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

Proposal for how to address the well-to-tank (WtT) emissions of fuel pathways for ships using cargo as fuel under the 2024 LCA Guidelines

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SUMMARY

Executive summary:	This document addresses the treatment of ships using part of their cargo as fuel and proposes that the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) Working Group on Life Cycle GHG Intensity of Marine Fuels (GESAMP-LCA WG) develops fuel pathway specific emission factors representing the emissions that can be deducted from the default pathway emission factors in case cargo is used as fuel. An alternative, if GESAMP-LCA WG does not have sufficiently detailed information, could be to use percentage-based correction factors associated with the relevant default pathway emission factors.
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 27
Related documents:	MEPC 84/7/14; ISWG-GHG 20/3/3 and resolution MEPC.391(81)

Introduction

1 Resolution MEPC.391(81), adopted by the Marine Environment Protection Committee (MEPC) in July 2023, approved the *2024 Guidelines on Life Cycle GHG Intensity of Marine Fuels* (2024 LCA Guidelines). Upon adoption, the Committee highlighted that the basket of candidate mid-term measures should consider the well-to-wake (WtW) greenhouse gas (GHG) emissions of marine fuels, as detailed in the 2024 LCA Guidelines. The 2024 LCA Guidelines provide a harmonized framework for assessing the GHG intensity of marine fuels across their full life cycle, from feedstock extraction and processing to onboard use.

2 MEPC 81 further established the GESAMP Working Group on Life Cycle GHG Intensity of Marine Fuels (GESAMP-LCA WG) to provide scientific and technical advice on matters related to the implementation and future development of the 2024 LCA Guidelines. This includes, inter alia, the evaluation of proposed default emission factors for the 128 fuel pathways currently identified in appendix 1 to the 2024 LCA Guidelines, as well as the consideration of new technological developments and scientific knowledge to ensure that the 2024 LCA Guidelines remain up-to-date and new fuel pathways are accounted for.

3 This document focuses on a specific issue relevant to the application of the 2024 LCA Guidelines, namely ships that use part of their cargo as fuel. It highlights that the current fuel pathway structure does not explicitly reflect the distinct well-to-tank (WtT) emissions characteristics of such ships and proposes a methodology to account for these differences in a transparent and consistent manner.

Relevance of ships using cargo as fuel

4 While the use of cargo as fuel is currently most relevant for liquefied natural gas (LNG), liquefied petroleum gas (LPG), ethane carriers, and LNG bunker ships, the issue is expected to become increasingly important for emerging low- and zero-carbon fuels, such as methanol and ammonia. As these fuels are introduced at scale, the use of cargo as fuel may represent one of the earliest and most practical deployment pathways, particularly during the initial phases of production and distribution, when dedicated bunkering infrastructure may be limited.

5 Accurately capturing the GHG intensity of such operational configurations within the LCA calculation framework will therefore be critical to ensuring consistent, transparent and environmentally robust accounting across the marine fuel supply chain, while avoiding unintended incentives or distortions.

6 In document ISWG-GHG 20/3/3 (ICS et al.), the matter of ships using cargo as fuel was raised, and ISWG-GHG 20 noted general support for addressing this issue (MEPC 84/7/14, paragraph 136). Several delegations supported the proposal to create specific fuel pathway codes or variants for ships using cargo as a fuel, while several other delegations expressed openness to considering new fuel pathway approaches, while recommending that more effective mechanisms for addressing upstream emissions be explored. The Working Group invited concrete proposals to be submitted to future sessions, providing the context for the present document.

Current fuel pathways under the 2024 LCA Guidelines

7 Appendix 1 to the 2024 LCA Guidelines currently identifies 128 fuel pathways, which assumes that ships bunker fuel in a conventional manner. For such ships, the defined WtT pathways represent an appropriate and robust characterization of upstream emissions associated with fuel production, transport, storage and bunkering.

8 However, these pathways do not fully represent the operational reality of ships that use part of their cargo as fuel. Such ships are typically regulated under the IGC Code (e.g. LNG carriers) or operate under alternative design and arrangement approvals (e.g. methanol carriers), and their energy use is directly integrated into the fuel supply chain itself.

9 As a result, the standard WtT pathways currently defined overestimate upstream emissions when applied to ships using cargo as fuel, as certain stages of the fuel supply chain are either not applicable or substantially reduced. A conceptual representation of these differences, using LNG as an illustrative example but applicable to other fuels, is presented in figure 1.

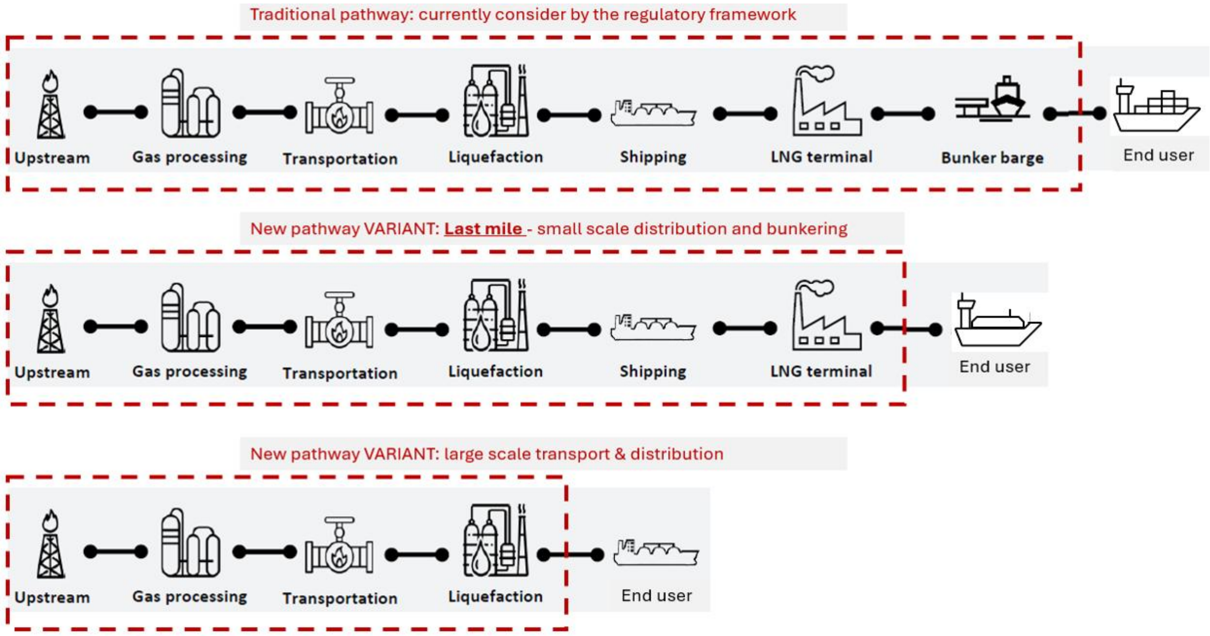

Figure 1: LNG cargo as fuel pathways variants

Distinction of fuel pathway variants

10 Using LNG as an example, three distinct pathway configurations can be identified, which are conceptually applicable to other fuels such as LPG, methanol and ammonia:

.1 the first configuration corresponds to ships that bunker LNG as fuel in a conventional manner. These pathways are already included in appendix 1 to the 2024 LCA Guidelines, notably WtT pathway order 31 to 43, and remain appropriate for ships operating under this configuration;

.2 the second configuration represents a "last-mile distribution pathway", typically applicable to LNG bunker ships or small-scale carriers supplying fuel from terminals to end users. In this case, part of the transported cargo is used to power the ship during the delivery voyage. Compared to ships that bunker fuel in a conventional manner, this configuration avoids certain upstream transport, transfer, storage and bunkering stages. As a result, the overall WtT emissions for this configuration are reduced; and

.3 the third configuration represents "large-scale transport or distribution", typically applicable to large LNG carriers transporting cargo from production regions to importing terminals, while consuming part of the cargo for propulsion during the voyage. In this configuration, the transported fuel serves both as cargo and as an energy source for transport. For such ships, a more substantial reduction in WtT emissions is observed when compared to the final consuming ship bunkering the fuel.

Supporting evidence

11 A recent study by Rystad Energy, entitled *Well-to-tank emissions assessment 2025 – GHG emissions study on the use of LNG as a marine fuel*, provides quantitative evidence supporting the differentiation of fuel pathways for ships using cargo as fuel. The study assesses the life cycle GHG emissions of LNG used as a marine fuel across different supply-chain configurations and ship types and was submitted to GESAMP-LCA WG as reported in documents MEPC 84/7/11 (Norway and Republic of Korea) and MEPC 84/7/16 (Secretariat).

12 The study, as illustrated in figure 2, provides the following emission intensity values that could be deducted for ships using cargo as fuel, represented as e_{td} in the 2024 LCA Guidelines:

.1 the "last-mile distribution pathway" represents an emission value of 0.7 gCO_2eq/MJ resulting from not applicable emissions associated with small-scale distribution and bunkering activities; and

.2 the "large-scale transport and/or distribution" represents an emission value of around 2.5 gCO_2eq/MJ resulting from not applicable upstream transport, transfer, storage and bunkering emissions, as well as improved energy integration across the supply chain.

13 This indicates that large LNG carriers using part of their cargo as fuel during transport can achieve substantial reductions in life cycle GHG intensity on a well-to-wake (WtW) basis when compared to the final consuming ship bunkering the fuel at the destination.

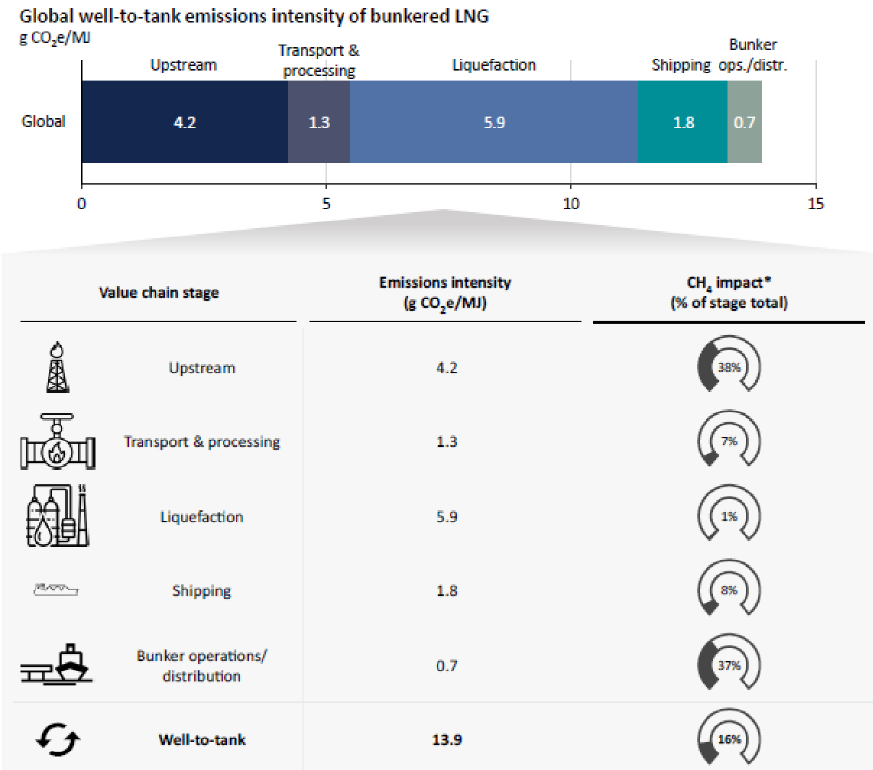

Figure 2: LNG pathway emissions breakdown[1]

1 Source: Rystad, *Well-to-tank emissions assessment 2025 – GHG emissions study on the use of LNG as a marine fuel*

14 Additional supporting evidence is provided by the Sphera study *1st Life Cycle GHG Emission Study on the Use of LNG as Marine Fuel*, first published in 2019. This study similarly assessed multiple LNG supply-chain configurations, including large-scale transport by LNG carriers and last-mile delivery to consuming ships. The Sphera study reported reductions in life cycle GHG emissions of approximately 3.2 gCO_2eq/MJ for large-scale LNG carriers using cargo as fuel during transport, compared to the final consuming ship, and reductions of approximately 0.7 gCO_2eq/MJ for last-mile distribution configurations (see figure 3).

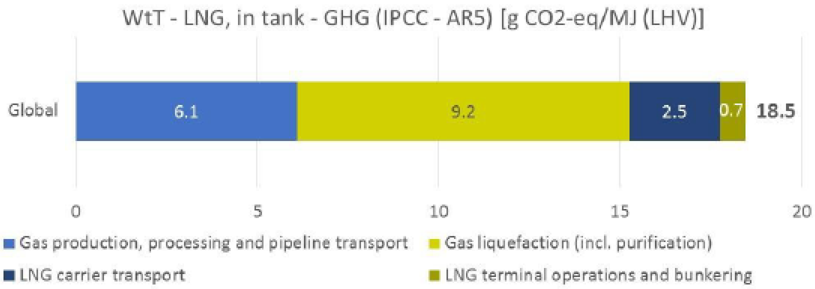

Figure 3: LNG pathway emissions breakdown[2]

15 While the absolute values differ slightly from those reported by Rystad Energy, the overall magnitude and direction of the results are consistent across both studies. Taken together, these independent assessments demonstrate a consistent pattern: ships using cargo as fuel exhibit systematically lower supply-chain-related GHG emissions compared to ships bunkering fuel in a conventional manner. The convergence of results across studies conducted at different times and using different data sets provides confidence in the robustness of the observed reductions.

16 These findings support the need to explicitly reflect such operational configurations within the IMO LCA framework. Doing so would improve the accuracy and environmental integrity of life cycle GHG intensity accounting, while maintaining consistency with the overall structure and objectives of the 2024 LCA Guidelines.

Proposed approach

17 To ensure completeness and accuracy in life cycle GHG intensity assessments, it is proposed that ships using part of their cargo as fuel be explicitly addressed within the 2024 LCA Guidelines through a specific methodological approach.

18 The co-sponsors propose that avoided emissions, where cargo is used as fuel, be quantified by GESAMP-LCA WG, based on the information submitted to the Group when proposing default emission factors in accordance with the *Methodology for submission, scientific review and recommendation of proposed default emission factors by GESAMP-LCA WG* (MEPC.1/Circ.916). The relevant emissions should be presented to the Group under the term e_{td}, which, according to the explanation in the 2024 LCA Guidelines, includes "emissions associated with the feedstock transport to conversion plant, and the emissions associated with the finished fuel transport and storage, local delivery, retail storage and bunkering". Provided that the data is sufficiently granular, this approach would enable a robust quantification of avoided emissions for specific fuel pathways and should not entail any additional workload for the Group.

2 Source: Sphera, *1st Life Cycle GHG Emission Study on the Use of LNG as Marine Fuel*

19 If the information that is submitted to GESAMP-LCA WG is not sufficiently detailed to quantify these avoided emissions directly or if it entails an additional workload for GESAMP-LCA WG, an alternative approach could be to apply correction factors expressed as percentage reductions, taking into account fuel logistics and distribution characteristics as well as the carbon intensity of the fuels concerned. The objective would be to derive percentage values that represent avoided emissions on a scientifically sound basis but expressed in a more generalized form. This approach could allow correction factors to be applied across multiple fuels and pathways that share similar logistics and distribution characteristics. At the same time, it is recognized that this more generalized approach may be less precise than pathway-specific quantitative correction factors.

20 If the use of correction factors is preferred, it is proposed that the standard LNG production fuel pathway remain the reference pathway, with the application, where appropriate, of two initial percentage-based correction factors, subject to further review and confirmation by GESAMP-LCA WG:

.1 a "last-mile distribution correction factor", representing a reduction of [5]% in well-to-tank (WtT) emissions compared to ships that bunker fuel in a conventional manner, applicable to bunker ships and small-scale carriers using cargo as fuel during delivery voyages; and

.2 a "large-scale transport and/or distribution correction factor", representing a reduction of [15]% in well-to-tank (WtT) emissions compared to ships that bunker fuel in a conventional manner, applicable to large carriers using cargo as fuel during long-distance transport.

21 The co-sponsors suggest inviting GESAMP-LCA WG to quantify the avoided emissions directly when developing new default emission factors, and that the avoided or non-applicable emissions can be deducted from the default pathway emission factors in case the cargo is used as fuel. The alternative option using correction factors applied to existing fuel pathways could be used if there is not sufficiently detailed data to quantify these emissions.

Summary and proposal

22 Based on the information provided in this document, the Working Group is invited to note that ships using part of their cargo as fuel are not addressed in the 2024 LCA Guidelines and to acknowledge that such ships exhibit distinct WtT emissions characteristics that require differentiated accounting.

23 The co-sponsors suggest inviting GESAMP-LCA WG to quantify the avoided WtT emissions for ships using cargo as fuel when developing new default emission factors and propose that two separate emission factors are determined to reflect different operational boundaries and supply-chain configurations, namely:

.1 a last-mile distribution emission factor; and

.2 a large-scale transport and/or distribution emission factor.

24 For fuel pathways with similar transport and/or distribution characteristics, these emission factors should be aligned.

25 Alternatively, if the information that is submitted to GESAMP-LCA WG is not sufficiently detailed to quantify these avoided emissions directly, GESAMP-LCA WG should consider an alternative approach using correction factors expressed as percentage reductions of the WtT values.

26 The Working Group is also invited to consider amendments to the 2024 LCA Guidelines, as set out in the annex to this document, to allow for the future incorporation of the avoided WtT emissions and related guidance for ships using cargo as fuel.

Action requested of the Working Group

27 The Working Group is invited to consider the information above and proposals in paragraphs 22 to 26 and to take action as appropriate.

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ANNEX

DRAFT AMENDMENT OF THE 2024 LCA GUIDELINES
(resolution MEPC.391(81))

1 The co-sponsors propose the following new paragraph to part II, section 4, of resolution MEPC.391(81) (new text is shown grey shaded):

> *4.7bis* Where ships use part of their own cargo as fuel, and certain transport, transfer, storage or bunkering steps are not applicable, the associated emissions should be appropriately differentiated and accounted for in the allocation of transportation and bunkering emissions. In such cases, when using the default emission factors, the following factors, given in table 2 of appendix 2, should be deducted to reflect the actual supply chain configuration.
>
> .1 A *last-mile distribution emission factor*, applicable to ships engaged in small-scale or last-mile transport of fuels, including bunker ships, where part of the cargo is used as fuel during the delivery voyage.
>
> .2 A *large-scale transport and/or distribution and export emission factor*, applicable to ships engaged in large-scale or long-distance transport of fuels, where part of the cargo is used as fuel during transport between production and receiving terminals.

2 The co-sponsors propose to add a new table 2 in appendix 2 to reflect the GHG intensity values that should be deducted for ships using cargo as a fuel, using LNG as an example with the values set out in figure 2, (for illustrative purposes only, actual values to be determined by GESAMP-LCA WG):

Table 2: Illustrative example of deductible GHG intensity values for LNG cargo used as a fuel

Order	**Fuel type**	**Fuel Pathway code**	**WtT GHG intensity (gCO_2eq/MJ)**	**LCV (MJ/g)**	**Energy converter**	**C_f CO_2 (gCO_2/g fuel)**	**C_f CH_4 (gCH_4/g fuel)**	**C_f N_2O (gN_2O /g fuel)**	**C_{slip}/C_{fug} (mass %)**	**e_c (gCO_2eq/g fuel)**	**TtW GHG intensity (gCO_2eq/ MJ)**
31	Liquefied natural gas (Methane)	LNG_f_SLP_gm	13.9 (0.7[1]) (2.5[2])	0.048	xxx	xxx	xx	xx	xx	xx	xx

1 The *last-mile distribution emission factor*, applicable to ships engaged in small-scale or last-mile transport of fuels, including bunker ships, where part of the cargo is used as fuel during the delivery voyage. See paragraph 4.7*bis*.1.

2 The *large-scale transport and/or distribution and export emission factor*, applicable to ships engaged in large-scale or long-distance transport of fuels, where part of the cargo is used as fuel during transport between production and receiving terminals. See paragraph 4.7*bis*.2.