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FURTHER CONSIDERATION OF THE DEVELOPMENT OF THE IMO LIFE CYCLE GHG ASSESSMENT (LCA) FRAMEWORK

Amendments to the 2024 LCA Guidelines and implementation of the IMO Net-Zero Framework: proposals for enhanced emission factor methodology

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SUMMARY

Executive summary: This submission presents recommendations to refine the *2024 Guidelines on life cycle GHG intensity of marine fuels (2024 LCA Guidelines)* (resolution MEPC.391(81)), addressing key methodological challenges. It calls for enhanced data quality standards, ensuring studies used to calculate default GHG emission factors are relevant, complete, consistent, reliable, transparent, and aligned with ISO 14040, ISO 14044:2006, and ISO/TS 14071. The current approach of selecting the upper emission value as default should be replaced with a scientifically representative method, such as a weighted average, to ensure credible, up-to-date factors across the industry. The document also proposes a biennial review to update default emission factors while avoiding retroactive impacts on the GFI calculations. For purely fossil fuel pathways lacking robust data, temporary use of credible alternative data sets is recommended until sufficient representative studies exist. Standardized methodologies for calculating emission credits should be adopted, following approaches like Directive (EU) 2018/2001 (RED II). Finally, specific fuel pathway variants for ships using part of their cargo as fuel are recommended to reflect their unique well-to-tank (WtT) emissions.

Strategic direction, if applicable: 3

Output: 3.2

Action to be taken: Paragraph 25

Related documents: Resolution MEPC.391(81); Circular Letter No.5005; MEPC 81/16; MEPC 83/7/1 and MEPC 83/17

Introduction

1 Resolution MEPC.391(81) on the *2024 Guidelines on life cycle GHG intensity of marine fuels (2024 LCA Guidelines)*, adopted in July 2023, includes the Guidelines on life cycle GHG intensity of marine fuels (LCA Guidelines). Upon adoption, the Committee highlighted that the basket of candidate mid-term GHG reduction measures, now substantiated in the IMO Net-Zero Framework, should consider the well-to-wake (WtW) GHG emissions of marine fuels as detailed in the 2024 LCA Guidelines. These guidelines are crucial for assessing and addressing the environmental impact of marine fuels throughout their life cycle, from production to combustion.

2 MEPC 81 established the GESAMP Working Group on Life Cycle GHG Intensity of Marine Fuels (GESAMP-LCA WG) to provide the best possible scientific and technical assessment of matters related to the implementation of the 2024 LCA Guidelines. This includes the evaluation of proposed default emission factors for any of the 128 fuel pathways identified in the 2024 LCA Guidelines. The report of the first GESAMP-LCA WG meeting, submitted as document MEPC 83/7/1 (Secretariat), outlines the assessment process developed by the Group, and highlights areas where methodological refinement and clarification may be needed as the experts progress with their evaluation.

3 The implementation of the IMO Net-Zero Framework hinges on the availability of, and is highly sensitive to, default emission factors for the relevant fuel pathways. From the calendar year 2028 onwards, each ship will be required to calculate its attained annual GHG fuel intensity (GFI) based on the fuel consumed during the reporting period, as submitted to the IMO Ship Fuel Oil Consumption Database. This calculation must use the GHG intensity of the fuel on a WtW basis, referencing where applicable the default emission factors listed in appendix 2 of the 2024 LCA Guidelines, organized by fuel pathway code. However, given the lack of transparency regarding the sources and underlying methodologies of the current values in appendix 2, the Committee agreed that these values should not be considered as formally approved. Instead, new proposals must be resubmitted in accordance with the methodology developed by the GESAMP-LCA WG, as outlined in document MEPC 83/17 (Secretariat). This effectively necessitates an industry-wide effort to generate new LCA analyses aligned with the 2024 LCA Guidelines in order to define robust and verifiable default values.

4 This document focuses on the requirements for submitting proposed default emission factors to the GESAMP-LCA WG, as well as their assessment process, in line with the timeline and provisions set out in the IMO Net-Zero Framework. These requirements are reflected in Circular Letter No.5005, which contains the text of the draft revised consolidated version of MARPOL Annex VI.

Addressing the data quality for the submission of data for the calculation of default GHG emission factors

5 The methodology developed by the GESAMP-LCA WG indicates that for each proposed default emission factor, the Group should assess the quality of data used for the calculation in terms of relevance, adequacy, completeness, consistency, reliability, transparency, and accessibility. To avoid bias being introduced in the process, the co-sponsors reiterate the primary importance that studies not fulfilling the above requirements are excluded from the assessment aiming to recommend default emission factors.

6 Furthermore, to ensure scientific integrity and regulatory credibility, default data should be based not only on the 2024 LCA Guidelines, but also on LCA work developed in accordance with internationally recognized standards. Specifically, ISO 14040 and ISO 14044:2006 and subjected to critical review under ISO/TS 14071. The use of non-LCA-

derived or generic emissions data to fill data gaps would compromise transparency, comparability, and methodological robustness. Such data should not be used to assign default values for regulatory purposes, as it would risk weakening the scientific foundation of the GHG intensity values and undermine trust in the IMO Net-Zero Framework.

Refining the selection of the default emission values

7 The 2024 LCA Guidelines stipulate that, to establish both the WtT and the TtW default emission factors, among the three (or more) values considered for a given fuel pathway, the upper emissions values should be selected as default.

8 While this approach aims to ensure environmental conservatism, it does not align with the underlying nature of life cycle assessment, which is inherently dynamic and reflective of temporal, technological, and regional variability. LCA is a method designed to capture changes in emissions performance over time, driven by feedstock shifts, process improvements, energy inputs, or regulatory developments. Fixing default values based on the highest observed figure risks distorting the actual performance profile of a fuel and may not reflect the direction of industry improvements.

9 Moreover, the selection of the highest value as default may discourage stakeholders from investing in and submitting high-quality LCA studies. If more accurate or lower emissions values are not reflected in the regulatory baseline, there is limited incentive for fuel suppliers or technology developers to demonstrate improvements or differentiation. Instead, default emission factors should be representative of typical fuel performance and credible across the industry.

10 In cases where three or more LCA values are available and there is a significant spread between the highest and lowest values, selecting only the upper bound as the default is unlikely to yield a representative result. Such outliers may reflect specific conditions or assumptions rather than typical industry practice. A more scientifically sound method, such as a weighted or central-tendency-based approach, would better capture the overall emissions performance across diverse sources and production contexts. In doing so, the reference dataset should be evaluated for consistency in timelines, giving greater weight to more recent and reliable data, while ensuring credibility and alignment within the regulatory framework.

11 In addition, the co-sponsors recommend establishing a mechanism for the periodic reassessment and revision of default emission factors, ideally on a biennial basis. This would allow the default values to evolve alongside the market and scientific understanding, while also recognizing improvements in emissions performance. This is not a new or untested approach, governments and institutions already apply similar practices. For example, the United Kingdom's Department for Environment, Food & Rural Affairs (DEFRA) publishes an annual update of its greenhouse gas conversion factors for company reporting, ensuring they reflect the most current data and methodological developments. A similar process under the IMO Net-Zero Framework would ensure that default emission factors remain both credible and reflective of technological progress. A two-year review cycle strikes a practical balance between regulatory stability and scientific responsiveness. To avoid unintended consequences, adjustments should not be applied retroactively in a way that would affect the calculation of the attained annual GFI.

Addressing the need for robust and verifiable WtT default factors for a purely fossil fuel pathway

12 This section aims to support the operationalization of the IMO Net-Zero Framework for fossil fuel pathways where the use of actual WtT emission factors is not permitted, as outlined in paragraph 10.4 of the 2024 LCA Guidelines ("purely fossil fuel pathways" in this document). For these pathways, default emission factors must be used to calculate the attained annual GFI.

13 Under the 2024 LCA Guidelines, establishing a default emission factor requires at least three reference values from three different, representative sources for the same fuel pathway. While some pathways are well established and supported by robust, long-standing data sets, others, particularly newer or less common fossil fuel pathways, lack sufficient high-quality, verifiable emissions data. In many cases, the fuels may be commercially available, but there is not yet an adequate body of verified LCA data to ensure robust and representative analysis.

14 This data gap poses a significant challenge to the timely and effective implementation of the IMO Net-Zero Framework, particularly given the 2028 deadline for ships to report their attained annual GFI using pathway-specific default emission factors. Using generic or non-LCA-derived emissions data to fill these gaps would undermine the scientific rigour and credibility of the GHG intensity values used in regulatory reporting. As stated in paragraphs 5 and 6 of this document, only data developed through an LCA approach consistent with the 2024 LCA Guidelines should be used, as it ensures transparency, comparability, and methodological robustness.

15 To address these limitations, it is proposed that the requirement for three reference studies per pathway be waived in specific cases where sufficient high-quality LCA data is not available. This flexibility is particularly relevant for purely fossil fuel pathways, where actual values cannot be used and robust LCA data may be inherently limited.

16 In such cases, credible alternative data sources could be accepted, provided they meet appropriate quality, transparency, and methodological standards. For example, WtT default emission values reported under schemes in other jurisdictions could be temporarily adopted if they are based on ISO-compliant LCA methodologies. These values could serve as an interim basis for assigning default emission factors until at least three reference studies using the 2024 LCA Guidelines methodology become available. Any revisions resulting from the assessment of additional studies could be incorporated into the periodic biennial reassessment mechanism proposed in paragraph 12 of this document, with the clear stipulation that adjustments are not applied retroactively so as to avoid unintended impacts on the calculation of the attained annual GFI.

Guidance on emissions credits should be clarified

17 Under the 2024 LCA Guidelines, several processes reflected by parameters in both the WtT and TtW equations may generate negative emission including (but not limited to) e_{sca} that accounts for emission savings associated with improved agricultural practices, S_{Fc} (carbon source factor equals 1 for biomass-derived carbon) coupled with e_c (biomass growth credit), S_{Fccu} coupled with e_{ccu} (captured CO_2 used as feedstock for synthetic fuels), or e_{occs} (credit from onboard CO_2 capture, transport, and storage). Despite the fact that these parameters may contribute to reducing WtW emissions, possibly to negative values for some biogenic or synthetic fuels pathways, when properly accounted, some are considered as zero for the establishment of the initial default emission factors or pending further methodological improvements guidance to be developed by the Organization.

18 These parameters are not theoretical, they reflect real mechanisms whereby biofuels or synthetic fuels can achieve net negative emissions through carbon avoidance, capture and sequestration, use after capture, and sustainable feedstock management. From a life cycle assessment perspective, if emissions avoided or sequestered exceed emissions produced, the net value should be negative. This outcome is consistent with the principles of LCA, which aim to capture true GHG performance, including removal or offset within the boundaries of the WtW GHG emission factors calculation. Yet the current guidance remains unclear, creating ambiguity in the implementation of the IMO Net-Zero Framework and create uncertainty for the investors willing to develop biofuels or synthetic fuels supply chains into the maritime sector.

19 Global practices already support fuel pathways with net negative GHG emissions. Existing regulatory and certification frameworks, such as the United Kingdom's Renewable Transport Fuel Obligation (RTFO) and EU Renewable Energy Directive (RED) schemes, explicitly recognize emission savings for biogas derived from manure or other waste feedstocks, acknowledging avoided methane emissions and carbon removal. Similar approach should apply within the LCA fuel context: emission removal or avoidance should be recognized and reflected in the emission factors, provided that credible, third-party verified evidence supports the value.

20 The 2024 LCA Guidelines should provide further clarity by including a methodology to calculate emission credits. Methodological definitions for key parameters, such as S_{Fccu}, e_{ccu}, and e_{occs}, should be standardized to ensure consistent treatment across fuel types and supply chains. A practical starting point could be the approach used in Directive (EU) 2018/2001 (RED II), Annex V, Part C, which recognizes that negative contributions to the calculated total emissions of a fuel can arise in three ways: from land-use change (e_l) when emissions can be negative; from soil carbon accumulation (e_{sca}), which enters the equation as a negative term; and from CO_2 capture, either stored geologically (e_{ccs}) or used to replace fossil CO_2 (e_{ccr}). Then establish additional detailed guidance on each of those negative contributions either in the text of the methodology (RED Annex V and VI), or through an approved sustainability certification scheme. Applying a similar detailed structure under the 2024 LCA Guidelines would provide a robust, transparent basis for calculating GHG emission credits and supporting consistent certification of sustainable fuels.

Distinction of fuel pathways for ships using cargo as fuel and accounted under WtT emissions

21 While this issue is highly relevant today for LNG carriers and LNG bunkering ships, it is likely to become increasingly important for emerging low- and zero-carbon fuels such as methanol and ammonia. As these fuels enter the market, using cargo as fuel may represent one of the most practical and early adoption pathways; particularly during the initial scale-up phases of production and distribution. Accurately capturing this in the LCA framework will be critical for ensuring consistent, transparent, and incentivized decarbonization across all segments of the marine fuel supply chain.

22 A recent study by Rystad Energy, titled *Well-to-tank emissions assessment 2025 – GHG emissions study on the use of LNG as a marine fuel*, shows that ships using cargo as fuel can have a reduced WtW value of around 15% when compared with the final consuming ship. This reduction stems from both avoided upstream transport, transfer, storage and bunkering emissions as well as improved energy integration across the supply chain. These findings support the need to include such configurations explicitly in the fuel pathways list and provide dedicated default emission factors that reflect their unique characteristics.

23 To ensure completeness and accuracy in life cycle assessments, it is proposed that specific fuel pathway variants be developed for ships using part of their cargo as fuel. These ships, often operating in supply chain segments where the transported fuel is also used for propulsion, present distinct WtT emissions profiles not captured by standard pathway definitions. Two such variants are suggested: the first for carriers using cargo as fuel while

sailing between loading and unloading terminals (e.g.: LNG carriers consuming cargo en route), and the second for bunker ships transporting fuel from terminals to the final user, where cargo powers the delivery voyage. In both cases, the energy use and emissions during transport differ significantly from ships using separate bunkered fuel, and the LCA emission allocation methodology should reflect these differences to ensure fair and accurate GHG intensity accounting.

24 The co-sponsors propose that, when refining the 2024 LCA Guidelines, and where appropriate, the Group considers the following aspects to guide the work of the GESAMP-LCA WG:

.1 ensure strict data quality requirements for studies used in calculating default GHG emission factors, applying resolution MEPC.391(81) criteria (relevance, adequacy, completeness, consistency, reliability, transparency, accessibility) and excluding studies that do not meet these standards;

.2 require alignment with internationally recognized LCA standards (ISO 14040, ISO 14044:2006, and ISO/TS 14071 critical review) in addition to the 2024 LCA Guidelines, prohibiting the use of non-LCA-derived or generic data for default factor determination;

.3 revise the default factor selection method to avoid automatically adopting the upper proposed emission value. Instead, use a scientifically representative approach (e.g. weighted average or central tendency) that reflects current pathways emissions, prioritizes recent and reliable data, and avoids discouraging the submission of high-quality studies;

.4 establish a biennial review mechanism for reassessing and updating default emission factors, ensuring values evolve with scientific knowledge and industry improvements, while avoiding retroactive changes that could affect attained GFI calculations;

.5 introduce flexibility for purely fossil fuel pathways where robust LCA data is lacking by allowing temporary use of credible alternative data sets (e.g. ISO-compliant values from other jurisdictions) until three representative studies are available;

.6 establish a clear and standardized methodology for calculating GHG emission credits and enabling sustainable fuel certification schemes (SFCS) to certify emission values. and to facilitate such development, consider adopting a framework similar to Directive (EU) 2018/2001 (RED II), Annex V, Part C, which includes provisions for calculating emission removal and avoidance from biofuels; and

.7 create dedicated fuel pathway variants for ships using cargo as fuel (both carriers and bunker ships) to reflect their distinct WtT emissions profiles and ensure fair, accurate GHG intensity accounting in the LCA framework.

Action requested of the Working Group

25 The Working Group is invited to consider the information and proposals presented in this document and take action as appropriate.