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17th session
Agenda item 2

ISWG-GHG 17/2/20
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FURTHER CONSIDERATION OF THE DEVELOPMENT OF CANDIDATE MID-TERM MEASURE(S)

Further information on the GHG Fuel Standard (GFS) and the incorporation of fuel and non-fuel on-board energy reward factors, a sustainable fuel sub target, and associated proposed amendments to documents ISWG-GHG 15/3/1 and ISWG-GHG 16/2/7 (Austria et al.)

Submitted by CSC

SUMMARY

Executive summary:	This document provides elements to consider in designing the GHG Fuel Standard (GFS), especially in relation to the GHG Fuel Intensity (GFI) targets, the competitiveness of alternative fuels and non-fuel technologies, and what constitutes a sustainable zero and near-zero emission fuel. Concretely, this document suggests the incorporation of dedicated mechanisms to promote non-fuels on-board energy sources (e.g. wind and solar) as well as sustainable marine fuels based on electrolytic-hydrogen. It provides draft amendments to modify the proposals contained in the annex to document ISWG-GHG 15/3/1 (Austria et al.) as well as in annexes 1 and 2 to document ISWG-GHG 16/2/7 (Austria et al.) in order to operationalize the aforementioned mechanisms.
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 34
Related documents:	ISWG-GHG 15/3/1; ISWG-GHG 16/2/7, ISWG-GHG 16/2/10, ISWG-GHG 16/2/14 and ISWG-GHG 16/2/19

Introduction

1 This document provides information to consider when developing the GFS in relation to the GFI targets, the competitiveness of alternative fuels and technologies and the sustainability criteria associated with alternative fuels. It builds on policy recommendations contained in document ISWG-GHG 16/2/19 (CSC) and provides technical justification and draft legal texts in annexes 1, 2 and 3 to the document to operationalize the concepts listed below:

.1 a reward factor mechanism (i.e. also known as a *fuels multiplier*) for the use of alternative fuels based on electrolytic hydrogen;

.2 a reward factor mechanism (i.e. also known as a *non-fuels multiplier*) for the use of zero-emission on-board non-fuel energy sources, such as wind and solar;

.3 a requirement for use of minimum amount of alternative fuels based on electrolytic hydrogen on board ships (i.e. sustainable fuels sub target); and

.4 a specific criteria to define zero and near-zero emission fuels based on electrolytic hydrogen, which are also called "sustainable fuels" throughout this document.

2 The draft legal texts are developed in the form of suggested modifications to the draft amendments to MARPOL Annex VI contained in the annex to document ISWG-GHG 15/3/1 (Austria et al.), as well as the draft guidelines for the calculation of the attained greenhouse gas fuel intensity (GFI) and the greenhouse gas fuel standard (GFS) register contained in annexes 1 and 2 to document ISWG-GHG 16/2/7 (Austria et al.).

GFS targets: ambitious and realistic

3 As explained in document ISWG 16/2/19 (CSC),[1] the GFS should be designed on a well-to-wake (WtW) CO_{2e} basis indicating maximum GFI targets permitted under each consecutive compliance period. This follows the logic of the *2023 IMO Strategy on Reduction of GHG Emissions from ships* (2023 IMO GHG Strategy) and would ensure a level playing field among all alternative fuel types. Considering the immediate benefits of energy efficiency measures in reducing GHG emissions in this decade and the need to deliver at least 10% zero and near zero emission fuels by 2030, we advocate for a moderate GFI target at the beginning of the enforcement period starting with a 9% (or 13% when accounting for the sustainable fuel *multiplier* – see information below) reduction by 2030 compared to the 2018 baseline of 91.21 gCO_{2e}/MJ (see figure 1).[2] The GFI targets would then need to increase from 2035 onwards as remaining emission reductions could only be achieved via a fuel switch.

1 Clean Shipping Coalition (2024). Further consideration of the development of candidate mid-term measure(s) in the context of phase III of the work plan for the development of mid- and long-term measures – Key design considerations for GFS and the baskets measures. https://cleanshipping.org/wp-content/uploads/2024/03/ISWG-GHG-16-2-19-Key-design-considerations-for-GFS-and-the-basket-of-measures-CSC.pdf

2 Fourth IMO GHG Study 2020 - https://greenvoyage2050.imo.org/wp-content/uploads/2021/07/Fourth-IMO-GHG-Study-2020-Full-report-and-annexes_compressed.pdf

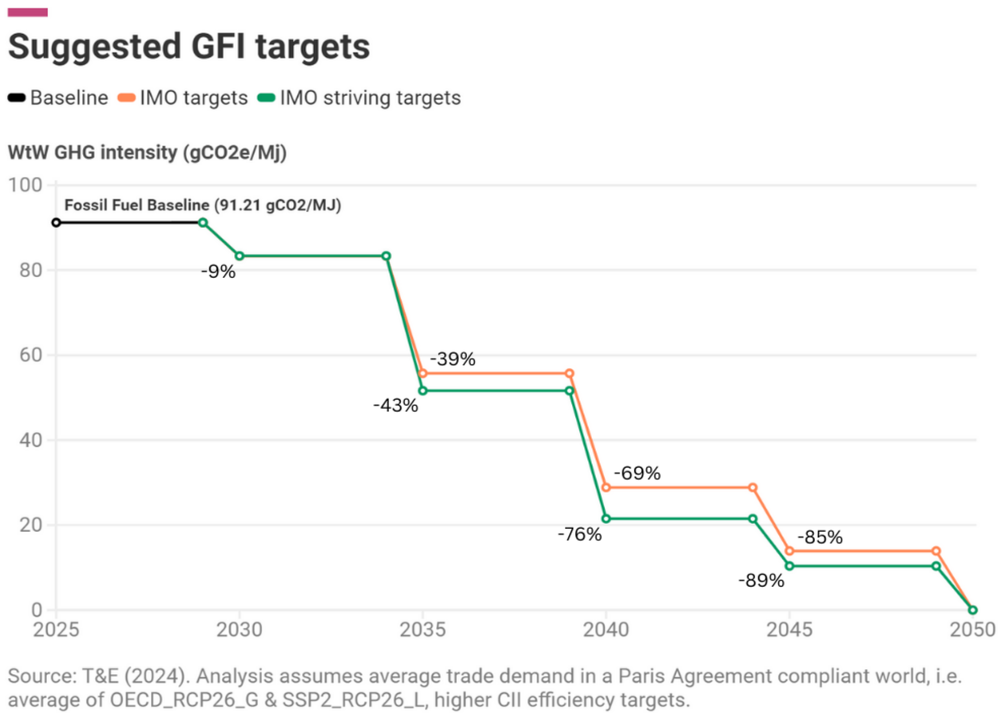

Figure 1: Suggested GFI targets under the GFS

4 It is important to keep in mind that imposing too stringent GFI targets in 2030 would risk the uptake of huge volumes of unsustainable biofuels, especially those produced from crop-based feedstocks, as the market for these fuels is more developed. While this document proposes new GFI targets for every five years, we do not oppose annually strengthened targets to provide a more predictable alternative fuels uptake trajectory for shipping.

A reward factor on zero-emission non-fuel energy sources

5 Considering the challenging head start of sustainable e-fuels and the potential move towards unsustainable biofuels, especially in the short term, zero-emission non-fuel on-board energy sources present an important opportunity to reduce shipping's fuel consumption, thereby smoothing the energy transition. According to Clarksons, a shipping services provider, 61 ships are equipped with some type of wind-assisted technology and 72 more ships in the order books are expected to be equipped with such a technology.[3] This represents a small share of the commercial fleet and prevents the shipping industry from having a more thorough understanding of this technology's potential.

6 According to the International Wind Ship Association (IWSA)wind-assist technologies fitted on existing ships could allow between 5% to 20% fuel savings.[4] For newly built ships, the fuel saving potential could be above 30%.[5] Optimistic numbers have also been presented in document MEPC 79/INF.21 (Comoros et al.), indicating that wind propulsion could reduce the

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3 Clarksons World Fleet Register

4 Gavin Allwright, International Wind Ship Association (IWSA) (2024). Wind propulsion and decarbonization - safety4sea. https://safety4sea.com/cm-wind-propulsion-and-decarbonization/

5 Wind Ship Association (2022). *La propulsion des navires par le vent: des technologies prêtes à décarboner le transport maritime Une opportunité industrielle pour la France - Livre Blanc* - Page 11 https://www.actu-environnement.com/media/pdf/news-39010-PDF1-2022-livreBlanc-Wind- Ship.pdf containership Canopée estimated the wind-propulsion accounted for 15% to 40% of this ship's energy needs https://zephyretboree.com/projets/canopee/

carbon intensity of a trip by 22.3% and above 27.8% when combined with other voyage optimization methods.[6] Similarly, academic researchers from the University of Manchester estimated that Flettner rotors and voyage optimization could result in 30% CO_2 emissions savings on routes with favourable wind conditions.[7] Finally, CE Delft – an independent research and consultancy, pointed out that a combination of wind-assist, speed reduction, and 5% to 10% e-fuels could result in 28% to 47% GHG emissions reduction by 2030.[8] Given the cost of installing wind-assist technologies and uncertainties around payback periods, there is a need for dedicated mechanisms to further incentivize the uptake and deployment of new wind-assist technologies.

7 With that in mind, this document proposes using a dedicated reward factor to promote their use under the GFI calculations. A reward factor on zero-emission on-board non-fuel energy sources is a multiplier that would allow the energy derived from those energy sources to count multiple times (twice) towards the attainment of the GFI target. This reward factor would incentivize the uptake of energy sources such as wind-assist and solar technologies used on board the ships and would help to reduce the payback period of these technologies.

A sustainable fuels sub target

8 As it stands, the proposal made in documents ISWG-GHG 15/3/1 (Austria et al.) and ISWG-GHG 16/2/10 (Austria et al.) proposal for the GFS is designed as a technology-neutral and fuels-neutral mechanism. While the goal is to create equal opportunities for all compliance options, such a system inadvertently favours incumbent alternative fuels that have already achieved a considerable level of cost reductions and market penetration due to decades-long policies promoted in other parts of the economy. Notably, the production and deployment of fuels of biogenic origin (i.e. biofuels) have been promoted through mandates as well as governmental subsidies by most countries as a transitional step to decarbonize road transport since the early 2000s. This has given biofuels a significant head-start compared to hydrogen-based synthetic fuels which do not yet have established supply chains and remain expensive. The proposal made in document ISWG-GHG 16/2/14 (Argentina et al.) additionally creates perverse incentives for alternative fossil and biogenic fuels due to an incomplete emissions accounting system (i.e. adjusted TtW) that does not reflect complete life cycle emissions.

9 Under both systems, market forces would inevitably favour biogenic fuels for compliance under the GFS for the next two decades. Figure 2(a) below shows that even if the GFS targets were implemented in combination with GHG emissions priced at $180-300/tonne CO2e,[9] biofuels would remain the most attractive compliance option all the way to the early 2040s. As illustrated in figure 2(b), the situation would remain the same in the absence of a GHG levy, although the price to pay to comply under the GFS with fossil fuels would be cheaper, as expected.

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6 Document MEPC 79/INF.21 (Comoros et al.) – Wind Propulsion

7 James Mason et al (2023). *Quantifying voyage optimisation with wind propulsion for short-term CO_2 mitigation in shipping*. Ocean Engineering Volume 289 – https://shorturl.at/WUjRE

8 Ce Delft (2023). *Shipping GHG emissions 2030: Analysis of the maximum technical abatement potential*. - https://cedelft.eu/wp-content/uploads/sites/2/2023/06/CE_Delft_230208_Shipping_GHG_emissions_2030_Def.pdf

9 The price of the GHG levy applied in this scenario is $180 from 2030, $225 from 2035, $250 from 2040, $275 from 2045 and $300 from 2050 based on the high levy scenario from DNV's Impact assessment of the basket of midterm candidate measures – second interim report and assuming $2400/t VLSFOeq.

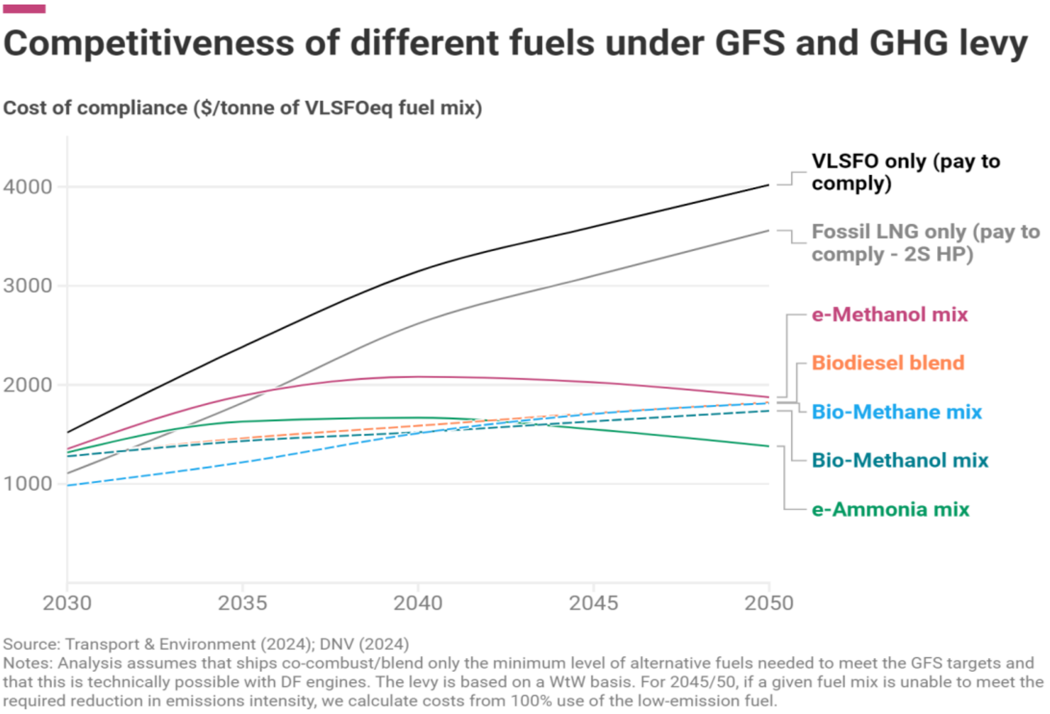

Figure 2(a): Competitiveness of alternative fuels under the GFS and GHG levy ($180-300/tonne CO2e)[10]

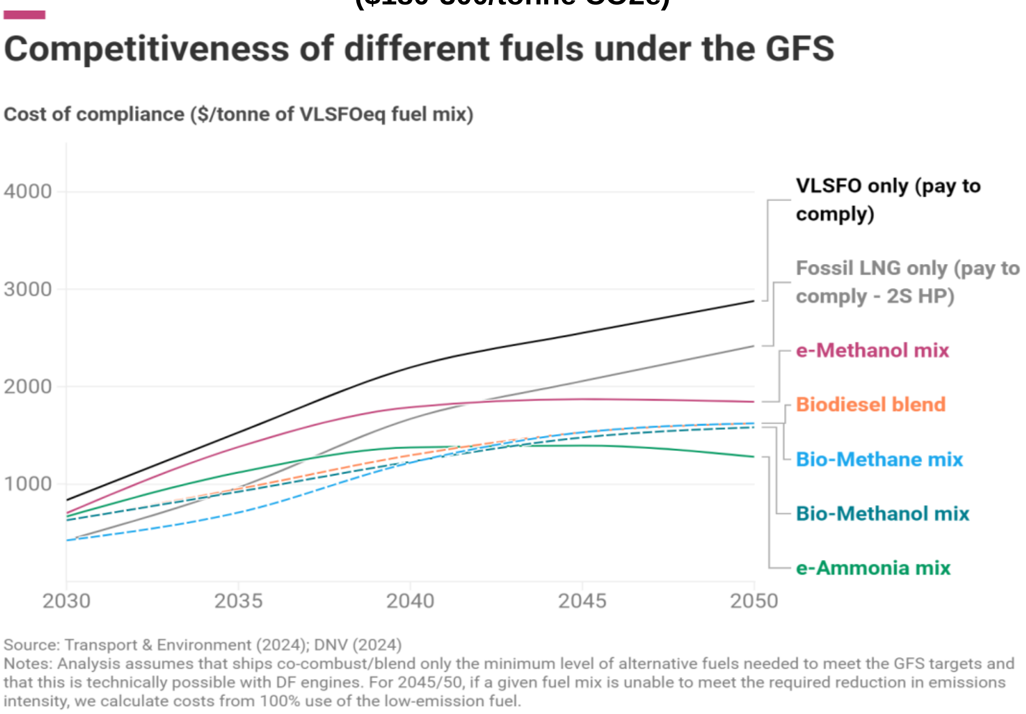

Figure 2(b): Competitiveness of alternative fuels under the GFS without a GHG levy

10 This will likely leave little space for the uptake of alternative fuels based on electrolytic hydrogen (as known as e-fuels). In general, the production of sustainable e-fuels is a capital-intensive business, which involves technical and financial uncertainties. To de-risk

10 The price of the GHG levy applied in this scenario is $180 from 2030, $225 from 2035, $250 from 2040, $275 from 2045 and $300 from 2050 based on the high levy scenario from DNV's Impact assessment of the basked of midterm candidate measures – second interim report and assuming $2400/t VLSFOeq.

those investments, it is important to create demand guarantees through dedicated policy tools. Experience from other sectors shows that mandating the use of targeted fuels/technologies is the most straightforward way to establish the guaranteed demand that investors and fuel producers need.[11]

11 To establish similar certainty for maritime fuel suppliers, a minimum uptake of sustainable e-fuels by ships under the GFS should be mandated. In practice, this means that ships should be required to use a minimum share of eligible e-fuels, including via a dedicated flexibility mechanism, in addition to reaching the GFI targets. This would ensure a minimum market share for sustainable fuels, thus incentivizing alternative fuels producers and relevant stakeholders to make those fuels available in the right quantities.

12 Considering the zero and near-zero energy objectives under the 2023 IMO GHG Strategy, a sub target of at least 5% by 2030 could be used as an initial objective – this would create a sustainable fuels demand of 596 PJ (or 14.26 Mtoe). This target demand could largely be met by the announced e-fuels projects in the 2030 horizon, i.e. 800 PJ or 19.10 Mtoe.[12] As the experience with the GFS increases, this target could be expanded for the post-2030 compliance periods in the future.

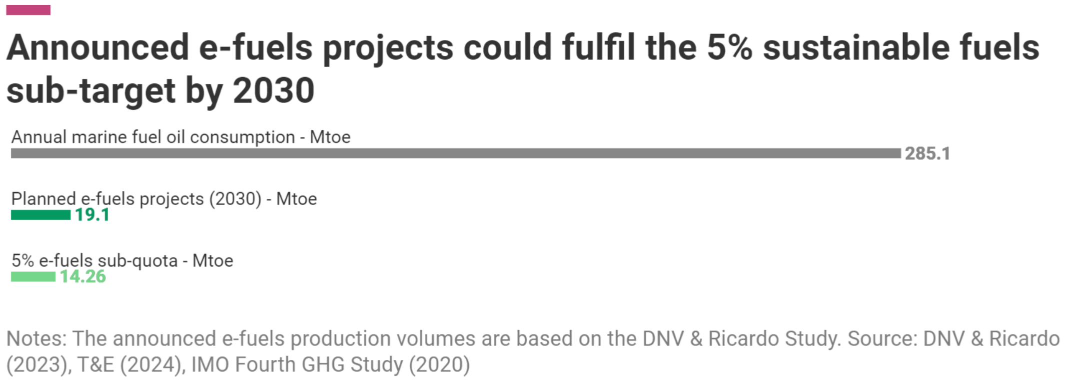

Figure 3: Comparison in Mtoe between planned production of e-fuels versus the 5% e-fuels sub target proposed by the CSC

13 It is worth pointing out that a sustainable e-fuels sub-target could represent an economic opportunity for countries with large solar, wind and hydro potential, including but not limited to Latin America, the Middle East and North Africa region, China, Australia, Southern and Northern Europe, most of Africa, etc. A quick desktop research demonstrates that a handful of countries, e.g. Chile, Egypt, Morocco, Namibia, Oman, could provide 20.93 Mtoe (7.3 Mt H2) of e-fuels. This amount is more than the required volumes under the proposed 5% target, if these countries' 2030 green H_2 production targets were met (and if all those volumes were allocated to shipping).[13]

11 E.g. Zero-emission vehicle mandates under the United Kingdom car CO_2 standard, or RFNBOs mandates under the ReFuelEU Aviation Regulation and EU Renewable Energy Directive III.

12 According to the DNV Comprehensive Impact Assessment of the Basket of Candidates Mid-Term GHG Reduction Measures – Task 2 (page 15), the median estimated supply of e-fuels would be 800 PJ by 2030.

13 For further information, please refer to: https://www.transportenvironment.org/articles/hydrogen-hype-why-the-eu-should-be-cautious-about-uncertain-imports-from-far-flung-places

Advantages of a sustainable fuel reward factor

14 While dedicated sub targets would be a preferable option to promote sustainable e-fuels, IMO may consider a softer transitional approach to incentivize their uptake before mandating them at a later stage. A reward factor for sustainable e-fuels presents such a possibility.

15 A sustainable e-fuel reward factor is a multiplier that would allow the energy from each tonne of an e-sustainable fuel to count multiple times (twice) towards the attainment of the GFI target. For example, a reward factor of two would allow one tonne of green e-methanol to count twice towards the required GFI attainment. This, in return, would make the deployment of sustainable marine fuels (especially electrolytic hydrogen-driven synthetic such as e-hydrogen and e-methanol) more cost-effective by reducing compliance costs. In practice, this means that ships deploying these sustainable and scalable fuels would be able to increase the size of the compliance pool (see figure 4 below) and distribute the extra costs associated with the use of these fuels among a bigger number of fossil ships. As the objective of the reward factor would be to incentivize the early uptake of sustainable e-fuels – as opposed to permanently making compliance easy – the reward factor would need to be limited in time (for example until 2035).

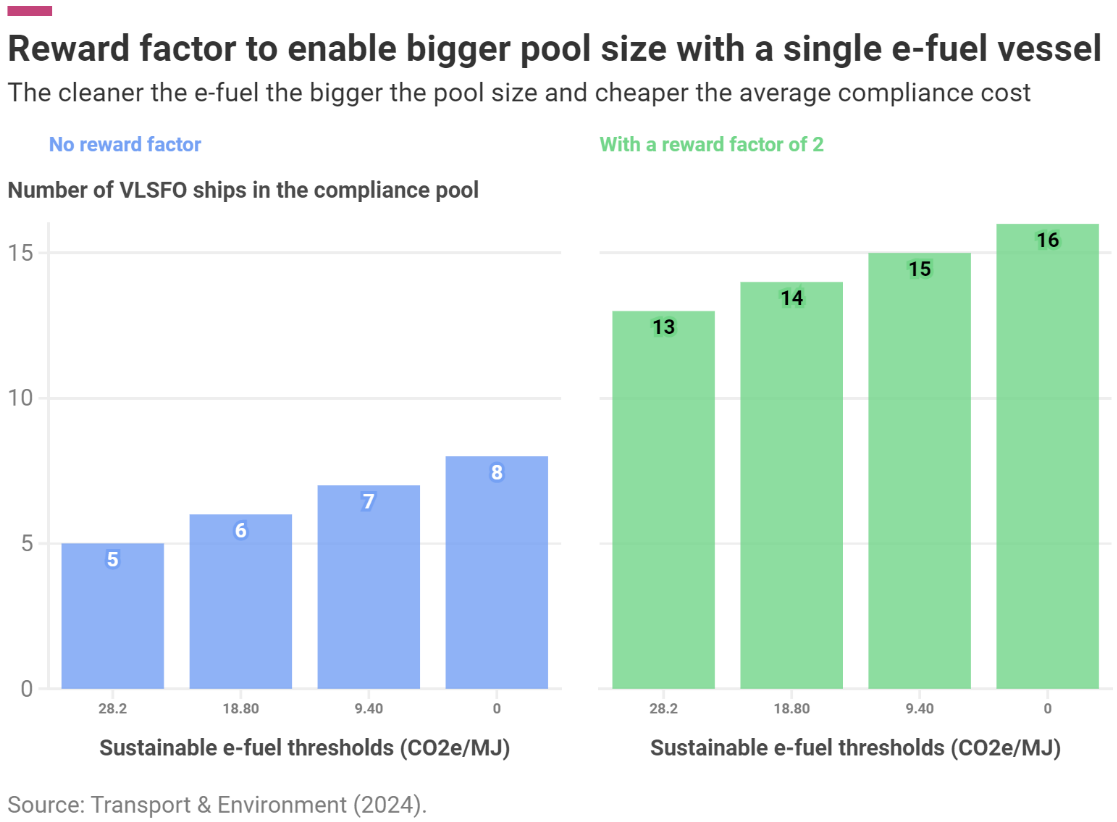

Figure 4: Impact of a reward factor of two on sustainable fuels

16 To illustrate the cost-reduction effect of the multiplier, figure 6 below shows that a reward factor of two could enable a vessel running on e-ammonia (e.g. with GHG intensity of a maximum of 9.4 gCO_{2e}/MJ) to reduce its compliance costs by more than 10% compared to a scenario where no reward factor was applied. This might seem a small improvement, but in reality, the reward factor would make green e-ammonia cost competitive against biodiesel. If, on the other hand, a ship ran on e-methanol, the application of the reward factor could lower this ship's cost by 15% and nearly close the compliance cost gap between e-methanol and bio-methanol (see figure 5 below).

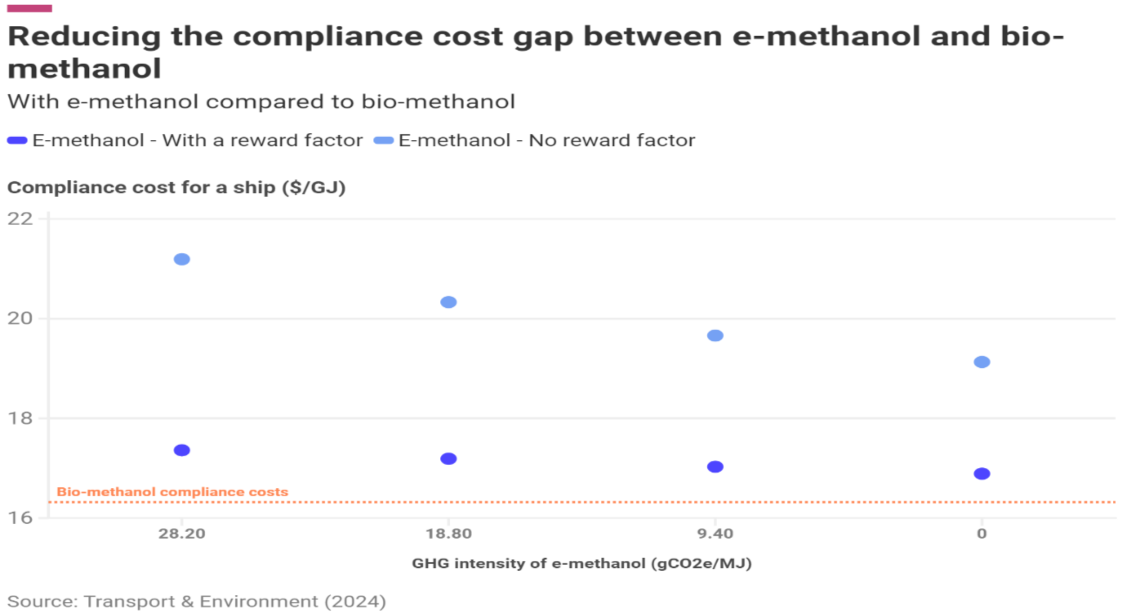

Figure 5: Compliance costs between e-methanol with and without a reward factor of two compared to bio-methanol

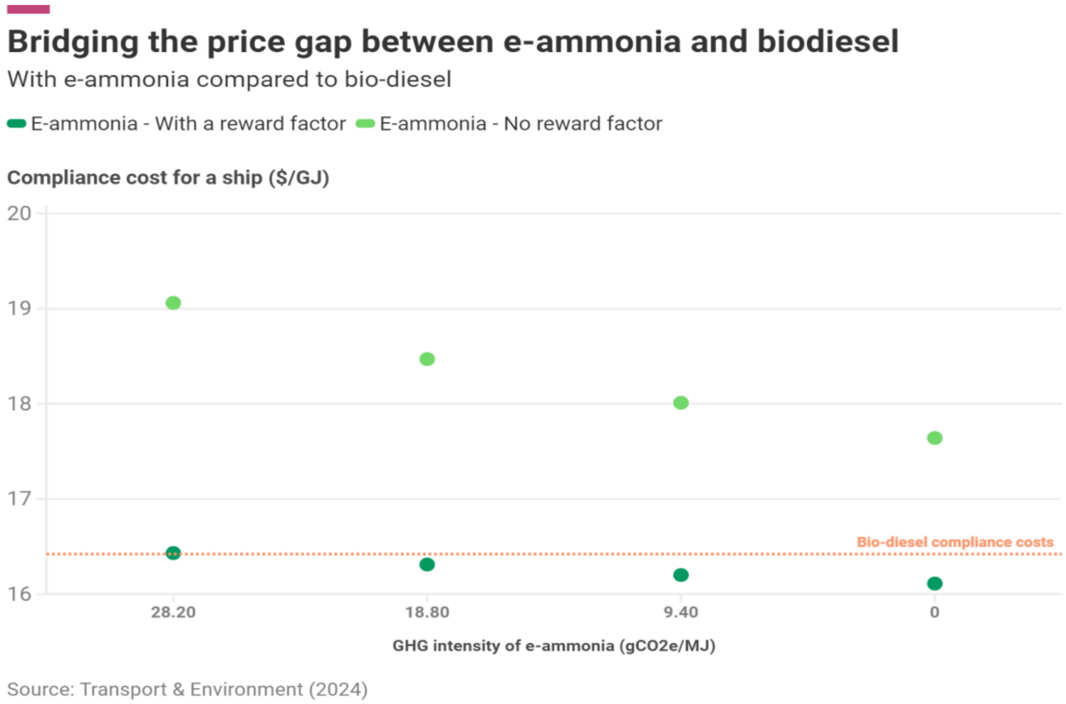

Figure 6: Compliance costs between e-ammonia with and without a reward factor of two compared to bio-diesel

17 From a mathematical perspective, the reward factor would "inflate" a ship's compliance under the GFS. In other words, using the reward factor would make ships appear as if they have emitted less GHG emissions than they did in reality. This is an expected and intended effect of the multiplier. However, the impact of the reward factor on GHG emissions reduction would likely be minimal (see figure 7 below). This is due to the fact that the uptake of sustainable electrolytic hydrogen-based fuels would necessarily be constrained by the

global availability of these fuels in the next decade.[14] Most importantly, it would be possible to adjust the GFI trajectory to account for the impact of the reward factor (see figure 8 below) which would then be phased out (e.g. by 2035).

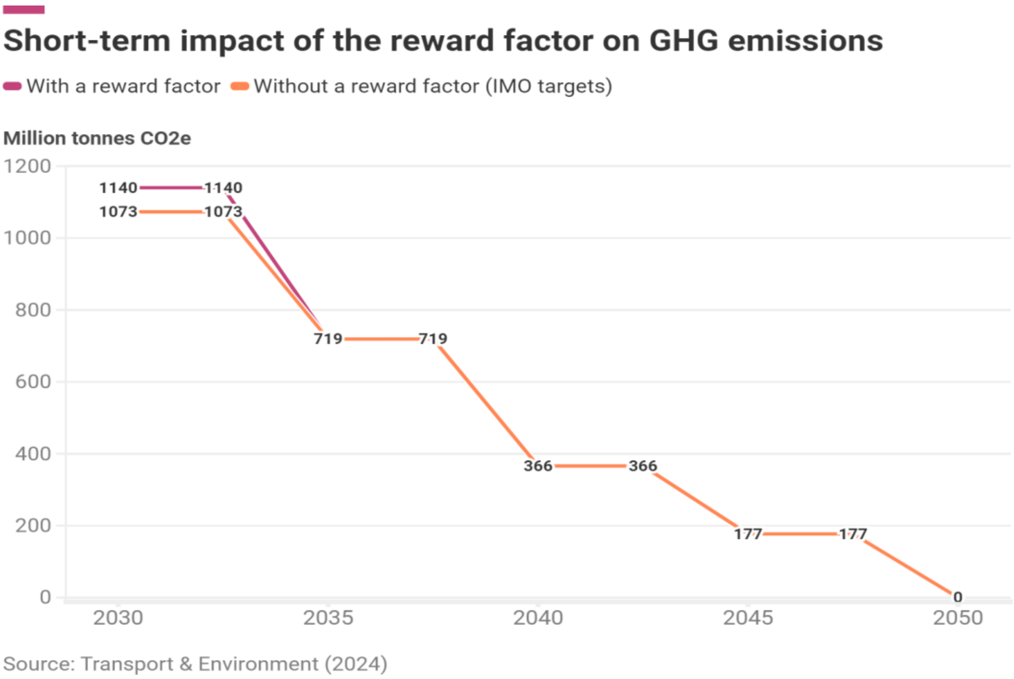

Figure 7: Impact of a sustainable e-fuel reward factor of two on GHG emissions

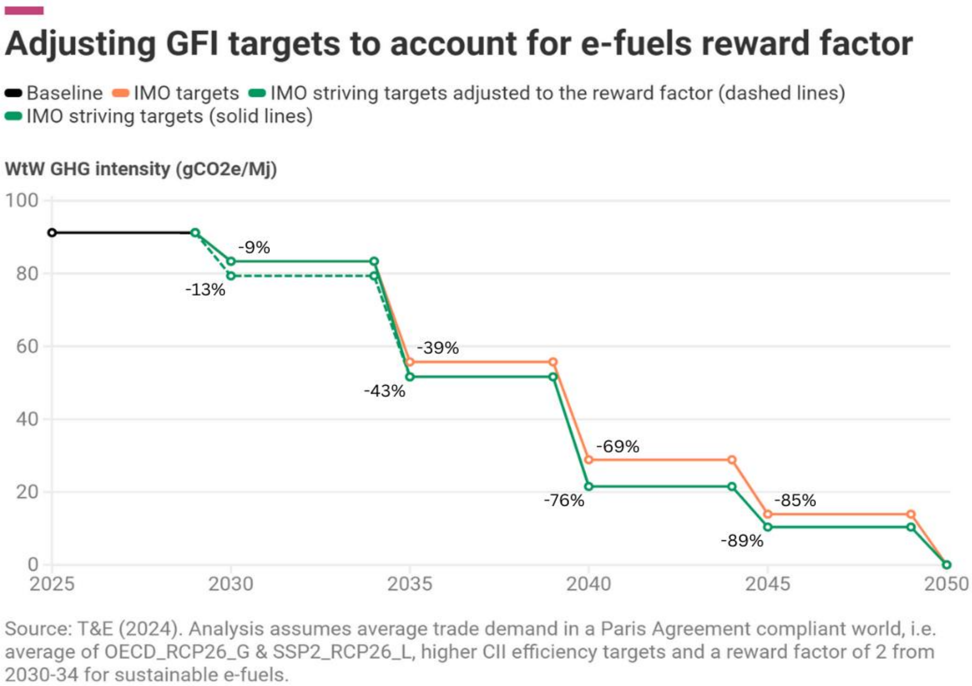

Figure 8: An example of how the impact of a sustainable fuels reward factor could be incorporated into the 2030 GFI target

14 According to the DNV Comprehensive Impact Assessment of the Basket of Candidates Mid-Term GHG Reduction Measures - Task 2 (page 15), the median estimated supply of e-fuels would be 800 PJ by 2030.

Interaction between reward factors, the sustainable e-fuels sub-target, and other mechanisms

18 The non-fuel on-board energy sources (e.g. wind and solar) reward factor could be implemented as soon as the GFS enters into force and discontinued at some point in the future whenever sufficient market confidence is gained in their technical maturity and cost-effectiveness.

19 When it comes to the interaction of the sustainable e-fuels sub-target and sustainable fuel reward factor, two options could be explored. Under a step-approach scenario, the sustainable fuels reward factor could be implemented as soon as the GFS enters into force and could at a later stage be replaced by a sustainable e-fuels sub target. In a parallel-implementation scenario, the sub target and reward factor could come into force at the same time, but the reward factor would be used on volumes of sustainable e-fuels that are above the sub target to ensure that it would remain an incentive for shipping companies to over-comply with the set target.

20 The use of a reward factor and sub target should not prejudge the use of feebates linked to the economic measure that IMO is also considering to develop. In fact, experience gained elsewhere demonstrates their mutually-reinforcing benefits. For example, a reward factor could be combined with a feebate mechanism, should one be incorporated. Since the feebate funds would originate from the global maritime GHG pricing mechanism, the amount of funding available to promote e-fuels would depend on the level of the GHG levy, the choice of revenue distribution options (e.g. energy transition of shipping in SIDs and LDCs, research & development, climate finance etc.), and whether these distribution options are to be capped. In this context, the use of a sustainable e-fuels sub target and/or reward factor could reduce the required amount of feebate funds allocated to bridge the price gap between e-fuels and other alternatives, making more available for other purposes.

Elements to consider when defining zero and near-zero emission fuels

GHG emission thresholds

21 Alternative marine fuels come with different WtW GHG footprints. Currently, there are no fuels in production that can deliver zero GHG on a life cycle basis. However, some renewable fuel pathways do have the potential to eventually reach that potential, while others will always have substantial residual emissions in the production chain.

22 To provide certainty for renewable fuels that could theoretically deliver the 2023 IMO GHG Strategy mid and long-term decarbonization objectives – while minimizing the risks of stranded assets for the fuel and technology options that cannot – it is essential to introduce a robust GHG reduction criteria to the definition of zero and near-zero emission fuels. We propose introducing the following transitional GHG reduction thresholds to qualify as such: 'sustainable fuels are electrolytic hydrogen-derived fuels that deliver:

.1 at least 90% WtW CO_{2e} emissions reduction relative to the fossil fuel baseline from 2030 onwards, or a maximum of 9.4 gCO_{2e}/MJ of energy GHG intensity;

.2 at least 95% WtW CO_{2e} emissions reduction relative to the fossil fuel baseline from 2040 onwards, or a maximum of 4.7 gCO_{2e}/MJ energy GHG intensity; and

.3 100% WtW CO_{2e} emissions reduction from 2050 onwards.'

23 Such a definition would ensure that only the fuels with long-term full decarbonization potential, especially those derived from renewable electricity, are promoted through the IMO GFS without prescribing the specific type of onboard conversion technology to be used, e.g. dual-fuel or mono-fuel engines or low or high-temperature fuel cells.

24 For illustrative purposes, figure 9 below demonstrates the potential impact of other GHG reduction thresholds on the eligibility of alternative fuels. For example, an 80% GHG reduction threshold would disqualify any fossil fuels from complying by a large margin for the zero or near-zero emissions energy uptake targets. It would also make some biofuels ineligible. For example, biomethane produced from biowaste can only deliver about 77.9% emissions reduction compared to the fossil fuel baseline.[15] This would even be the case if biomethane was used on a ship equipped with a two stroke high pressure engine (generally regarded as the liquefied natural gas (LNG) dual-fuel engine type with lowest methane slip).[16] On the other hand, popular biofuel feedstock such as used cooking oil (UCO) would comply, although a margin error would remain given that the reduction potential is estimated to be 82.6%. This could be an issue, given that the demand for UCO – notably from road transport and aviation – far outstrips existing feedstock availability and there is growing evidence for fraudulent supplies (see information box below).

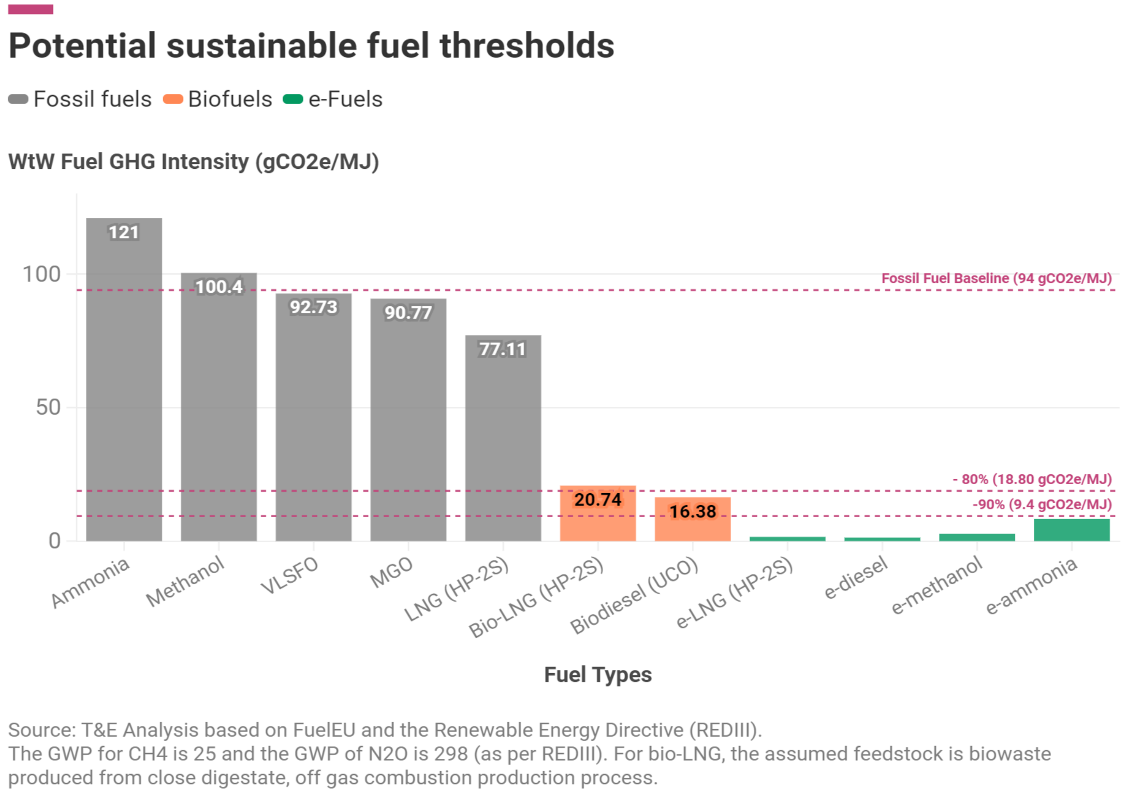

Figure 9: Potential sustainable fuels thresholds compared to a fossil fuel baseline at 94 g CO_{2e} /MJ

15 Biowaste produced from close digestate, off-gas combustion production process using the lowest GHG intensity of 14 gCO_{2e}/MJ https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001. It is important to note that biomethane can be produced from different feedstocks some of which could comply under the 80% GHG reduction threshold.

16 According to the Fourth IMO GHG Study, the engine type with the lowest methane slip is the High-Pressure Two-Stroke (HP 2S) engine with a methane slip of 0.15% of the fuel (0.2 gCH4/kWh). This would result in a WtW Fuel GHG Intensity of 20.54 gCO_{2e}/MJ (implying a 78.15% reduction threshold). The methane slip assumption in the EU is slightly higher (0.20% of the fuel) which is why the graph indicates 20.74 gCO_{2e}/MJ (or 77.9% reduction threshold).

25 It is important to note that this document suggests defining zero and near-zero emission fuels as those that are derived from electrolytic hydrogen in addition to meeting a specific GHG reduction threshold. Should IMO cast the net wider to allow other fuel pathways to qualify as zero or near-zero emission, then the application of a sub target and/or a sustainable fuels reward factor (i.e. multiplier) discussed above should only be limited to sustainable e-fuels and not all alternative fuels that meet the emissions reduction thresholds illustrated above.

A precautious approach towards e-ammonia

26 E-ammonia could become a viable alternative marine fuel and help decrease shipping's GHG emissions. Ammonia is already a feedstock traded internationally along established supply chains and is often used in the agricultural sector. There are, however, serious risks associated with the development of e-ammonia as a marine fuel which are crucial to consider before its large-scale deployment and use among ships.[17] Besides safety risks, emissions of nitrous oxide (N_2O), one of the most potent greenhouse gases with a GWP 100 of 265 (AR5), could impact global warming negatively. If N_2O emissions were to occur, these would undo any claimed CO_2 savings associated with the use of e-ammonia. In addition, potential ammonia emissions could also take place and contribute to air pollution through the formation of particulate matter. As such, transparent and complete information on N_2O and NH_3 emissions from the forthcoming dual-fuel ammonia-powered engines should be thus an absolute priority to ensure a strong regulatory design at IMO level and the safe deployment of that fuel.

Sustainable fuels and renewable requirements

27 The production of electrolytic hydrogen-derived fuels requires a source of electricity which should be decarbonized and come in addition to the decarbonization requirements of the electricity grid. This last point is especially important as the objective is to ensure the production of sustainable fuels does not rely on renewables that are already used or could be used in the future to decarbonize the electricity consumption in other sectors of the economy.

28 Should the production of sustainable electrolytic hydrogen-fuels rely on electricity originating from the grid, this implies that the grid should be almost fully decarbonized in order to produce very low GHG intensity H2-derived fuels that could meet the suggested thresholds. In fact, grid-connected hydrogen-based e-fuel production would already require renewable and/or low-carbon (i.e. nuclear) electricity to make up over 90% of the power mix in order to meet the 70% GHG intensity-reduction threshold. With a reduction threshold of 90%, this would necessitate the grid to be nearly completely decarbonized, or for e-fuel production facilities to be directly connected to renewable power sources. In reality, this means that relying on electricity from the grid to produce e-fuels with strict sustainability requirements would not be feasible today (figure 10 below) in almost any country. In other words, a high threshold would ensure both sustainability and additionality under one single mechanism.

[17] Öko-Institut (2021). Ammonia as a marine fuel Risks and perspectives https://en.nabu.de/imperia/md/content/nabude/verkehr/210622-nabu-study-ammonia-marine-fuel.pdf

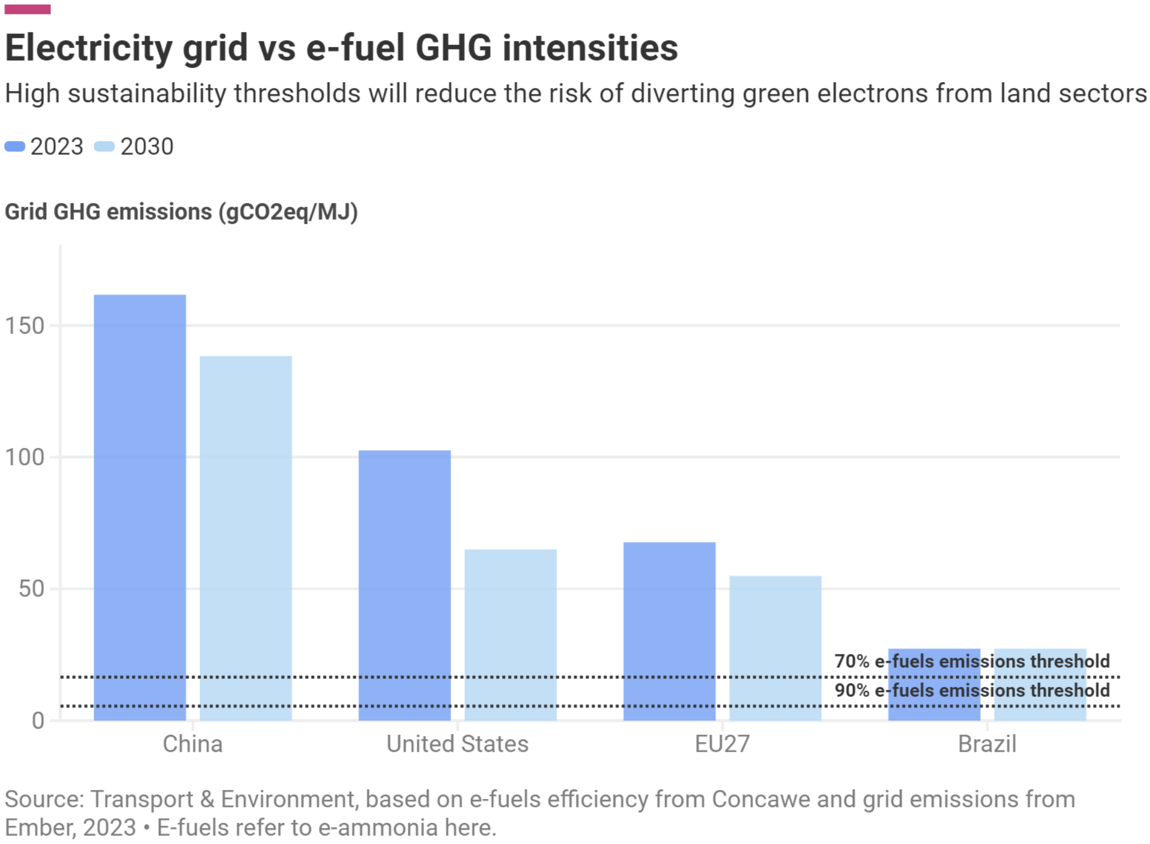

Figure 10: Grid GHG intensity vs max electricity GHG intensity needed to deliver different GHG thresholds for e-fuels

Used cooking oil (UCO): A slippery slope

29 Sustainability criteria allowing UCO to comply as a feedstock for shipping would be problematic. Increasing demand for UCO has resulted in United States and European imports from Asia, indicating that UCO collected locally is not available in sufficient quantities. In addition, a comparison between UCO exports and domestic consumption data from the main exporter countries (China, Indonesia and Malaysia) to those countries' UCO imports and collected waste oil volumes do not appear to match (figure 11 below). This raises strong suspicions over whether virgin vegetable oils, such as palm oil, are being mislabelled as waste oils, potentially associated with indirect land use change with negative consequences for the climate and biodiversity.

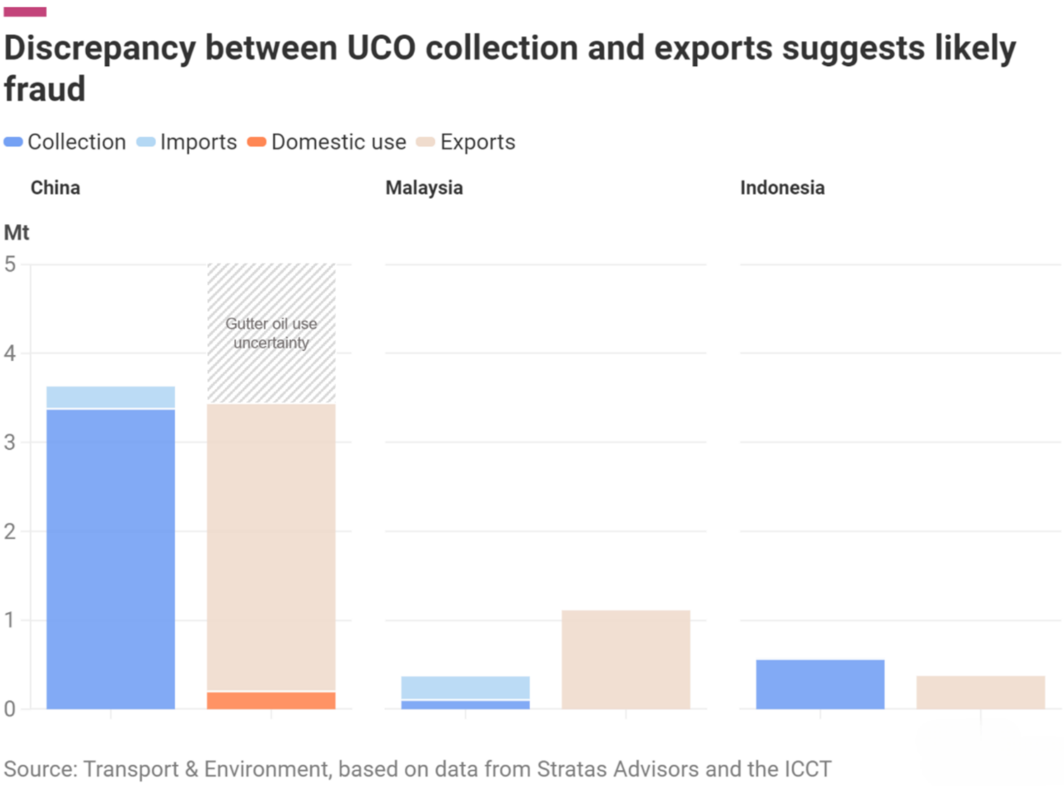

Figure 11: 2023 collection, imports, exports and domestic uses of UCO and UCO biofuels

30 Provided that UCO was only made up of used cooking oil, its potential as a fuel feedstock would remain limited. In fact, the collected volume potential would remain small compared to the demand, especially considering the demand for the aviation sector to produce sustainable aviation fuel (SAF). In 2023, China collected 3.4 Mt (million tonnes) of UCO, and would only be able to collect an extra 2.5 Mt, resulting in 5.9 Mt per year (see figure 12 below).

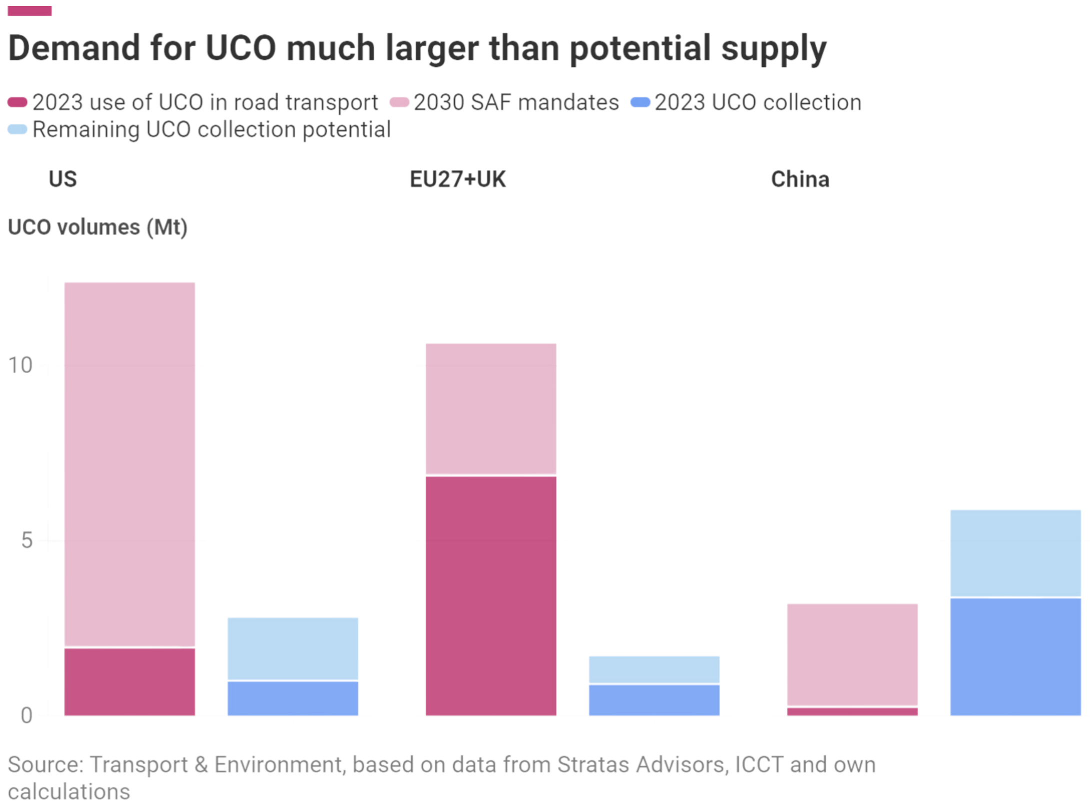

Figure 12: Current and projected demand for UCO biofuels vs collection potential

Conclusions

31 The incorporation of a reward factor on non-fuel on-board energy sources would allow a greater number of ships wishing to be equipped with solar or wind-assisted technologies to reduce the payback period of these technologies which struggle against market and non-market barriers.

32 The absence of a sustainable fuels reward factor (multiplier) or a sustainable e-fuels sub-target would result in a slower uptake of renewable synthetic fuels, making it more challenging for shipping companies – including the small ones in the long run – to afford their use as a means to attain the objectives of the 2023 IMO GHG Strategy. Without the sustainable e-fuels reward factor effect – and in the absence of a sub target – the flexibility pooling mechanism suggested in document ISWG-GHG 15/3/ would primarily incentivize ships to rely on cheaper low-hanging fruit alternative fuels options that do not have deep emissions reduction potential or scalability.

33 It should be noted that the reward factors and the sub-target would also be compatible with the technology-neutral stance of the GFS as they do not prejudge the choice of onboard energy converter (i.e. type of ICE or fuel-cells) and would only promote a family of potentially scalable fuels as opposed to a specific fuel type.

Action requested of the Working Group

34 The Working Group is invited to consider the information provided in this document, and consider incorporating the draft amendments provided in the annexes, into the final GFS legal text, and take action as appropriate.

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ANNEX 1

SUGGESTED AMENDMENTS TO THE "DRAFT AMENDMENTS TO MARPOL ANNEX VI ON GHG FUEL STANDARD (GFS)", CONTAINED IN THE ANNEX TO DOCUMENT ISWG-GHG 15/3/1 (Austria et al.)

Amendment 1 to Regulation 28*bis* | Addition of a new paragraph 5bis to read as follows:

> "Requirement for use of minimum amount of sustainable fuels on board ships
>
> Without prejudice to the flexibility compliance mechanism contained in Regulation 28*ter*, by 2030, each ship shall ensure a minimum share of 5% of sustainable fuels in the total annual energy consumption. "

Amendment 2 to the Regulation 28*bis* | Addition of a new paragraph to read as follows:

> "Reward factor for the use of sustainable fuels and zero-emissions on board fuel energy sources
>
> Without prejudice to the flexible compliance mechanism, a ship may use until 2035 as reward factor (RWDf) of two to sustainable fuels and/or a reward factor of 1.5 to zero emissions on board non-fuel energy sources (RWDk) when determining its attained annual GFI."

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ANNEX 2

SUGGESTED AMENDMENTS TO "DRAFT GUIDELINES ON THE CALCULATION OF THE ATTAINED GFI" CONTAINED IN ANNEX 1 TO DOCUMENT ISWG-GHG 16/2/7 (AUSTRIA ET AL.)

Amendment 1 | To add reward factors to the fuel-related (RWD_f) and zero-emission on board non-fuel energy sources-related (RWD_k) energy terms in the denominator of Equation (2) in paragraph 4.3 of the draft guidelines contained in annex 1 of ISWG-GHG 16/2/7. Additions are presented in bold in the below revised equation (2).

$$GFI_{attained} = \frac{\sum_{j=1}^{J} GHG_{WtW,j} \times E_j}{\sum_{f=1}^{F}(M_f \times LCV_f \times \mathbf{RWD_f}) + \sum_{k=1}^{K}(E_k \times \mathbf{RWD_k}) + \sum_{c=1}^{C} P_C}$$

Amendment 2 | To add two new elements to the *definition of terms* for Equation (2) in paragraph 4.3 of the draft guidelines contained in annex 1 of ISWG-GHG 16/2/7 :

New".13 *RWD_f is a reward factor of 2 and is applied to sustainable fuels used during the annual compliance period until 2035. For all other fuels RWD_f = 1.*"

New".14 RWD_k is a reward factor of 2 and is applied to zero-emission on-board non-fuel energy sources during the compliance period until 2035."

Amendment 3 | To add a new paragraph 4.*3bis* to the draft guidelines contained in annex 1 to the document ISWG-GHG 16/2/7

"A sustainable fuel means electrolytic hydrogen-derived fuels that deliver:

- At least 90% WtW CO2e emissions reduction relative to the fossil fuel baseline *from 2030 onwards, or a maximum of 9.4 gCO2e/Mj;*
- At least 95% WtW CO2e emissions reduction relative to the fossil fuel baseline *from 2040 onwards, or a maximum of 4.7 gCO2e/Mj;*
- *100% WtW CO2e emissions reduction from 2050 onwards, or a maximum of 0 gCO2e/Mj.*

For the purpose of application of this paragraph, fossil fuel baseline shall be set at 94 gCO2e/MJ."

Note: if the drafting group considers that this amendment is more appropriate in a different draft guideline, the co-sponsors of this document are happy to consider that option too.

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ANNEX 3

SUGGESTED AMENDMENTS TO THE "DRAFT GUIDELINES ON THE GFS REGISTER" CONTAINED IN ANNEX 2 TO THE DOCUMENT ISWG-GHG 16/2/7 (AUSTRIA ET AL.)

Amendment 1 | To revise the definition of the term *Ea* of equation (1) in paragraph 6.1 as follows (the addition is in **bold**)

> "*Ea is the amount of energy consumed by the ship during reporting period (a)* ***as calculated by the denominator of the expanded attained GFI equation***".

Amendment 2 | To revise the definition of the term Ea of equation (1) in paragraph 6.6 as follows (the addition is in **bold**)

> "*Ea is the amount of energy consumed by the ship during reporting period (a)* ***as calculated by the denominator of the expanded attained GFI equation***".

Amendment 3 | To add a new paragraph 6*bis* entitled **"Determination of flexible compliance units with respect to the minimum share of sustainable fuel use"**

The new paragraph should contain the following equation and new definition of terms as presented further below:

$$N_{FCUsf,a} = \left|\left(T_{SF} \times \sum_{f=1}^{F}(M_f \times LCV_f)\right) - \left(\sum_{sf=1}^{SF}(M_f \times LCV_f)\right)\right|$$

"**where:**

.1 ***$N_{FCUsf,a}$ is the number of separate sustainable fuel FCUs created due to over-compliance with the regulatory requirement during the reporting period a;***

.2 ***T_{SF} is the required minimum amount of sustainable fuels, expressed as a percentage of total fuel-derived energy consumption, to be set initially to 5% from 2030 onwards;***

.3 ***SF is the total number of fuel types defined as sustainable fuels;***

.4 ***M_f is the mass (in metric tonnes) of fuel type f;***

.5 ***LCV_f is the lower calorific value (in MJ/kg) of fuel type f***"

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