APOIO:

FuelEU Maritime

Technical Session

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About the presenters

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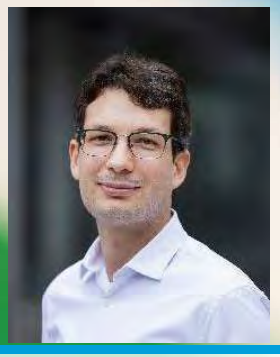
DNV



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Agenda

Start	Description	Responsible
09:15-10:30	**Session 1 – Main requirements**	
10:45-12:30	**Session 2 – Calculation examples**	
12:30-13:30	Lunch	
13:30-14:15	**Session 3 – Monitoring, reporting and verification**	
14:30-16:00	**Session 4 – Commercial and financial implications**	

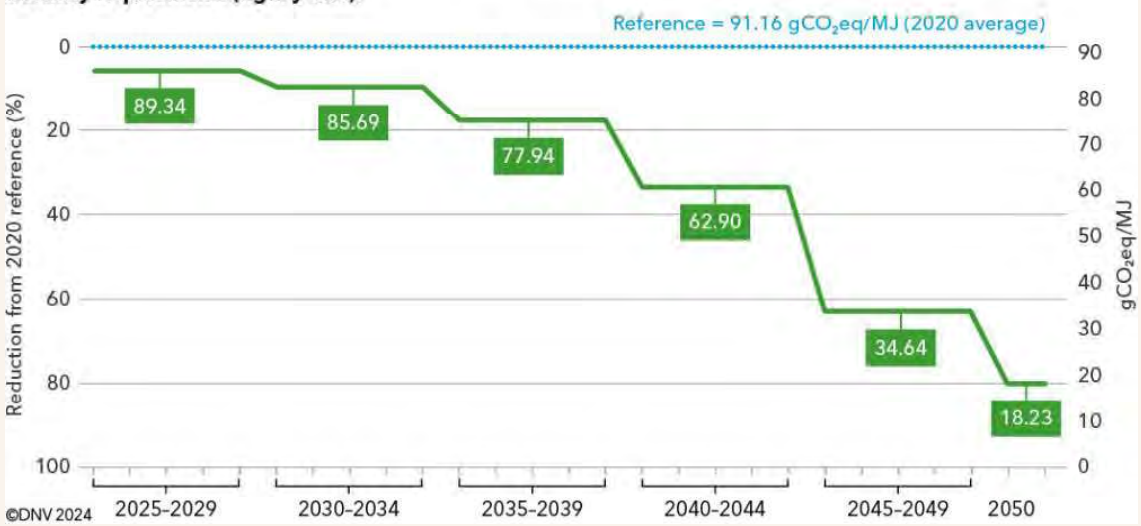
Session 1 – Main requirements

GHG intensity and flexibility mechanisms

FuelEU Maritime establishes stringent well-to-wake GHG emission intensity requirements for ships

$$\text{GHG intensity}\left[gCO_2eq/MJ\right] = \frac{\text{Total GHG emissions } [tCO_2eq]}{\text{Total energy from fuels } [TJ] + \text{Total shore power } [TJ] + \text{Reward}_{RFNBO}\ [TJ]} \times \text{Reward}_{wind}$$

FuelEU Maritime GHG intensity requirements from 2025 to 2050. The requirements are given as percentage reductions (left y-axis) relative to a reference (the GHG intensity in 2020), which provide the absolute GHG intensity requirements (right y-axis).



- Applies to ships above 5,000 GT transporting cargo or passengers for commercial purposes in the EU/EEA from 1 January 2025
- Vessels must meet annual well-to-wake GHG emissions intensity requirements
- GHG emissions are calculated in a well-to-wake perspective
- FuelEU Maritime offers flexibility mechanisms banking, borrowing, pooling – for ships not meeting the required GHG intensity, and for ships doing better than required
- Ships with negative compliance balance after any banking, borrowing, or pooling will have to pay a penalty

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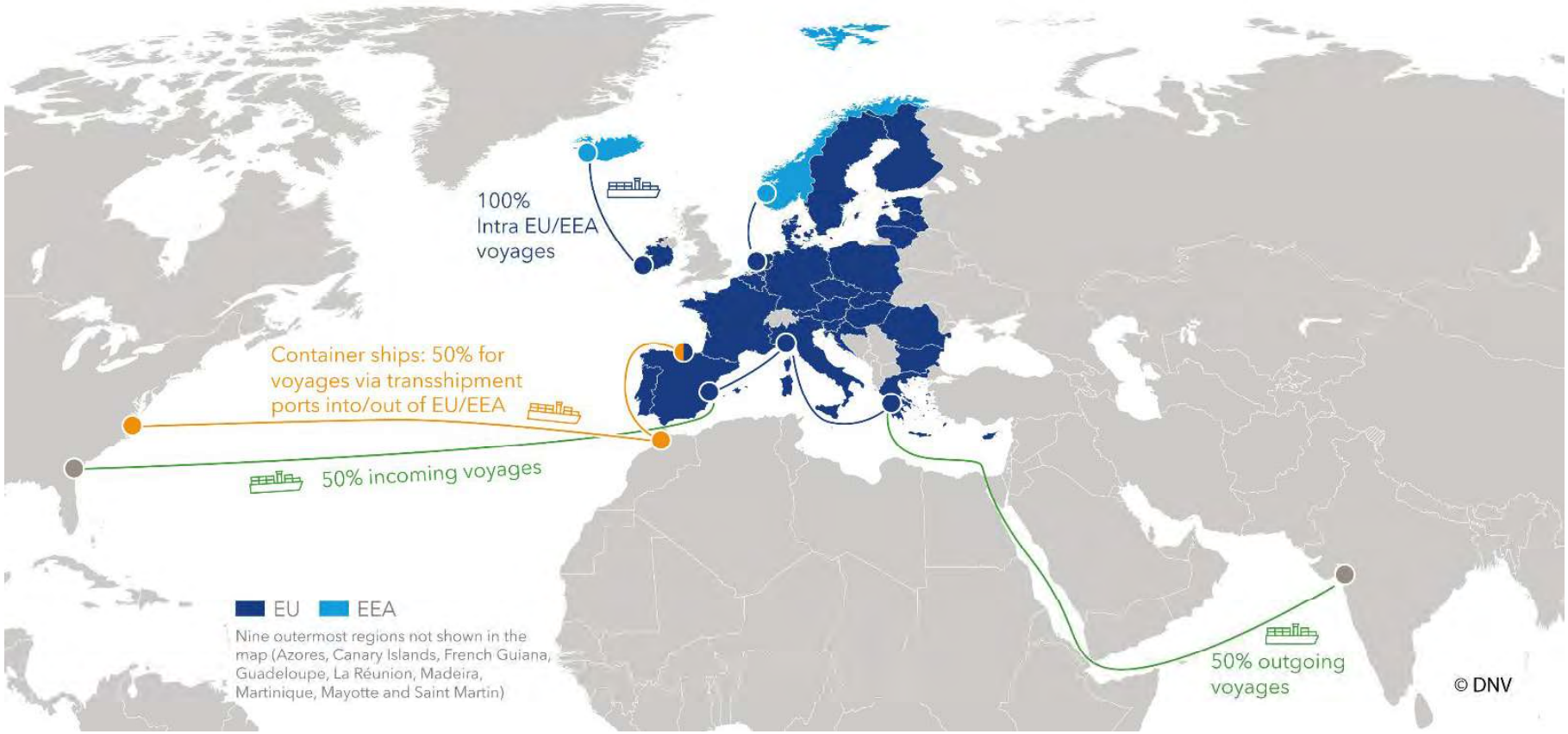
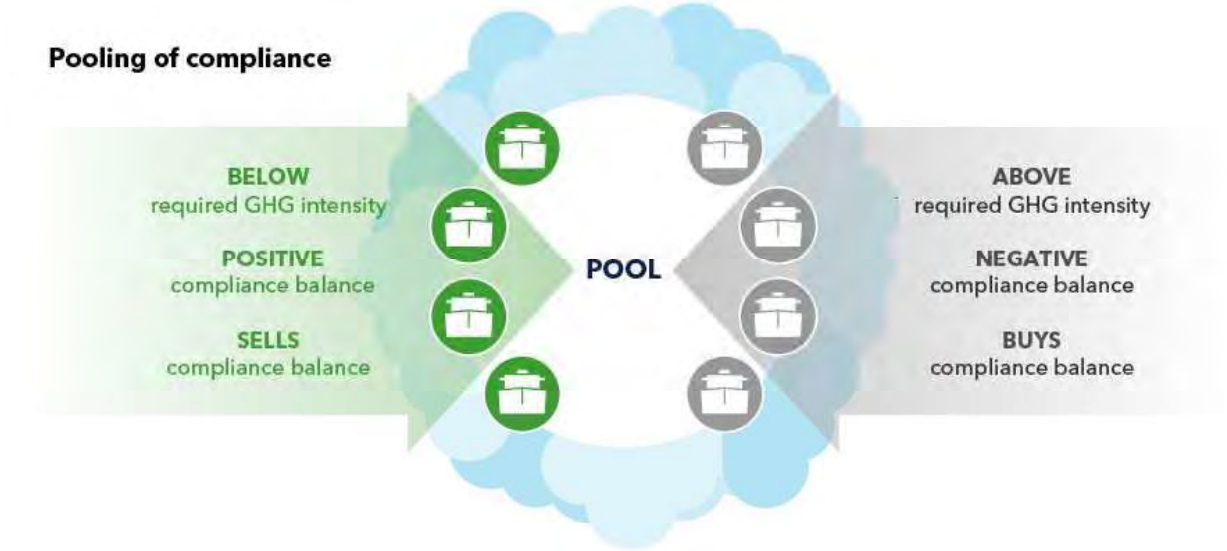
FuelEU applies to voyages and port calls in EU/EEA and voyages to and from EU/EEA



FuelEU offers flexibility mechanisms for non-compliant ships and for ships doing better than required

Simplified formula for calculating the compliance balance for each vessel

$$\text{Compliance balance } [tCO_2eq] = \left(\text{Required GHG intensity } \left[gCO_2eq/MJ\right] - \text{Actual GHG intensity } \left[gCO_2eq/MJ\right]\right) \times \sum \text{Energy } [TJ]$$



Flexibility mechanisms

- **Compliance pooling** with other ships
- **Borrowing** compliance surpluses from next year
- **Use banked** compliance surplus from last year(s)

Banking and borrowing

Borrow compliance

2025 2026

Max 2% of total CO_2e emissions (intensity limit multiplied by energy consumption) can be borrowed.

Next year's compliance balance reduced by an additional 10%

No pooling allowed

If no port calls the following year, a penalty has to be pad for the borrowed amount

Bank compliance

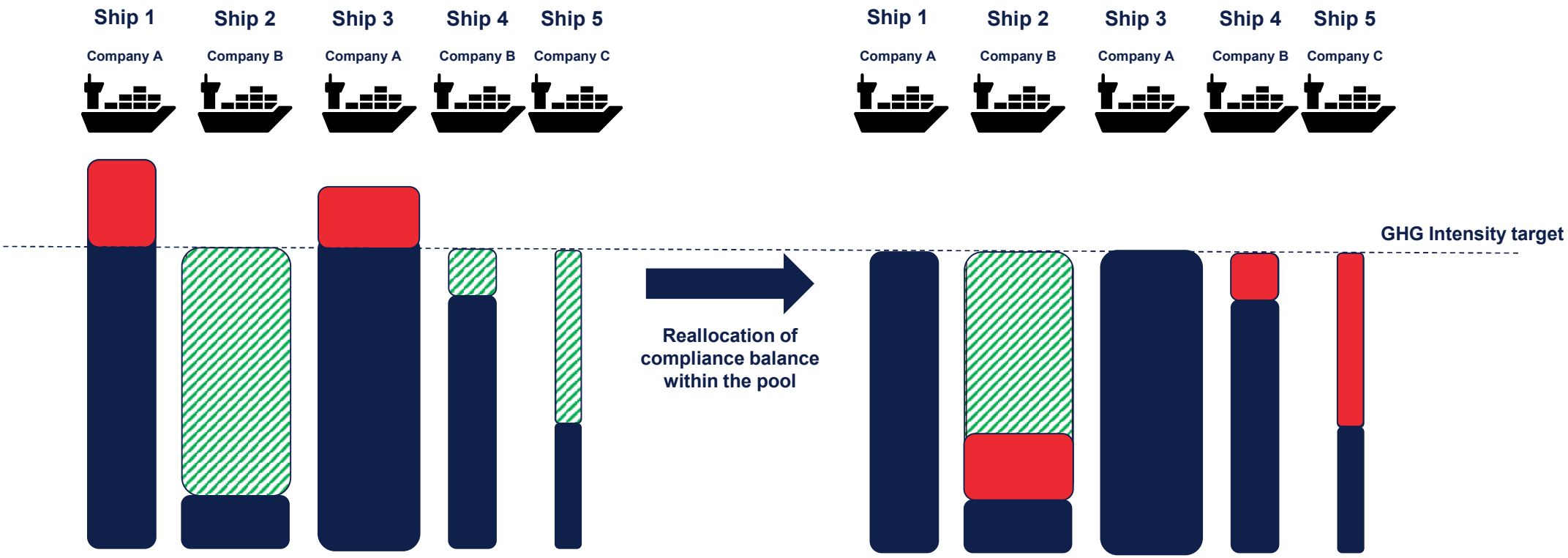
2025 2026

Compliance surplus be banked indefinitely

Compliance pooling

General rules

- Total pool compliance balance must be positive
- Ships with deficit before do not have a higher deficit
- Ships with surplus before do not have deficit



Adjusted compliance balance – tonnes CO_2eq

CB from reporting period + banked surplus - borrowed surplus

(width represents energy consumption, illustration only)

Annual compliance balance – tonnes CO_2eq

Pool members decide of allocation of compliance balance to individual ships

Remaning surplus can be banked

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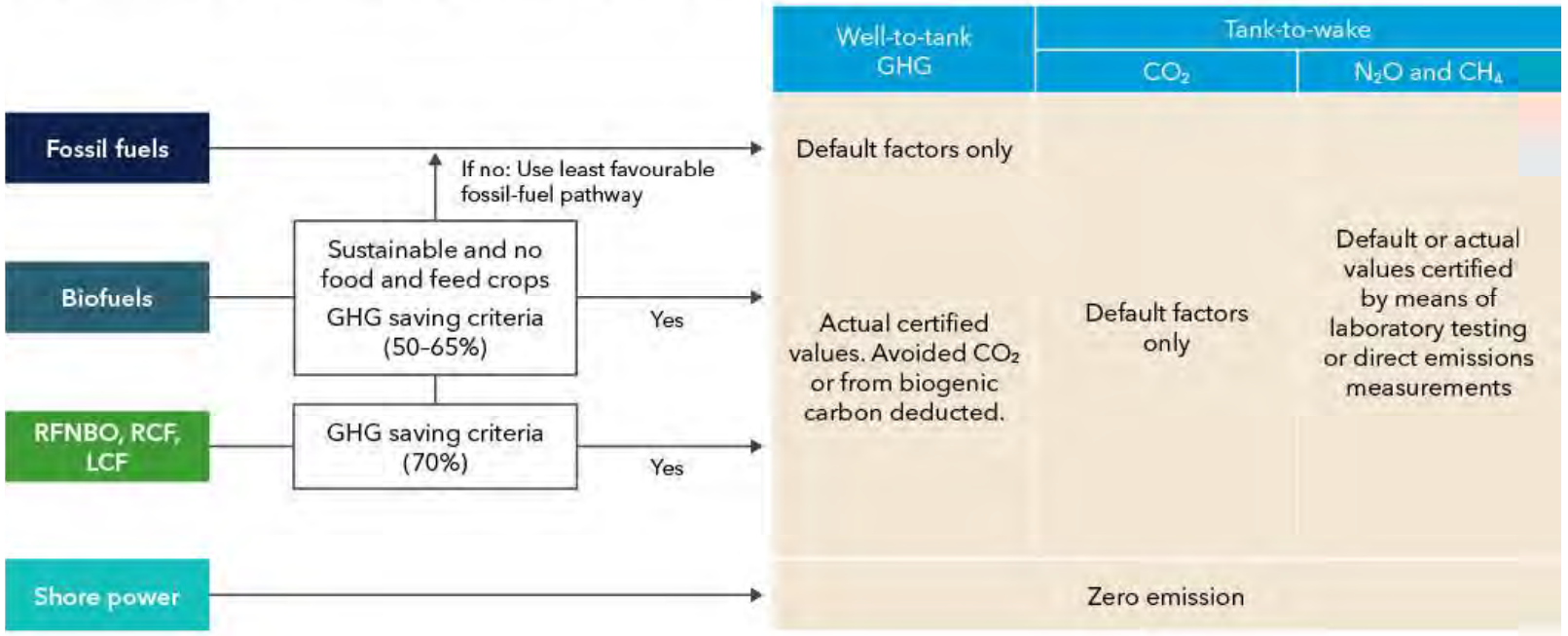
Fuels

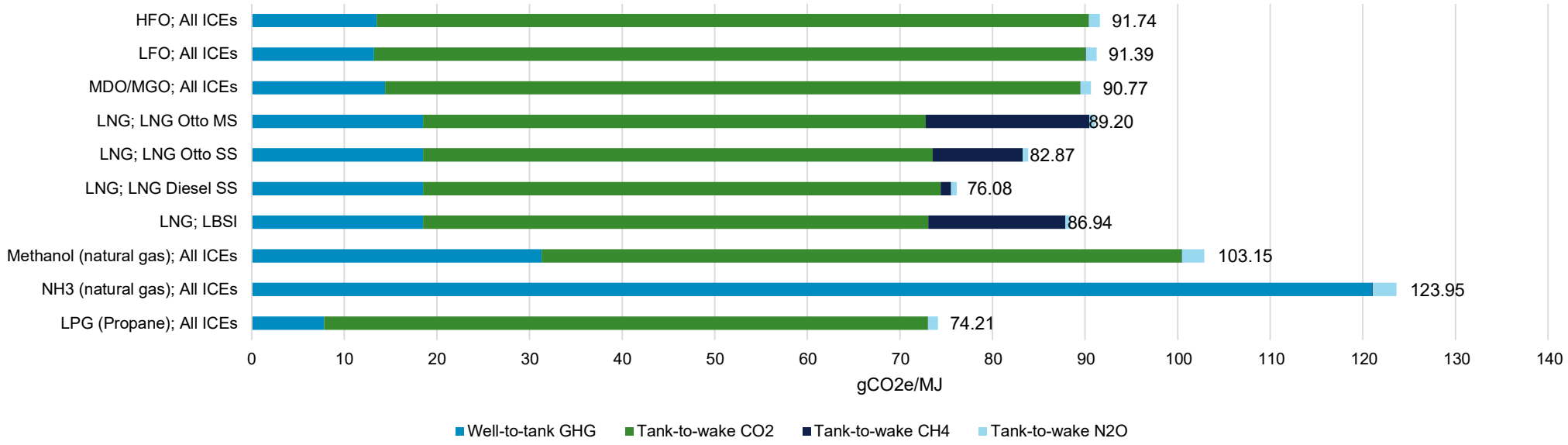
Only certified sustainable fuels with specified GHG savings can use actual GHG intensity emission factors

Fuel definitions and well-to-tank and tank-to-wake emission factors



RFNBO: Renewable Fuels of Non-Biological Origin; RCF: Recycled Carbon Fuels; LCF: Low Carbon Fuels

Default emission factors for fossil fuels



Based on AR4 GWP values.

Source: FuelEU Maritime Annex II

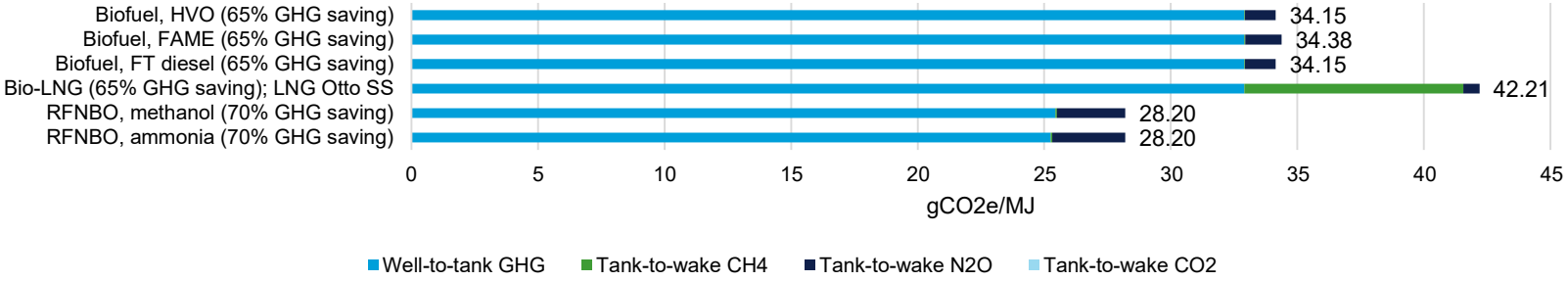
- Specific tank-to-wake CH_4 and N_2O emission factors can be used based on laboratory testing or direct emissions measurement (details on certification to be provided in delegated act)
- Only default factors allowed for well-to-tank GHG and tank-to-wake CO_2 emissions

Specific certified well-to-tank GHG values for non-fossil fuels

- Based on fuel definitions in EU's Renewable Energy Directive (RED)
- Must fulfil sustainability and GHG saving criteria – otherwise considered according to the least favourable fossil fuel type pathway
- Default factors from RED can be used during certification

Fuel		GHG saving criteria
Fossil fuel comparator		*94 gCO_2e/MJ*
Biofuels	Installations starting operation before 5 October 2015	50%
	Installations starting operation between 6 October 2015 and 31 December 2020	60%
	Installations starting operation from 1 January 2021	65%
Renewable fuels of non-biological origin		70%
Recycled Carbon Fuels		70%
Low carbon fuels		70%

Emission factor examples

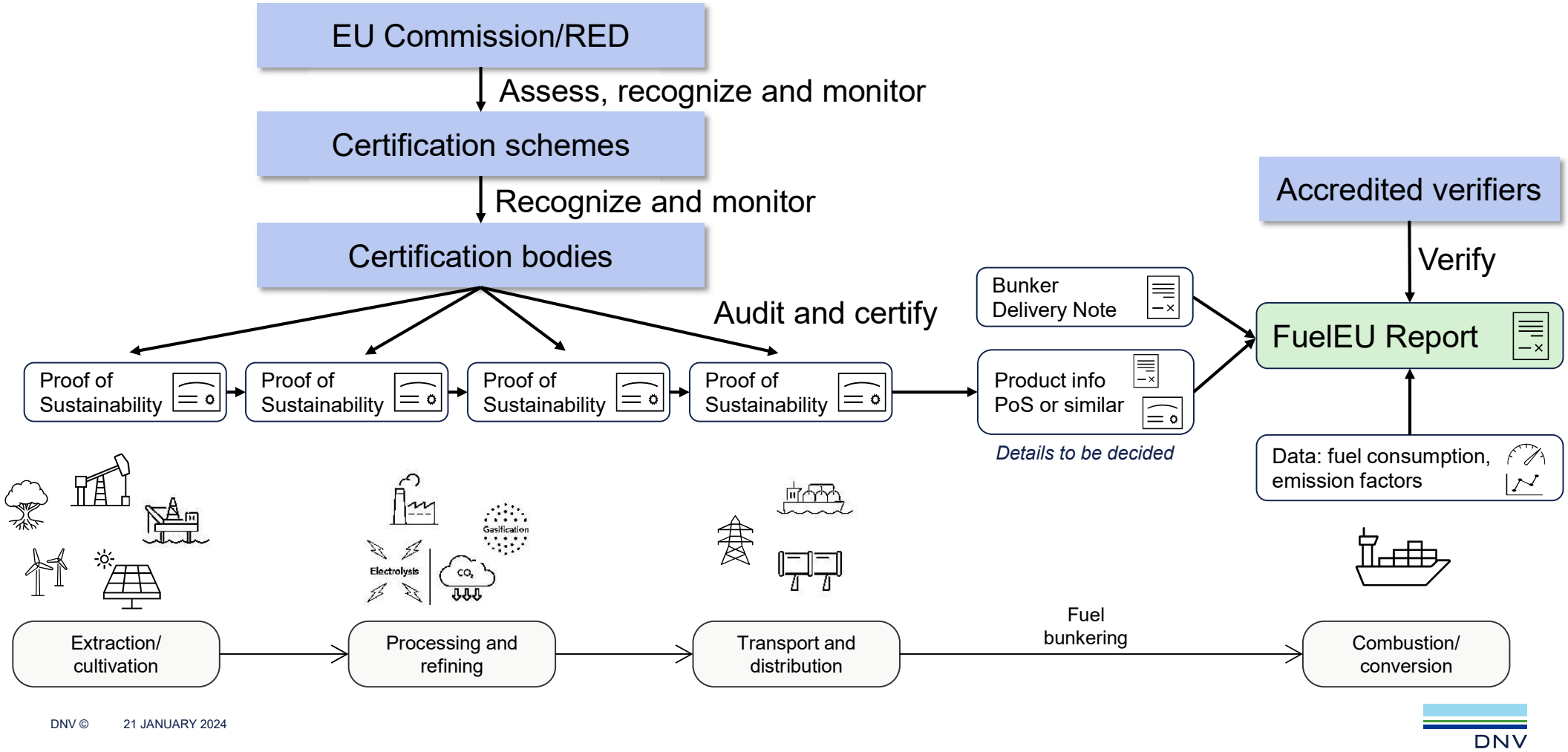


CO2 emissions not deducted from WtT and not included in TtW

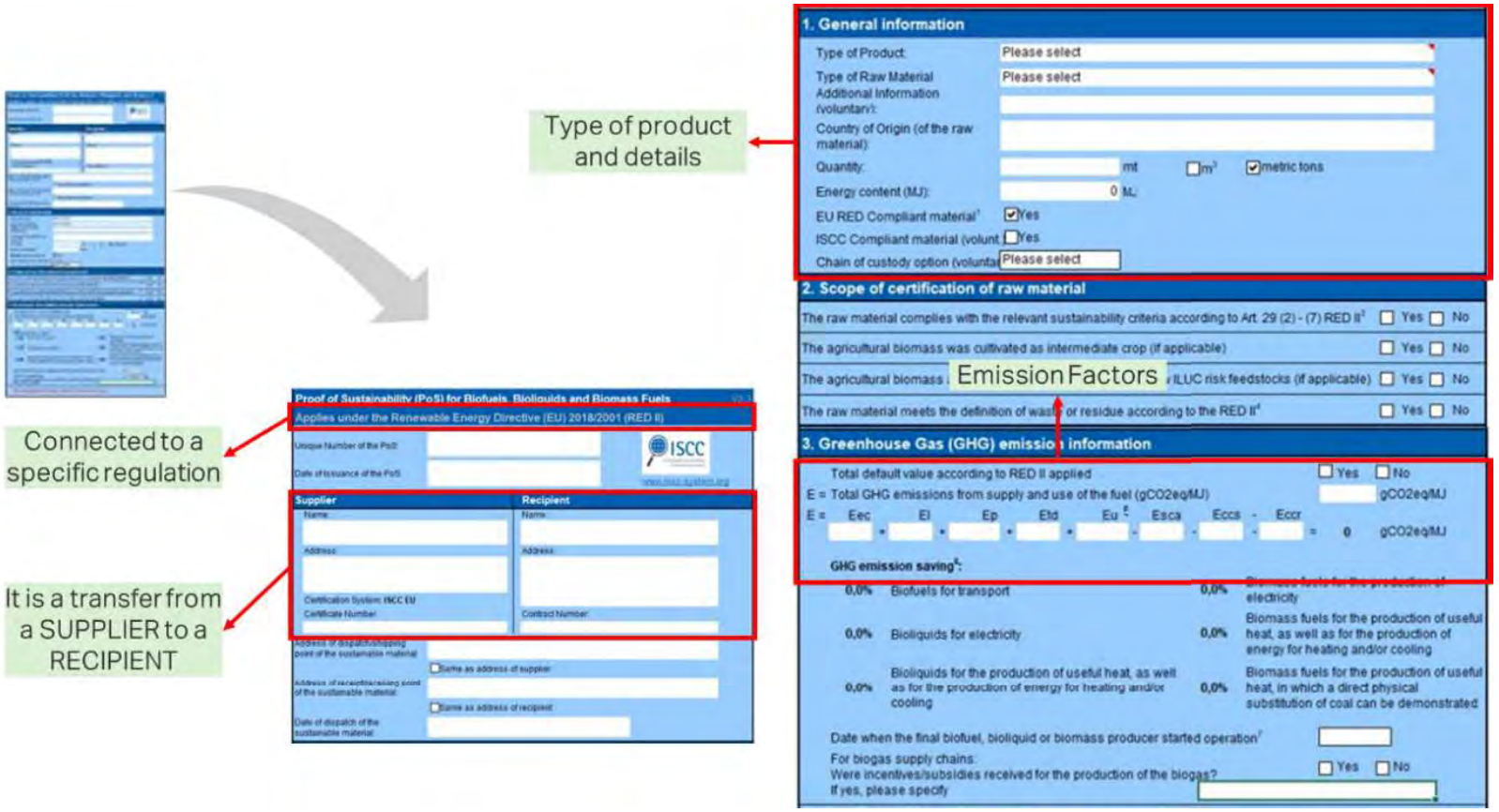
Based on AR4 GWP values

Source: FuelEU Maritime Annex II

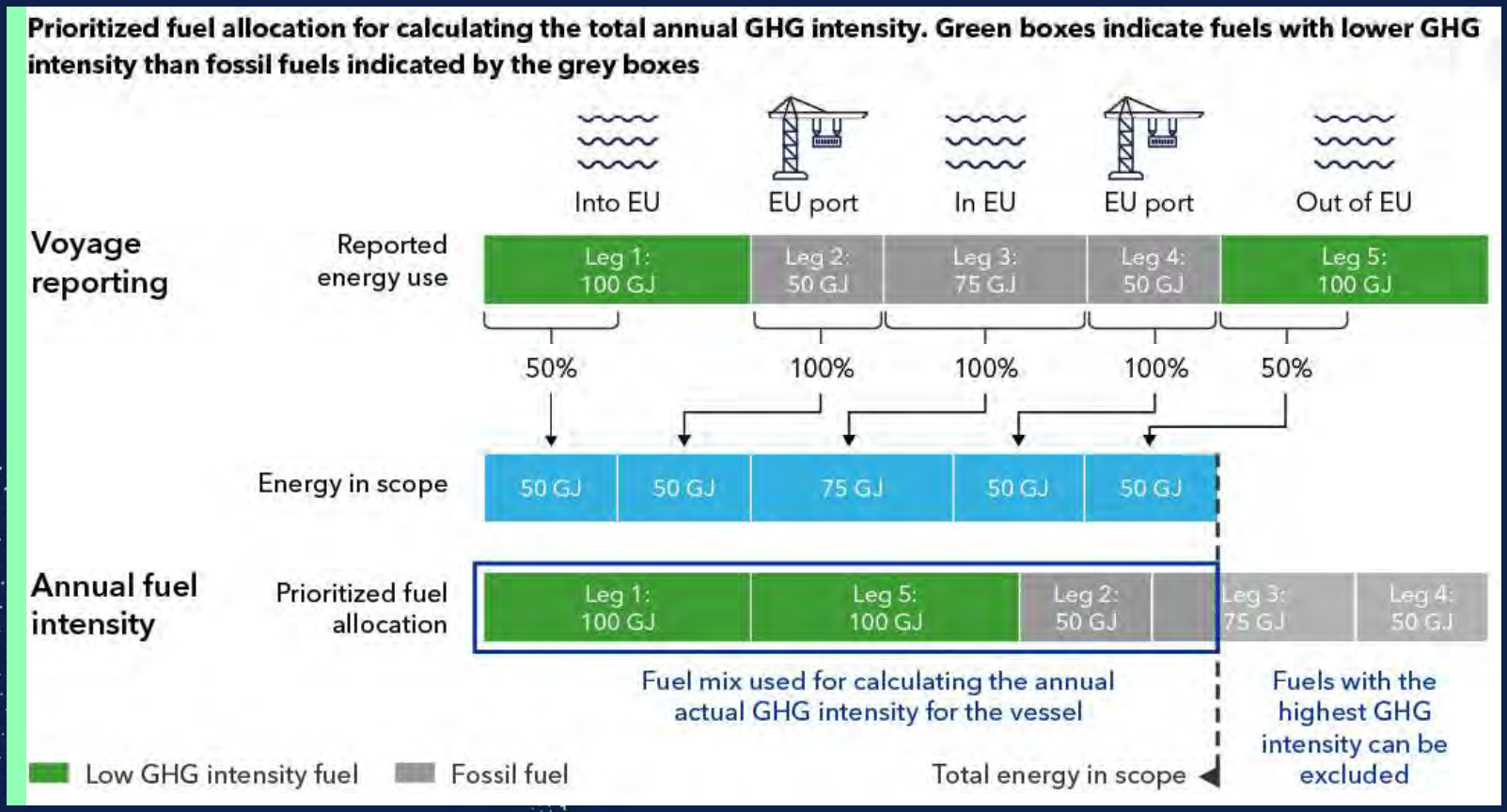
Certification of fuels and emissions reports



Proof of Sustainability - sample



Prioritized allocation of fuels across voyages



Other requirements and review

Shore power requirement

From 2030, container and passenger ships are required to connect to shore power, or use zero-emission technologies, for all electrical power demand when at berth for more than two hours in a TEN-T maritime port

From 2035, the requirement applies to all ports where shore power is available

Vessels not complying with the shore power or zero-emission technology requirement will need to pay a penalty

$$\text{Penalty}\,[€] = 1.50\,[€/_{kWh}] \times \text{Electrical power demand}\,[kW] \times \text{Time at berth not compliant}\,[\text{hours}]$$

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RFNBO requirement (possibly applicable from 1 January 2033)

The regulation includes a possible additional requirement on the use of RFNBOs from 1 January 2033, which will be triggered if the share of RFNBO in the energy mix in the 2031 reporting year is below 1%

The FuelEU Maritime Regulation will be reviewed by 31 December 2027

The review will particularly address:

- Ship types and sizes in scope –offshore vessels and ships below 5,000 GT could be included
- The GHG intensity limits in light of the EU's GHG emission targets
- Inclusion of onboard carbon capture as a compliance method
- Zero-emission requirements for ships at anchorage
- Exemptions and reward factors

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Session 2 – Calculation examples

GHG intensity calculation

GHG intensity

$$\text{GHG intensity}\left[gCO_2eq/MJ\right] = \frac{\text{Total GHG emissions } [tCO_2eq]}{\text{Total energy from fuels } [TJ] + \text{Total shore power } [TJ] + \text{Reward}_{RFNBO}\ [TJ]} \times \text{Reward}_{wind}$$

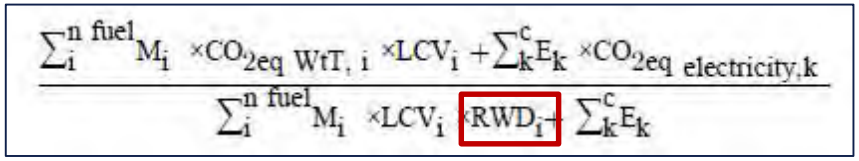
- GHG intensity is calculated on well-to-wake (WtW) basis
- The WtW GHG intensity can be separated in two parts:
  - Well-to-tank (WtT)
  - Tank-to-wake (TtW)
- Moreover, there are two reward factors:
  - Where wind-assisted propulsion is installed on board, a reward factor can be applied
  - Where the fuel is of non-biological origin, a reward factor of 2 from 1 January 2025 to 31 December 2033 can be applied. Otherwise RWDi = 1.

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

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

Well-to-tank emissions

- WtT



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

$$\frac{Sum(WtT\ emissions_{fuel}) + \sout{Sum(emissions_{shore\ power})}}{Sum(energy_{fuel} * reward) + Sum(energy_{shore\ power})}$$

- For the purposes of this Regulation, the term referent to electricity emissions shall be set to zero.
- Where the fuel is of non-biological origin, a reward factor of 2 from 1 January 2025 to 31 December 2033 can be applied. Otherwise RWDi = 1.

Tank-to-wake emissions

- TtW

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

$$\frac{Sum\left(TtW\ emissions_{combusted\ fuel,\ engine} + TtW\ emissions_{methane\ slip}\right)}{Sum\left(energy_{fuel} * reward\right) + Sum\left(energy_{shore\ power}\right)}$$

- Methane slip is relevant for LNG engines
- Where the fuel is of non-biological origin, a reward factor of 2 from 1 January 2025 to 31 December 2033 can be applied. Otherwise RWDi = 1.

Reward factor for wind-assisted propulsion (f_{wind})

- f_{wind}

Reward factor for wind-assisted propulsion – WIND (f_{wind})	$\frac{P_{Wind}}{P_{Prop}}$
0,99	0,05
0,97	0,1
0,95	≥ 0,15

- **P_{Wind} is the available effective power of the wind-assisted propulsion systems** and corresponds to f_{eff} * P_{eff} as calculated in accordance with the 2021 guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained energy efficiency design index (EEDI) and energy efficiency existing ships index (EEXI) (MEPC.1/Circ.896);
- **P_{Prop} is the propulsion power of the ship** and corresponds to P_{ME} as defined in the 2018 guidelines on the method of calculation of the attained EEDI for new ships (IMO resolution MEPC.364(79)) and the 2021 guidelines on the method of calculation of the attained EEXI (IMO resolution MEPC.333(76)). Where shaft motor(s) are installed, $P_{Prop} = P_{ME} + P_{PTI(i),shaft}$.

Examples: Single fuel GHG intensity calculation

GHG intensity calculation Fossil MGO

$$Well\ to\ Wake\ GHG\ intensity = \frac{gCO_{2eq}}{MJ}$$

- **Learning notes:**
  - Retrieve default factors from Table in Annex to the regulation
  - Divide TtW emission factors by LCV
  - Apply Global Warming Potential to CH_4 and N_2O
    - GWP CH_4 = 25
    - GWP N_2O = 298
- **Intensity based on default emission factors:**
  - WtT GHG: 14.4 gCO_2e/MJ
  - TtW CO_2: 3.206 / 0.0427 = 75.08 gCO_2e/MJ
  - TtW CH_4: 0.00005 / 0.0427 x 25 = 0.03 gCO_2e/MJ
  - TtW N_2O: 0.00018 / 0.0427 x 298 = 1.26 gCO_2e/MJ
- **WtW GHG intensity: 90.77 gCO_2e/MJ**

Default emission factors

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

GHG intensity calculation
Fossil LNG on LNG diesel (dual fuel slow speed)

- **Learning note:**
  - Methane slip to be deducted from TtW CO_2 and N_2O emissions

- **Intensity based on default emission factors:**
  - WtT GHG: 18.5 gCO2e/MJ
  - TtW CH_4-slip: 0.002 / 0.0491 x 25 = 1.02 gCO_2e/MJ
  - TtW CO_2: 2.75 x 0.998 / 0.0491 = 55.90 gCO_2e/MJ
  - TtW CH_4: 0 gCO_2e/MJ
  - TtW N_2O: 0.00011 x 0.998 / 0.0491 x 298 = 0.67 gCO_2e/MJ

- **WtW GHG intensity: 76.08 gCO_2e/MJ**

$$Well\ to\ Wake\ GHG\ intensity = \frac{gCO_{2eq}}{MJ}$$

Default emission factors

1	2	3	4	5	6	7	8	9
			WtT	TtW				
Fuel Class	Pathway name	$\left[\frac{LCV\ MJ}{g}\right]$	$\left[\frac{CO_{2eq\ WtT}\ gCO2eq}{MJ}\right]$	Fuel Consumer Unit Class	$\left[\frac{C_{f\ CO_2}\ gCO2}{gFuel}\right]$	$\left[\frac{C_{f\ CH_4}\ gCH_4}{gFuel}\right]$	$\left[\frac{C_{f\ N_2O}\ gN_2O}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used by the engine
Fossil	LNG	0,0491	18.5	LNG Otto (dual fuel medium speed)	2,750	0	0,00011	3,1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuel slow speed)				0,2
				LBSI				2,6[25]

GHG intensity calculation ammonia RFNBO

- **Learning note:**
  - Reward factor (2025 to 2033) set to 2
  - WtT emissions based on value from Proof of Sustainability with emissions from fuel in use subtracted

- **Intensity based on default emission factors:**
  - WtT GHG: 28.2 – 2.95 = 25.3 gCO2e/MJ
  - TtW CO_2: 0 gCO_2e/MJ
  - TtW CH_4: 0.00005 / 0.0186 x 25 = 0.07 gCO_2e/MJ
  - TtW N_2O: 0.00018 / 0.0186 x 298 = 2.88 gCO_2e/MJ

- **WtW GHG intensity: 28.2 gCO_2e/MJ**

$$Well\ to\ Wake\ GHG\ intensity = \frac{gCO_{2eq}}{MJ}$$

Default emission factors

1	2	3	4	5	6	7	8	9
			WtT	TtW				
Fuel Class	Pathway name	LCV $\left[\frac{MJ}{g}\right]$	$CO_{2eq\ WtT}$ $\left[\frac{gCO2eq}{MJ}\right]$	Fuel Consumer Unit Class	$C_{f\ CO_2}$ $\left[\frac{gCO2}{gFuel}\right]$	$C_{f\ CH_4}$ $\left[\frac{gCH_4}{gFuel}\right]$	$C_{f\ N_2O}$ $\left[\frac{gN_2O}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used by the engine
Renewable Fuels of Non-Biological Origin (RFNBO)-- e-Fuels	e-NH3	0,0186	N/A	Fuel Cells	0	N/A	TBM	N/A
				ICE	0	N/A	TBM	N/A

Assumed with 70% GHG saving

94 x (1-70%) = 28.2 gCO_2e/MJ. This includes emission from fuel in use assumed to be 2.95

Set to 0.00005

Set to 0.00018

GHG intensity calculation Sustainable biofuel

- **Learning notes:**
  - WtT emissions based on value from Proof of Sustainability with CO_2 emission subtracted (biomass credit) giving a negative WtT value

- **Intensity based on default emission factors:**
  - WtT GHG: 32.9 – 70.80 = – 37.90 gCO2e/MJ
  - TtW CO_2: 3.115 / 0.044 = 70.80 gCO_2e/MJ
  - TtW CH_4: 0.00005 / 0.044 x 25 = 0.03 gCO_2e/MJ
  - TtW N_2O: 0.00018 / 0.044 x 298= 1.22 gCO_2e/MJ

- **WtW GHG intensity: 34.15 gCO_2e/MJ**

$$Well\ to\ Wake\ GHG\ intensity = \frac{gCO_{2eq}}{MJ}$$

Default emission factors

1	2	3	4	5	6	7	8	9
			WtT	TtW				
Fuel Class	Pathway name	LCV $\left[\frac{MJ}{g}\right]$	$\left[\frac{CO_{2eq\ WtT}}{MJ}\right]$	Fuel Consumer Unit Class	$\left[\frac{C_{f\ CO_2}}{gFuel}\right]$	$\left[\frac{C_{f\ CH_4}}{gFuel}\right]$	$\left[\frac{C_{f\ N_2O}}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used by the engine
Biofuels	Hydrotreated Vegetable Oil (HVO) Production Pathways of Directive (EU) 2018/2001	Value as set out in Annex III of Directive (EU) 2018/2001	$E - \frac{C_{f\ CO_2}}{LCV}$	ALL ICEs	3,115	0,00005	0,00018	-

LCV_{HVO} = 0.044 MJ/g

Assumed produced with 65% GHG saving

94 x (1-65%) = 32.9 gCO_2e/MJ

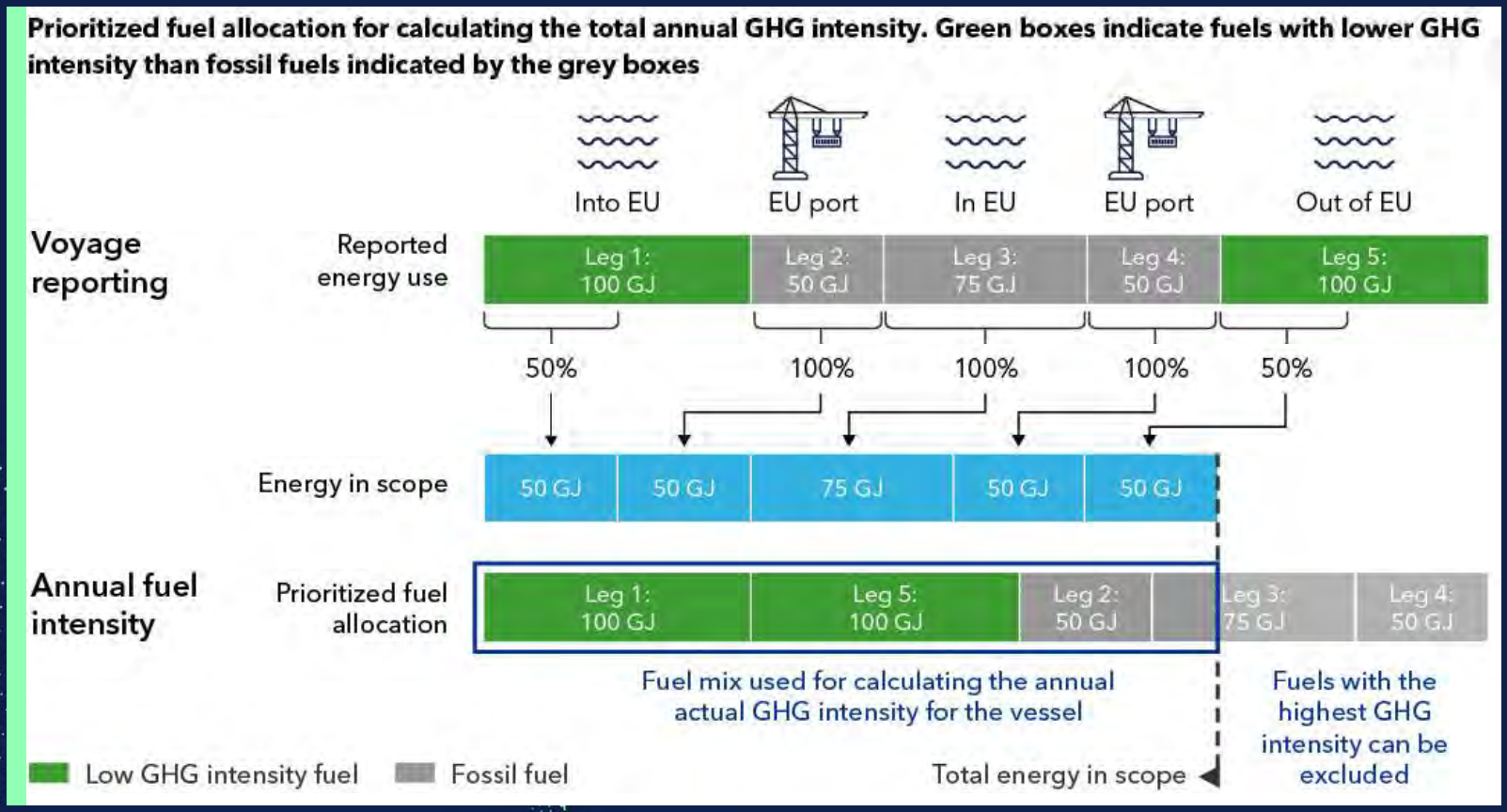
Examples: Annual GHG intensity calculation

GHG intensity compliance calculation example fossil MGO

- Monitor fuel consumption per voyage
- Convert to energy
- **Calculate energy in scope**
  - Voyages in and out of EU: 50%
  - Voyages and port calls in EU: 100%
  - Energy in scope: (5000 x 0.0427 x 50%) + (2000 x 0.0427 x 100%) = 192.2x10^6 MJ
- **Calculate GHG intensity:**
  - (90.77 x 192.2) / 192.2 = 90.77 gCO_2e/MJ

Voyage number	FuelEU	MGO [t]
Leg 1	Within EU	500
Port of Call 1	Within EU	100
Leg 2	Out of EU	1250
	Outside EU	N/A
Leg 3	Into EU	1250
Port of Call 2	Within EU	100
Leg 4	Within EU	500
Port of Call 3	Within EU	100
Leg 5	Out of EU	1250
	Outside EU	N/A
Leg 6	Into EU	1250
Port of Call 4	Within EU	100
Leg 7	Within EU	500
Port of Call 5	Within EU	100

Prioritized allocation of fuels across voyages



GHG intensity compliance calculation example
Biofuel blend – with prioritized allocation

- **Learning note:**
  - Two fuels where all biofuel used on voyages also in/out of the EU are prioritized first
- **Calculate energy in scope**
  - Voyages in and out of EU: 50%
  - Voyages and port calls in EU: 100%
  - Energy in scope: (3000 x 0.0427 x 50%) + (2000 x 0.0427 x 100%) + (2000 x 0.044 x 50%) = **193.5x10^6 MJ**
- **Fuel allocation:**
  - Total HVO used: (2000 x 0.044) = **88.0x10^6 MJ**
  - HVO used in calculation: min[193.5, 88.0] = **88.0x10^6 MJ**
    - Biofuel gets prioritized allocation
  - MGO used in calculation: 193.5 - 88.0 = **105.5x10^6 MJ**
    - MGO used for the remaining energy in scope
- **Calculated GHG intensity:**
  - (90.77 x 105.5 + 34.15 x 88) / 193 = **65.02 gCO$_2$e/MJ**

Voyage number	FuelEU	MGO [t]	MGO [GJ]	HVO [t]	HVO [GJ]	Energy in Scope [GJ]
Leg 1	Within EU	500	21 350	0	0	21 350
Port of Call 1	Within EU	100	4 270	0	0	4 270
Leg 2	Out of EU	750	32 025	500	22 000	27 013
	Outside EU	N/A				
Leg 3	Into EU	750	32 025	500	22 000	27 013
Port of Call 2	Within EU	100	4 270	0	0	4 270
Leg 4	Within EU	500	21 350	0	0	21 350
Port of Call 3	Within EU	100	4 270	0	0	4 270
Leg 5	Out of EU	750	32 025	500	22 000	27 013
	Outside EU	N/A				
Leg 6	Into EU	750	32 025	500	22 000	27 013
Port of Call 4	Within EU	100	4 270	0	0	4 270
Leg 7	Within EU	500	21 350	0	0	21 350
Port of Call 5	Within EU	100	4 270	0	0	4 270

Examples: Compliance balance and penalty

Compliance balance and penalty calculation

- **Calculated GHG intensity: 90.77 gCO_2eq/MJ**
- **Required GHG intensity (2025) = 89.34 gCO_2eq/MJ**

$$\text{Compliance balance } [tCO_2eq] = \left(\text{Required GHG intensity } \left[gCO_2eq/MJ\right] - \text{Actual GHG intensity } \left[gCO_2eq/MJ\right]\right) \times \sum \text{Energy } [TJ]$$

- **Compliance balance:** (89.34 – 90.77) x 192.2 = **- 274.8 tCO_2eq**

$$\text{Penalty } [€] = \frac{|\text{Compliance balance}|\,[tCO_2eq]}{\text{Actual GHG intensity } \left[gCO_2eq/MJ\right]} \times \frac{2{,}400\,[€/tVLSFOeq]}{41{,}000\,[MJ/tVLSFOeq]} \times \left(1 + \frac{\text{Consecutive periods} - 1}{10}\right)$$

- **Penalty:** |- 247.8| / 90.77 * 2400 / 41000 x 10^6 = **177 199 €**

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Compliance balance calculation example
Biofuel blend – with prioritized allocation

- **Fuel consumption:**
  - Voyages **in and out of EU**: 3 000 t MGO , 2 000 t HVO
  - Voyages and port calls **in EU**: 2 000 t MGO
- **Energy used and in scope:**
  - Energy in scope: (3000 x 0.0427 x 50%) + (2000 x 0.0427 x 100%) + (2000 x 0.044 x 50%) = **193.5×10^6 MJ**
- **Fuel allocation:**
  - HVO used in calculation: **88.0×10^6 MJ**
  - MGO used in calculation: **105.5×10^6 MJ**
- **Calculated GHG intensity:**
  - (90.77 x 105.5 + 34.15 x 88) / 193 = **65.02 gCO_2e/MJ**
- **Required GHG intensity (2025) = 89.34 gCO_2e/MJ**
- **Compliance balance:** (89.34 – 65.02) x 193.5 = **+ 4705.9 tCO_2e**
- **No penalty**

Voyage number	FuelEU	MGO [t]	HVO [t]
Leg 1	Within EU	500	0
Port of Call 1	Within EU	100	0
Leg 2	Out of EU	750	500
Leg 3	Into EU	750	500
Port of Call 2	Within EU	100	0
Leg 4	Within EU	500	0
Port of Call 3	Within EU	100	0
Leg 5	Out of EU	750	500
Leg 6	Into EU	750	500
Port of Call 4	Within EU	100	0
Leg 7	Within EU	500	0
Port of Call 5	Within EU	100	0

Biofuel break-even vs penalty example

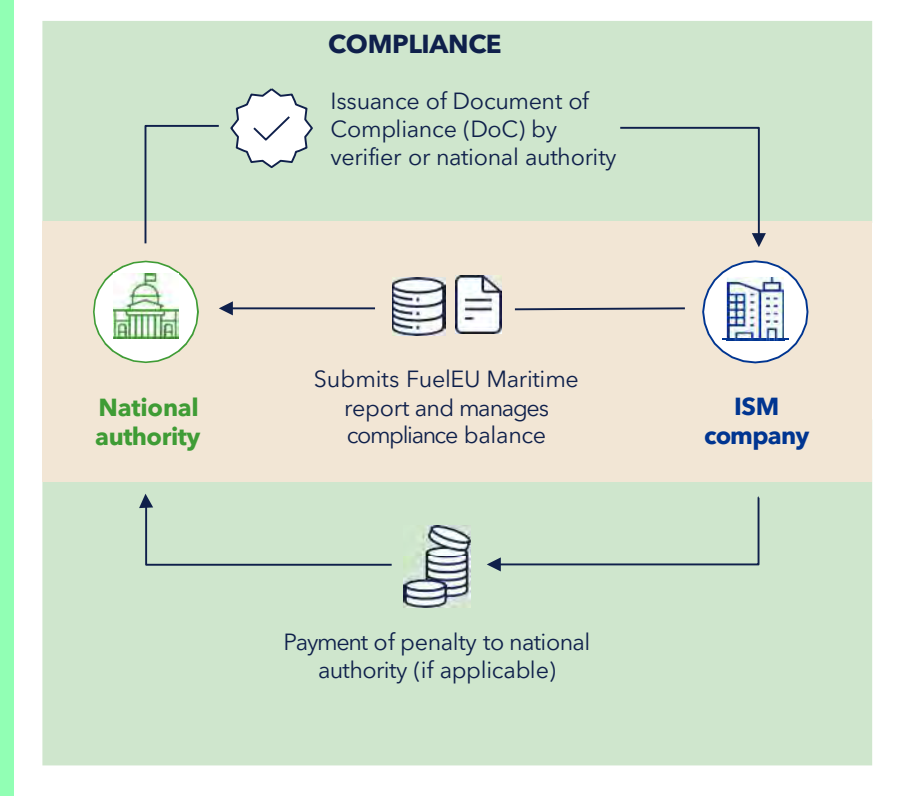
$$\text{Penalty}\,[€] = \frac{|\,\text{Compliance balance}\,|\,[tCO_2eq]}{\text{Actual GHG intensity}\,\left[{}^{gCO_2eq}/_{MJ}\right]} \times \frac{2{,}400\,[{}^{€}/_{tVLSFOeq}]}{41{,}000\,[{}^{MJ}/_{tVLSFOeq}]} \times \left(1 + \frac{\text{Consecutive periods} - 1}{10}\right)$$

- **Fuel consumption: 100 t LFO (4100 GJ)**
- **Penalty value: 2400 € / t VLSFO**
- **Compliance balance:** (89.34 – 91.39) x 4100 x10^3 MJ = **–8.4 tCO_2e**
- **Penalty:** –8.4 x 10^6 / (91.39 x 41000) x 2400 = **5384 €**
- **Carbon cost: 5384 / 8.4 = 641 €/tCO_2e**
- **Alternatively:** 97 t LFO and 3 t FAME
- **Compliance balance:** 0
- **LFO cost:** 600 USD/t
- **Break-even FAME cost (C):** 97t x 600 €/t + 3t x C €/t = 100t x 600€/t + 5384€ -> C = **2 394 €/t**

DNV

Session 3 – Monitoring, reporting and verification

ISM company is the responsible entity for FuelEU compliance



The ISM company:

- Can not shift responsibility to another entity
- Reports annual GHG emissions data for FuelEU compliance and declare banking, borrowing, and pooling
- Pays the FuelEU penalty cost if there is a compliance balance deficit

National authority

- Each ISM company will be assigned an Administering State which is the national authority of an EU/EEA Member State

Administering State (AS)

List of assignments to AS published by the Commission

Assignment criteria:

1. In the case of a shipping company **registered* in a Member State**, the Member State in which the shipping company is registered;
2. In the case of a shipping company that is **not registered in a Member State**, the Member State with the **greatest estimated number of port calls in the preceding four monitoring years**
3. In the case of a shipping company that is **not registered in a Member State** and that did **not carry out any voyage** in the preceding four monitoring years, the Member State where a ship of the shipping company **has started or ended its first voyage**

*Based on shipping company address as recorded in Thetis MRV

2024/411

COMMISSION IMPLEMENTING DECISION (EU) 2024/411

of 30 January 2024

on the list of shipping companies specifying the administering authority in respect of a shipping company in accordance with Directive 2003/87/EC of the European Parliament and of the Council

(Text with EEA relevance)

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC (1), and in particular Article 3gf(2), point (a), thereof,

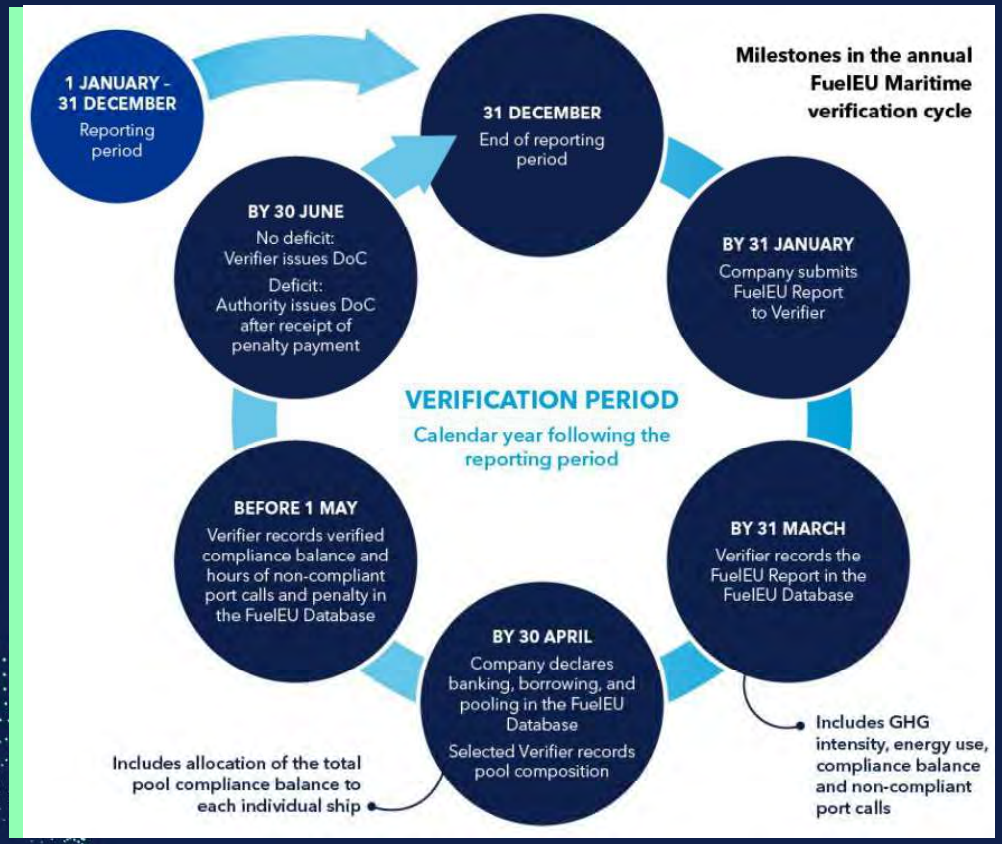
Whereas:

(1) Directive 2003/87/EC was amended recently by Directive (EU) 2023/959 of the European Parliament and of the Council (2) to include maritime transport emissions within the system for greenhouse gas emission allowance trading within the Union (the EU ETS).

(2) Directive 2003/87/EC provides for one Member State to be responsible for each shipping company. Pursuant to Directive 2003/87/EC, the Member State responsible for administering a shipping company is referred to as the 'administering authority in respect of a shipping company'. Article 3gf(1) and (3) of Directive 2003/87/EC and Articles 4 and 5 of Commission Implementing Regulation (EU) 2023/2599 (3) govern the attribution of each shipping company to its administering authority in respect of a shipping company. The establishment of a list of shipping companies and their administering authority in respect of a shipping company (the 'list') aims at reducing the administrative burden on shipping companies and on Member States by providing information on which Member State will administer a particular shipping company.

Commission Implementing Decision (EU) 2024/411

Monitoring, reporting and verification



Data monitoring and Emission Report

Digitalize and simplify

- The amount of data is significant
- This process is ideal for digitalization
- Digitalization of the process have delivered some key benefits:
  - Reduce administrative workload
  - Improved data quality – reduced workload correcting data issues
  - With good tools for managing data it is easy to meet contractual obligations connecting to sharing and collaboration between contractual parties in the maritime value chain

What to do?

1. **Plan for Digital reporting**

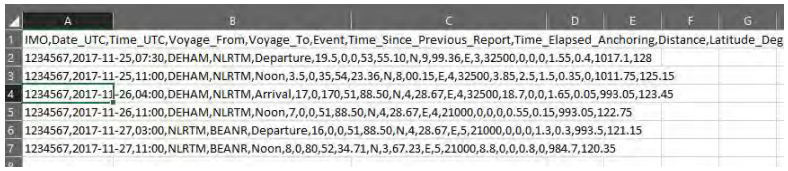
1) Set-up software monitor and to connect to your verifier (if possible)

2. **Generate your MP**

2) Prepare your MP

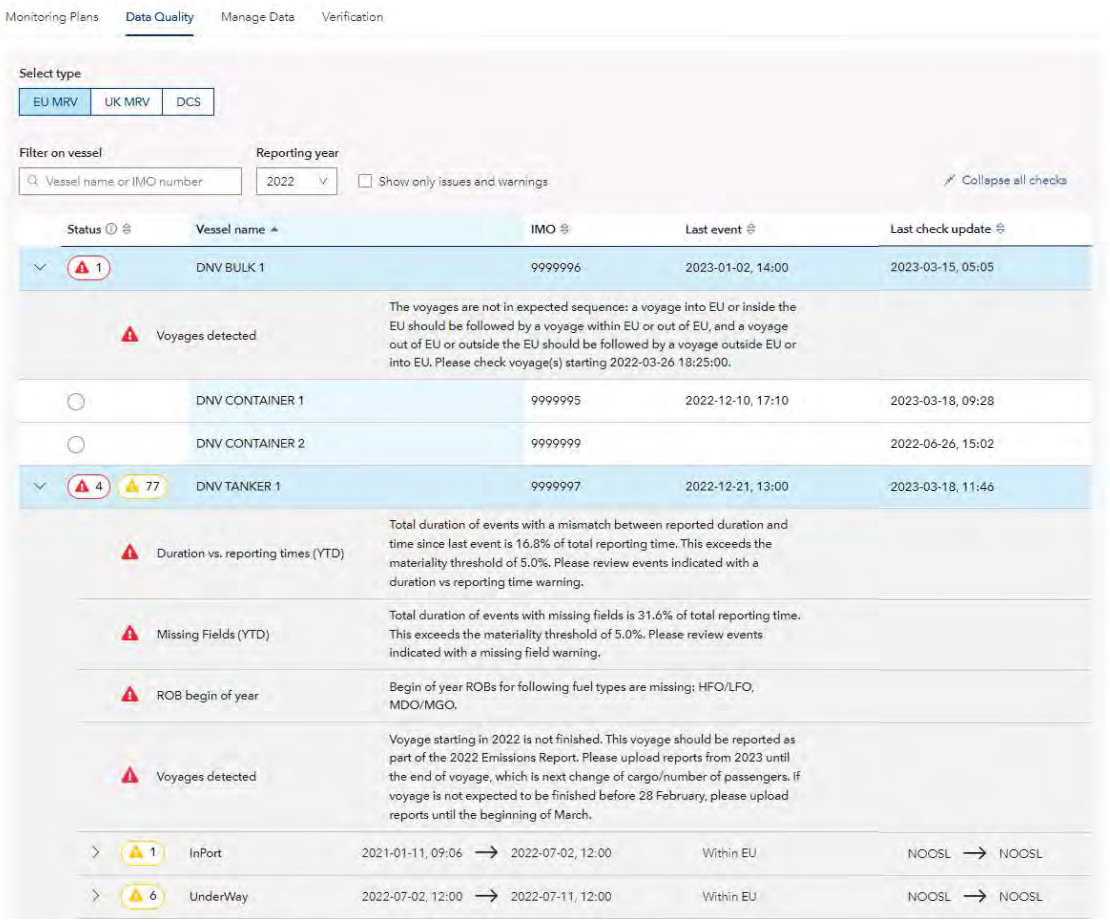
3. **Start monitoring!**

3) Start reporting ASAP – identify pain points, try & fail, then succeed



	A	B	C	D	E	F	G
1	IMO,Date_UTC,Time_UTC,Voyage_From,Voyage_To,Event,Time_Since_Previous_Report,Time_Elapsed_Anchoring,Distance,Latitude_Deg						
2	1234567,2017-11-25,07:30,DEHAM,NLRTM,Departure,19.5,0,0,53,55.10,N,9,99.36,E,3,32500,0,0,0,1.55,0.4,1017.1,128						
3	1234567,2017-11-25,11:00,DEHAM,NLRTM,Noon,3.5,0,35,54,23.36,N,8,00.15,E,4,32500,3.85,2.5,1.5,0.35,0,1011.75,125.15						
4	1234567,2017-11-26,04:00,DEHAM,NLRTM,Arrival,17,0,170,51,88.50,N,4,28.67,E,4,32500,18.7,0,0,1.65,0.05,993.05,123.45						
5	1234567,2017-11-26,11:00,DEHAM,NLRTM,Noon,7,0,0,51,88.50,N,4,28.67,E,4,21000,0,0,0,0.55,0.15,993.05,122.75						
6	1234567,2017-11-27,03:00,NLRTM,BEANR,Departure,16,0,0,51,88.50,N,4,28.67,E,5,21000,0,0,0,1.3,0.3,993.5,121.15						
7	1234567,2017-11-27,11:00,NLRTM,BEANR,Noon,8,0,80,52,34.71,N,3,67.23,E,5,21000,8.8,0,0,0.8,0,984.7,120.35						

Continuous data quality feedback



Transfer of company

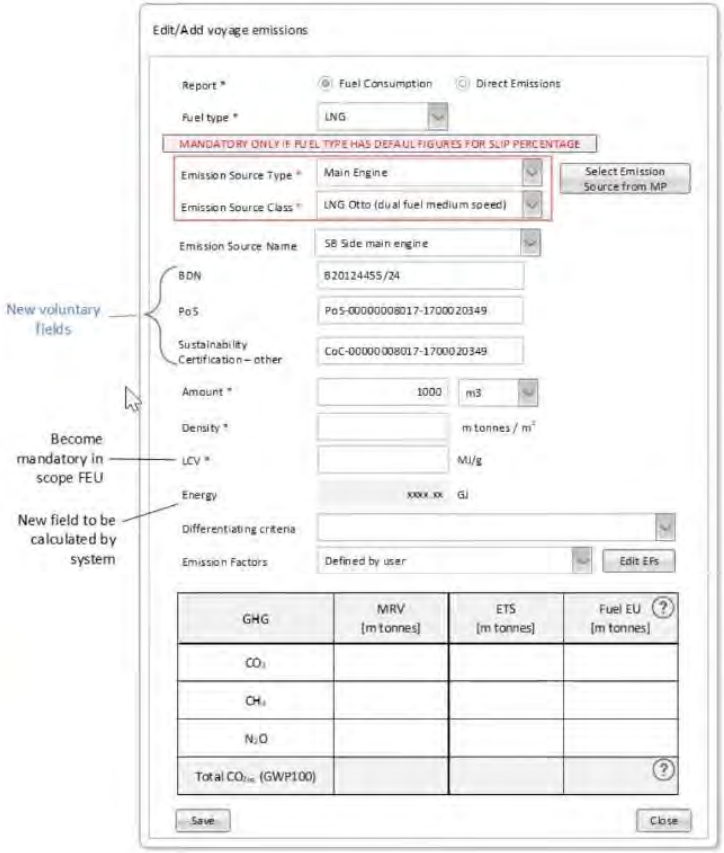
- Losing company must notify the verifier and within one month a partial FuelEU Report must be verified and recorded in the FuelEU Database.
- The company responsible for the ship on 31 December in each reporting period is responsible for requirements for the full reporting period, even if it gained the ship during the year.
  - If taking over a ship – make sure to get documentation about GHG emissions and intensity and compensation for any liability (i.e. negative compliance balance) incurred

FuelEU Database (Thetis MRV)

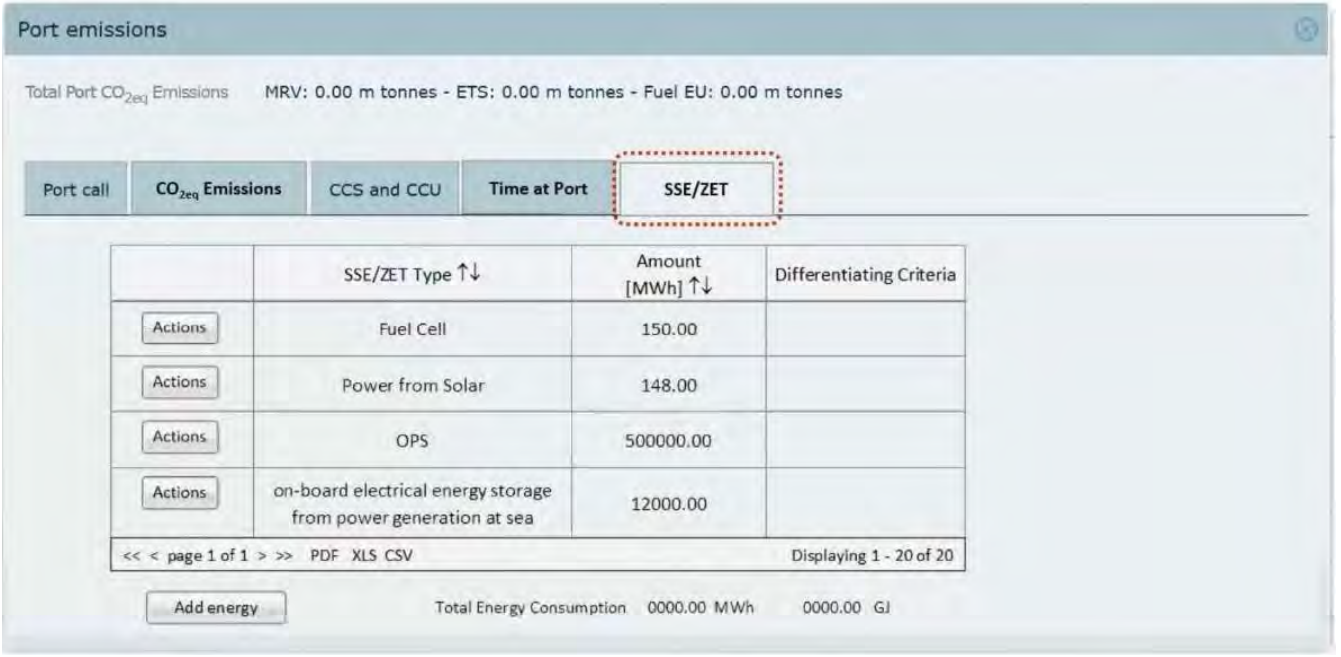
FuelEU Monitoring Plan functionality is available in Thetis - can clone current MRV MP. or upload via xml

Source: EMSA webinar 28 November 2024

As opposed to MRV, FuelEU requires reporting of each voyage in Thetis MRV

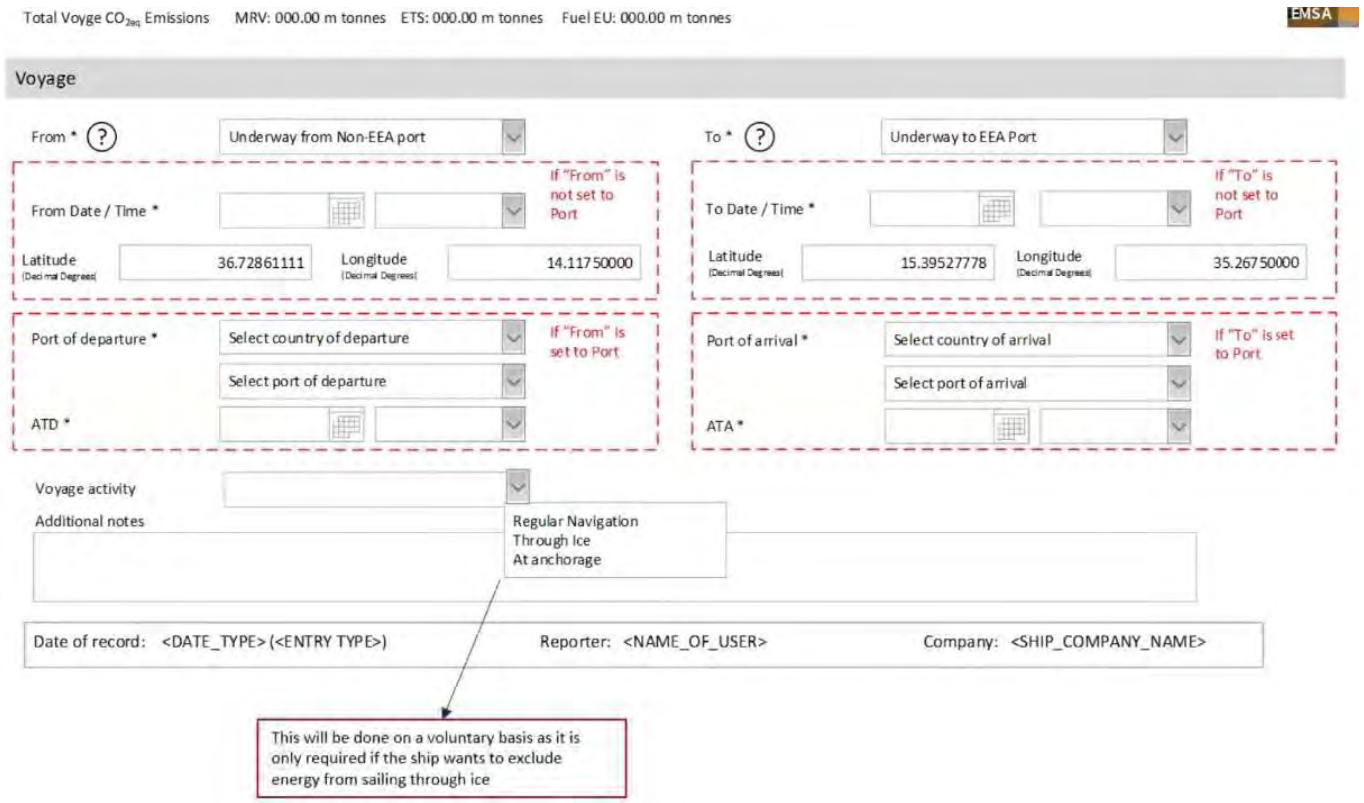


Bulk upload of data through xml possible

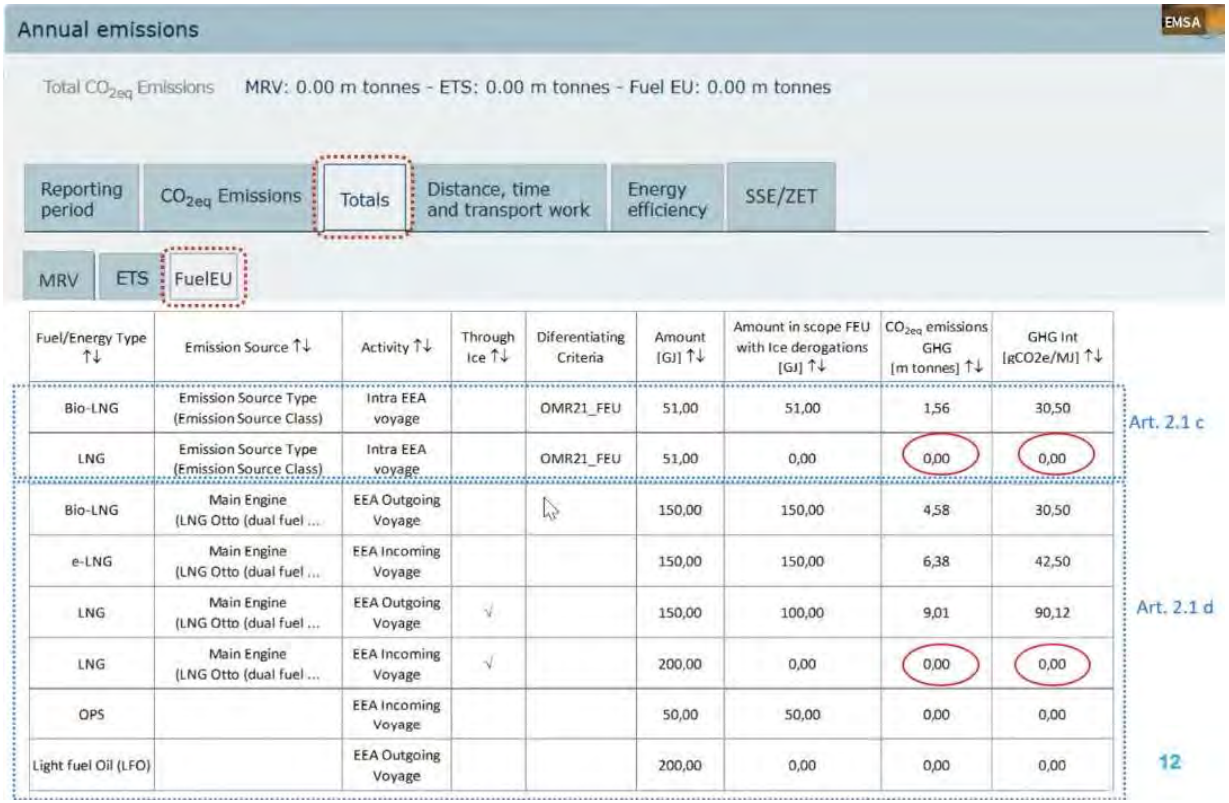


Source: EMSA webinar 28 November 2024

Sailing in ice



Annual emissions



Annual emissions

EMSA

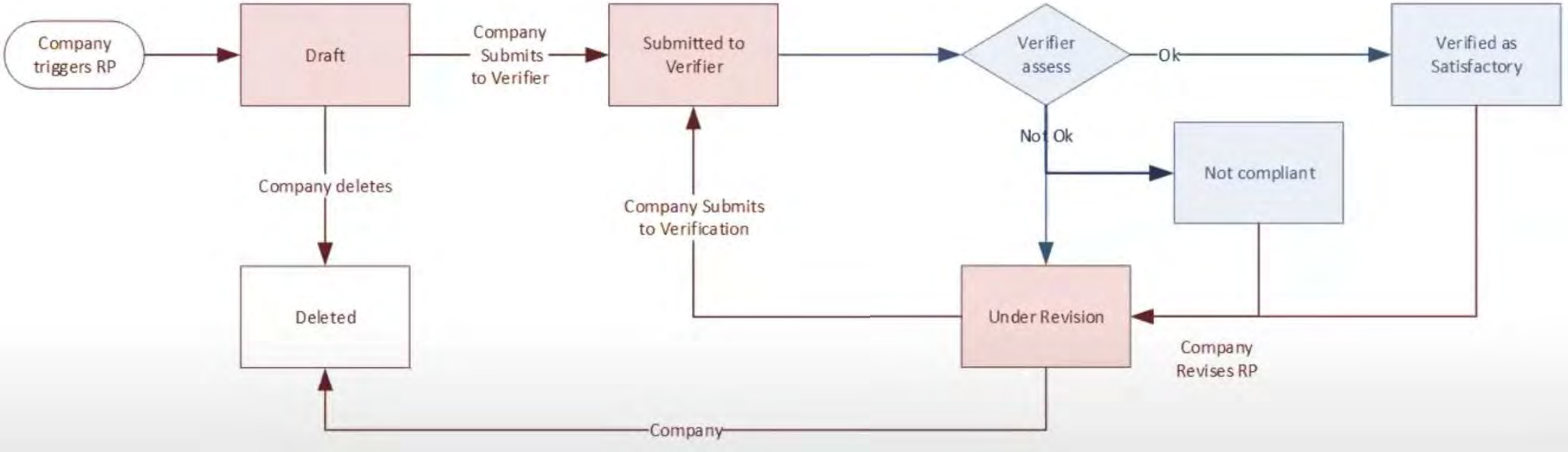
Total CO_{2eq} Emissions MRV: 0.00 m tonnes - ETS: 0.00 m tonnes - Fuel EU: 0.00 m tonnes

Reporting period | CO_{2eq} Emissions | Totals | Distance, time and transport work | Energy efficiency | SSE/ZET

MRV | ETS | FuelEU

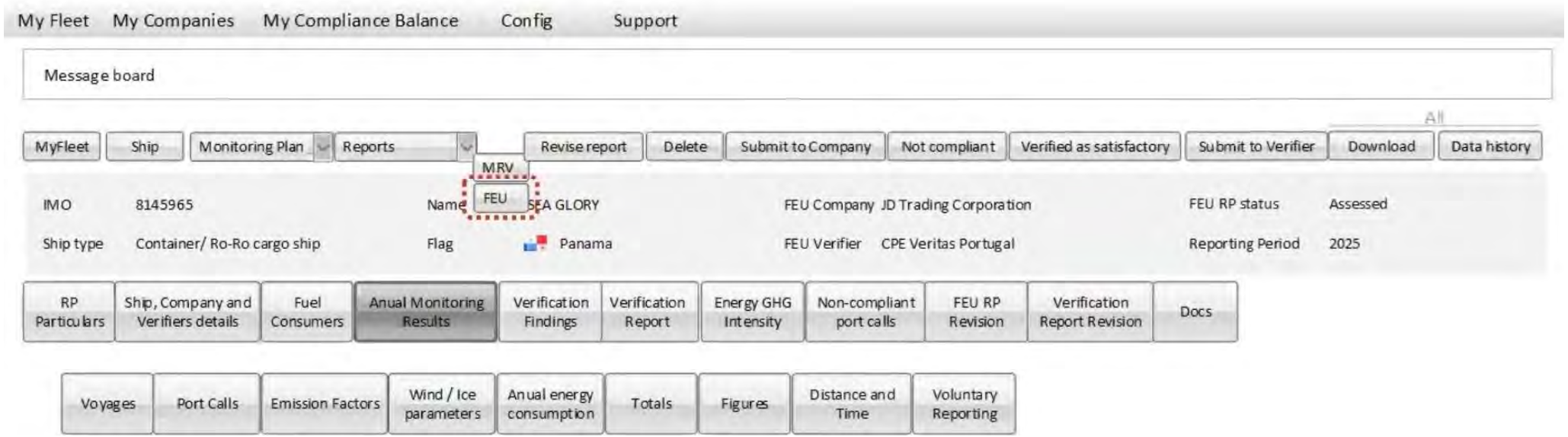
Fuel/Energy Type ↑↓	Emission Source ↑↓	Activity ↑↓	Through Ice ↑↓	Diferentiating Criteria	Amount [GJ] ↑↓	Amount in scope FEU with Ice derogations [GJ] ↑↓	CO_{2eq} emissions GHG [m tonnes] ↑↓	GHG Int [gCO2e/MJ] ↑↓	
Bio-LNG	Emission Source Type (Emission Source Class)	Intra EEA voyage		OMR21_FEU	51,00	51,00	1,56	30,50	Art. 2.1 c
LNG	Emission Source Type (Emission Source Class)	Intra EEA voyage		OMR21_FEU	51,00	0,00	0,00	0,00	
Bio-LNG	Main Engine (LNG Otto (dual fuel ...	EEA Outgoing Voyage			150,00	150,00	4,58	30,50	
e-LNG	Main Engine (LNG Otto (dual fuel ...	EEA Incoming Voyage			150,00	150,00	6,38	42,50	
LNG	Main Engine (LNG Otto (dual fuel ...	EEA Outgoing Voyage	√		150,00	100,00	9,01	90,12	Art. 2.1 d
LNG	Main Engine (LNG Otto (dual fuel ...	EEA Incoming Voyage	√		200,00	0,00	0,00	0,00	
OPS		EEA Incoming Voyage			50,00	50,00	0,00	0,00	
Light fuel Oil (LFO)		EEA Outgoing Voyage			200,00	0,00	0,00	0,00	12

FuelEU Report Workflow



Source: EMSA webinar 28 November 2024

Triggering reporting period



Voyage and port data

Voyage Data

RP Particulars | Ship, Company and Verifiers details | Fuel Consumers | Anual Monitoring Results | Verification Findings | Verification Report | Energy GHG Intensity | Non-compliant port calls | FEU RP Revision | Verification Report Revision | Docs

Voyages | Port Calls | Emission Factors | Anual energy consumption | Totals | Figures | Distance and Time | Voluntary Reporting

Departure		Arrival		Distance ↑↓	Through Ice ↑↓	Fuel Amount [m tonnes] ↑↓	SSE [GWh] ↑↓	Differentiating criteria ↑↓
Port/Position ↑↓	ATD ↑↓	Port/Position ↑↓	ATA ↑↓					
Funchal (EEA)	25/12/2024 15:35	Underway to EEA Port	01/01/2025 00:00			Bio-diesel - 30 LFO - 100 MDO - 15	Power from Wind - 1.5 Power from Solar - 0	OMR24_FEU
Underway to EEA Port	01/01/2025 00:00	Rotterdam	03/01/2025 08:02			Bio-diesel - 15 LFO - 40 MDO - 8	Power from Wind - 1.5 Power from Solar - 0	OMR24_FEU
Rotterdam	03/01/2025 18:15	Underway to EEA Port	04/01/2025 09:20			e-diesel - 40 LFO - 75 MDO - 10	Power from Wind - 1.5 Power from Solar - 0	
Underway from EEA Port 62°24.2' N 19°46.3' E	04/01/2025 09:20	Kemi	04/01/2025 16:30	700	√	Bio-diesel - 8 LFO - 32 MDO - 3	Power from Wind - 1.5 Power from Solar - 0	
Kemi	05/01/2025 09:30	Underway to non-EEA Port 63°16'06.7"N 20°07.6' E	05/01/2025 18:15	850	√	Bio-diesel - 6 LFO - 24 MDO - 3	Power from Wind - 1.5 Power from Solar - 0	
Underway from non-EEA Port	05/01/2025 18:15	Southampton	07/01/2025 12:15			Bio-diesel - 30 LFO - 120 MDO - 8	Power from Wind - 1.5 Power from Solar - 0	

Port Data

RP Particulars | Ship, Company and Verifiers details | Fuel Consumers | Anual Monitoring Results | Verification Findings | Verification Report | Energy GHG Intensity | Non-compliant port calls | FEU RP Revision | Verification Report Revision | Docs

Voyages | Port Calls | Emission Factors | Anual energy consumption | Totals | Figures | Distance and Time | Voluntary Reporting

Port ↑↓	ATA ↑↓	ATD ↑↓	Time at Berth ↑↓	Fuel Amount [m tonnes] ↑↓	SSE/ZET [GWh] ↑↓	Diferentiating criteria ↑↓
Funchal (EEA)	03/01/2025 08:02	03/01/2025 18:15	At Quayside - 23 At Anchorage- 10	MDO - 125 HVO - 50	Power from Wind - 0 Power from Solar - 0 OPS - 250 ZET - 0	OMR24_FEU
Kemi (EEA)	04/01/2025 16:30	05/01/2025 09:30	At Quayside - 23 At Anchorage- 11	MDO - 125 HVO - 51	Power from Wind - 0 Power from Solar - 0 OPS - 0 ZET - 250	

Emission factors

Emissions Factors list

Slip emission factor included in Fuel Consumers list

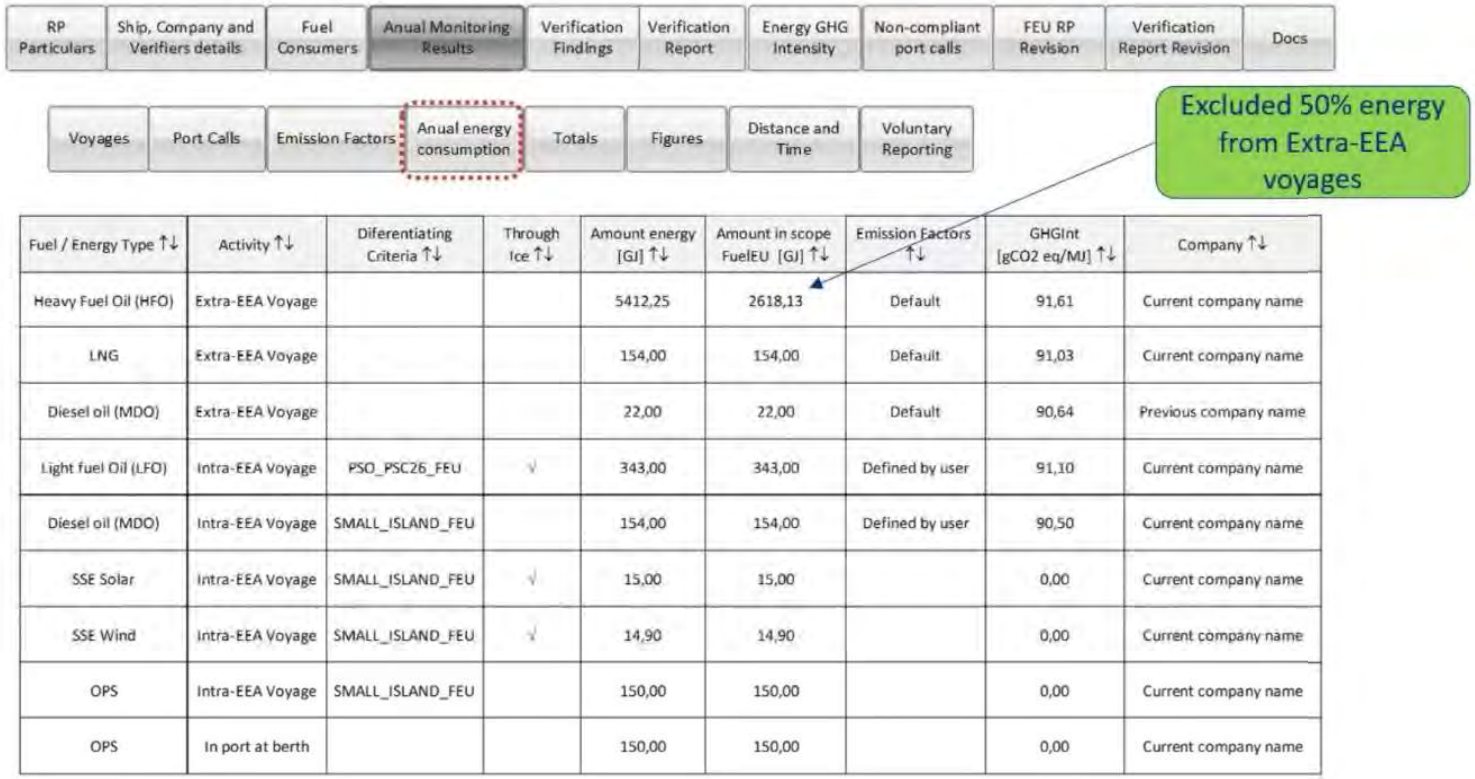
RP Particulars | Ship, Company and Verifiers details | Fuel Consumers | Anual Monitoring Results | Verification Findings | Verification Report | Energy GHG Intensity | Non-compliant port calls | FEU RP Revision | Verification Report Revision | Docs

Voyages | Port Calls | Emission Factors | Anual energy consumption | Totals | Figures | Distance and Time | Voluntary Reporting

Fuel Type	Fuel amount (m tonnes)	LCV (MJ/g)	EF Type	Emission Factors	EF Value
Diesel oil (MDO)	154,00	0,0427	WtT	Default	14,40000
Diesel oil (MDO)	154,00	0,0427	TTW CO_2	Default	3,20600
Diesel oil (MDO)	154,00	0,0427	TTW CH_4	Default	0,00005
Diesel oil (MDO)	154,00	0,0427	TTW N_2O	Default	0,00018
Light Fuel Oil (LFO)	5412,25	0,0410	WtT	Default	13,20000
Light Fuel Oil (LFO)	5412,25	0,0410	TTW CO_2	Default	3,15100
Light Fuel Oil (LFO)	5412,25	0,0410	TTW CH_4	Default	0,00005
Light Fuel Oil (LFO)	5412,25	0,0410	TTW N_2O	Defined by user	0,00011
Bio-Diesel	51,23	0,0440	WtT	Defined by user	-49,50000
Bio-Diesel	51,23	0,0440	TTW CO_2	Defined by user	2,82000
Bio-Diesel	51,23	0,0440	TTW CH_4	Defined by user	0,00004
Bio-Diesel	51,23	0,0440	TTW N_2O	Default	0,00018

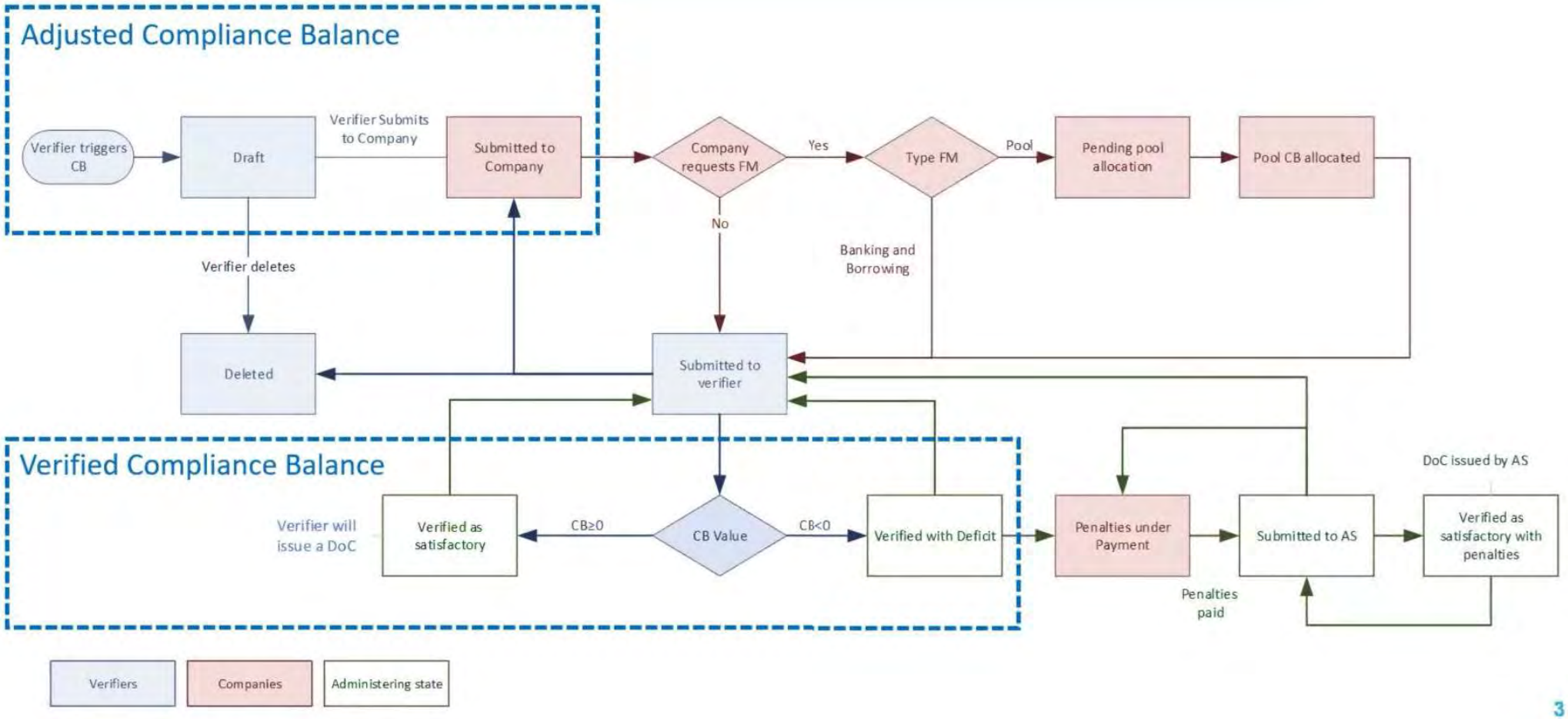
Reason for EF change	Fuel amount (m tonnes)	EF type	EF Value
Onboard measurement	5412,25	TTW N_2O	0,00011 [gGHG/gFuel]
Proof of sustainability	51,23	WTT	-49,5 [gGHG/MJ]
Accredited laboratory result	51,23	TTW CO_2	2,82 [gGHG/gFuel]
Methodology defined in the Monitoring Plan	51,23	TTW CH_4	0,00004 [gGHG/gFuel]

Annual energy consumption



Fuel / Energy Type ↑↓	Activity ↑↓	Diferentiating Criteria ↑↓	Through Ice ↑↓	Amount energy [GJ] ↑↓	Amount in scope FuelEU [GJ] ↑↓	Emission Factors ↑↓	GHGInt [gCO2 eq/MJ] ↑↓	Company ↑↓
Heavy Fuel Oil (HFO)	Extra-EEA Voyage			5412,25	2618,13	Default	91,61	Current company name
LNG	Extra-EEA Voyage			154,00	154,00	Default	91,03	Current company name
Diesel oil (MDO)	Extra-EEA Voyage			22,00	22,00	Default	90,64	Previous company name
Light fuel Oil (LFO)	Intra-EEA Voyage	PSO_PSC26_FEU	√	343,00	343,00	Defined by user	91,10	Current company name
Diesel oil (MDO)	Intra-EEA Voyage	SMALL_ISLAND_FEU		154,00	154,00	Defined by user	90,50	Current company name
SSE Solar	Intra-EEA Voyage	SMALL_ISLAND_FEU	√	15,00	15,00		0,00	Current company name
SSE Wind	Intra-EEA Voyage	SMALL_ISLAND_FEU	√	14,90	14,90		0,00	Current company name
OPS	Intra-EEA Voyage	SMALL_ISLAND_FEU		150,00	150,00		0,00	Current company name
OPS	In port at berth			150,00	150,00		0,00	Current company name

Verification process



Source: EMSA webinar 28 November 2024

Banking and borrowing

Borrow compliance

2025 2026

Max 2% of total CO_2e emissions (intensity limit multiplied by energy consumption) can be borrowed.

Next year's compliance balance reduced by an additional 10%

No pooling allowed

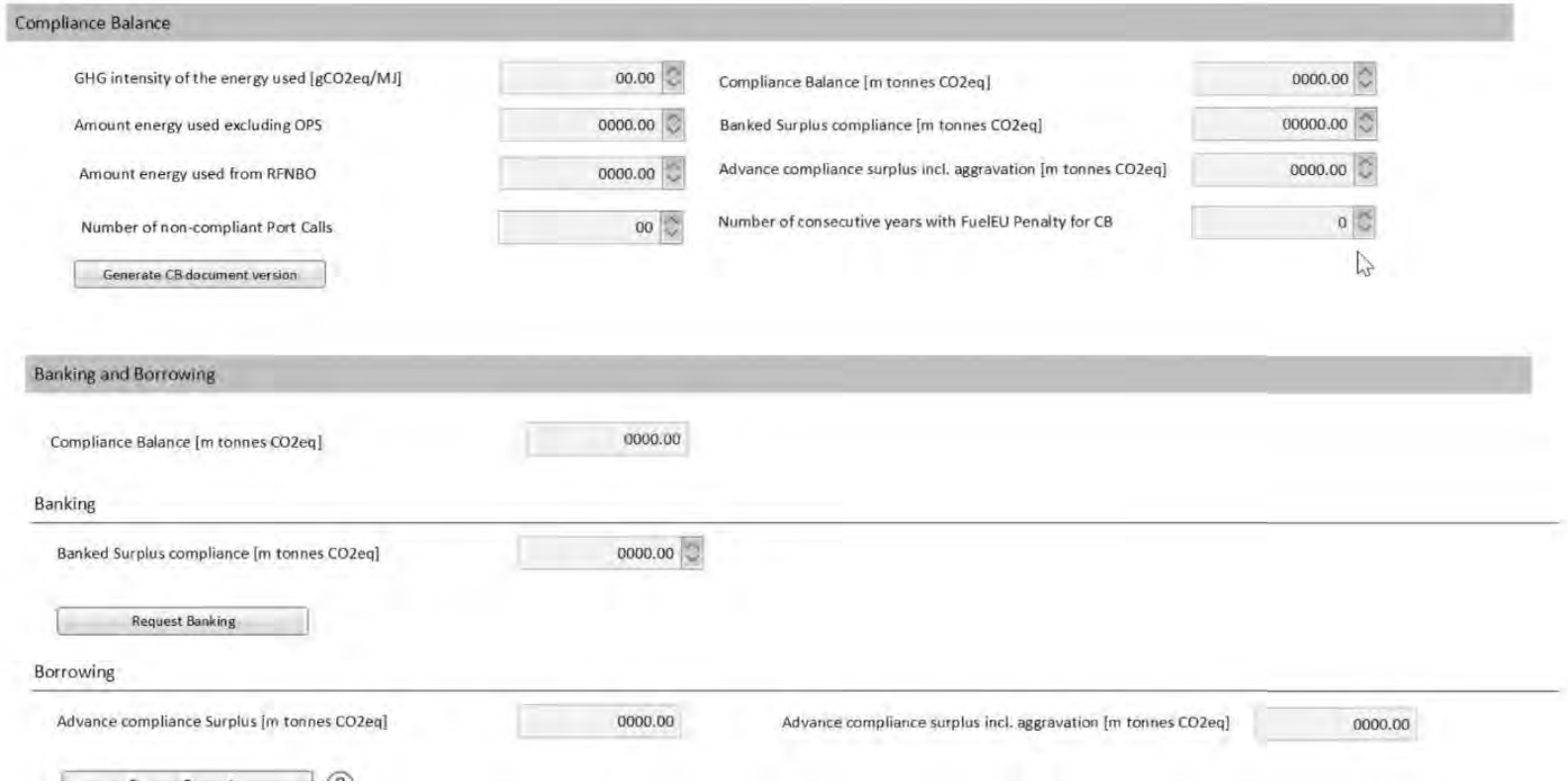
If no port calls the following year, a penalty has to be pad for the borrowed amount

Bank compliance

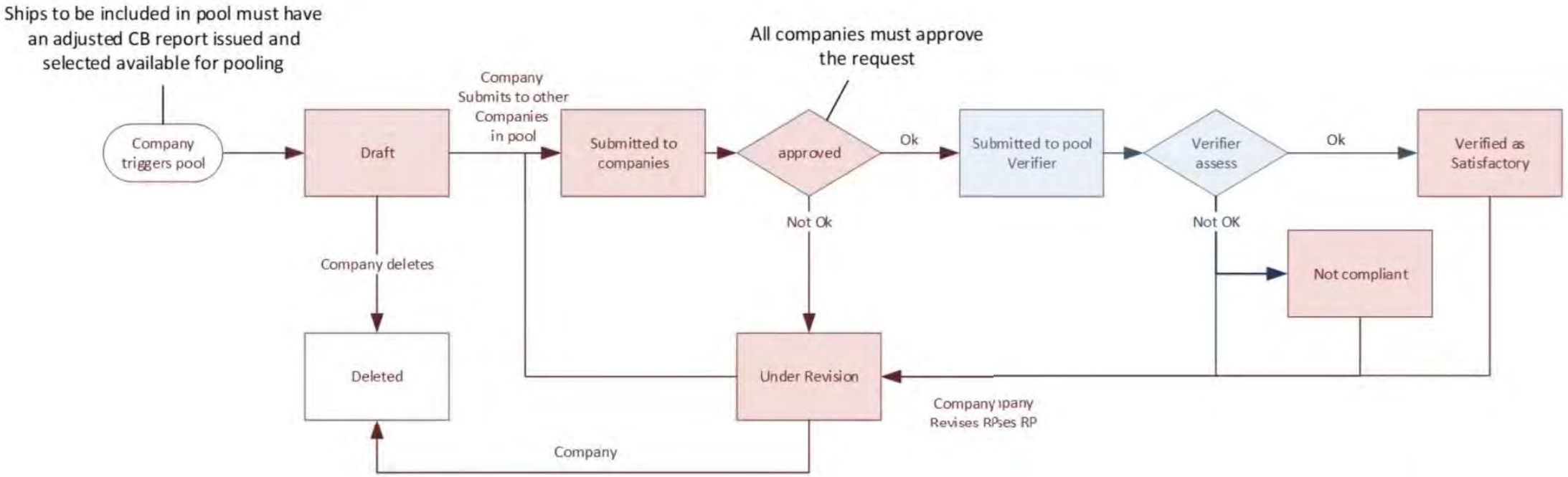
2025 2026

Compliance surplus be banked indefinitely

Adjusted compliance balance, banking and borrowing



Pooling process

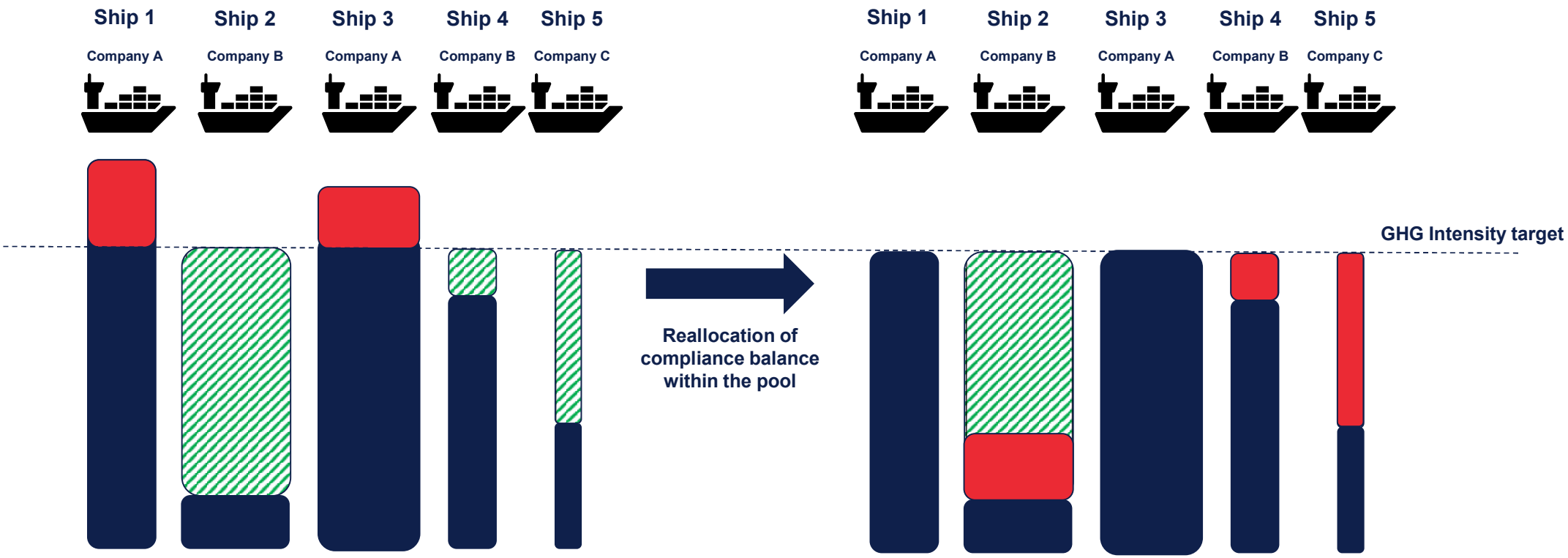


Source: EMSA webinar 28 November 2024

Compliance pooling

General rules

- Total pool compliance balance must be positive
- Ships with deficit before do not have a higher deficit
- Ships with surplus before do not have deficit



Adjusted compliance balance – tonnes CO_2eq

CB from reporting period + banked surplus - borrowed surplus

(width represents energy consumption, illustration only)

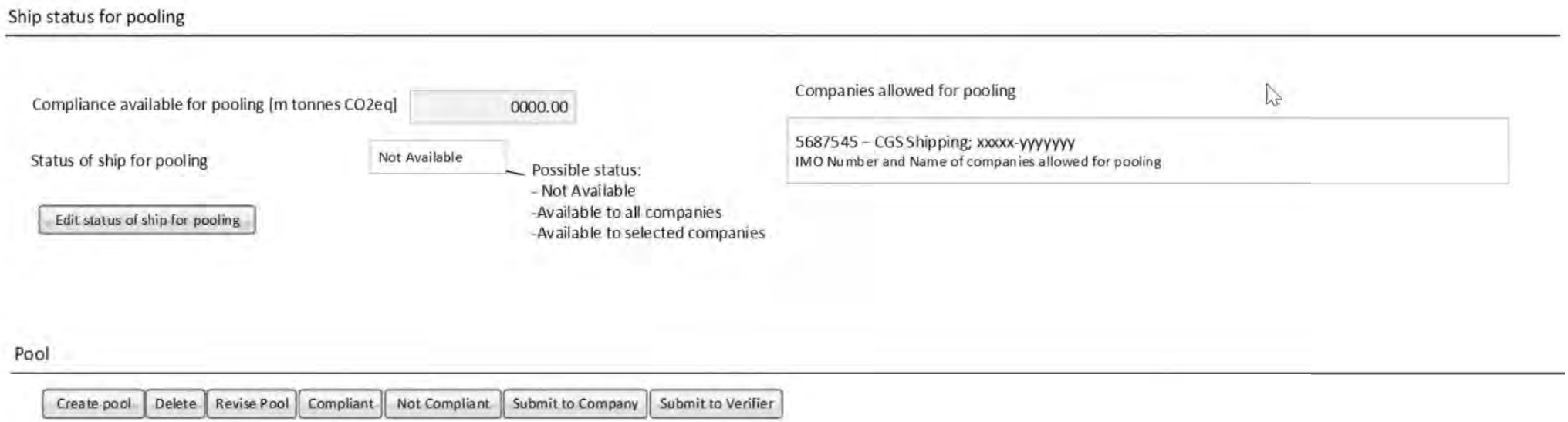
Annual compliance balance – tonnes CO_2eq

Pool members decide of allocation of compliance balance to individual ships

Remaning surplus can be banked

DNV

Manage pooling



Create pool

Create Pool

5 ships found
2 ships not available for pooling
2 ships ready for pooling with deficit
1 ship ready for pooling with surplus
Please consult comments column for details on ships not available to be added
Please add ships if and only if the IMO number is correct.

IMO ↑↓	Name ↑↓	Flag ↑↓	Ship type ↑↓	FEU Company	FEU Verifier	Compliance Balance to Pool [m tonnes]↑↓	Comments
5234823	PIRINEU	Malta	Bulk carrier	MMD Trading Corporation	CPE Veritas	-950,23	Available for Pooling
8654823	ALPACA	Panama	Passenger ship	JD ISM Trading	CPE Veritas	-1240,67	Available for Pooling
5422445	ROGER RABIT	Portugal	Container	Naval Shipping	Sea Verifiers	4167,9	Available for Pooling
8654822	ALASKA	Malta	Chemical tanker	MMD Trading Corporation	CPE Veritas		Not available for pooling
6241354	TARRACO	Malta	Container	New Company	Sea Verifiers		Already participating in a pool

<< < page 1 of 1 > >> PDF XLS CSV Displaying 1 - 20 of 20

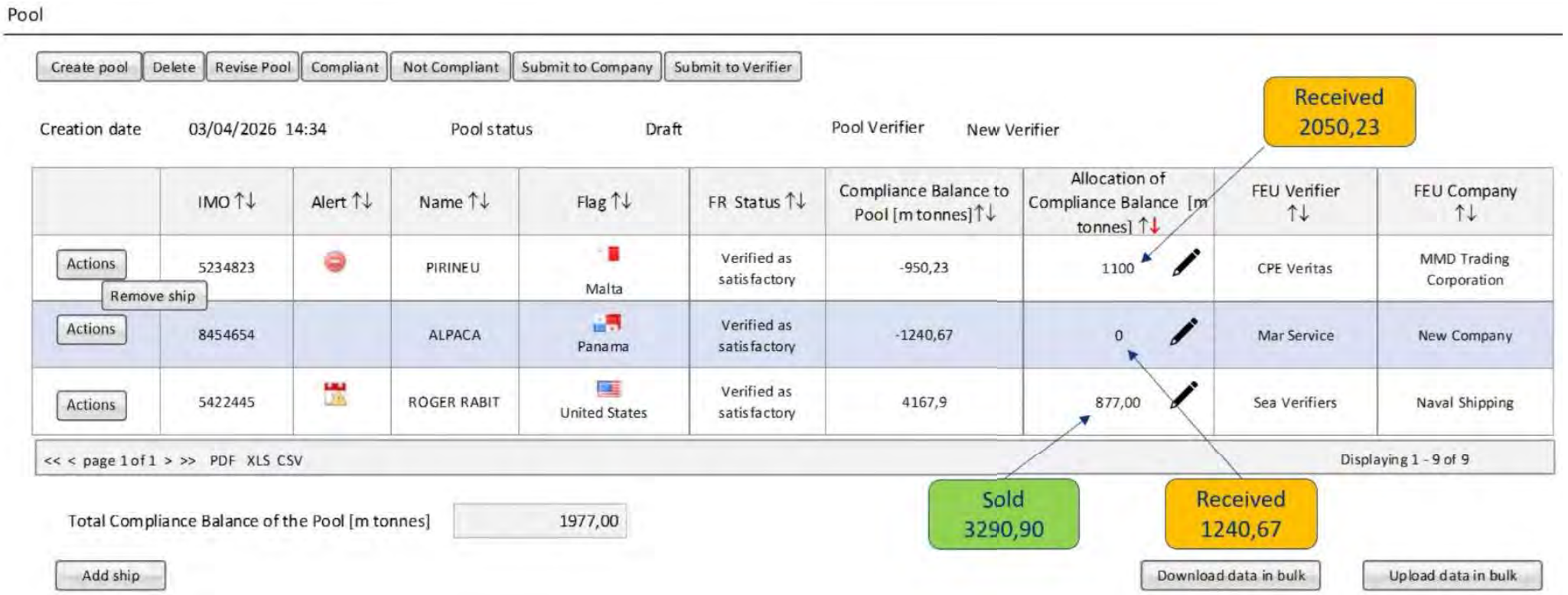
Total Compliance Balance of the Pool [m tonnes] 1977.00

Pool Verifier New Verifier

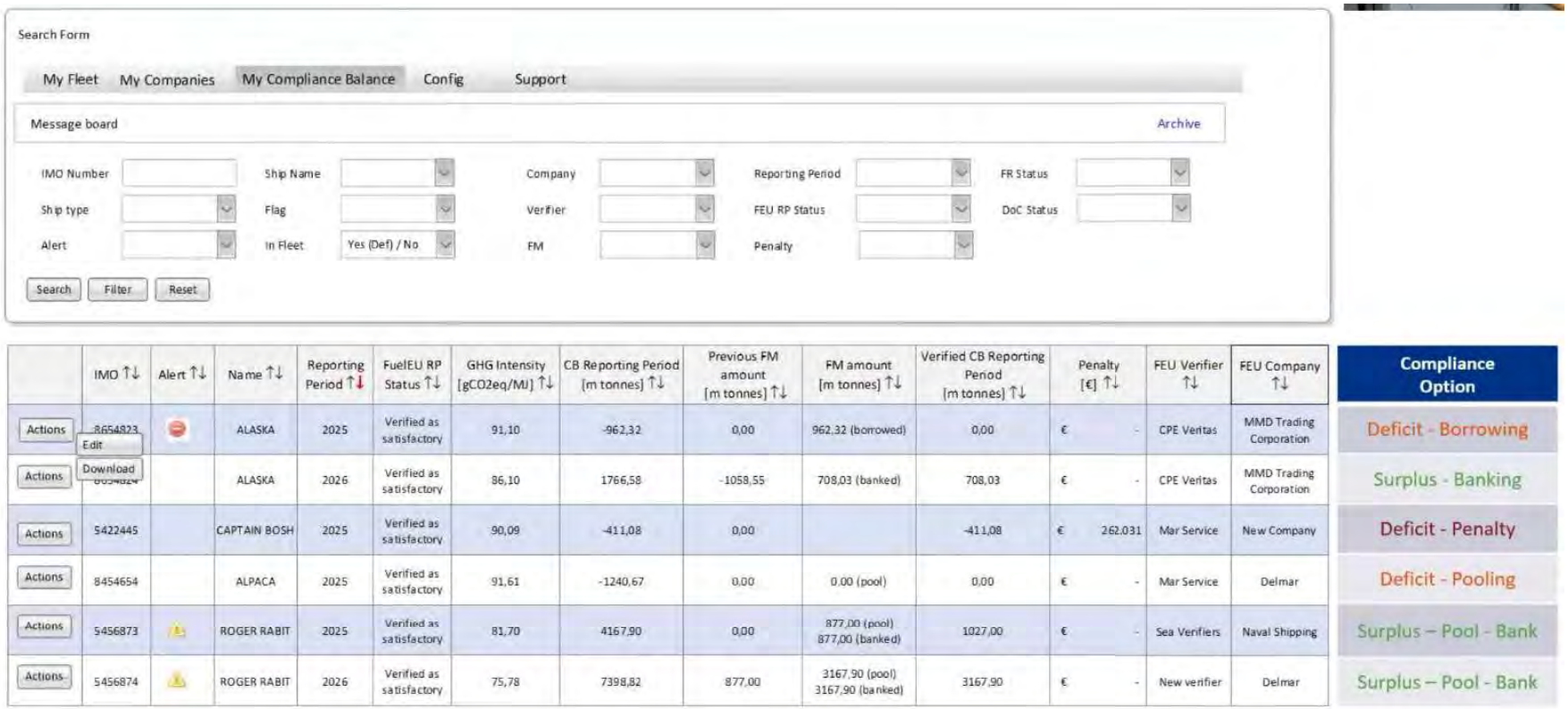
Create pool

Close

Reallocate compliance balance in pool



Final compliance balance



	IMO	Alert	Name	Reporting Period	FuelEU RP Status	GHG Intensity [gCO2eq/MJ]	CB Reporting Period [m tonnes]	Previous FM amount [m tonnes]	FM amount [m tonnes]	Verified CB Reporting Period [m tonnes]	Penalty [€]	FEU Verifier	FEU Company	Compliance Option
Actions (Edit, Download)	8654823		ALASKA	2025	Verified as satisfactory	91,10	-962,32	0,00	962,32 (borrowed)	0,00	€ -	CPE Veritas	MMD Trading Corporation	Deficit - Borrowing
Actions	8654824		ALASKA	2026	Verified as satisfactory	86,10	1766,58	-1058,55	708,03 (banked)	708,03	€ -	CPE Veritas	MMD Trading Corporation	Surplus - Banking
Actions	5422445		CAPTAIN BOSH	2025	Verified as satisfactory	90,09	-411,08	0,00		-411,08	€ 262.031	Mar Service	New Company	Deficit - Penalty
Actions	8454654		ALPACA	2025	Verified as satisfactory	91,61	-1240,67	0,00	0,00 (pool)	0,00	€ -	Mar Service	Delmar	Deficit - Pooling
Actions	5456873	⚠	ROGER RABIT	2025	Verified as satisfactory	81,70	4167,90	0,00	877,00 (pool) 877,00 (banked)	1027,00	€ -	Sea Verifiers	Naval Shipping	Surplus – Pool - Bank
Actions	5456874	⚠	ROGER RABIT	2026	Verified as satisfactory	75,78	7398,82	877,00	3167,90 (pool) 3167,90 (banked)	3167,90	€ -	New verifier	Delmar	Surplus – Pool - Bank

EC/EMSA – resources

European Commission FAQ

FuelEU Webinars – EMSA

Thetis MRV FAQ

General guidance document for shipping companies – MRV/ETS

Main requirements: Regulation 2023/1805

Template for monitoring plans: Implementing regulation 2024/2031

Verification: Implementing regulation 2024/2027

Accreditation of verifiers: C(2024)6218

List of neighbouring container transhipment ports - draft on hearing

Reporting to DNV – resources

OVD Veracity guidances / resources page

Data standard documentation

OVD Whitepaper

Session 4 – Commercial and financial implications

FuelEU offers a set of compliance options

Use fuels/energy with lower well-to-wake GHG intensity

- Fossil LNG/LPG
- Sustainable biofuels
- Renewable fuels of non-biological origin (RFNBO), recycled carbon fuels (RCF), low carbon fuels (LCF)
- Shore power
- Wind-assisted propulsion system

Flexibility mechanisms

- Borrowing compliance surpluses from next year
- Use banked compliance surplus from last year(s)
- Compliance pooling with other ships

Pay penalty

DNV

Case study to investigate the impact of compliance strategies – 80,000 DWT Bulk vessel 100% in EU/EEA

80,000 DWT Bulk vessel - Operational assumptions

Capacity	80,000 DWT
First year of operation	2025
Lifetime	20 years (year: 2025-2044)
Annual fuel consumption	6,260 t MGO equivalent (267,300 GJ)
Quay side	285 t MGO equivalent (12,150 GJ)
At sea	5,975 t MGO equivalent (255,150 GJ)
Area of operation	100% within EU/EEA

Compliance strategies analyzed in this case study

Pay penalty
Use fuels/energy with lower well-to-wake GHG intensity
Flexibility mechanism (borrowing, banking and pooling)

DNV

Each compliance strategy is presented in a template with three main elements

Case description and assumptions

1

Key takeaways

3

Annual expenses (left) and well-to-wake GHG intensity (right)

2

Total cost (2025–2044):	Accumulated compliance balance (2025–2044):

DNV

Compliance strategy:

Pay penalty

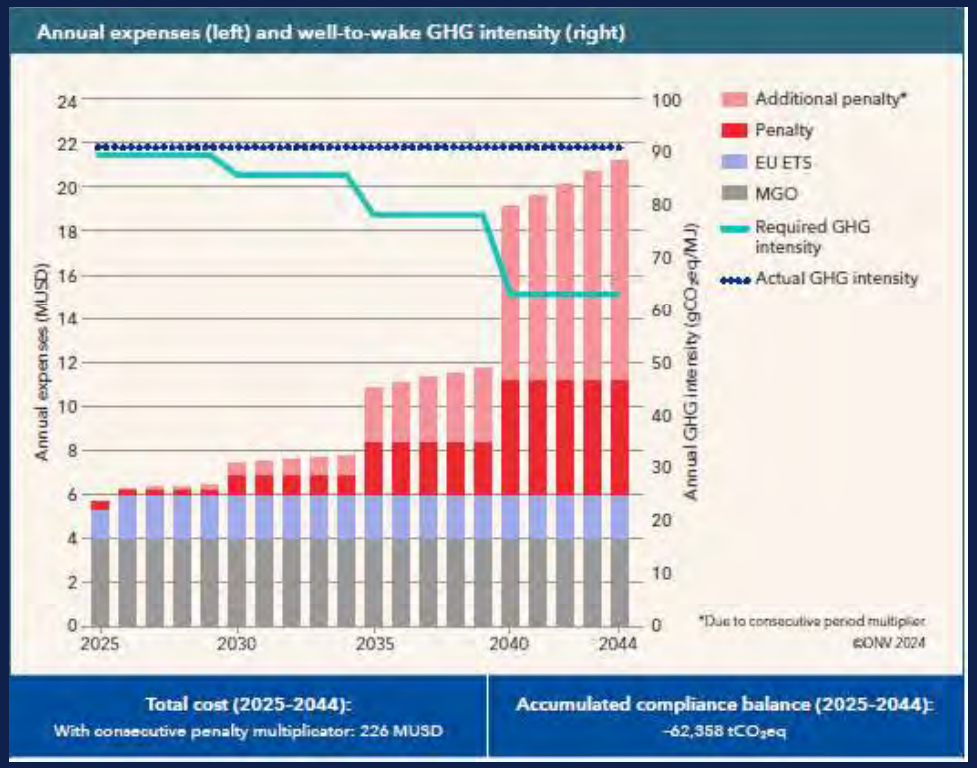
Pay penalty

Case description and assumptions

Case vessel runs on fossil MGO throughout its lifetime, 2025 to 2044, and pays the penalty in all years.

Key takeaways

- The annual penalty cost increases with stricter GHG intensity requirements, without the consecutive penalty multiplicator, from 0.2 MUSD in 2025 to 5.2 MUSD in 2044.
- Already by 2030, the impact of the consecutive period multiplier on penalty cost is significant.
- From 2035 onwards, the annually penalty cost is higher than the EU ETS cost, if assuming a EUA price of 100 USD/tCO2eq.



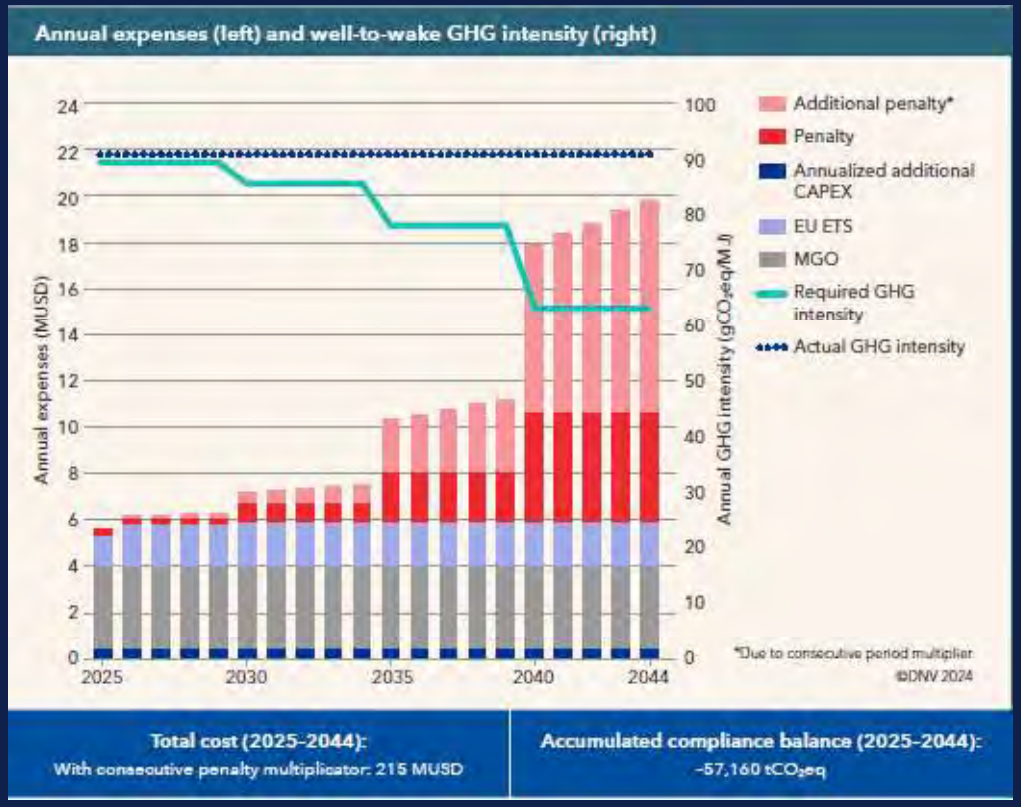
Pay penalty and use of energy-efficiency measures

Case description and assumptions

Case vessel uses fossil MGO (2025-2044), pays penalties, and applies energy-efficiency measures reducing annual energy demand by 9%, illustrating impact on penalty cost.

Key takeaways

- Energy-efficiency measures (except for WAPS technology) do not impact the actual GHG intensity, and as such, the FuelEU compliance status does not change.
- However, energy-efficiency measures reduce the energy demand, reducing the fuel cost, the EU ETS cost, and the FuelEU compliance balance, and resulting in a lower FuelEU penalty cost.
- Compared to a penalty only strategy, the total cost is 11 MUSD lower over the lifetime if including the consecutive penalty multiplicator, with an additional capex of 4 MUSD.

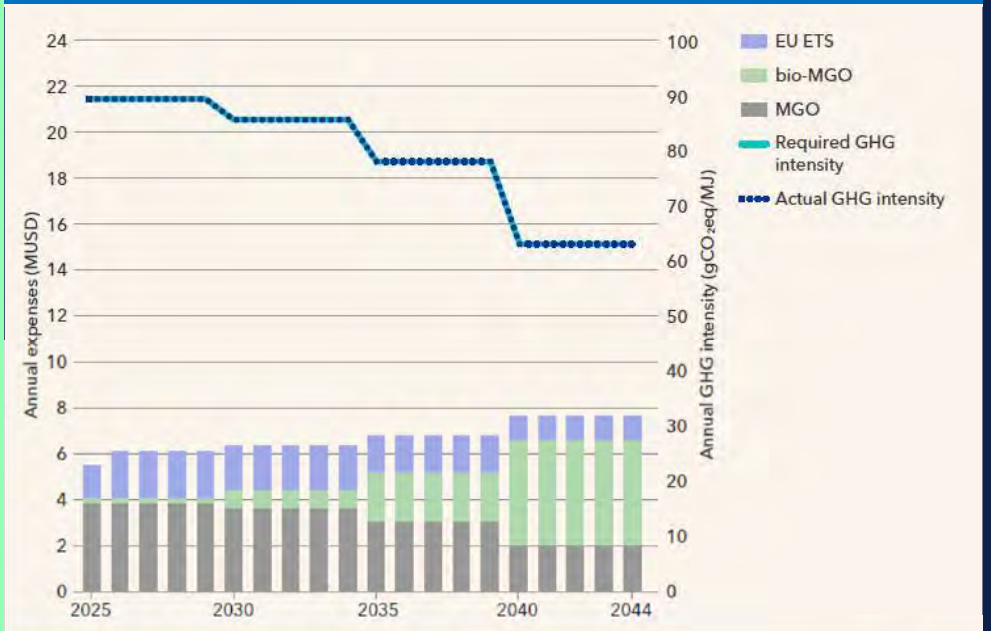


Compliance strategy:

Use fuels/energy with lower well-to-wake GHG intensity

The compliance strategy “Blend in bio-MGO” for exact compliance is used as a reference case

Annual expenses (left) and well-to-wake GHG intensity (right)



Total cost (2025-2044):
134 MUSD

Accumulated compliance balance (2025-2044):
0 tCO_2eq

Key takeaways

- The vessel incurs no penalties throughout its lifetime as it obtains a compliance balance equal to zero in all years
- To remain compliant throughout the period, the vessel gradually increases the bio-MGO share of the fuel mix
- Annual fuel cost increases from around 4 MUSD in 2025 to above 6.5 MUSD in 2044
- Annual EU ETS cost decreases with increasing bio-MGO consumption

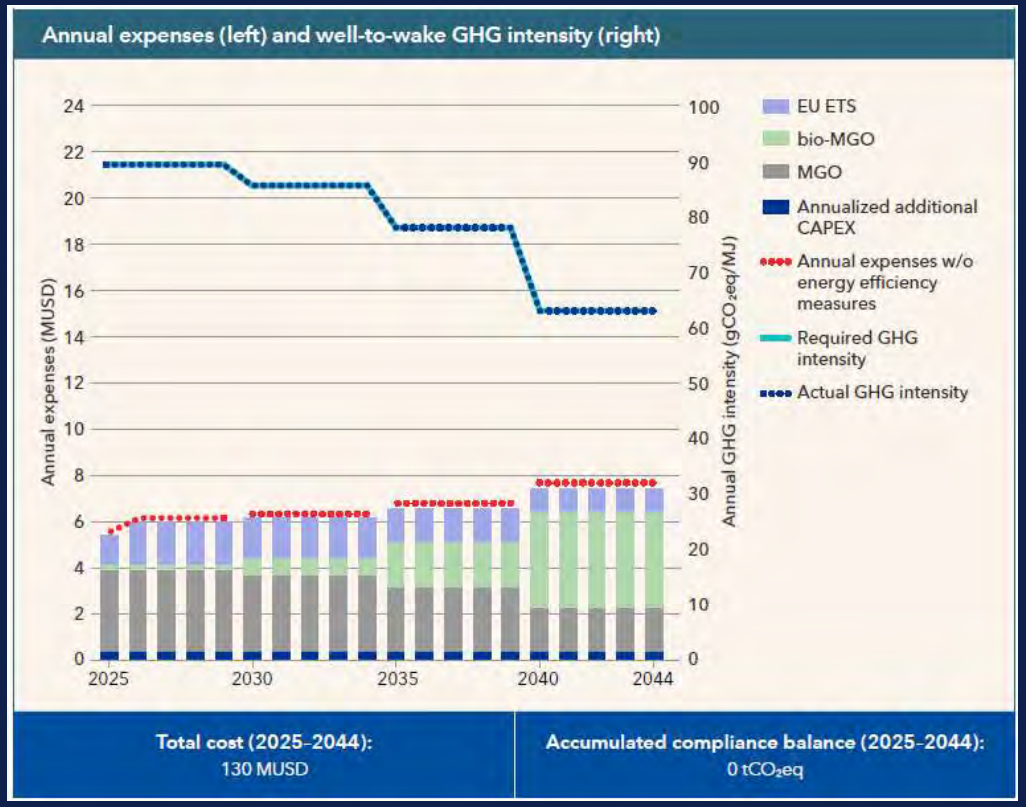
Blend in bio-MGO and use of energy-efficiency measures

Case description and assumptions

The case vessel operates on a mix of MGO and bio-MGO throughout its lifetime, 2025 to 2044. It has implemented energy-efficiency measures, and blends in bio-MGO.

Key takeaways

- When comparing with a blend-in bio-MGO strategy without energy-efficiency measures, the total cost is 4 MUSD lower over the lifetime.
- With stricter FuelEU requirements, the cost saving from the energy-efficiency measures increases.



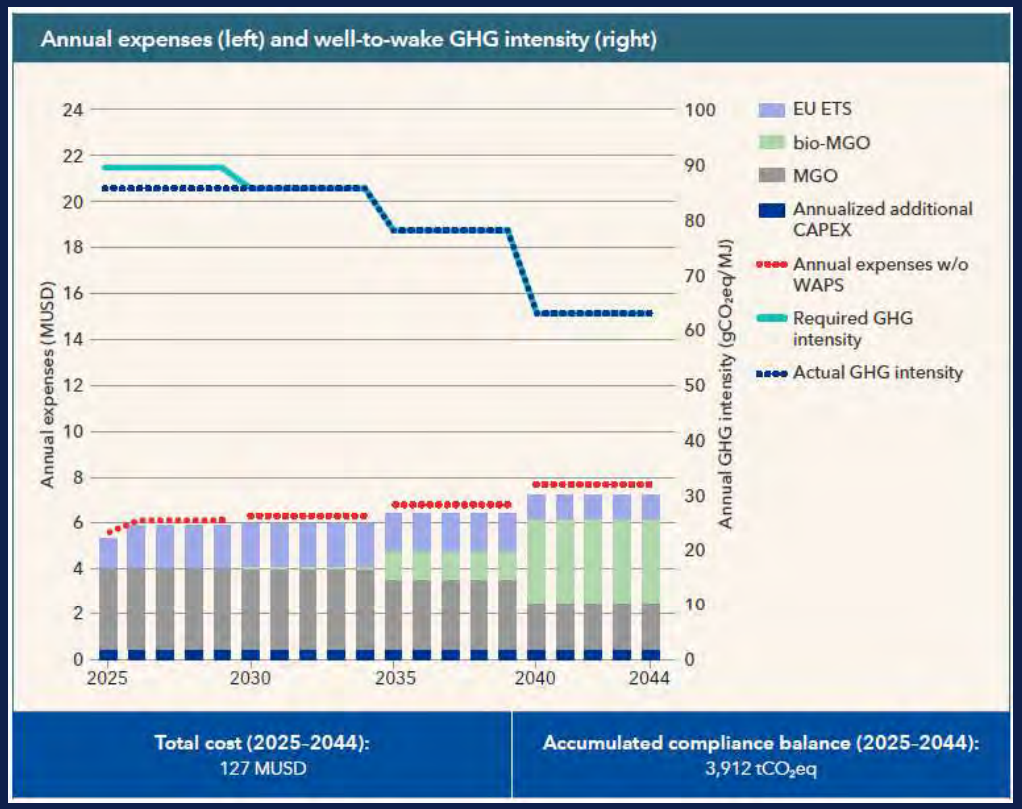
Blend in bio-MGO and use of wind-assisted propulsion systems (WAPS)

Case description and assumptions

The case vessel installs WAPS and operates on a mix of MGO and bio-MGO from 2025 to 2044, blending in bio-MGO to maintain FuelEU compliance.

Key takeaways

- Dashed line shows significant annual savings with WAPS, which are increasing as FuelEU requirements tighten.
- During the first five-year period (2025–2029), the vessel has an annual compliance surplus which could be banked or used in a pool, potentially generating an indirect source of revenue.



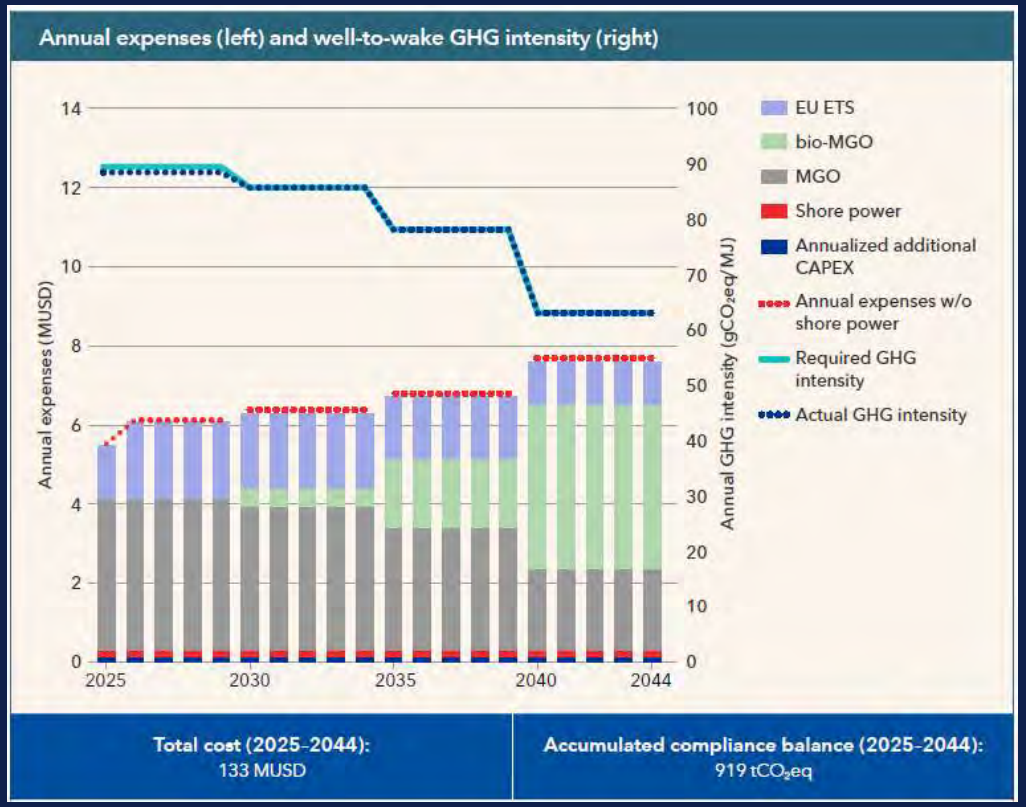
Blend in bio-MGO and use of shore power

Case description and assumptions

To maintain FuelEU compliance, the case vessel operates on a mix of MGO and bio-MGO from 2025 to 2044, covers the required energy demand in port from shore power.

Key takeaways

- In the first five years, the vessel can comply with FuelEU using shore power alone, generating a compliance surplus that can be banked or pooled, potentially creating indirect revenue.
- The dashed line in the chart shows that using shore power lowers the vessel's annual expenses compared to not using it.



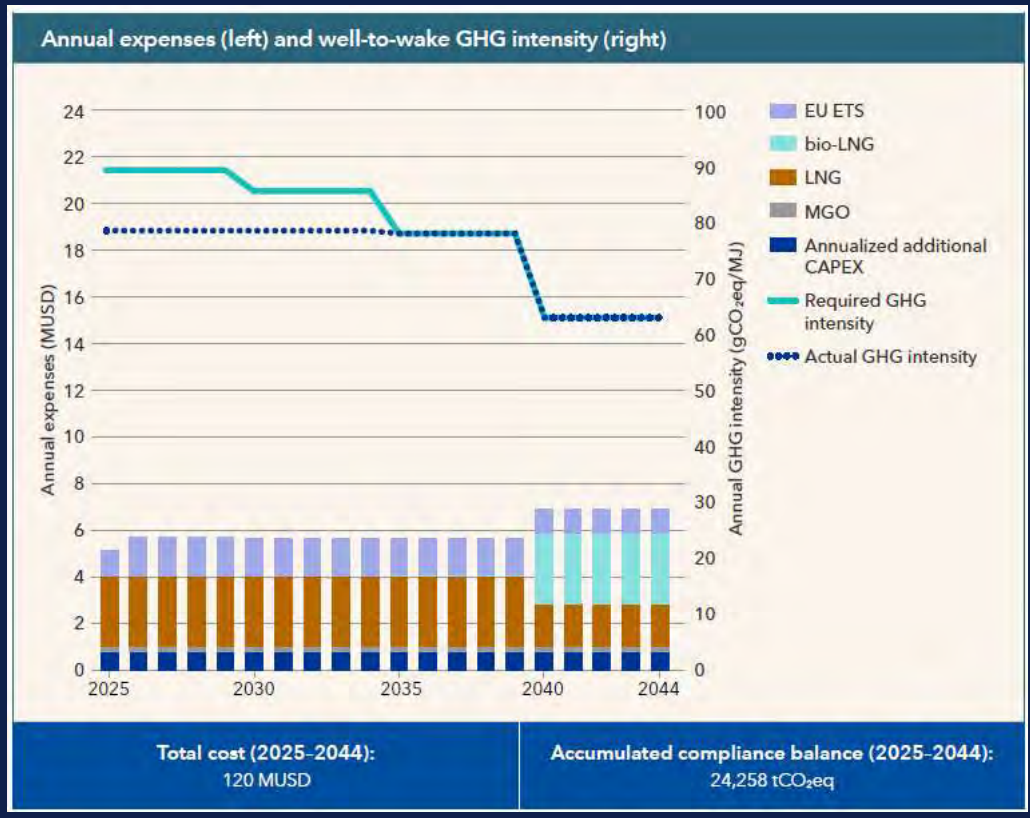
Blend in bio-LNG

Case description and assumptions

The case vessel operates on a mix of LNG and bio-LNG from 2025 to 2044 (MGO only for pilot fuel), blending in bio-LNG to maintain FuelEU compliance.

Key takeaways

- From 2025 to 2034, the vessel is over-compliant generating compliance surpluses, which can potentially generate income in a compliance pool.
- From 2035, the vessel needs to blend in some bio-LNG to maintain FuelEU compliance. From 2040, this leads to a significantly increased fuel cost, but also a reduction in the EU ETS costs.
- Comparing total cost, this strategy costs around 14 MUSD less than the blend-in bio-MGO strategy.



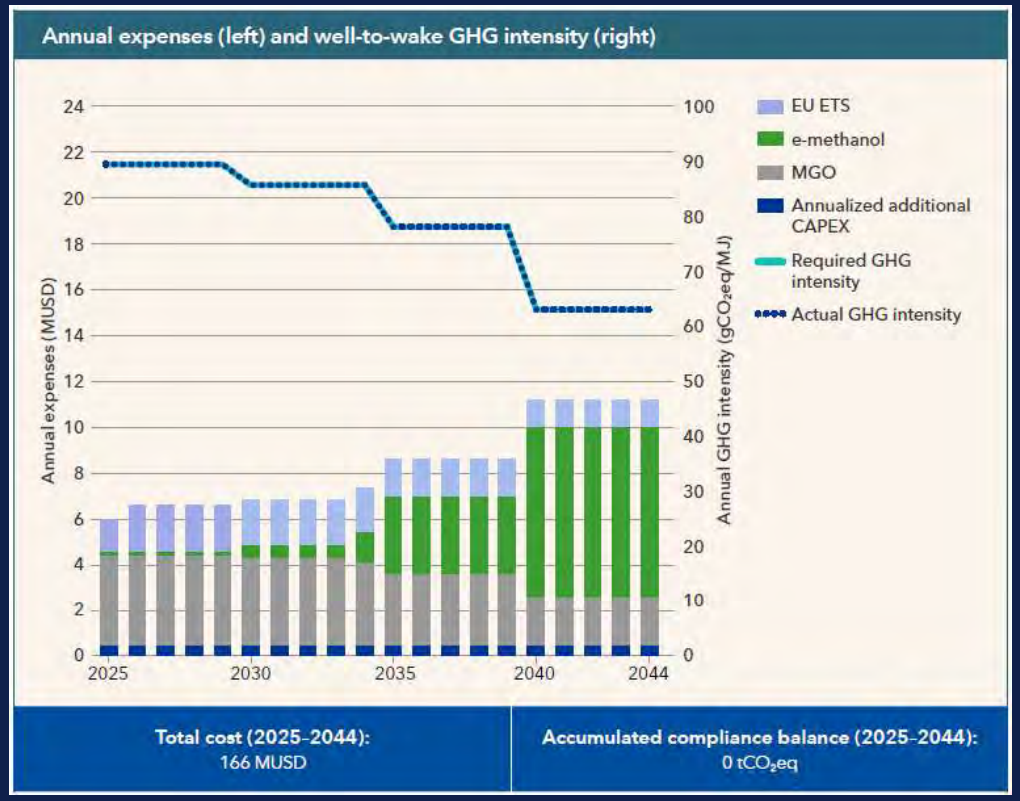
Blend in e-methanol

Case description and assumptions

The case vessel operates on a mix of MGO and e-methanol from 2025 to 2044, progressively increasing the e-methanol consumption to maintain FuelEU compliance.

Key takeaways

- Stricter FuelEU rules require rising e-methanol use, raising annual costs from 6 MUSD (2025) to 8+ MUSD (2035) and 11+ MUSD (2040).
- From 2025–2033, the RFNBO reward factor lowers e-methanol needs for compliance. In 2034, the required amount increases significantly.
- Note that from 1 January 2033, a separate RFNBO requirement will possibly be introduced, which could add to the benefit of this case.



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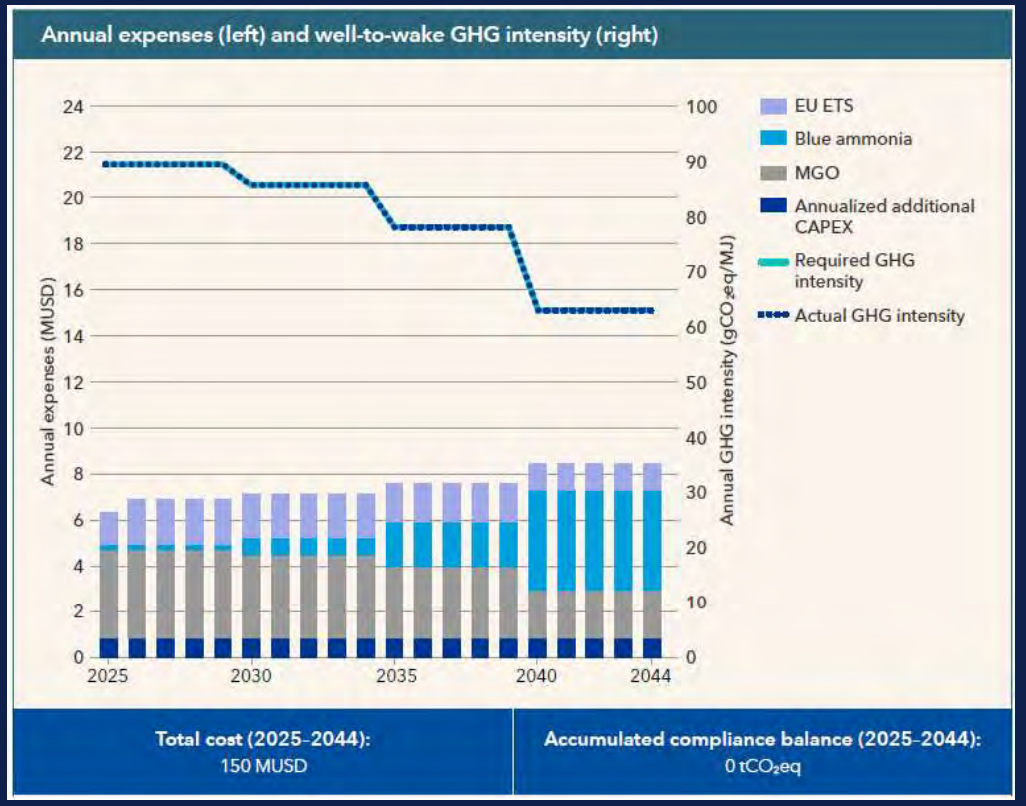
Blend in blue ammonia

Case description and assumptions

The case vessel operates on a mix of MGO and blue ammonia from 2025 to 2044, progressively increasing blue ammonia consumption to maintain FuelEU compliance.

Key takeaways

- The vessel needs to progressively increase the blue ammonia consumption over the years due to stricter regulations.
- With more blue ammonia in the fuel mix, the annual expenses increase from around 6 MUSD in 2025 to above 8 MUSD in 2044.
- Compared to the blend-in bio-LNG strategy, this strategy has a significantly higher total cost of around 30 MUSD over the lifetime.



Compliance strategy:

Flexibility mechanisms (borrowing, banking, pooling)

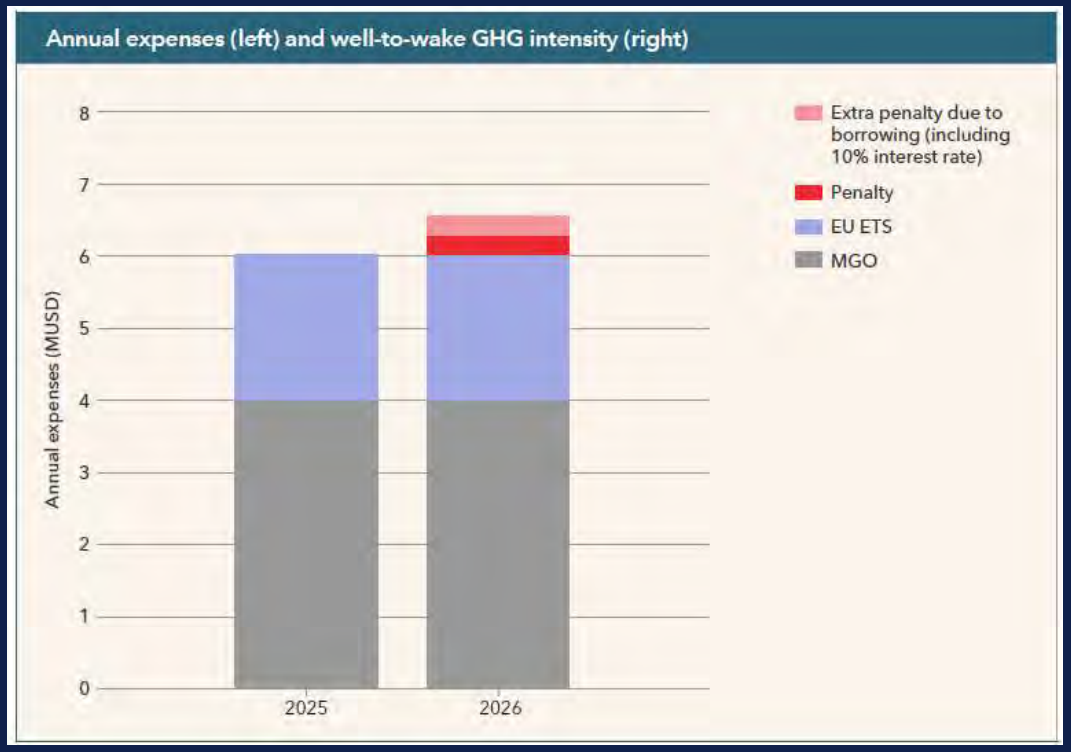
MGO vessel borrowing compliance balance

Case description and assumptions

The case vessel operates on 100% fossil MGO in 2025 and 2026. In 2025 the vessel borrows compliance balance from the following year and in 2026 the vessel pays the penalty cost (including 10% interest rate on the borrowed compliance balance).

Key takeaways

- In 2025, the vessel can borrow a sufficient amount of compliance balance from the following year to offset compliance deficits, resulting in zero penalty cost.
- In 2026, the vessel pays the penalty cost of 0.5 MUSD to compensate for the accumulated compliance deficits (2025 to 2026) including interest on borrowed compliance balance.



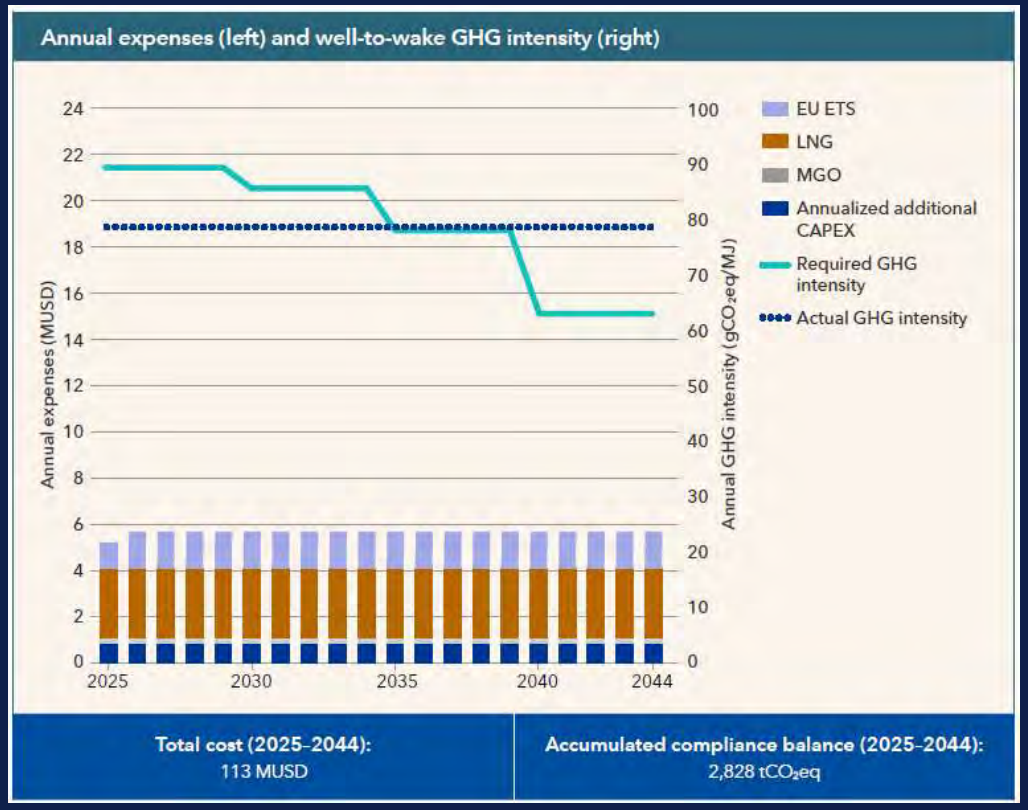
LNG vessel banking compliance surpluses

Case description and assumptions

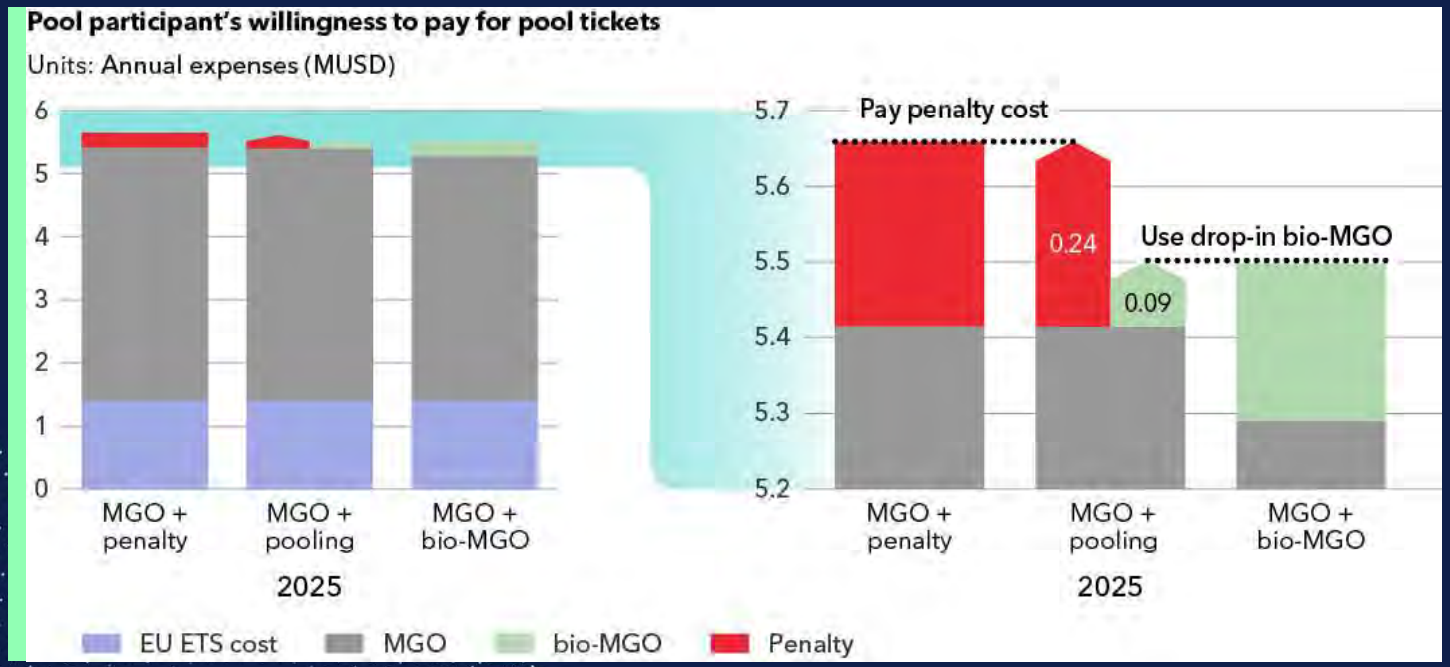
The case vessel operates on LNG with MGO as pilot fuel from 2025 to 2044 and using banking as a flexibility mechanism to obtain FuelEU compliance.

Key takeaways

- Operating on LNG the vessel creates compliance surpluses until 2034, which can be banked and used later to offset compliance deficits.
- From 2035, the vessel exceeds the required GHG intensity, resulting in annual compliance deficits. The banked surpluses can cover these deficits from 2035 to 2044, ensuring compliance throughout the vessel's lifetime.
- This demonstrates that LNG, using the banking mechanism, is a viable fuel option from 2025 to 2044, allowing for complete avoidance of penalties.



Compliance pooling offers a potentially financially advantageous alternative to paying the penalty



For an MGO-fuelled vessel, the three main compliance alternatives to consider are:

i) Use fuels with drop-in capability and low GHG intensity (e.g. bio-MGO)
ii) Pay the penalty cost
iii) Join a compliance pool

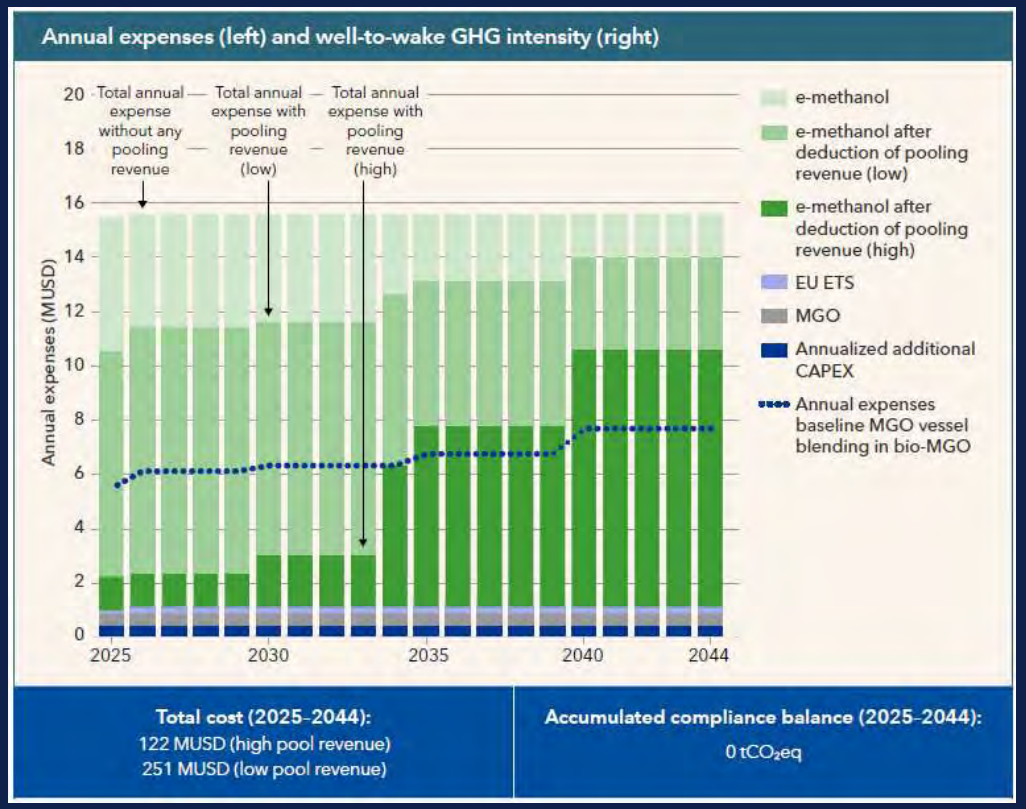
Maximum e-methanol use and compliance pooling

Case description and assumptions

The vessel operates on maximum e-methanol with MGO as pilot fuel (2025–2044), selling all compliance surplus to MGO-fueled vessels in a compliance pool. The pooling ticket price depends on either the FuelEU penalty cost (high revenue) or the bio-MGO cost (low revenue).

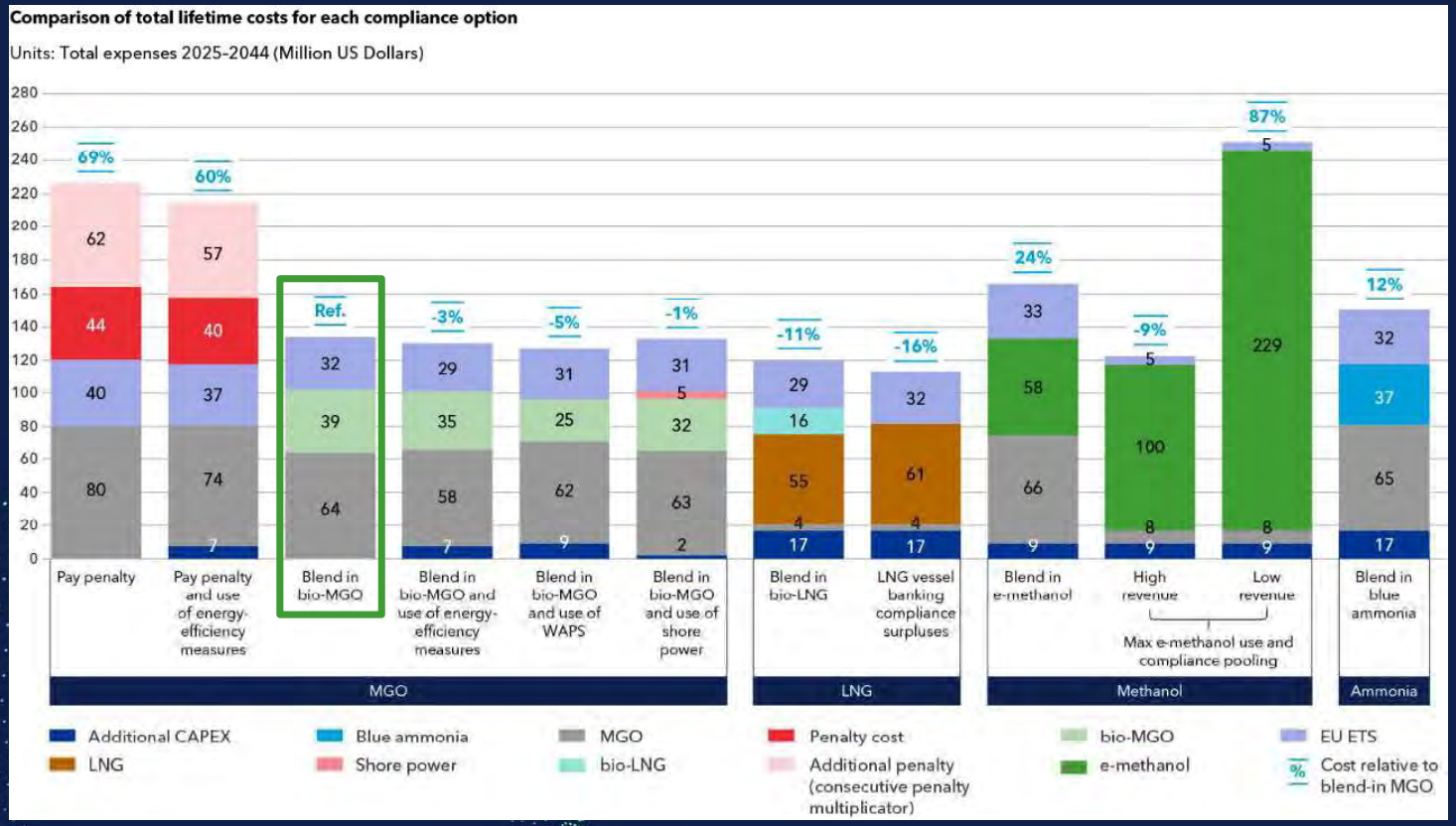
Key takeaways

- Without pooling revenue, the vessel's annual expenses are much higher than for a conventional MGO vessel blending bio-MGO. However, pooling revenue can significantly reduce net expenses.
- With low pooling revenue, the vessel's annual expenses remain higher than a conventional MGO vessel blending bio-MGO. But with high pooling revenue, net expenses are lower until 2034 (first year without RFNBO reward factor). Over time, lower surplus generation and decreasing pooling revenue make pooling more attractive in the first years.



The results presented in this case example are sensitive to the fuel price assumptions and the well-to-wake GHG intensity of the fuel.

Selection of FuelEU compliance strategies has clear cost implications

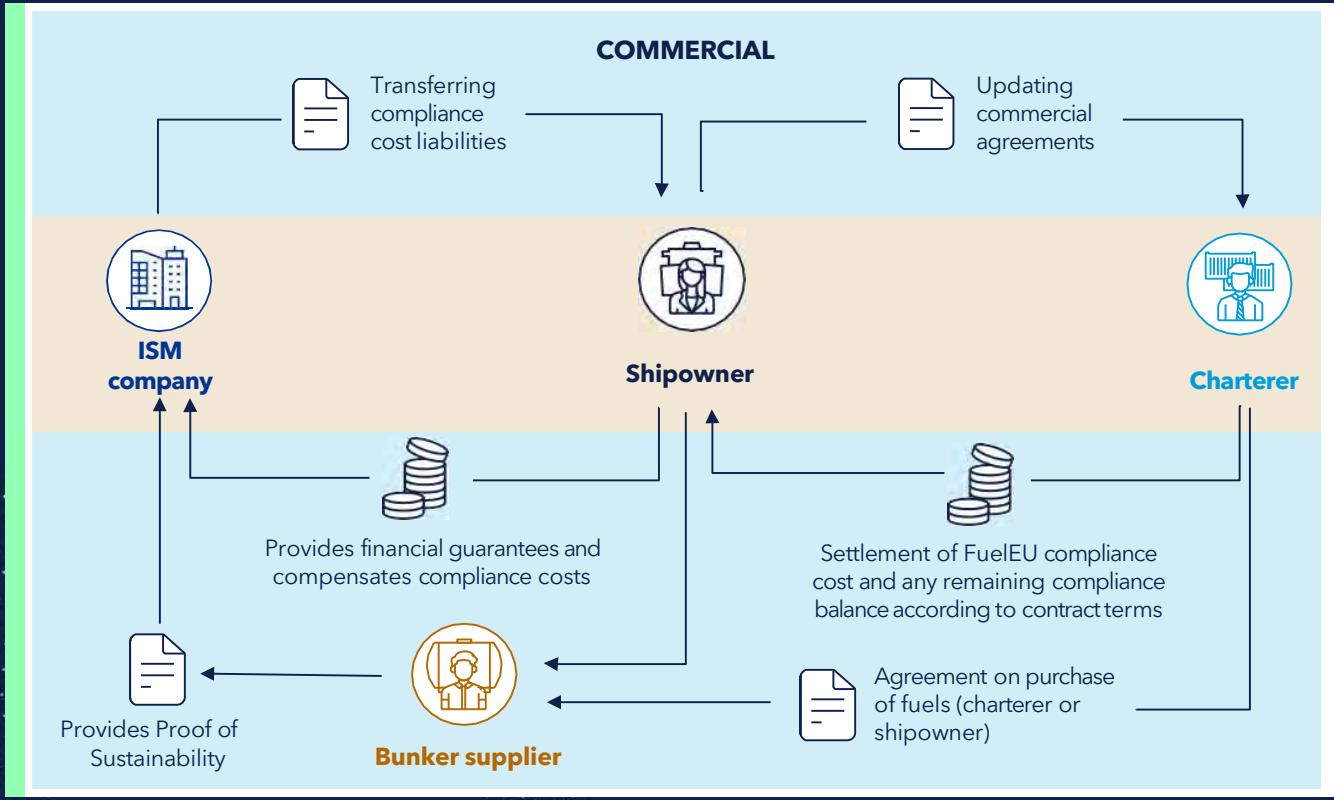


Key takeaways

- Paying penalty cost is likely to be the most expensive option.
- Using LNG and bio-LNG is least costly.
- Using bio-MGO and WAPS is an attractive option reducing fuel consumption and improves well-to-wake GHG intensity.
- Energy-efficiency measures cut fuel, EU ETS, and FuelEU compliance costs, lowering total expenses in ‘pay-the-penalty’ and ‘blend in bio-MGO’ strategies.
- Shore power enables cost-effective FuelEU compliance by improving GHG intensity and reducing fuel costs.
- Compliance pooling can share costs and enable sustainable business cases for vessels using full green-fuel capacity.
- Results are sensitive to input assumptions, such as the fuel price, fuel availability, and the well-to-wake GHG intensity.

Compliance and commercial impacts

FuelEU Maritime is expected to impact commercial processes and contracts



ISM company and shipowner

- Update the ship management contract to secure coverage from the shipowner for any FuelEU related cost liabilities

Shipowner and charter

- Review and update commercial contracts to consider FuelEU compliance. The type of charter party has a significant impact

Bunker suppliers

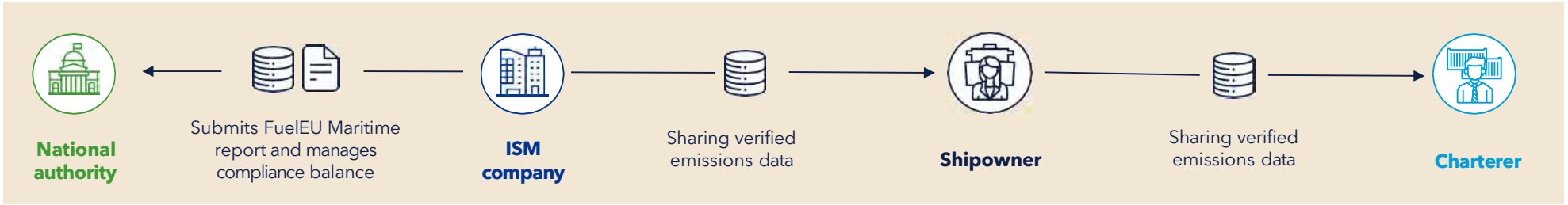
- Proof of Sustainability or similar document should accompany the Bunker Delivery Note

Verified emissions data vital for compliance and commercial purposes

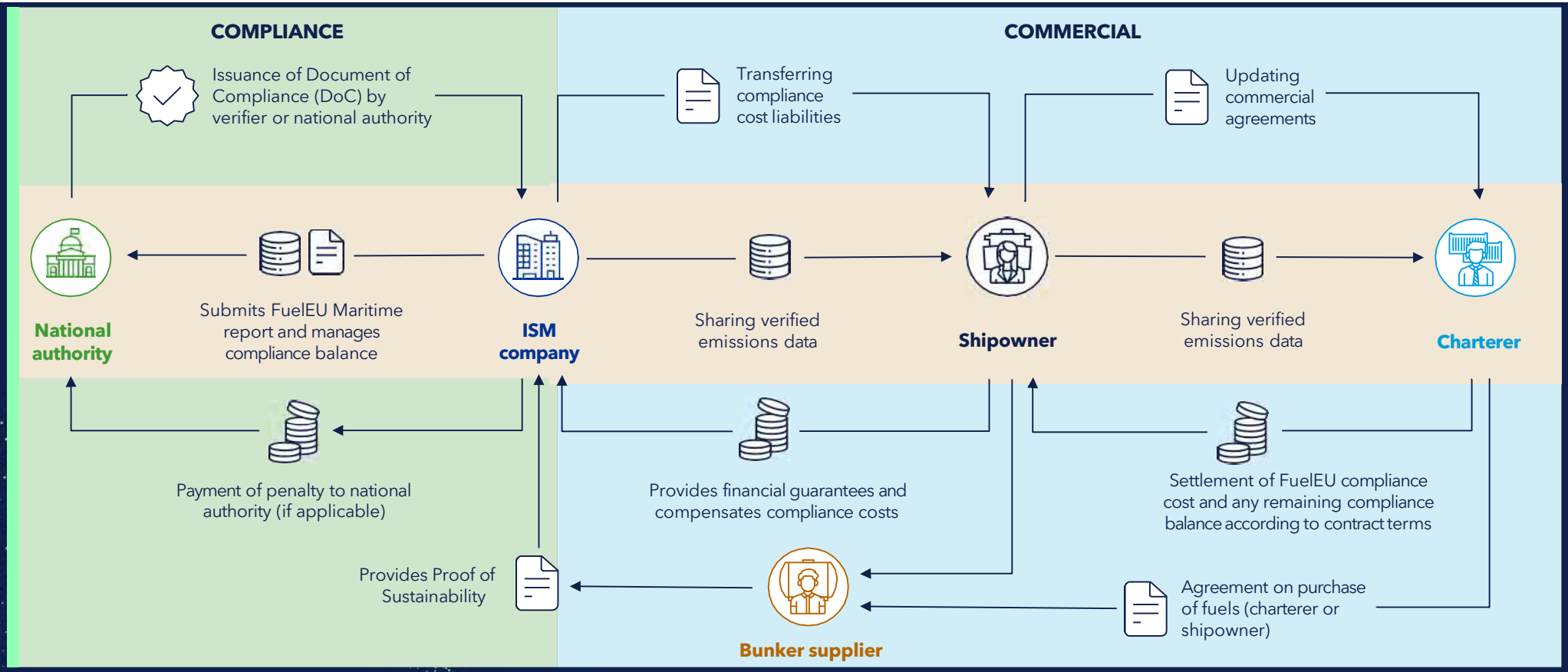
Key practices include:

- Ensuring continuous data quality from the vessels
- Standardizing data formats across platforms
- Establishing controlled, consistent processes for data sharing
- A single-source approach to data – in which verified emissions data is shared from a centralized point – eliminates the risk of double reporting

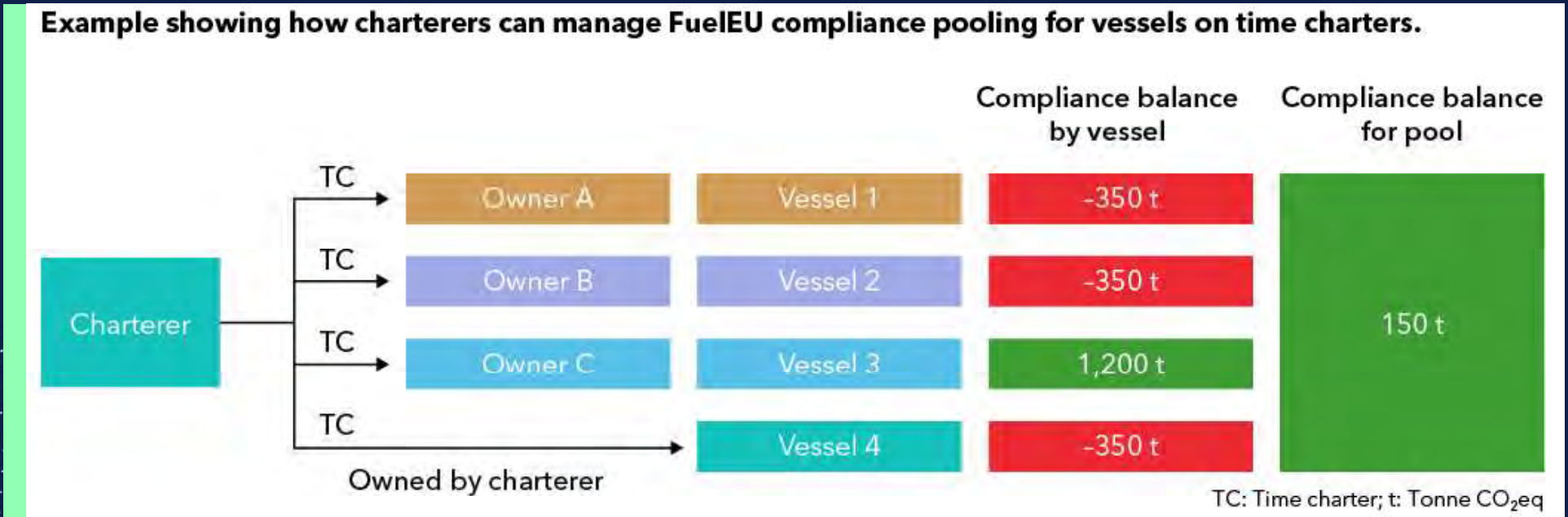
Robust data governance is essential for long-term resilience and effective FuelEU-related cost management



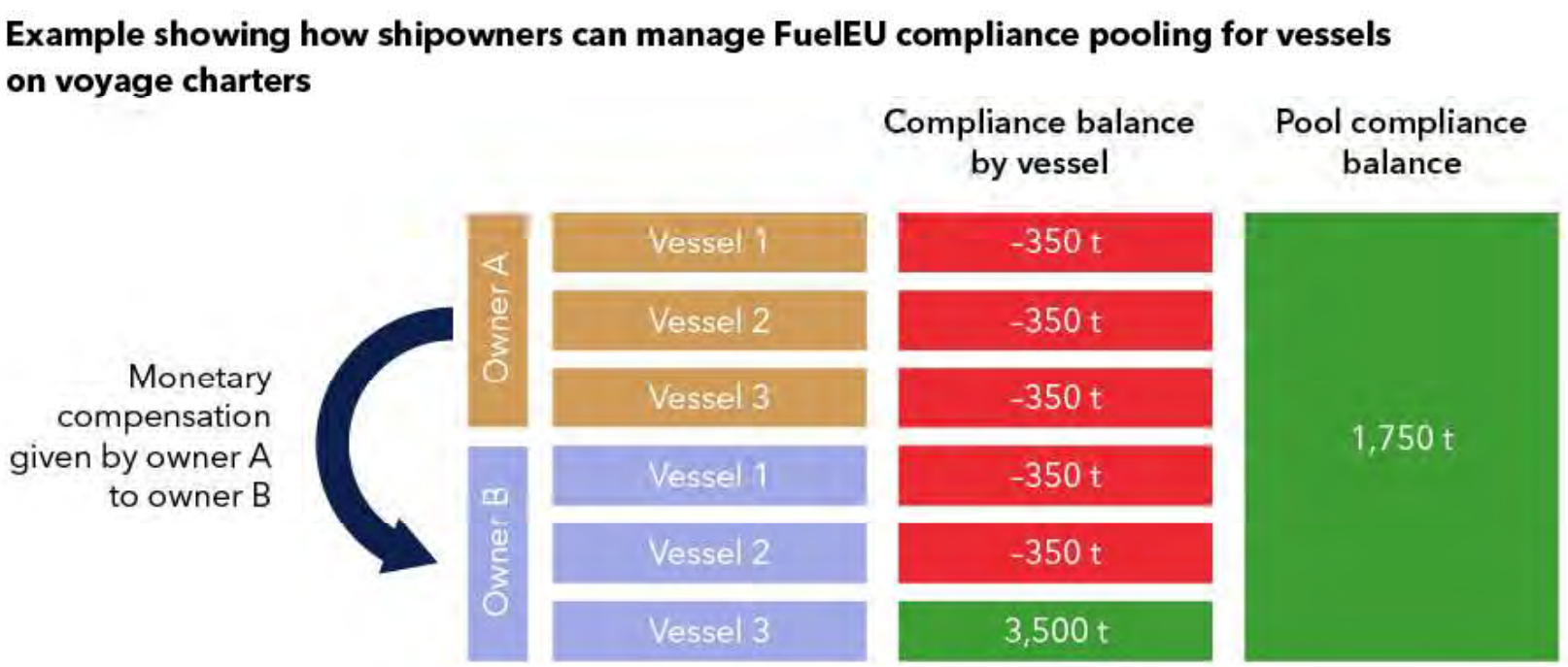
Managing compliance and commercial transactions will involve many stakeholders



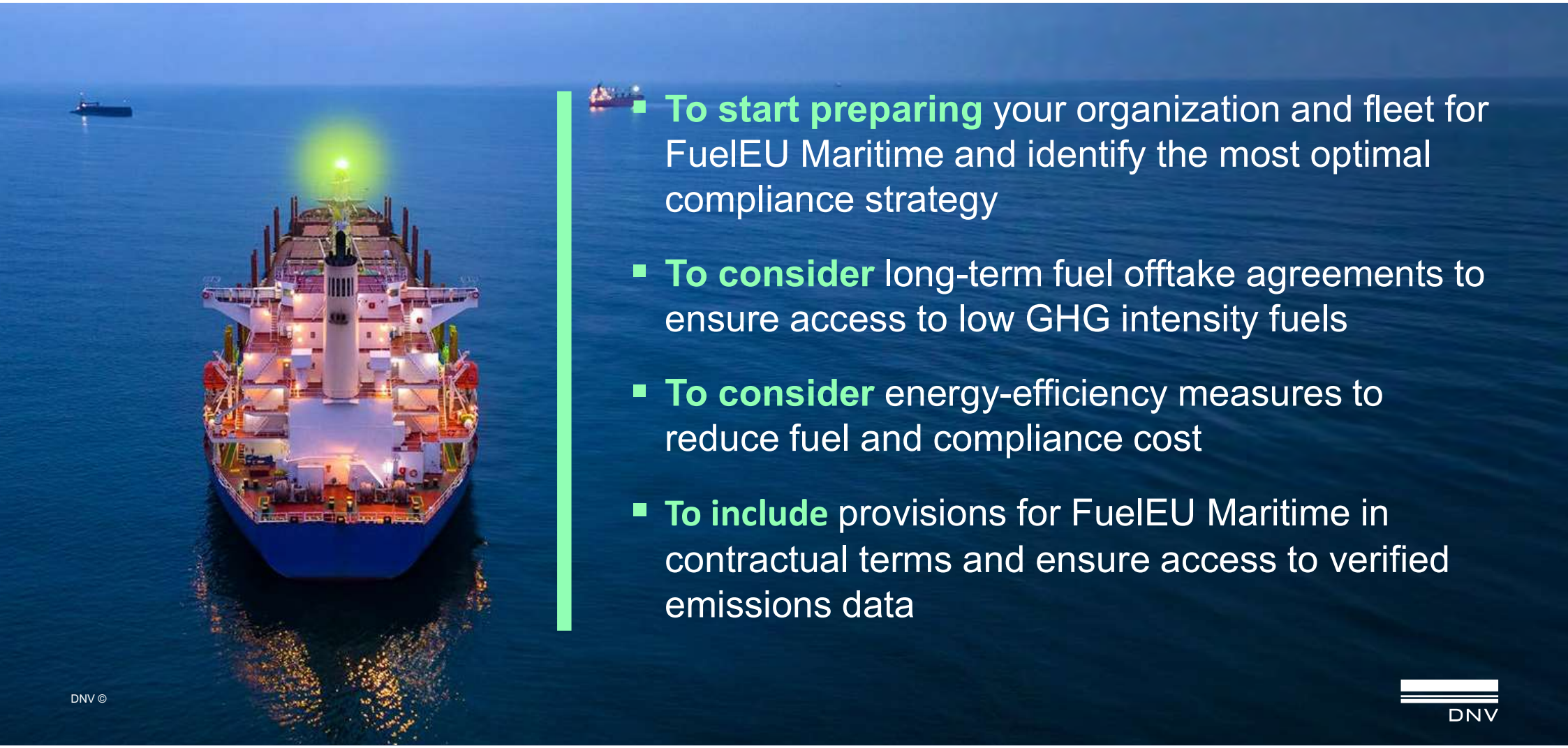
Example: Pooling of compliance under time charters



Example: Pooling of compliance under voyage charters and CoA



We recommend



- **To start preparing** your organization and fleet for FuelEU Maritime and identify the most optimal compliance strategy
- **To consider** long-term fuel offtake agreements to ensure access to low GHG intensity fuels
- **To consider** energy-efficiency measures to reduce fuel and compliance cost
- **To include** provisions for FuelEU Maritime in contractual terms and ensure access to verified emissions data

DNV

Newly published DNV white paper on FuelEU Maritime

Download here

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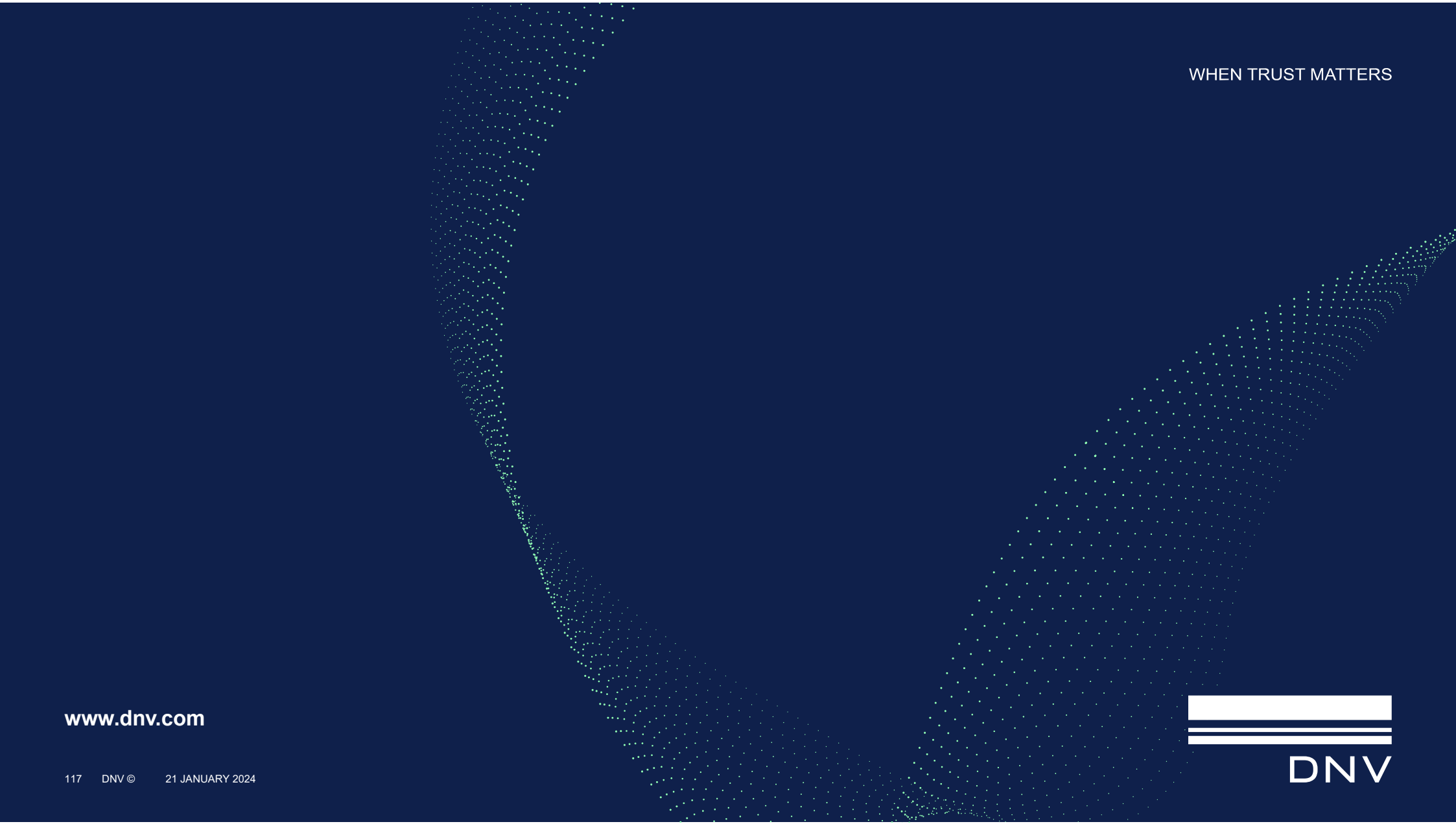
WHEN TRUST MATTERS



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