier

Assess FuelEU MP by 2024

Monitoring FuelEU data for the calendar year

For the 1st time FuelEU Scope voyage

Submit within 2 months after first call for EU

| Company | ~31 Jan

FuelEU Report
Submit to verifier

| Verifier | ~31 Mar

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Issue to company
Verification Report

Calculate and notify to company
GHG Intensity & CB**

※ For each vessel

1. GHGIE Obligation (2025~)
2. RFNBO Obligation (2034~)
3. OPS Obligation (2030~)

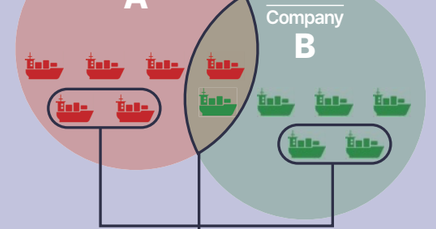
Deficit

Surplus

Member State (MS)

All FuelEU data will be recorded in FuelEU Database and MS can check data anytime via FuelEU Database

| Chance for pooling compliance |



Pooling

Approval of pooled **CB before 1 May

1 Borrowing (or)
2 Pooling (or)
3 Paying (or)

1 Banking (and/or)
2 Pooling (or)

FuelEU Penalty

DOC Issuance

* AS: Administering State

** Compliance Balance

Administering State shall ensure final Penalty considered GHGIE, RFNBO, OPS, deficit for two or more consecutive years by 1 June

B. Initial implementation guidelines following the introduction of FuelEU Maritime

1. General

In July 2021, as part of its efforts to reduce greenhouse gases, the European Commission announced the 'EU Fit for 55' package. This legislative package aims to reduce GHG emissions by 55% by 2030 compared to 1990 levels. Among the initiatives directly related to international maritime transport is FuelEU Maritime*.

FuelEU Maritime is a legislative proposal that promotes the use of renewable and low-carbon fuels in maritime transport, applicable to all ships voyaging at EU/EEA ports, regardless of their flag. The proposal seeks to gradually-enhanced the limits on GHG intensity of ship fuels by 2050, there by stimulating demand for alternative fuels and enhancing the use of On-shore Power Supply (OPS) and Zero-emission Technology (ZET) within ports.

In response, the Korean Register has published technical information to assist shipping companies in effectively complying with FuelEU Maritime. It is recommended that stakeholders refer to this information for related operations.

* FuelEU Maritime : Regulation (EU) 2023/1805 - On the use of renewable and low -carbon fuels in maritime transport, and amending Directive 2009/16/EC

FuelEU Maritime's key objectives

Phased reduction of the GHG intensity of fuel used on board

Promote the use of sustainable fuels

Mandatory OPS a EU ports (For container and passenger ships)

2. Application

From January 1, 2025, FuelEU Maritime regulations will apply to all ships above 5,000 GT voyaging at EU/EEA ports, with specific requirements based on the jurisdiction of a Member State as follows;

- Extra-EU Voyage (EU ↔ Non-EU): 50% of energy used is considered
- Intra-EU Voyage (EU ↔ EU): 100% of energy used is considered
- Within EU Ports: 100% of energy used is considered
- Outermost Regions Voyage (EU or Non-EU ↔ Outermost Regions*): 50% of energy used is considered.

The ISM company is responsible entity for the ship, according to Annex I of EC Directive 336/2006, must ensure compliance with the ISM Code under FuelEU Maritime.

Voyages between outermost regions, isolated territories to the mainland (such as Ceuta and Melilla), and panssenger ships other than cruise passenger ships between islands with permanent residents under 200,000 within the jurisdiction of the same Member State are exempt until December 31, 2029.

The company may request ships classified as Ice Class IA Super, IA, IB, or IC exclusions annually for additional energy used under ice conditions until December 31, 2034, as specified in Annexes VI and V of EU Directive 2023/1805.

* Outermost Regions

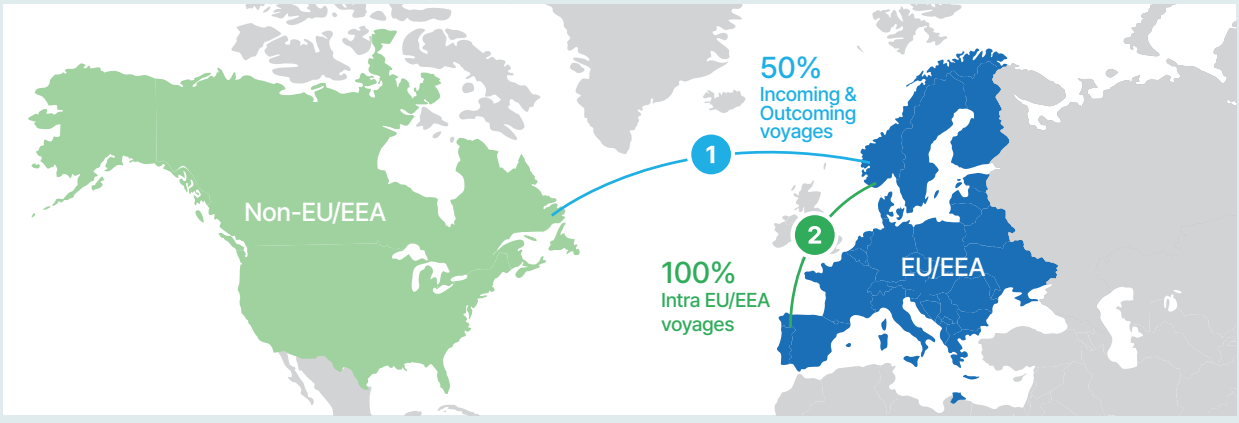
→ French Guiana, Guadeloupe, Martinique, Mayotte,Reunion Island and Saint-Martin (France)

→ Azores, Madeira (Portugal)

→ The Canary Islands (Spain)

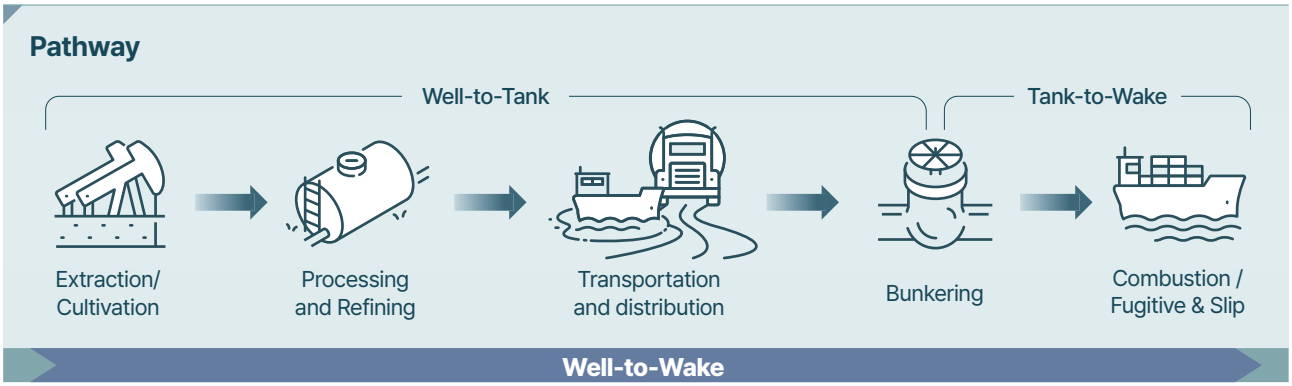
https://ec.europa.eu/regional_policy/policy/themes/outermost-regions_en

Scope of voyage



3. Well to Wake

FuelEU Maritime applies to GHG emissions from fuels using the "Well to Wake" approach. The "Well to Tank" phase includes emissions from the extraction or cultivation, processing or refining, and transportation or distribution of the fuel. The "Tank to Wake" phase covers emissions from the combustion of the fuel.

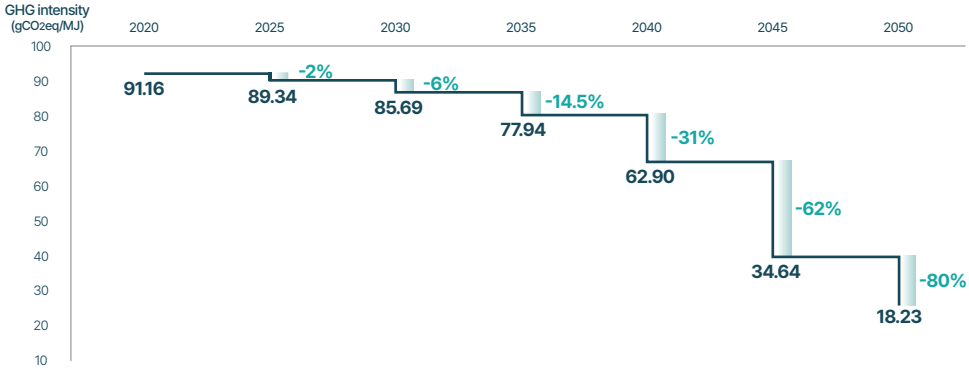


The greenhouse gases accounted for include not only carbon dioxide (CO_2) but also methane (CH_4) and nitrous oxide (N_2O). Methane and nitrous oxide are converted to CO_2 equivalents using the Global Warming Potential (GWP100*) values.

* In accordance with the FuelEU Maritime Regulation ANNEX I, the GWP 100 is converted to the value 25 & 298 according to Directive (EU) 2018/2001 (RED II). However, for the EU ETS, the value is 28 & 265 according to Regulation (EU) 2020/1044.

4. GHG Intensity Limit

The European Commission set a reference value of 91.16 gCO_{2eq}/MJ for GHG intensity using the 2020 MRV data. Based on this reference value, they have set targets to progressively reduce the GHG Intensity Limit of the energy used in ships at five-year intervals until 2050.



Year	2020	2025	2030	2035	2040	2045	2050
Reduction	-	-2%	-6%	-14.5%	-31%	-62%	-80%
GHG intensity (gCO_{2eq}/MJ)	91.16	89.34	85.69	77.94	62.90	34.64	18.23

5. $GHGIE_{actual}$ Calculation

The GHG Intensity for energy used in ships is expressed as the Well to Wake (WtW) GHG emissions per unit of energy (gCO_{2eq}/MJ) and is calculated as follows in Equation (1). Additionally, the results from Equations (2) and (3) for Well to Tank (WtT) and Tank to Wake (TtW), respectively, are summed and then multiplied by the wind compensation factor f_{wind}. The result of this calculation is used as the $GHGIE_{actual}$ value in Section C's Penalty calculation.

Calculation(1)

$$\text{GHG Intensity}[\frac{gCO2eq}{MJ}] = f_{wind} \times (\text{WtT+TtW})$$

f_{wind} is the wind-assisted propulsion reward factor, calculated as P_{Wind}/P_{Prop}. The P_{Wind} value can be represented by the verified EEDI or EEXI value according to MEPC.1/Circ.896*, multiplied by $f_{eff} \times P_{eff}$**. P_{Prop}, representing the ship's propulsion power, corresponds to the PME value as defined in MEPC.364(79) and MEPC.333(76)***. If a shaft motor is installed, P_{Prop} can be represented as $P_{ME}+P_{(PTI(i),\ shaft)}$.

*
MEPC.1/Circ.896: 2021 GUIDANCE ON TREATMENT OF INNOVATIVE ENERGY EFFICIENCY TECHNOLOGIES FOR CALCULATION AND VERIFICATION OF THE ATTAINED EEDI AND EEXI

**
f_eff: Availability factor P_eff: Power reduction factor

***
MEPC.364(79): 2022 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY DESIGN INDEX (EEDI) FOR NEW SHIPS

MEPC.333(76): 2021 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)

Calculation(2)

$$WtT = \frac{\sum_i^{n\ fuel}(M_i \times CO_{2eq\ WtT,\ i} \times LCV_i) + \sum_k^c E_k \times CO_{2eq\ electricity,k}}{\sum_i^{n\ fuel}(M_i \times LCV_i \times RWD_i) + \sum_k^c E_k}$$

Calculation(3)

$$TtW = \frac{\sum_i^{n\ fuel}\sum_j^{m\ engine} M_{i,j} \times [(1 - \frac{1}{100} C_{slip\ j}) \times (CO_{2eq\ TtW,\ i,j}) + (\frac{1}{100} C_{slip\ j} \times CO_{2eq\ TtW,\ slip,\ i,\ j})]}{\sum_i^{n\ fuel}(M_i \times LCV_i \times RWD_i) + \sum_k^c E_k}$$

In this formula, i represents the fuel types, j represents the fuel consumer units on board the ship, k represents OPS connection points, n is the total number of fuel types, c is the total number of OPS connection points, m is the total number of fuel consumer units, M is the Mass of fuel i consumed by fuel consumer unit j (gFuel), E_k is the Electriciy delivered to the ship per OPS connection point k (MJ), $CO_{2eqWtT,i}$ is the WtT GHG emission factor of fuel i (gCO_{2eq}/MJ), $CO_{2eq,\ electricity,\ k}$ is the WtT GHG emission factor associated with the electricity delivered to the ship at berth per OPS connection point k (gCO_{2eq}/MJ), LCV is the lower calorific value of fuel i (MJ/gFuel), C_{slip} is Non-combusted fuel coefficient as a percentage of the mass of the fuel i consumed by fuel consumer unit j. C_{slip} includes fugitive and slipped emissions (%), $CO_{2eq,TtW}$ is the TtW CO_2 equivalent emissions of combusted fuel i in fuel consumer unit j (gCO_{2eq}/gFuel), and $CO_{2eq,\ TtW,\ slip}$ is the TtW GHG emission factors by slipped fuel i towards fuel consumer unit j (gCO_{2eq}/gFuel). RWD is the reward factor for ships using where the fuel is of non-biological origin, a reward factor of 2 from 1 January 2025 to 31 December 2033can be applied. Otherwise RWDi = 1.

The WtT GHG emission factors for fossil fuels should use default values. However, alternative fuels like biofuels and RFNBO can use actual values recognized by certification systems under Article 10 of FuelEU Maritime. TtW GHG emission factors can also use actual values if experimental data are available, but fossil fuel CO_2 emission factors must use default values.

| Applicable Actual Emission Factors | Tank to Wake

	TtW			
	Combustion Emission Factors			Slippage
	CO_2	CH_4	N_2O	
FOSSIL	N	Y	Y	Y
BIO	Y	Y	Y	Y
RFNBO	Y	Y	Y	Y

The WtT GHG emission factor (gCO_{2eq}/MJ) for biofuels can be derived using Equation (4).

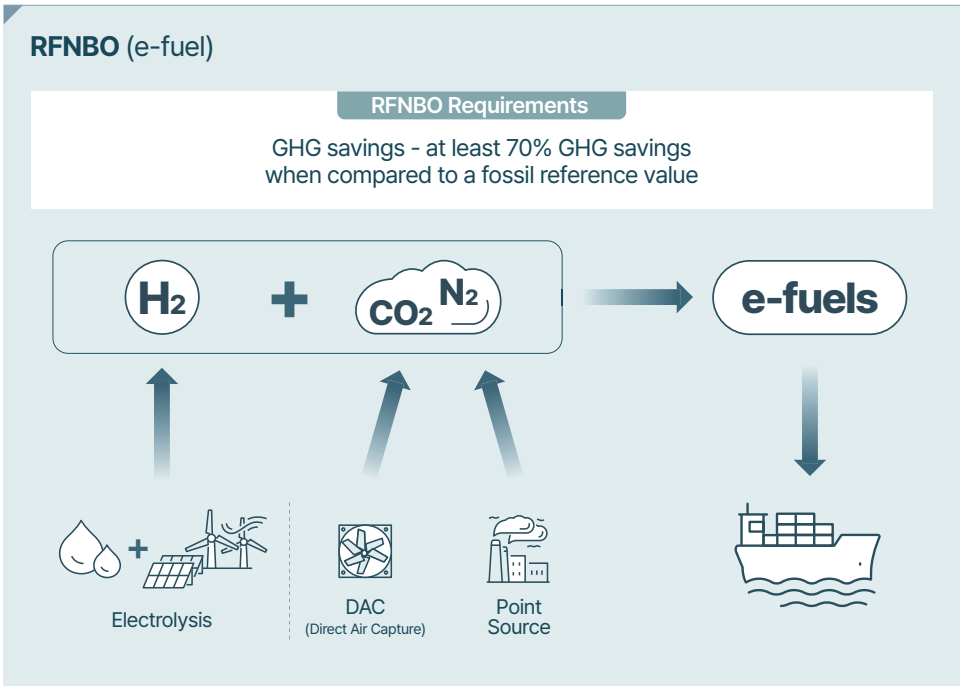
Calculation(4)

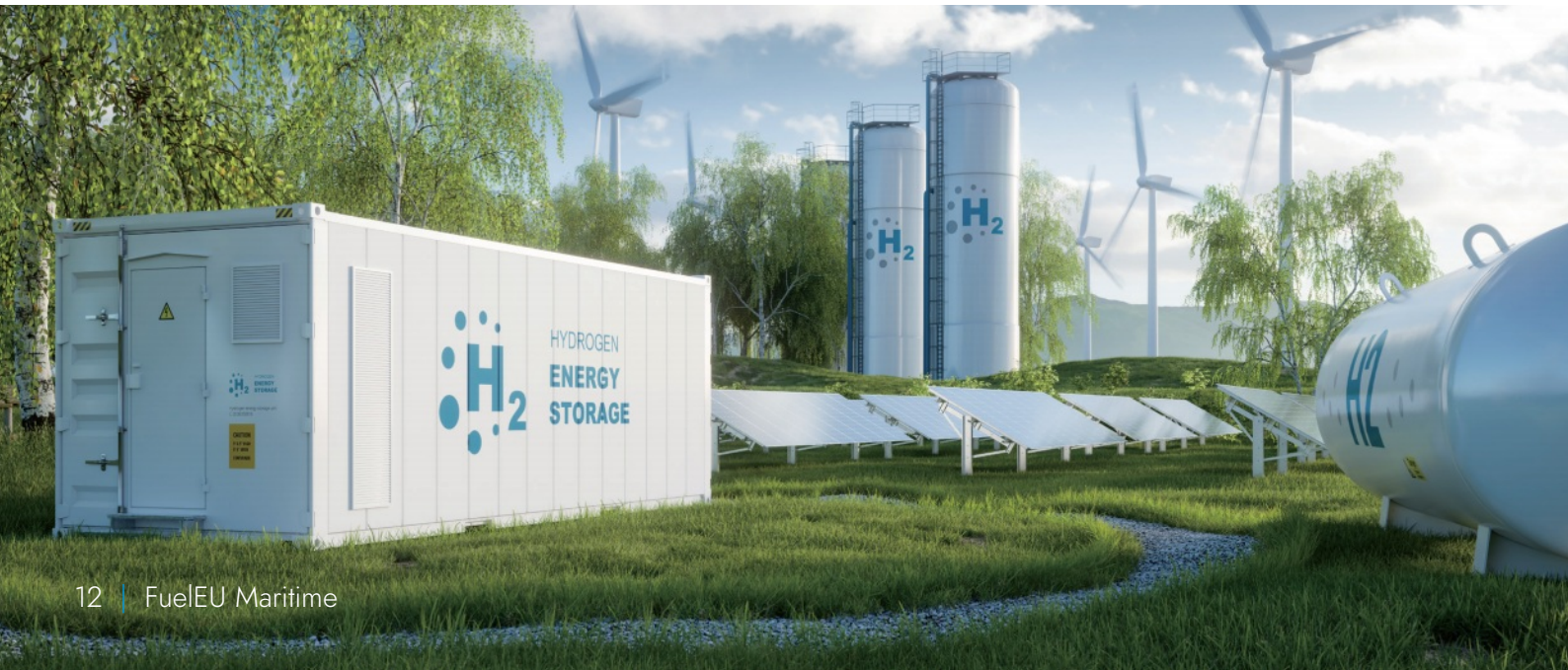
$$E - \frac{C_{fco_2}}{LCV} \quad (CO_{2eq\ WtT,\ i} \text{ for Biofuels})$$

For liquid biofuels, the default values shall be calculated by using the values of E established in accordance with the methodologies laid down in RED II (Directive (EU) 2018/2001), Part C of Annex V to that Directive for all liquid biofuels except bio-LNG and Part B of Annex VI to that Directive for bio-LNG C_{fCO2} uses the TtW CO_2 emission factor default value for biofuels, and LCV is determined according to the values specified in Annex III of RED II. As shown in Equation (4), the reason for subtracting the value of C_{fCO2} divided by LCV from the value E is because E represents the WtW value, but in FuelEU Maritime, WtT and TtW are calculated separately to avoid double counting of emissions.

6. RFNBO

To comply with the FuelEU Maritime regulation, transitioning from fossil fuels to sustainable alternative fuels is essential. RFNBO (Renewable Fuels of Non-Biological Origin), also known as e-Fuel, is synthesized electrically using hydrogen (H_2). FuelEU Maritime may provide for a combination of measures to ensure the support for the uptake of sustainable RFNBO, including the possibility to use a 'multiplier' until the end of 2033, allowing the energy from RFNBO to count twice. In addition, a 2% RFNBO subtarget should apply as of 2034 if, further to monitoring of the market, the Commission reports that the share of RFNBO in the maritime bunker fuels used by ships falling under the scope of this Regulation is less than 1 % by 2031.





7. OPS

Container and passenger ships since those are the ship categories that produce the highest amount of emissions per ship while moored at the quayside, according to the data collected within the framework of Regulation (EU) 2015/757 in 2018. Considering the positive effects of the use of OPS on local air pollution and the need to incentivise the uptake of that technology in the short term, the carbon intensity of the production of the electricity supplied at berth should be counted as zero. Therefore, for container and passenger ships moored at EU/EEA ports for more than two hours, the use of Onshore Power Supply (OPS) or Zero Emission Technology (ZET) is mandated. If these requirements are not complied with, it is referred to as a 'Non-Compliant port of call', which is verified by a verifier and reported to the EU. The OPS mandate aims to reduce air pollution emissions in densely populated areas near ports, with penalties for non-compliance starting in 2030 for ports included in the TEN-T(Trans-European Transport Network)*. Furthermore, from 2035, penalties will also be applied to ports not included in TEN-T but equipped with OPS facilities.

* TEN-T : Trans-European Transport Network (TEN-T) is a key instrument for the development of efficient and high-quality transport infrastructure across EU. The terms 'TEN-T core maritime port or TEN-T comprehensive maritime port' means a maritime port of the TEN-T core network or TEN-T comprehensive network, as listed and categorised in Annex II to Regulation (EU) No 1315/2013.

Obligation by using OPS (Passenger ship, Container ship only)

| PORTS: GATEWAYS OF THE TEN-T |

2030~

For TEN-T Maritime Port

2035~

For none TEN-T Maritime Port
(If OPS connection exists)

| Exemptions (EU 2023/1805 Article 6(5)) **|**

- Moored less than 2 hours
- Use zero-emission technologies
- Unscheduled port call
- Unable to connect to OPS
- Unavailability of OPS connection points in a port
- Onboard energy generation for maintanance tests or functional tests

C. Penalty

1. GHG Intensity Penalty

Starting in 2025, ships under the regulation whose annual ship energy consumption GHG intensity is below the GHG Intensity Limit will generate a surplus in their Compliance Balance (CB), while those exceeding the limit will incur a deficit. Ships with a deficit must pay a penalty proportional to their deficit. The CB can be expressed as the difference between the GHG Intensity Limit and the annual GHG Intensity value, multiplied by the energy consumption. Energy consumption is calculated using the mass of the fuel, its Lower Calorific Value (LCV), and the amount of power supplied to the ship. Additionally, ships that have sustained a deficit for a consecutive period of N years (two years or more) must pay an additional penalty of (N-1) X 10%.

Compliance Balance

$$\text{Compliance balance } [gCO_{2eq}] = (GHGIE_{target} - GHGIE_{actual}) \times \left[\sum_{i}^{nfuel} M_i \times LCV_i + \sum_{k}^{c} E_k\right]$$

(GHG intensity limit on energy used on board by a ship for the reporting period(gCO_{2eq}/MJ)
– Yearly average of the GHG intensity of the energy used on-board a ship calculated for the relevant reporting period(gCO_{2eq}/MJ))
X (Each fuel consumption(gFuel) X Each fuel's low calorific value(MJ/gFuel) + OPS energy used(MJ))

Penalty

$$\text{FuelEU Penalty} = \frac{|\text{Compliance Balance}|}{GHGIE_{actual} \times 41\,000} \times 2\,400$$

$$\frac{|\text{ Compliance Balance}(gCO_{2eq})\ |}{\text{(Yearly average of the GHG intensity of the energy used on-board a ship calculated for the relevant reporting period}(gCO_{2eq}\text{/MJ) X 41000MJ/tonne)}} \text{ X 2400Euro(EUR/tonne)}$$

2. RFNBO Penalty

Despite incentives for the use of RFNBO (Renewable Fuels of Non-Biological Origin) until 2033, if the proportion of RFNBO used in the total annual energy consumption of is less than 1% of the reported total fuel energy in 2031, a new subtarget may be provided. The subtarget may be applied from 2034, requiring at least 2% of a ship's annual energy consumption to be from RFNBO. This subtarget may lead to additional penalties for shipping company, calculated based on the value of the compliance balance for RFNBO the 2% target and considering the Price difference between RFNBO and fossil fuel compatible with ship installation.

Compliance Balance (RFNBO)

$$CB_{RFNBO}[MJ] = \left(0,02 \times \left(\sum_{i}^{n\ fuel} M_i \times LCV_i\right)\right) - \left(\sum_{i}^{n\ RFNBO} M_i \times LCV_i\right)$$

(0.02 X (Each fuel consumption(gFuel) X Each fuel's low calorific value(MJ/gFuel))
- (RFNBO consumption(gFuel) X RFNBO low calorific value(MJ/gFuel))

Penalty (RFNBO)

$$\text{FuelEU Penalty (RFNBO)} = \frac{CB_{RFNBO}}{41\,000} \times P_d$$

$\frac{\text{Compliance Balance(RFNBO)(MJ)}}{\text{41000MJ/tonne}}$ X Price difference between RFNBO and fossil fuel compatible with ship installation

3.
OPS Penalty

Starting from 2030, container and passenger ships will be subject to penalties if they fail to comply with the Onshore Power Supply (OPS) requirements at any EU/EEA port of call. For all applicable ships that are not exempt, an additional OPS penalty will be paid, calculated by resulting from the multiplication of EUR 1.5 by the established total electrical power demand of the ship at berth and by the total number of hours rounded up to the nearest whole hour, spent at berth by the ship in non-compliance with the requirements.

OPS Penalty

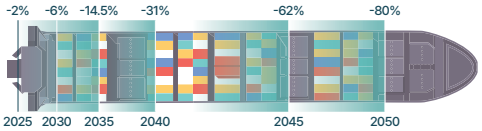
Total Electrical Power Demand of ship at berth × Total Number of hours(round up to nearest hour) × 1.5 EUR

(The highest value, expressed in kilowatts, of the total demand for electricity of a ship at berth,
including hotel and cargo handling workloads X The total number of hours rounded up to the nearest whole hour(h) X 1.5 Euro

| GHGIE Penalty | 2025~

GHGIE Target

Annual average GHG intensity reduction compared to the average in 2020



GHGIE Actual

f_{wind} (WtT + TtW)

- f_{wind}: Reward factor for wind-assited propulsion
- WtT: Fuel production
- TtW: Fuel combustion & fugitive, slipped

Compliance Balance

$$(GHGIE_{target} - GHGIE_{actual}) \times \text{Total Energy Used}$$

gCO_{2eq}/MJ MJ

Pooling

Pooled Compliance Balance > 0

Compliance Balance > 0 (LNG, Biofuels, RFNBOs) + Compliance Balance < 0 (Fossil Fuels) = No FuelEU Penalty

| RFNBO Penalty | When fail to meet the 2% subtarget

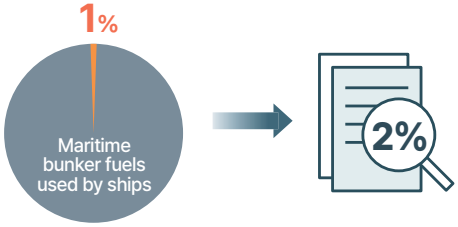
2025	2026	2027	2028	2029	2030	2031	2032	2033

The multiplier '2' can be applied to the use of RFNBO

RFNBO ENERGY X 2

Energy used by RFNBO less than 1% in 2031

2% RFNBO subtarget will be applied (2034~)



| OPS Penalty |

2030~ Passengership, Container ship only

Zero Emission / Zero Penalty

General requirements for zero-meission technologies
(EU 2023/1805 ANNEX III)

Fuel Cells

On-board electrical energy storage

On-board power generation from wind and solar energy

Energy Demand at port (Demand * hour(s) * 1.5EUR)

D. Flexibility Mechanism

1. Banking

On the basis of $GHGIE_{actual}$ calculations where the ship has, for the reporting period, a compliance surplus on its GHG intensity, 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.

2. Borrowing

On the basis of $GHGIE_{actual}$ calculations where the ship has, for the reporting period, a compliance deficit, the company may borrow an advance compliance surplus of the corresponding amount from the following reporting period. The advance compliance surplus shall be added to the ship's compliance balance in the reporting period and the advance compliance surplus multiplied by 1.1 shall be subtracted from the same ship's compliance balance in the following reporting period. The advance compliance surplus may not be borrowed:

- For an amount exceeding by more than $GHGIE_{target}$ by 2%
- For two consecutive reporting periods

3. Pooling

The compliance balances for GHG intensity referred to $GHGIE_{target}$ of two or more ships, as calculated in accordance with $GHGIE_{actual}$ calculations, may be pooled for the purposes of complying with the requirements. By April 30th, the definitive composition of the pool and allocation of the total pool compliance balance to each individual ship after pooling compliance by verifier. Ships with a surplus in their CB relative to the $GHGIE_{target}$ can be used as flexiblity mechanism to assist ships with a CB deficit. The requirements for pooling are as follows:

- A ship's compliance balance may not be included in more than one pool in the same reporting period.
- Where the ships participating in the pool are controlled by two or more companies, the pool details is validated same verifier.
- A pool is valid only if the total pooled compliance is positive.

4. RFNBO Flexibility Mechanism

If the proportion of RFNBO used in the total annual energy consumption of is less than 1% of the reported total fuel energy in 2031, the subtarget may be applied from 2034, requiring at least 2% of a ship's annual energy consumption to be from RFNBO. Similarly to the GHGIE flexible mechanism, there is also an opportunity for pooling under the RFNBO subtarget. Two separate pools may be used for GHGIEtarget and for the subtarget for RFNBO, and the pooling requirements for banking/borrowing remain the same.

Member State can check all process via FuelEU Database

Member State Roles
- → Administering State (AS)
- → Competent Authority (CA) Port of call
- → Flag state (EU only)

Every year from 2026

by 31 Mar

| 1 | EU 2023/1805 Article 15

- Date and time for Departure/Arrival EU port and time spent at sea
- Use OPS connection or application of any exemptions
- Each Fuel consumption at berth and at sea
- Electricity delivered to the ship through OPS
- All GHG emission factor for each type of fuel
- All amount of energy for each substitute source
- Ice class relevant documents

Company | 1 | FuelEU Report → Verifier KR | 2 | CB

| 2 | EU 2023/1805 Article 16(4)

- Yearly average GHG intensity
- Compliance Balance(CB)
- The number of non-compliant port calls
- Yearly Energy used excluding from OPS
- Yearly Energy used from the RFNBO

by 30 Apr

Surplus — Deficit

Surplus: 89.34 GHGIEtarget; 7.09 / e-fuel → CB

Deficit: VLSFO 92.59 → CB

Banking

For following period

If the pooled CB results in a surplus, it can be banked to the surplus ship's CB for the following period

Pooling

CB + CB

Requirement for Pooling

1. A ship can be included in only one pool per year
2. Different companies available, but must be verified by same verifier
3. Must be positive compliance after pooling

Borrowing

From Next year's CB as multiplied by 1.1 shall be subtracted

Not allowed for Borrowing

1. Amount more than 2% of $GHGIE_{target}$
2. For two consecurive reporting periods

Paying

FuelEU Penalty

Vessel can choose Banking/Borrowing or Pooling

AS shall ensure FuelEU Penalty by 1 June

by 30 June

DOC Issuance

※ Compliance with paying penalty

※ No more banking after issuance of DoC

CAUTION

If a ship fails to comply with the FuelEU obligation **two or more** consecutive reporting periods, **MS gives an expulsion order**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