

INTERSESSIONAL MEETING OF THE  
WORKING GROUP ON AIR POLLUTION  
AND ENERGY EFFICIENCY  
1st session  
Agenda item 2

ISWG-APEE 1/2/10  
18 February 2025  
ENGLISH ONLY  
Pre-session public release:

**FURTHER CONSIDERATION OF POSSIBLE OPTIONS TO ADDRESS THE IDENTIFIED  
CHALLENGES/GAPS IN THE SHORT-TERM GHG REDUCTION MEASURE**

**Illustrating the overlap of the CII with the mid-term measures, and proposing Z-factors  
in alignment with the 2023 IMO GHG Strategy targets**

**Submitted by CSC**

**SUMMARY**

*Executive summary:* This document presents evidence for the high potential of energy efficiency to contribute to the achievement of the 2023 IMO GHG Strategy, and includes new calculations that show this would require a supply-based carbon intensity reduction factor of 55% by 2030, compared to 2008, equivalent to a reduction factor of 41% by 2030 compared to 2019. The analysis also shows that it would be possible to quite easily go beyond the 2023 IMO GHG Strategy targets and align shipping emission reductions with a genuine 1.5°C Paris Agreement trajectory.

*Strategic direction,  
if applicable:* 3

*Output:* 3.2

*Action to be taken:* Paragraph 30

*Related documents:* Resolutions MEPC.377(80) and MEPC.338(76); MEPC 83/6/10; MEPC 82/WP.8, MEPC82/6/17; MEPC 81/6/18, MEPC82/6/42, MEPC 82/INF.8/Add.1; MEPC 76/INF.10; ISWG-GHG 18/2/8; ISWG-GHG 17/2/2, ISWG-GHG 17/2/20 and ISWG-GHG 16/2/19

**Introduction and background**

1 The 2023 IMO GHG Strategy (resolution MEPC.377(80)) increased its ambition in recognition of international shipping's responsibility to urgently reduce and phase out GHG emissions from international shipping. The 2023 IMO GHG Strategy thus increases the overall reduction target for 2050 from 50% in the Initial Strategy, and introduced additional goals to reduce GHG emissions by 20%, striving for 30% by 2030. Yet, the sub target to achieve a 40% reduction of the carbon intensity of transport work by 2030 received no such revision. The ongoing review of the short-term GHG reduction measure, particularly the review of carbon intensity reduction factors of the carbon intensity indicator (CII) is an opportunity to rectify this misalignment with the 2023 IMO GHG Strategy's increased ambition.

2 MEPC 82 established a two-phased way forward for the review of the short-term GHG reduction measure, in line with the levels of ambition of the 2023 IMO GHG Strategy (MEPC 82/WP.8, annex 5). Phase 1, to be concluded by 1 January 2026, requires the establishment of CII reduction (Z) factors for the years 2027 to 2030 through a correspondence group and ISWG-APEE 1, as established with their respective terms of reference.

3 Failing to align these reduction factors with the emission reduction targets of the revised 2023 IMO GHG Strategy leaves significant emissions unabated and ignores synergies with the Global Fuel Standard (GFS) currently under negotiation.

4 As the bespoke measure to improve the efficiency of international shipping through technical and operational means, the CII should incentivize and speed up the uptake of non-fuel technologies to reduce fuel burn. The uptake of these technologies uniquely improves the impact of future mitigation measures, while adding to cumulative emissions saved from day one. While the deployment of zero and near-zero (ZNZ) emission fuels will be needed to decarbonize maritime transport fully, efficiency improvements and technologies are essential to minimize the need for these fuels and to reduce the overall cost of this transition.

### **The role of efficiency in decarbonizing shipping**

5 Ambitious energy efficiency targets can deliver substantial GHG emission reductions by minimizing a ship's fuel burn from the moment of adoption, saving significant cumulative emissions throughout the next decade before the uptake of zero-emission fuels is expected to ramp up. Implementing readily available energy efficiency options, e.g. through efficient ship design, or by exploiting renewable energy sources for propulsion, such as wind-assisted propulsion systems (WAPS), in turn reduces the demand volumes for costly ZNZ fuels, amplifying the effect of the GFS. Similarly, immediate GHG reductions can be achieved through operational measures, e.g. optimization of ship speeds for just-in-time arrival, or optimizing cargo space utilization.

6 To bring about these benefits, bespoke, ambitious, and robust targets are required, as market-driven improvements in energy efficiency have stalled.<sup>1</sup> Additionally, the current 40% carbon intensity reduction by 2030 will be outpaced by predicted demand growth.<sup>2</sup>

7 In document ISWG-GHG 16/2/19 (CSC), CSC proposes to revise the CII into a bespoke energy efficiency measure by changing the denominator from gCO<sub>2</sub>/t-nm to GJ/t-nm. This would avoid the current overlap with the GFS, whereas in the CII's current form, compliance with both measures can be achieved through the uptake of fuels with lower tank-to-wake (TtW) emissions. While the discussion of this proposal was postponed to Phase 2 of the review, the level of ambition should be set through the Z-factors as soon as possible, and maintained in light of any future change of the CII metric.

### **Developing Z-factors aligned with the 2023 IMO GHG Strategy by 2030**

8 The report of the Correspondence Group on the review of the short-term GHG reduction measure (MEPC 83/6/10 (Brazil et al.)) shows clear majority support for defining Z-factors in Phase 1 for the years 2027 to 2030. The thirty-four proposed Z factors range from -14% to -38% compared to 2019. Through the Correspondence Group, CSC proposed a Z-factor of -35% for 2030.

---

<sup>1</sup> UMAS, UCL (2024). *Transition Trends: International Shipping Emissions from 2018 to 2022*

<sup>2</sup> Simon Bullock, Alice Larkin & Jonathan Köhler (07 Jan 2025): Beyond fuel: the case for a wider perspective on shipping and climate change, *Climate Policy*. <https://www.tandfonline.com/doi/full/10.1080/14693062.2024.2447474>

9 With this document, CSC updates its contribution to the Correspondence Group and proposes Z-factors that align the CII with the 2030 level of ambition of the revised 2023 IMO GHG Strategy. The suggested reduction factors are calibrated to incentivize the uptake of non-fuel technologies and operational measures to improve the carbon intensity of international shipping.

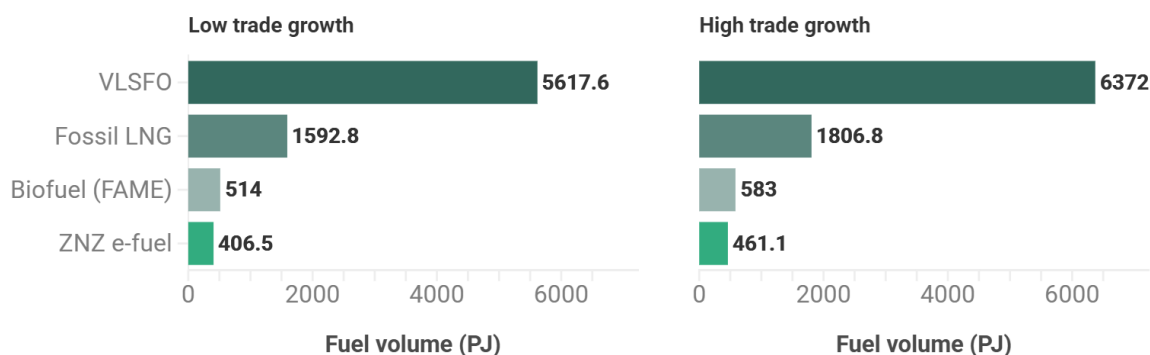
10 Under the current metric of the CII ( $\text{gCO}_2/\text{t-nm}$ ), ships can comply through technical and operational energy efficiency measures and through the uptake of alternative fuels with a lower TtW  $\text{CO}_2$  emission value. To establish sufficient incentives to leverage the CII's unique opportunity, this overlap with the GFS needs to be accounted for when establishing reduction targets.

11 In order to estimate the carbon intensity reduction from the uptake of alternative fuels, this document estimated a potential fuel mix suited to achieve 2023 IMO GHG Strategy-aligned base target GFI proposed in document ISWG-GHG 17/2/2 (Austria et al.) for 2030, and in line with the methodology underlying document ISWG-GHG 18/2/8 (CSC). This marine fuel mix needs to achieve an average well-to-wake (WtW) GHG intensity of  $82 \text{ gCO}_2\text{eq}/\text{MJ}$ . Figure 1 and table 1 illustrate compliant fuel mixes for 2030 under DNV's low and high trade growth scenarios.

12 It should be noted that this fuel mix is based on one of multiple proposals currently under discussion regarding the design of the mid-term measures. It was chosen as an illustrative background for the overlap of the GFS and the CII. While representing the lower end of target GFI in document ISWG-GHG 17/2/2, other submissions propose a significantly lower level of ambition for the GFS. The resulting fuel-mix might feature a higher share of carbon-intensive fossil LNG, VLSFO, and damaging biofuels over green e-fuels.

## A marine fuel mix compliant with IMO GHG strategy base targets

By 2030, international shipping will rely primarily on fossil fuels under the GFS.



Source: T&E (2025) • Fuel mix based on base GFI targets proposed in ISWG-GHG 17/2/2. ZNZ e-fuels assume e-ammonia and set to 5%, Biofuels TtW emission factors match fossil counterparts for TtW  $\text{CO}_2$  emissions following MEPC 76/6/1. Emission factors based on FuelEU Maritime and EU Renewable Energy Directive.

**Figure 1: Marine fuel mix compliant with the 2023 IMO GHG Strategy-aligned GFI target of  $82 \text{ gCO}_2\text{eq}/\text{MJ}$  by 2030, as proposed in document ISWG-GHG 17/2/2**

**Table 1: Predicted fuel mix under a Global fuel standard to meet the base GFI values set out in document ISWG-GHG 17/2/2 by 2030 (82 gCO<sub>2</sub>eq/MJ)**

Fuel type	Low growth		High growth	
	Fuel volumes (PJ)	Fuel volumes (%)	Fuel volumes (PJ)	Fuel volumes (%)
ZNZ e-fuel	406.5	5%	461.1	5%
VLSFO	5,617.6	69%	6,372.0	69%
Fossil LNG	1,592.8	20%	1,806.8	20%
Biofuels	514.0	6%	583.0	6%
Total energy (PJ)	8,131	100%	9,223	100%

13 By applying the scope of the CII metric, i.e. accounting for TtW emissions only, excluding non-CO<sub>2</sub> emissions, and adjusting the fleet to include only ships sized >5,000 GT, it is possible to calculate CII Z-factors that would align with these particular fuel pathways. By assigning either measure of transport work (i.e. using AER or EEOI metrics) of ships sized >5,000GT, the carbon intensity and thus fuel-equivalent reduction factors are derived. Annex 1 to this document provides a detailed overview of the fuel scenario and demand growth.

14 Due to inaccuracies in the original 2008 baseline for calculation of the CII, resolution MEPC.338(76) sets new minimum targets for the reduction of carbon intensity of at least 21.5% AER or 10% EEOI between 2019 and 2030.

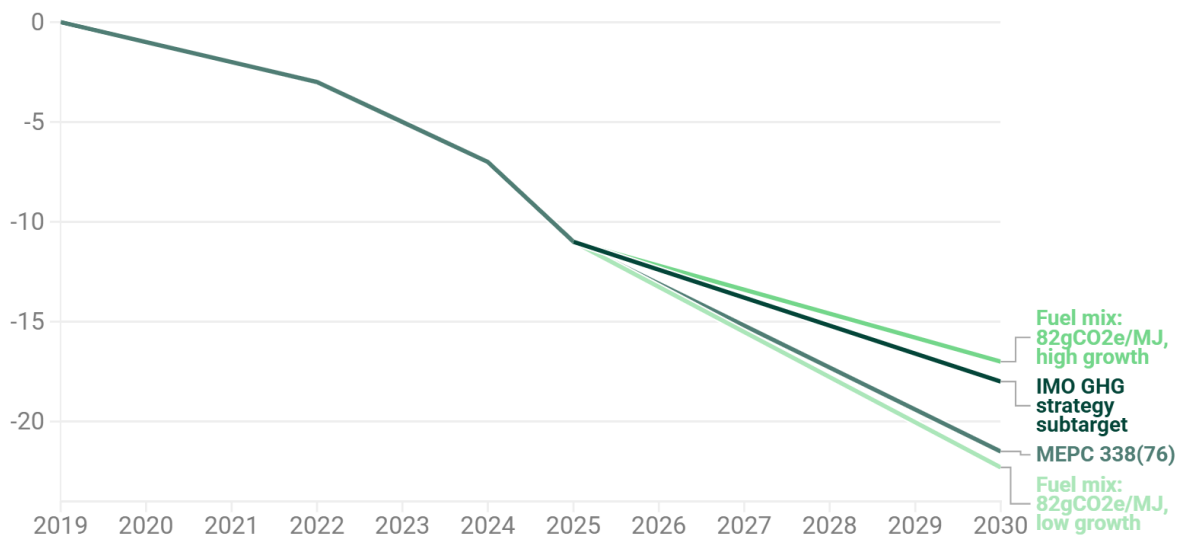
15 Using this method and fuel pathway, Z-factors for 2023 equivalent to a successful, base GFI-aligned fuel pathway at low and high trade growth would be as follows, and as depicted in figure 2:

- .1 Low trade AER: -41% (compared to 2008), or -22.3% (compared to 2019)
- .2 High trade AER: -37% (compared to 2008), or -17.0% (compared to 2019)
- .3 Low trade EEOI: -47% (compared to 2008) or -20.5% (compared to 2019)
- .4 High trade EEOI: -43% (compared to 2008) or -15.1% (compared to 2019)

## By 2030, carbon intensity reduction from a low target GFI could exceed 40%

Unless CII reduction factors are increased, they will not add unique incentives beyond the IMO GHG strategy's sub-target.

### Carbon intensity reduction (%)



Source: T&E (2025), MEPC338(76) • The Single trajectory until 2025 is based on supply-based (AER) carbon intensity targets from MEPC 338(76). The fuel trajectories are based on base and striving GFI targets from ISWG-GHG 17/2/2, and DNV's high-growth scenario from MEPC 82/INF.8/Add.1.

**Figure 2: AER CII target trajectory under the current IMO GHG Strategy sub-target, compared to the impact of a fuel mix compliant with 82 gCO<sub>2</sub>eq/MJ on the carbon intensity of international shipping at low and high trade growth.**

16 Under a similar methodology, but aligned with the striving target GFI from document ISWG-GHG 17/2/2 (i.e. below 70 gCO<sub>2</sub>eq/MJ), the fuel-equivalent Z-factors for 2030 would be as follows:

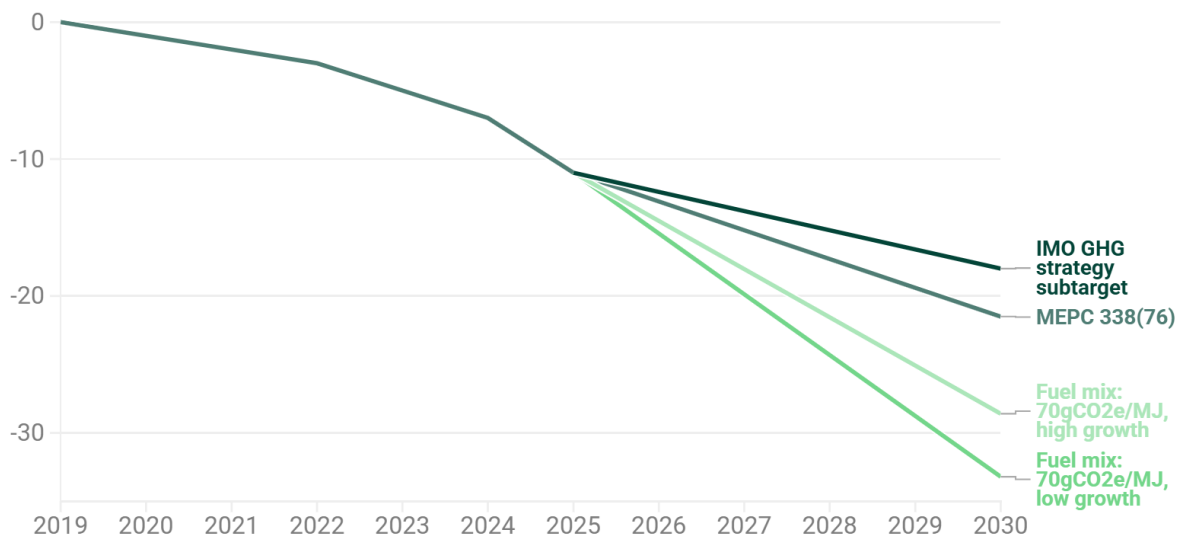
- .1 Low trade AER: -49% (compared to 2008), or -33.2% (compared to 2019)
- .2 High trade AER: -45% (compared to 2008), or -28.6% (compared to 2019)
- .3 Low trade EEOI: -54% (compared to 2008), or -31.6% (compared to 2019)
- .4 High trade EEOI: -51% (compared to 2008), or -26.9% (compared to 2019)

The supply-based carbon intensity impacts are illustrated in figure 3, with the corresponding fuel mix added in annex 2 to this document.

## A striving GFI target would overtake the 2030 carbon intensity goal

The IMO GHG strategy's sub-target will not add any incentives for energy efficiency if combined with a more ambitious GFS

### Carbon intensity reduction (%)



Source: T&E (2025), MEPC338(76) • The Single trajectory until 2025 is based on supply-based (AER) carbon intensity targets from MEPC 338(76). The fuel trajectories are based on base and striving GFI targets from ISWG-GHG 17/2/2, and DNV's high-growth scenario from MEPC 82/INF.8/Add.1.

**Figure 3: AER CII target trajectory under the current IMO GHG Strategy sub-target, compared to the impact of a fuel mix compliant with a carbon intensity of 70 gCO<sub>2</sub>eq/MJ for international shipping at low and high trade growth.**

17 Comparing the carbon intensity reduction expected by the uptake of alternative fuels with the current sub-targets shows the following results:

- .1 Compared to the 2008 baseline, the current sub-target of 40% carbon intensity reduction by 2030 will be outperformed by GFS-driven changes in marine fuel mix alone for three of four scenarios. For the exception of a base-GFI under high trade growth, the fuel-induced carbon intensity reduction is only 3% lower than the base target.
- .2 For the supply-based metric (AER), a target of at least 21.5% by 2030 as established in the *2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines (CII Reduction Factor Guidelines, G3)* (resolution MEPC.338(76)) compared to 2019 falls short of the impact of fuel, as a proximate estimate reduction of 22.3% compared to 2019 could be driven by fuel uptake alone. In a high-trade growth scenario, the fuel uptake is expected to decrease carbon intensity of shipping by 17%, still achieving most of the current sub-target.
- .3 For the demand-based metric EEOI, the target 10.0% compared to 2019 is significantly lower than the impact of alternative fuel uptake estimated at 15% to 32% across scenarios.

- 
- .4 The difference between Z-factors equivalent to fuel compliant with the base and striving GFI targets is substantial. This is due to the increased uptake of biofuels in the striving fuel mixes which can convert their WtW emissions savings to TtW. Assuming a broader range of biofuel pathways could reduce this disparity, as biofuels with higher TtW CO<sub>2</sub> emissions after applying the correction factor would deteriorate their impact on carbon intensity.
- .5 Counter-intuitively, shipping's carbon intensity reduction from fuel uptake decreases with higher trade scenarios. This is due to the relationship of WtW and TtW emissions, and the types of fuel likely bunkered under higher trade demand whereas increased energy demand causes higher fuel uptake, exponentially increasing TtW CO<sub>2</sub> even if WtW CO<sub>2</sub>eq/MJ remains stable.

18 Under the current metric of the CII, any reduction factor that is less ambitious than 41% AER or 47% EEOI compared to 2008 (22.3% AER or 20.5% EEOI compared to 2019) does not provide additional incentives when compared to a fuel mix in line with a base target GFI by 2030.

### **Aligning Z-factors with absolute emission reduction requirements**

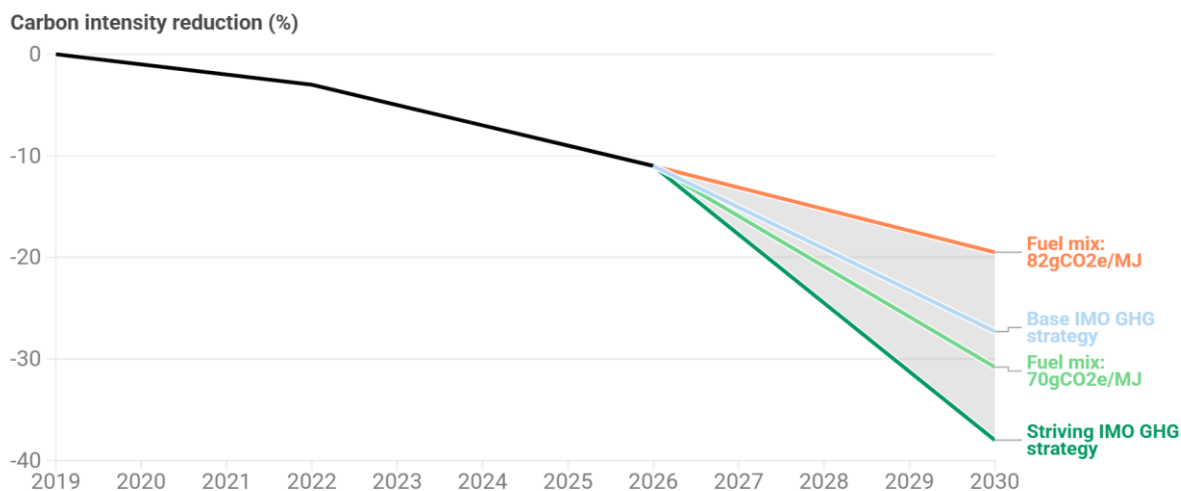
19 If the CII only targets the 2023 IMO GHG Strategy sub-target of 40% carbon intensity reduction by 2030 (or the 23.6% AER updated target compared to 2019), the very substantial improvements in energy efficiency are possible as a result of changes to operational practices, energy-efficient ship designs, or the uptake of wind-assisted propulsion systems (WAPS) would remain untapped, and the associated cost savings and emission reductions unrealized.

20 In addition to this so far unaddressed opportunity, the 2023 IMO GHG Strategy is almost guaranteed not to set international shipping on a Paris-aligned trajectory to keep global warming below 1.5°C, even if striving emission reduction targets are realized. Emphasizing the uptake of energy efficiency improvements further improves long term impact, as it offers a unique opportunity to improve cumulative emission reductions by reducing fuel burn from the day of adoption, rather than incrementally switching to cleaner fuels. Over time, this drastically increases the total emissions abated.

21 To meet the striving 2023 IMO GHG Strategy targets in terms of absolute emission reductions, would require at least an additional 18.5% carbon intensity improvement under average trade growth, depending on the fuel mix. Figure 3 compares Z-factors equivalent to a base and striving GFI with those required to meet striving 2023 IMO GHG Strategy targets.

## Ambitious CII reduction factors are needed to achieve 2030 GHG emission reductions targets

To meet absolute emission reduction targets, CII targets need to increase by about 18.5%.



Source: T&E (2025), MEPC338(76) • The shrouded area indicates current lack of ambition. The Single trajectory until 2025 is based on supply-based (AER) carbon intensity targets from MEPC 338(76). The fuel trajectories are based on base and striving GFI targets from ISWG-GHG 17/2/2, and DNV's average-growth scenario from MEPC 82/INF.8/Add.1.

**Figure 3: CII target trajectory under the current IMO GHG Strategy sub-target, compared to the impact of a base and striving GFS fuel mix on the carbon intensity of international shipping, and the required carbon intensity reduction to achieve the striving targets of the 2023 IMO GHG strategy.**

22 The required absolute emission reductions, and consequently the reduction in the carbon intensity of international shipping are very sensitive to future growth of transport work. This analysis assumes the "high-growth" and "low-growth" scenarios presented by DNV in document MEPC 82/INF.8/Add.1 (Secretariat). Other analyses, e.g. Bullock et al.<sup>3</sup> estimate higher transport work estimations for 2030. According to this analysis, a demand-based CII reduction factor of 52% to 55%, or 58% to 62% by 2030 would be required to ensure absolute emission reductions of 20% or 30% compared to 2008, respectively. Annex 3 to this document compares the impact of high, average, and low-trade demand growth on the trajectories.

23 Across demand growth scenarios, the 2023 IMO GHG Strategy striving target of reducing shipping emissions by 30% by 2030 also implies ambitious targets for the CII. At the same time, setting the reduction factors to achieve carbon intensity equivalent to a low-TtW fuel mix defines the lower end of ambition. This would align the GFS and CII without accounting for additional compliance options to the latter. In contrast, calculating CII reduction factors based on required absolute carbon emission reduction mark the higher end of ambition offers, while offering two distinct advantages: First, they indicate what level of ambition would be required to meet the 2023 IMO GHG Strategy targets. Second, by contrasting high-ambition Z-factors with the contribution of future fuel mixes, such targets indicate the contribution required through energy efficiency.

<sup>3</sup> Simon Bullock, Alice Larkin & Jonathan Köhler (07 Jan 2025): Beyond fuel: the case for a wider perspective on shipping and climate change, *Climate Policy*.  
<https://www.tandfonline.com/doi/full/10.1080/14693062.2024.2447474>

24 Under its current metric of gCO<sub>2</sub>/t-nm, ships can improve their carbon intensity both through the uptake of fuels with a lower carbon intensity, as well as through operational and technical improvements such as reduced sailing speed or wind propulsion, among others. As clean fuels, particularly those with a long-term decarbonization potential will be scarce and expensive, especially in the short term, a high-ambition CII offers additional incentives for lower-cost alternatives.

### **The potential of wind, technical and operational energy efficiency**

25 As demonstrated, a reduction factor aligned with a fuel pathway marks the minimum ambition for the CII, whereas the striving 2023 IMO GHG Strategy offers a more ambitious alignment with absolute emission reduction targets. Under an average trade growth scenario, the added ambition of the latter approach ranges from at least 18.5%, depending on the specific fuel mix. This range can be understood as the required contribution of non-fuel efforts. Interestingly, even its upper limit falls within the potential for energy efficiency improvements as estimated by various sources. Indeed, this shows that not only could the striving target of the IMO GHG Strategy easily be met if proper incentives for energy efficiency gains are put in place, it does offer the potential to go beyond and align shipping emission reductions with a 1.5°C trajectory under the Paris Agreement.

26 For example, the *Fourth IMO GHG Study* estimates an even higher efficiency savings potential of 26.2% by 2030. While estimates vary by ship type and available technology, even ambitious carbon intensity reduction targets could be met by energy efficiency, while reducing the overall cost of the transition.

27 These projections are backed up by multiple analyses of the potential for operational efficiency improvements, particularly from slow steaming. Here DNV estimates between 14.5% and 30%. Separately, CE Delft<sup>4</sup> finds similar figures, with improvement potential of 13%, 24%, or 33% should sailing speed be reduced by 12%, 20%, or 30% respectively. A joint analysis by UCL and UMAS<sup>5</sup> showed a potential of 10% to 25% from avoiding port congestion by reducing ships' speed accordingly.

28 This evidence shows that ambitious CII carbon intensity targets can easily be achieved by improved energy efficiency of shipping, adding to and activating synergies with the uptake of ZNZ fuels with low TtW CO<sub>2</sub> emissions.

### **Conclusion and policy recommendations**

29 In light of this analysis, CSC urges the Group to agree to recommend to the Committee a supply-based carbon intensity reduction factor for the CII for 2030 of 55% compared to 2008, or 41% compared to 2019.

### **Action requested of the Working Group**

30 The Group is requested to take the information provided in this document into account when making recommendations in respect of revised Z-factors for the CII.

\*\*\*

---

<sup>4</sup> CE Delft (2017). *Regulating speed: a short-term measure to reduce maritime GHG emissions*. Retrieved from <https://cedelft.eu/publications/regulating-speed-a-short-term-measure-to-reduce-maritime-ghg-emissions/>

<sup>5</sup> UMAS, UCL (2024). *Port congestion, Waiting Times and Operational Efficiency*. Retrieved from <https://www.u-mas.co.uk/wp-content/uploads/2024/12/Port-Congestion-Report-v1.8.pdf>



## ANNEX 1

### METHODOLOGY

#### 2030 GFI scenario

The following tables outline the model assumptions and emission factors to estimate a realistic marine fuel mix for 2030 derived from the 2023 IMO GHG Strategy. The fuel mix is estimated so that its WtW GHG intensity is equal or below the specified GFI target for 2030, here 82 gCO<sub>2</sub>eq/MJ. ZNZ e-fuels and LNG proportions are assumed to be fixed and will represent respectively 5% and 20% of the energy used in 2030. Biofuels and VLSFO quantities are then adjusted so that the fuel mix's WtW GHG intensity is compliant with the GFI target. For energy efficiency, the base scenario is derived from the *Fourth IMO GHG Study* efficiency forecasts (table 38). Energy efficiency reduces energy demand by 3% in 2024, and increases monotonously to 13% reduction in energy demand by 2030

Dimension	Assumption and source
Ship coverage	Ships above 5,000 GT involved in international shipping
% emissions exempted by $f_{voy}$	None
Emission scope	Well-to-Wake
Trade growth scenario	BAU high growth scenario, as defined in document MEPC 82/INF.8/Add.1
Inherent energy efficiency scenario	Base scenario as per the <i>Fourth IMO GHG Study</i>
GFI target scenario	82 gCO <sub>2</sub> eq/MJ in 2030, as per document ISWG-GHG 17/2/2

#### Overview of model assumptions

##### Demand growth / Transport work forecasts

Transport work forecasts are based on DNV's BAU transport work high growth scenario, from their comprehensive impact assessment (MEPC 82/INF.8/Add.1). Since carbon intensity requirements apply only to ships of more than 5,000 GT, the BAU high growth scenario is scaled down by 5%. Sensitivity tests are performed with reduction by 15 and 10% percent as well, and find no significant differences in the results.

Share of transport work	Transport work	EEOI (gCO <sub>2</sub> /t-nm)	AER (gCO <sub>2</sub> /dwt-nm)
100%	72748	8.23	4.35
95%	69111	8.67	4.58
90%	65473	9.15	4.84
85%	61836	9.68	5.12

## Fuels

Emission factors are based on FuelEU Maritime and the EU Renewable Energy Directive. E-ammonia emission factors are used for ZNZ e-fuels, and FAME (advanced biodiesel from waste cooking oil) for biofuels. Biofuels TtW emission factors are based on their WtW emission factors. According to MEPC.1/Circ.905, since the WtW emission factor for biofuels is 16.38 gCO<sub>2</sub>eq/MJ, below the 33 gCO<sub>2</sub>eq/MJ threshold, the WtW emission factor are used as the TtW emissions.

Fue type	TtW emission factors (gCO <sub>2</sub> /MJ)	WtW emission factors (gCO <sub>2</sub> eq/MJ)
ZNZ e-fuel	0.00	10.00
VLSFO	76.89	92.73
Fossil LNG	55	76.08
Biofuels	16.38	16.38

## TtW CO<sub>2</sub> estimates in 2030

TtW CO<sub>2</sub> emissions for 2030 are calculated using the forecasted energy demand in 2030, and the fuel proportions required to create a fuel mix compliant with the GFI target scenario.

Energy use in 2023 is calculated based on the carbon intensity (91.16 gCO<sub>2</sub>eq/MJ) and overall WtW CO<sub>2</sub>eq emissions (in Mt CO<sub>2</sub>), as estimated in DNV's comprehensive impact assessment. For years between 2023 and 2030, it is estimated that increases in energy demand will be proportional to increases in transport work. In addition, energy demand is corrected by accounting for expected efficiency gains based on the *Fourth IMO GHG Study* projections. In consequence, energy demand is reduced by 13% in 2030. TtW CO<sub>2</sub> emissions are then calculated according to the formula:

$$TtW\ CO_2 = E * (ef_i * p_i)$$

with  $E$  the energy demand,  $ef_i$  the TtW CO<sub>2</sub> emission factor for a fuel  $i$ , and  $p_i$  the proportion of fuel  $i$  in the global fuel mix.

## EEOI and AER estimates

The EEOI is calculated using CO<sub>2</sub> emissions and transport work for the global fleet of ships above 5,000 GT with the formula:

$$EEOI = \frac{TtW\ CO_2}{Transport\ Work}$$

With transport work expressed in tonnes \* nautical miles, and TtW CO<sub>2</sub> expressed in gCO<sub>2</sub>. The AER formula is similar to the EEOI's, but uses transport work expressed in deadweight \* nautical miles instead. However, there is no reliable forecast of transport work expressed in dwt \* nautical miles to calculate the AER. To circumvent this issue, the EEOI value is converted into an AER value by using the historical average ratio between the two indicators. The ratios AER / EEOI for the years between 2019 to 2023 are calculated and take the average as the conversion factor, giving us a value of 0.529. Hence, the AER formula is:  $AER_{2030} = EEOI_{2030} * 0.529$ . This approach assumes that the ratio will stay stable until 2030. The method is controlled by calculating the average ratio for the year 2008 to 2019, and finds a value of 0.532, indicating that the average ratio has remained stable between 2008 and 2023.

In addition, the would-be the AER / EEOI ratio in 2030 is extrapolated, based on the annualized ratio evolution between 2019 and 2023. This finds a ratio value of 0.46 in 2030, exhibiting a small downward decrease. This decrease is not significant enough however to affect results.

### CII to meet the IMO targets

Calculated are what should be the CII targets in 2030 in order to meet the IMO target of at least 20% reduction in GHG emissions compared to 2008. Three scenarios are created, based on low, average and high transport work growth estimates. For each of them, there is a WtW CO<sub>2</sub>eq value, a transport work value, and the composition of the fuel mix. The BAU low and high transport work growth scenarios are from DNV's comprehensive impact assessment. The BAU average growth scenario is calculated using the average of the low and high growth scenarios for every year between 2023 and 2030.

For each scenario, WtW GHG emissions are separated into two parts: 85% of emissions are attributed to the ships above 5,000 GT that must comply with the GFS (GFS fleet), and the remainder is attributed to the ships that are not subject to the GFS (non - GFS fleet).

The GFS fleet's emissions are converted into energy and then into TtW CO<sub>2</sub> emissions based on the WtW and TtW carbon intensity of the fuel mix. The formula for this process is:

$$TtW\ CO2 = 0.85 * \frac{WtW\ CO2e}{I_{WtW}} * I_{TtW}$$

with  $I_{WtW}$  the GHG WtW intensity,  $I_{TtW}$  the CO<sub>2</sub> TtW intensity

The EEOI and AER are then calculated based on the method outlined above. To calculate CII values compliant with the IMO targets, subtract to the GFS fleet GHG WtW emissions enough emissions so that it is equal to the IMO target, i.e. set R so that  $0.8 * WtW\ CO2e_{2008} = WtW\ CO2e_{nonGFS,2030} + (WtW\ CO2e_{GFS,2030} - R)$  is true. Then repeat the above CII calculation methodology with the same transport work values, but using  $WtW\ CO2e_{GFS,2030} - R$  instead of  $WtW\ CO2e_{GFS,2030}$  for the calculations. This results in lower CII values for 2030. Based on those updated CII values, updated Z-targets for the years 2027 to 2030 are calculated.

\*\*\*



**ANNEX 2**

**FUEL MIX UNDER A GLOBAL FUEL STANDARD TO MEET THE STRIVING GFI VALUES  
SET OUT IN DOCUMENT ISWG-GHG 17/2/2 BY 2030 (70 gCO<sub>2</sub>eq/MJ).**

Fuel type	Low growth		High growth	
	Fuel volumes (PJ)	Fuel volumes (%)	Fuel volumes (PJ)	Fuel volumes (%)
ZNZ e-fuel	406.5	5%	461.1	5%
VLSFO	4,399.7	54%	4,990.6	54%
Fossil LNG	1,592.8	20%	1,806.8	20%
Biofuels	1,731.8	21%	1,964.4	21%
Total energy (PJ)	8,131	100%	9,223	100%

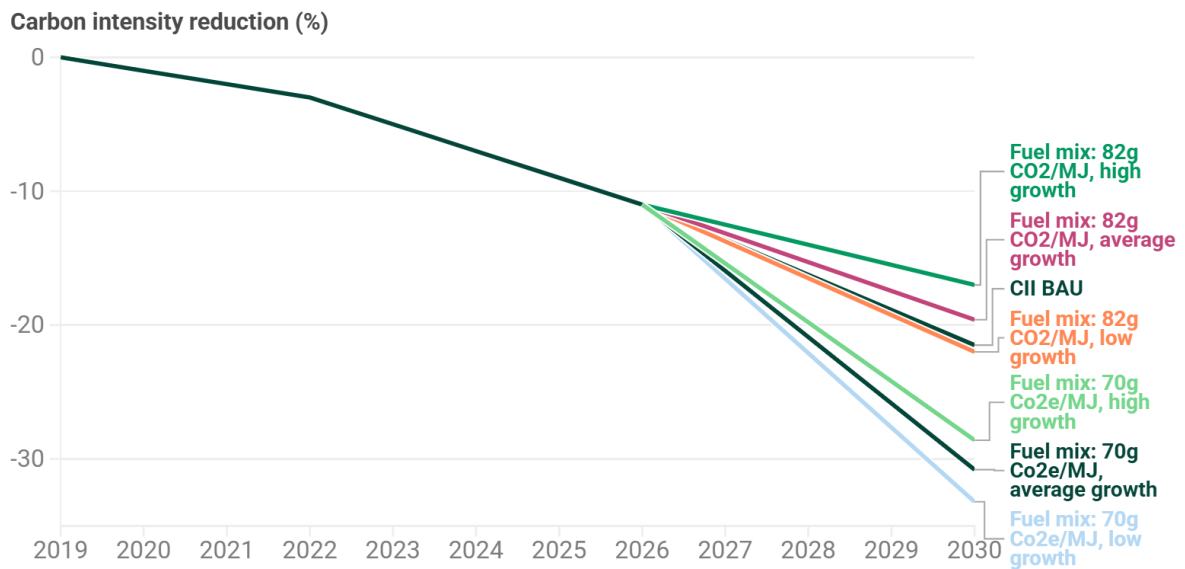
\*\*\*



ANNEX 3

ILLUSTRATION OF THE IMPACT OF TRADE GROWTH ON CARBON INTENSITY TRAJECTORIES UNDER SIMILAR FUEL MIXES

Comparison of carbon intensity impacts of fuel mixes under three growth scenarios



Source: T&E (2025), MEPC338(76) • The shrouded area indicates current lack of ambition. The Single trajectory until 2025 is based on supply-based (AER) carbon intensity targets from MEPC 338(76). The fuel trajectories are based on base and striving GFI targets from ISWG-GHG 17/2/2, and DNV's average-growth scenario from MEPC 82/INF.8/Add.1.