INTERNATIONAL MARITIME ORGANIZATION

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INTERSESSIONAL MEETING OF THE
WORKING GROUP ON REDUCTION OF
GHG EMISSIONS FROM SHIPS
7th session
Agenda item 5

ISWG-GHG 7/5/8
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FURTHER CONSIDERATION OF CONCRETE PROPOSALS TO ENCOURAGE THE UPTAKE OF ALTERNATIVE LOW-CARBON AND ZERO-CARBON FUELS, INCLUDING THE DEVELOPMENT OF LIFE CYCLE GHG/CARBON INTENSITY GUIDELINES FOR ALL RELEVANT TYPES OF FUELS AND INCENTIVE SCHEMES, AS APPROPRIATE

Draft life cycle GHG and carbon intensity guidelines for maritime fuels

Submitted by Australia, Japan, Norway, Republic of Korea and ICS

SUMMARY

Executive summary:	This document contains draft life cycle GHG and carbon intensity guidelines for maritime fuels, based on the documents submitted to and discussions during ISWG-GHG 6. To enable reporting according to the IPCC inventory guidelines, the document proposes to introduce a fuel life cycle label (FLL) which broadly categorizes a fuel based on carbon source and other sustainability aspects and determines if the CO_2 emissions should be accounted for by international shipping. All aspects in the guidelines are not fully elaborated and would need further consideration.
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 0
Related documents:	MEPC 75/7/2; ISWG-GHG 6/2/3, ISWG-GHG 6/5, ISWG-GHG 6/5/1, ISWG-GHG 6/5/2, ISWG-GHG 6/2/10 and ISWG-GHG 6/2/11

Background

1 In its work on addressing the uptake of alternative low-carbon and zero-carbon fuels, ISWG-GHG 6 supported to establish a dedicated workstream to develop life cycle GHG/carbon intensity guidelines for all relevant types of fuels, including fossil fuels currently in use. The Group also agreed that priority should be given to "tank-to-propeller" (TTP) emission factors,

while being cognizant of upstream “well-to-tank” (WTT) emissions, and invited Member States to cooperate and submit proposals for draft guidelines to this session.

2 As a follow-up of the decisions taken by ISWG-GHG 6 (MEPC 75/7/2, paragraph 49), the co-sponsors provide in this document a proposal for draft guidelines that focuses on TTP emissions and addresses WTT emissions through a Fuel Lifecycle Label (FLL) which broadly categorizes fuels based on carbon source and other sustainability aspects. The approach taken in the guidelines is in alignment with the task as expressed in the candidate measure in paragraph 4.7.11 of the Initial GHG Strategy, and the outcome of ISWG-GHG 6. In the co-sponsors’ opinion, the draft guidelines proposed in this document provide the following benefits:

.1 enable reporting of GHG emissions from international shipping according to IPCC guidelines for all types of fuel;

.2 provide GHG and CO_2 emission factors for all relevant maritime fuels needed in existing and future possible IMO requirements;

.3 provide necessary information about sustainability of biofuels and other key production aspects through the use of existing standards;

.4 are flexible as more detailed information can be added as new standards and methods become available; and

.5 avoid unnecessary administrative burden for the Organization, Administrations and shipping stakeholders, as requested in resolution A.1103(29).

3 The document also contains an evaluation of which MARPOL regulations should take these guidelines into account, and which existing guidelines should be amended. Due to time-constraints, not all aspects are fully elaborated and would need further consideration. These elements are marked with a placeholder in the draft guidelines for later development.

Examples of well-to-propeller emission of different supply chains

4 Figure 1 shows a generic well-to-propeller supply chain for a fuel. Bunkering marks the step between well-to-tank and tank-to-propeller. The emissions during these phases include direct emissions due to combustion and fugitive emissions, as well as indirect emissions for example from using electricity produced from fossil fuel.

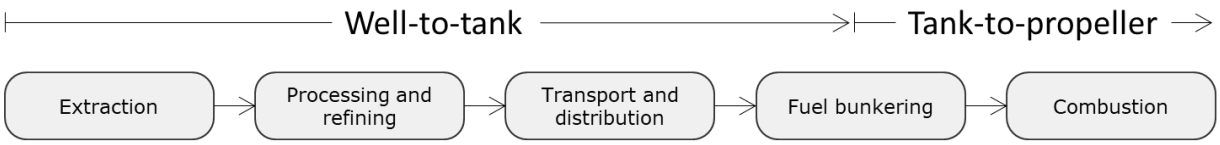

Figure 1: Generic well-to-propeller supply chain.

5 While the generic supply chain may look simple, there is huge variation in the extraction and production of even a single fuel type. For example, the crude oil used for producing a heavy fuel oil can be extracted from one or more different onshore or offshore wells, each with different emissions. The crude oil is processed by multiple steps to produce a range of products such as gasoline, aviation fuel, auto-diesel and middle distillates. The characteristics of the crude determines the processing steps and resulting emissions which

would need to be distributed between the end products. Transport distances will also vary, both transport from extraction to refineries and from refineries to bunkering stations. Figure 2 illustrates the supply chain of gasoline which is based on multiple crudes and processed in different refineries.

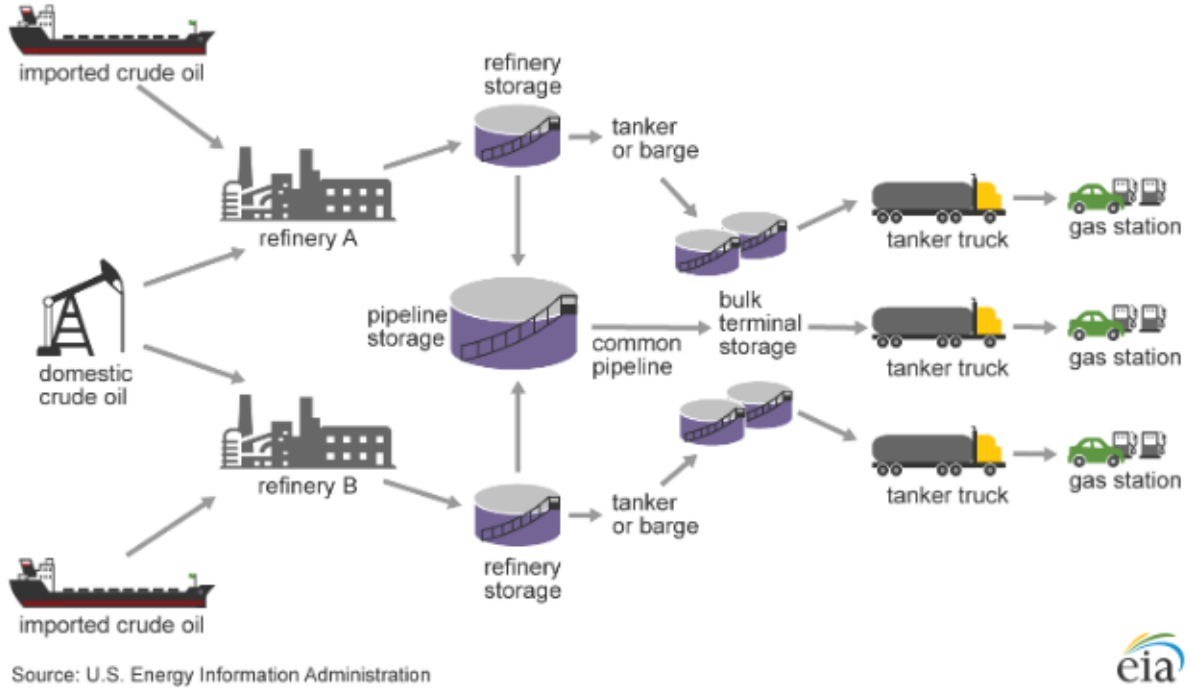

Figure 2: Example of a gasoline supply chain.
A similar supply chain applies for HFO and MGO for shipping.

6 This illustrates the complexity of addressing GHG emissions in the well-to-tank phase in detail. Other supply chains, for example biofuels, ammonia or hydrogen, are expected to be as complex.

Key considerations in relation to the GHG/carbon intensity guidelines

7 While developing the guidelines, the co-sponsors have identified several important issues that need to be considered and decided upon as the basis for developing the guidelines. Among the key questions considered in the draft guidelines, the co-sponsors would like to highlight the following:

.1 Should all fuels used for ship propulsion and operation be included?

In the view of the co-sponsors, the answer is yes. All fuel oils delivered to a ship, as defined in regulation 1 of MARPOL Annex VI, should fall into a category identified by these guidelines, and hence the guidelines need to be updated when new fuels are introduced. The definition of fuel oils in MARPOL may need to be extended, or a separate definition for the purpose of addressing GHG and CO_2 could be established.

.2 Which climate control regime will emissions from international shipping be subject to?

GHG emissions will occur in various countries with various climate control regimes and reported to UNFCCC according IPCC principles.

The tank-to-propeller emissions from international shipping will be subject to an IMO emission control regime addressed by the IMO GHG Strategy. The well-to-tank emissions fall under the responsibility and control of the country or countries extracting and producing the fuel and are addressed and reported to the UNFCCC by the relevant countries accordingly. Hence, in general the well-to-tank emissions can be expected to be subject to a climate control regime.

.3 Should the GHG and carbon intensity for all individual fuel lots delivered to ships be assessed?

As shown above, the well-to-tank supply chains of shipping fuels are complex and will become more so in the future when more types of fuels from non-fossil sources will be available. The GHG emissions for the same type of fuel may vary significantly for different supply chains and bunker lots. Introducing a scheme to verify the lifecycle GHG emissions for each fuel lot will impose significant administrative burdens, if at all possible. Therefore, a simplified approach, focusing on the most important aspects of the WTT emissions, should be developed.

.4 Who should verify the GHG and carbon intensity of a fuel?

What needs to be verified at which point is a crucial question. It is important to balance the need for accounting and control, the need for shipping actors to use sustainable fuels, and the administrative burden for ships and Administrations. WTT emissions should be subject to national verification schemes, while TTP emissions fall under the remit of the IMO which should develop verification schemes.

Purpose and scope of the GHG/carbon intensity guidelines

8 The main application for the guidelines would be to provide carbon and GHG emission factors (grams CO_2 and CO_2-eq per gram fuel) to be used in the current fuel Data Collection System (DCS), the Energy Efficiency Design Index (EEDI) scheme, and other instruments under discussion such as the Carbon Intensity Indicators (CII) and Energy Efficiency for Existing Ships (EEXI). Currently, only carbon factors for a selection of fuels are provided in the EEDI calculation guidelines. With other fuels becoming available to shipping, including biofuels and zero-carbon fuels, it is important to establish clear guidelines for all fuels. An evaluation of MARPOL requirements and guidelines which should take the lifecycle GHG and carbon intensity guidelines into account can be found in paragraph 23 and onwards.

9 The scope of the guidelines is all GHG emissions related to all fuels used for combustion and energy conversion (e.g. fuel cells) purposes for propulsion and operation onboard a ship. As the focus is on fuels, the guidelines will not provide guidance for a complete IMO GHG inventory for international shipping and does not cover for example emissions from cargo (VOC), or use of refrigerants. Other short-lived climate forcers and precursors such as NMVOC, NOx, SOx, CO, PM and Black Carbon are also not included in the scope, as they are either not dependent on the fuel or they are addressed by other MARPOL requirements.

10 The GHGs included are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). For tank-to-propeller emissions, CO_2 emissions are determined by the fuel and engine specific fuel consumption, while CH_4 and N_2O emissions are dependent on the engine type and fuel used. The GHG emissions are calculated as CO_2-equivalents (CO_2e) using the Global Warming Potential over a 100-year horizon (GWP100). Each fuel type will have default carbon

emission factors according to its physical properties, while the GHG emission factor will depend on the engine (e.g. methane slip).

Fuel lifecycle label to address well-to-tank emissions

11 The accounting of GHG emissions is based on the IPCC principles laid out in the IPCC Guidelines for National Greenhouse Gas Inventories[1], which determines which emissions are the responsibility of the international shipping sector. The production of fuel is not controlled by the international shipping sector and the WTT GHG emissions from extracting, processing, refining and transporting fuel used by the shipping sector will be accounted for in national GHG inventories and reported to the UNFCCC.

12 Even though WTT emissions are not accounted for in IMO's GHG inventory for international shipping, it is important to be aware of the sustainability of the fuels used, including GHG emissions and other aspects such as feedstock for biofuels, enabling a ship owner to take informed decisions. However, it would be challenging, and in some cases almost impossible, to calculate and verify complete life cycle emissions of all bunker lots delivered to a ship.

13 To simplify the matter and ensure that the most significant aspects of fuel production are taken into account, and to enable reporting according to the IPCC inventory guidelines, the co-sponsors propose to introduce a Fuel Lifecycle Label (FLL) which broadly categorizes a fuel based on carbon source and other sustainability aspects.

14 The key aspect for reporting emissions according to IPCC guidelines is whether the carbon comes from biomass or from other non-fossil captured carbon. Further, the key sustainability aspects are the biomass feedstock, and if the hydrogen is produced from electricity or reformed methane. The FLL should contain information about these aspects.

15 The main labels would be 1) Fossil, 2) Biomass, 3) Captured carbon and 4) Zero-carbon. Biofuels are particularly challenging as there are other sustainability issues not related to GHG and the international shipping sector should not create incentives to use non-sustainable biofuels. Sub-categories could for example be established on biofuels to document the feedstock. Similarly, sub-categories could be established on Zero-carbon to document if the fuel was made by electricity or reforming methane with or without carbon capture and storage (CCS).

16 Figure 3 below shows an overview of the main well-to-tank fuel pathways and the main labels determined by the energy source and pathway.

[1] *2006 IPCC Guidelines for National Greenhouse Gas Inventories:* https://www.ipcc-nggip.iges.or.jp/public/2006gl/ and the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

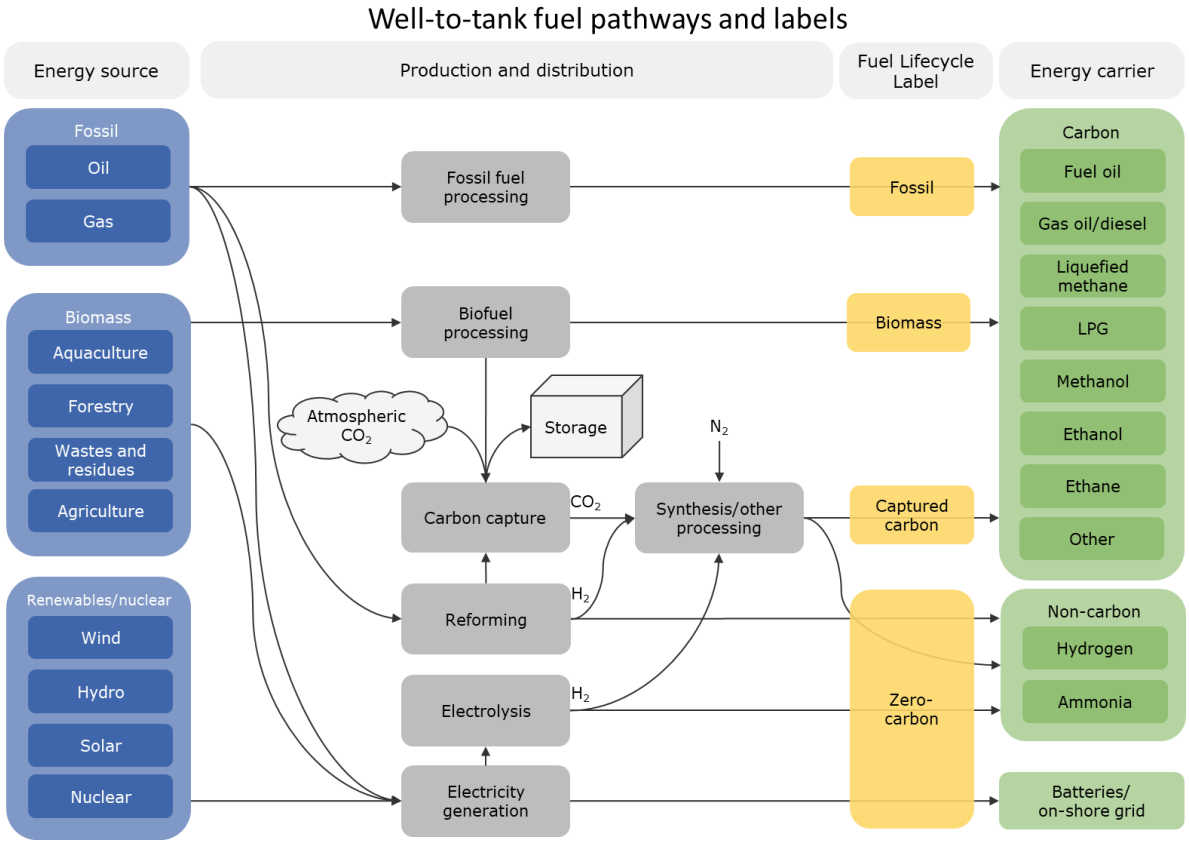

Figure 3: Overview of main well-to-tank fuel pathways and labels.

17 The IMO should not develop own fuel standards and the labelling of fuels should be based on internationally recognized standards listed in the guidelines. One example of such standard could be the International Sustainability Carbon Certification (ISCC)[2] for biofuels. A bunker supplier having an ISCC certificate could sell fuel with a Biomass label. The ship using this fuel could report emissions accordingly using the relevant factors.

18 The FLL should be documented through the Bunker Delivery Note. If the supplier is not able to document the label it will be Fossil by default. When verifying the Fuel Oil Consumption Reports from a Company the Administration or RO could review the documentation through the BDN and supplier certificate.

19 To prevent any emissions from falling between two chairs and not being counted, IMO's GHG inventory for international shipping should record all use of energy and direct emissions regardless of the source of the carbon. Zero-carbon energy carriers such as hydrogen and ammonia will have a carbon content of zero, regardless of whether it comes from electrolysis with renewable electricity or from reformed natural gas, with or without CCS. This also applies to electricity from onshore, used either directly by a shore connection or stored in batteries. For energy carriers that contains carbon, such as diesel, methane and methanol, the source of the carbon is critical to accounting.

20 The FLL includes a carbon source factor (S_F) which should be multiplied with the carbon factor for the specific fuel (C_F). The carbon source factor determines if the TTP CO_2 emissions should be accounted for in IMO's GHG inventory for international shipping (S_F = 1)

[2] See: https://www.iscc-system.org/

or not (S_F = 0). For fuel blends, for example of bio and fossil methane, the S_F is the weighted average of the blend feedstocks.

21 The above proposals should not impose further obligations on Administrations beyond what are currently in Regulation 18 of MARPOL Annex VI. Certification of fuels and bunker suppliers will be done through existing standards, similar to for example the ISO 8217 marine fuel standard.

Existing relevant standards for determining the Fuel Life cycle Label

22 The labelling of fuels should be determined based on recognized international standards addressing the fuel and bunker supplier. The IMO should not develop own standards and methods, but continuously identify and review international standards and map them to FLLs. Certificates from the recognized standards should serve as documentation for the FLL. Multiple standards can map to the same label as long as they have equivalent scope. New labels can also be added as necessary, taking into account future technology development and when more standards and methods become available.

23 The standards to be listed in the guidelines which qualifies a fuel for a certain Fuel Life cycle Label should be continuously reviewed by the IMO. Proposals for adding standards should be submitted to the Committee and evaluated according to the following criteria:

.1 International and have at least a regional reach;

.2 Have clear certification procedures performed by independent certification bodies;

.3 Address the supply chain of the fuel;

.4 Address sustainability aspects; and

.5 Readily maps to existing labels.

Implications for other IMO instruments and guidelines

24 The guidelines should be applied by both new and existing MARPOL regulations to determine carbon and GHG emissions from combustion of fuel oils. Consequently, amendments of the relevant regulations need to be discussed separately. The following paragraphs map the relevant requirements and what needs to be addressed.

25 Energy Efficiency Design Index (EEDI) and the proposed EEXI (MARPOL Annex VI, regulations 20 and 21, the proposed regulations 20A and 21A in document ISWG-GHG 6/2/3, and related guidelines):

.1 The MARPOL Annex VI regulations do not need any amendments.; only the EEDI and EEXI calculation guidelines would need to be changed. Consider changing the EEDI and EEXI to use the GHG factor instead of the current carbon factors. Until a method of applying methane and nitrous oxide factors are developed, the calculation would remain the same.

.2 Consider how the carbon source factor (S_F) could be applied to the attained EEDI and EEXI. At the design stage a ship would be capable of using for example fossil MGO and biodiesel. A restriction to carry and use certain types of fuels will be needed to allow application of a low emission factor at

design stage. This restriction, similar to the restriction on sulphur content in the IAPP, would need to be specified in the Energy Efficiency Certificate (EEC) or the Air Pollution Certificate (IAPP). The Port State Control Guidelines would also need to include this.

26 Collection and reporting of ship fuel oil consumption data (MARPOL Annex VI, regulation 22A, and appendix IX, and related guidelines):

.1 Add the FLL and the carbon source factor (S_F) to the required reporting items per fuel type consumed in appendix IX. This should also be included in the SEEMP Part II under ship engines and fuel oil consumer as part of the plan on which fuels the ship uses.

.2 Add checking of the FLL in case of non-fossil labels used in the DCS verification guidelines, for example by verifying that the bunker supplier has a valid certificate.

27 The proposed Carbon Intensity Indicators (CII) in documents ISWG-GHG 6/2/11 and ISWG-GHG 6/2/10 (proposed amendments to MARPOL Annex VI, regulation 22 and related guidelines):

.1 Add the carbon source factor (S_F) to the calculation.

.2 Consider if the indicator should be a GHG Intensity Indicator and use the GHG factor.

28 Fuel oil quality and the Bunker Delivery Note (MARPOL Annex VI, regulation 18 and appendix V):

.1 The required content of the BDN, specified in appendix V, should include the FLL, including a declaration or certificate in case the label is other than Fossil. See annex 2 for an amendment proposal.

.2 Consider if the FLL for fuels based non-fossil carbon and not containing any carbon should be required in Regulation of MARPOL Annex VI including a reference to the GHG and carbon intensity guidelines.

Work plan

29 In order to structure the work, the co-sponsors propose to agree on a Work Plan for the further development of the guidelines as outlined in annex 3. The first version of the guidelines should be finalized for adoption at MEPC 76. Progress can be ensured by intersessional activity with working arrangements (e.g. Correspondence Groups, intersessional Working Group meetings) as agreed by the Committee.

Proposal

30 To summarize, the co-sponsors propose to:

.1 take into account TTP GHG emissions through developing carbon and GHG emissions factors from combustion and conversion of all fuels onboard the ship;

.2 consider addressing WTT GHG emissions by introducing a Fuel Life cycle Label (FLL) which broadly categorizes fuels based on carbon source and other sustainability aspects and enable reporting of GHG emissions from international shipping according to IPCC guidelines for all types of fuel;

.3 develop a procedure for including new standards in the guidelines and keeping the guidelines under review;

.4 use the draft guidelines set out in annex 1 as the base document for developing the Life cycle GHG and carbon intensity guidelines for maritime fuels; and

.5 develop a work plan based on annex 3, for the further development of the guidelines aiming at a finalization of a first version for adoption at MEPC 76.

Action requested of the Working Group

31 The Group is invited to consider the proposals put forward in this document and take action as appropriate.

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ANNEX 1

DRAFT LIFE CYCLE GHG AND CARBON INTENSITY GUIDELINES FOR MARITIME FUELS

CONTENTS

PART I: GENERAL

1 INTRODUCTION

1.1 These guidelines provide carbon and GHG emission factors (grams CO_2 and CO_2e per gram fuel) for all fuels used on onboard a ship, to be used in regulations such as the fuel Data Collection System (DCS), the Energy Efficiency Design Index (EEDI) scheme, and other instruments to be developed. The guidelines also set provisions for applying a Fuel Life cycle Label (FLL) which broadly categorizes the fuel based on carbon source and other sustainability aspects.

2 ABBREVIATIONS

GWP – Global Warning Potential
TTP – Tank-to-propeller
WTP – Well-to-propeller
WTT – Well-to-tank

3 SCOPE

3.1 The scope of these guidelines is all GHG emissions related to all fuels used for combustion and energy conversion (e.g. fuel cells) purposes for propulsion and operation onboard a ship. It is not intended to provide guidance for a complete IMO GHG inventory for international shipping and does not cover e.g. emissions from cargo (VOC), or use of refrigerants. Other short-lived climate forcers and precursors such as NMVOC, NO_x, SO_x, CO, PM and Black Carbon are also not included in the scope.

3.2 The GHGs included are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). For tank-to-propeller emissions, CO_2 emissions are determined by the fuel and engine specific fuel consumption, while CH_4 and N_2O emissions are dependent on the engine type and fuel used. The GHG emissions are calculated as CO_2-equivalents (CO_2e) using the Global Warming Potential over a 100-year horizon (GWP100).

3.3 The accounting of GHG emissions is based on the IPCC principles laid out in the IPCC Guidelines for National Greenhouse Gas Inventories[3], which determines which emissions are the responsibility of the international shipping sector.

3.4 Figure 1 below shows a generic well-to-propeller (WTP) supply chain for a fuel. The bunkering marks the step between the well-to-tank (WTT) and tank-to-propeller (TTP) phases.

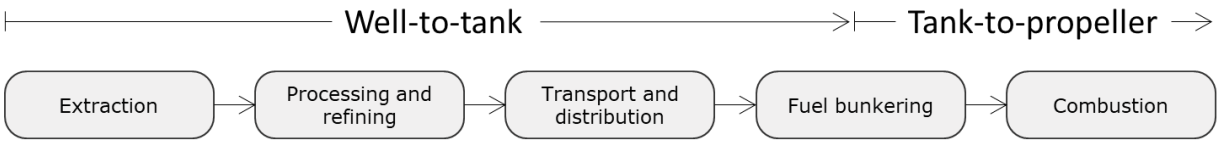

Figure 1: Generic well-to-propeller supply chain.

[3] *2006 IPCC Guidelines for National Greenhouse Gas Inventories*: https://www.ipcc-nggip.iges.or.jp/public/2006gl/ and the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

3.5 The exploration, production, processing, refining, transport and distribution of the fuel are not covered by the IMO's GHG inventory for international shipping and the WTT emissions are covered by the national GHG inventories of the country exploring, producing, processing, refining, transporting and distributing the fuel.

3.6 Even if the WTT emissions are not accounted for in the international shipping sector, it is important to be aware of the sustainability of the fuels used, both on GHG and other matters, to make informed decisions.

3.7 The key aspects for IPCC reporting are if the carbon comes from biomass or from other non-fossil captured carbon. Further, the key sustainability aspects are the biomass feedstock, and if the hydrogen is produced from electricity or reformed methane. These aspects are included in the Fuel Life cycle Label (FLL) described in Section 6.

4 GHG EMISSIONS FACTOR BASED ON GLOBAL WARMING POTENTIAL

4.1 The GHG emission factors are calculated based on the GWP100 factors in the *2013 IPCC Fifth Assessment Report*, without feedback mechanisms.

4.2 The GHG emission factor (t CO_2-e/t fuel) is calculated as follows:

$$GHG_F = S_F \cdot C_F + GWP_M \cdot M_F + GWP_N \cdot N_F$$

S_F: The weighted average of the carbon source factors of the specific fuel blend. See Section **Error! Reference source not found.**.

C_F: The carbon emission factor (t CO_2/t fuel) of the specific fuel. See Section 8.

M_F: The methane emission factor (t CH_4/t fuel) based on engine measurements using the specific fuel. See Section 0.

N_F: The nitrous oxide emission factor (t N_2O/t fuel) based on engine measurements using the specific fuel. See Section 0.

GWP_M: Global warming potential for CH_4, equals 28 for 100-year time horizon.

GWP_N: Global warming potential for N_2O, equals 265 for 100-year time horizon.

5 IPCC ACCOUNTING PRINCIPLES

5.1 In order to avoid double-counting of the same emissions between the IMO's GHG inventory and national GHG inventories, IMO's GHG inventory for the international shipping sector should follow the principles laid out in the IPCC Guidelines for National Greenhouse Gas Inventories[4]. International water-borne navigation (international bunkers) is grouped under Mobile combustion under the Energy sector, but emission from fuel used by ships in international transport should not be included in national totals in national GHG inventories and has to be covered by the IMO's GHG inventory.

[4] *2006 IPCC Guidelines for National Greenhouse Gas Inventories*: https://www.ipcc-nggip.iges.or.jp/public/2006gl/ and the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

5.2 According to the IPCC guidelines, any non-combustion emissions including fugitive emissions should be accounted for in the sector(s) where the fuel is explored, produced, processed, refined, transported or distributed. IMO's GHG inventory for international shipping should only be concerned with GHG emissions from fuel used by ships, while the GHG emissions from exploring, producing, processing, refining, transporting and distributing the fuel it uses should be accounted for in national GHG inventories. To prevent any emissions from falling between the two chairs and not being counted, IMO's GHG inventory for international shipping sector should estimate and report all emissions from fuel used by ships regardless of the source of the carbon.

5.3 Zero-carbon energy carriers such as hydrogen and ammonia will have a carbon content of zero, regardless of whether it comes from electrolysis with renewable electricity or from reformed natural gas, with or without CCS. This also applies to electricity from onshore, used either directly by a shore connection or stored in batteries. For energy carriers that contains carbon, such as diesel, methane and methanol, the source of the carbon is critical to the accounting.

5.4 The carbon source factor (S_F) addresses this. The factor determines if the TTP CO_2 emissions should be accounted for in IMO's GHG inventory for international shipping ($S_F = 1$) or not ($S_F = 0$) and should be multiplied with the carbon emission factor for the specific fuel (C_F). Emissions of CH_4 and N_2O should be reported regardless of carbon source. For fuel blends, for example of bio and fossil methane, the S_F is the weighted average of the blend feedstocks.

PART II: WELL-TO-TANK EMISSIONS

6 FUEL LIFE CYCLE LABEL

6.1 To ensure that the most significant aspects of fuel production are taken into account, and to enable reporting according to the IPCC inventory guidelines, a fuel delivered on board a ship should include a Fuel Life cycle Label (FLL) which categorizes the fuel based on carbon source and other sustainability aspects. The FLL provides the necessary information for cross-checking and transparency.

6.2 The full FLL consists of the main label, sub-category and fuel type and should be documented in the Bunker Delivery Note. The FLL determines which carbon source factor (S_f) should be applied for accounting of CO_2 emissions.

6.3 The FLL of a fuel should be based on a certification of the supplier and/or fuel according to internationally recognized standards listed in the appendix to these guidelines. The accepted certification bodies are determined by the individual certification scheme.

6.4 If the fuel supplier and/or fuel are not certified according to any accepted standards, the main label for all carbon-based fuels should be Fossil. See Part VI in these guidelines for criteria and procedures for establishing a list of accepted standards.

6.5 The main labels are Fossil, Biomass, Captured Carbon and Zero-carbon, with sub-categories established on Biomass to document the feedstock; and on Zero-carbon to document if the fuel was made by electricity or reforming methane.

6.6 **Fossil:** The carbon from fossil fuels is not part of the natural carbon cycle and the CO_2 emissions from combustion should be accounted for by the ship ($S_F = 1$). This

label also includes synthetic fuels made from captured carbon from fossil sources. There are no sub-categories under the Fossil label.

6.7 **Biomass**: In principle fuels based on biomass are carbon neutral as the carbon comes from the natural cycle, but the IPCC guidelines do not automatically consider it so[5]. The IPCC guidelines stipulate that CO_2 emissions from biomass combustion for energy should not be reported in sectors of national GHG inventories where the biomass was combusted but should be reported as an information item for cross-checking purposes. The CO_2 emissions from biomass combustion are estimated and accounted for in the Agriculture, Forestry and Other Land Use (AFOLU) sector as net changes in the carbon stocks ($S_F = 0$).

Sub-categories of biofuels should indicate the feedstocks used and whether they are sustainable.

6.8 **Captured carbon:** IPCC guidelines state that any captured CO_2 for later uses should not be deducted in the sector where it is captured, unless it is accounted for elsewhere in national GHG inventories, while emissions associated with the CO_2 capture should be reported under the sector (e.g. stationary combustion or industrial activities). This means that regardless whether the CO_2 was captured directly from the atmosphere, from biogas, from reforming fossil methane, or any other process, it should be reported by the IMO's GHG inventory for international shipping as carbon neutral ($S_F = 0$). The IPCC does not specifically mention how CO_2 captured from the atmosphere should be handled, but assuming that it is not counted as removal in the sector producing the fuel, it would be counted as carbon neutral. Although not mentioned specifically, the CO_2 emission from using these fuels should also be recorded for cross-checking.

6.1 **Zero-carbon:** For zero-carbon energy carriers such as hydrogen, ammonia, and electricity the carbon emission factor (C_F) is zero. The IPCC guidelines do not address accounting methods for CO_2 emissions from combustion of such fuels ($S_F = 0$), while any CO_2 emissions from production and transport of such fuels are accounted for in national GHG inventories.

Sub-categories of non-carbon fuels should indicate the process for producing the fuel – e.g. electrolysis, natural gas reforming with or without carbon capture and storage. The default sub-category is natural gas reforming, and any other production methods must be certified.

6.2 Figure 2 below shows an overview of the main well-to-tank fuel pathways and how the energy source and pathway determine the main label of the FLL.

[5] The IPCC guidelines do not automatically consider biomass used for energy as "carbon neutral" not only because land use change caused by biomass production (e.g. conversion of land to bioenergy production) can also result in significant GHG fluxes, but also because there may be significant additional emissions which are reported in sectors where they occur including: from the processing and transportation of the biomass; from direct methane and nitrous oxide emissions from the biomass combustion; and from production and use of fertilizers and liming if either is used in cultivation of biomass. For example, direct methane emissions from biomass combustion for energy use are reported in the energy sector.

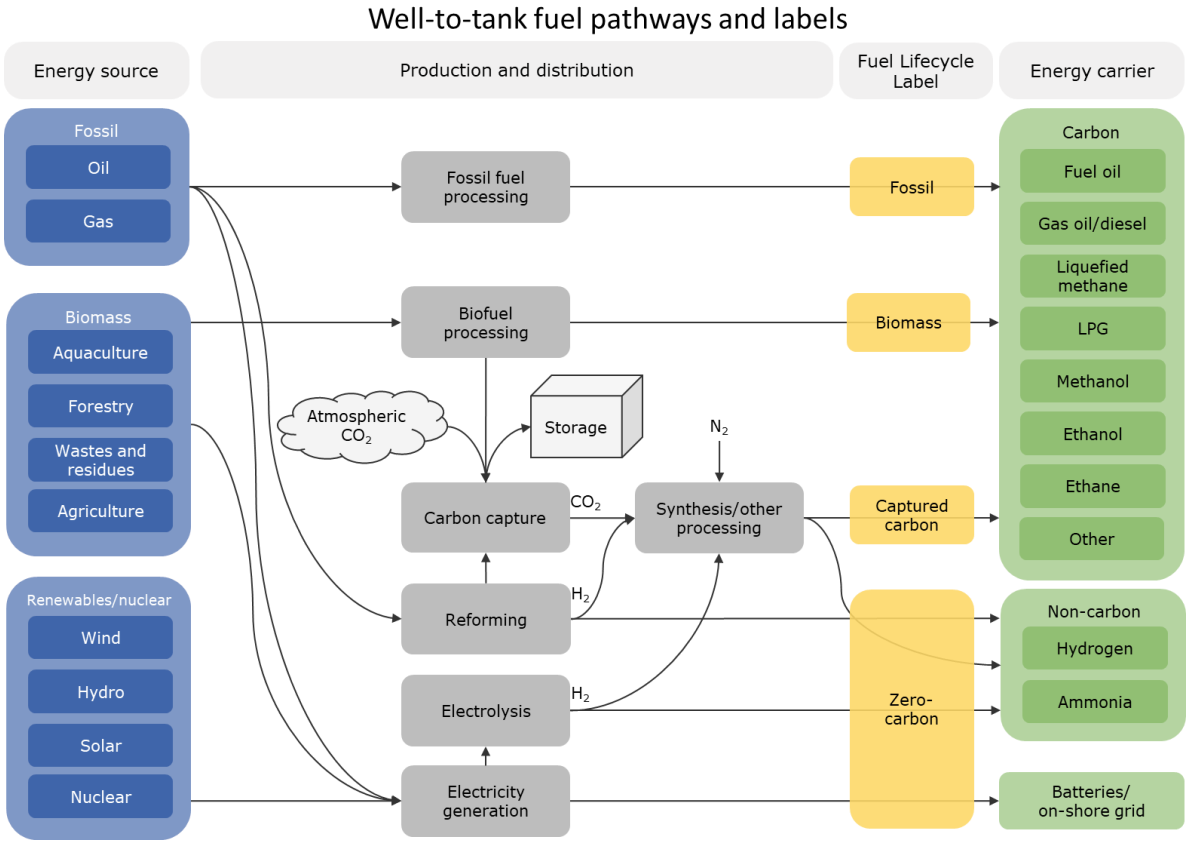

Figure 2: Overview of main well-to-tank fuel pathways and labels.

6.3 Table 1 contains a list of main labels, sub-categories, if the CO_2 emissions should be included in the TTP GHG emissions reported.

Table 1: List of main Fuel Life cycle Labels and sub-categories

Main label	**Sub-category**	**Include CO_2 emissions in TTP**	***S_F* (t-CO_2/t-Fuel)**
Fossil	-	Yes	1
Biomass	[TBD]	For info	0
Captured carbon	-	For info	0
Zero-carbon	Reformed fossil without CCS	N/A	0
Zero-carbon	Reformed fossil with CCS	N/A	0
Zero-carbon	Electricity	N/A	0

7 BLENDING OF FUELS

7.1 A fuel batch is likely to be a mix of various sources, for example by blending 20% biodiesel into MGO. The S_F should be calculated as the weighted average of the mass of the various blend stocks. Each blend stock should be accompanied with a FLL.

PART III: TANK-TO-PROPELLER EMISSIONS

8 CARBON EMISSION FACTORS BASED ON CHEMICAL COMPONENTS IN THE FUEL

8.1 C_F is a non-dimensional conversion factor between fuel consumption measured in grams and CO_2 emissions also measured in grams based on carbon content. A list of fuels and C_F can be found in the Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships (MEPC.308(73)). The list has been extended with other relevant maritime fuels.

8.2 To provide consistency, the values from MEPC.308(73) is retained, including the carbon content. The lower calorific value (LCV) and carbon emission factors (C_F) are based on the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 2, Chapter 1: Table 1.2 provides the LCV, while the C_F is calculated by multiplying the LCV with the CO_2 emission factors in Table 1.4. For DME, HVO and FAME, the LCV is taken from Annex III of Directive (EU) 2018/2001.
[Carbon emission factors to be developed for DME, HVO and FAME]

8.3 The value of C_F per fuel is given in Table 2:

Table 2: List of carbon factors per fuel type.

Type of fuel	Reference	Lower calorific value (kJ/kg)	Carbon content	C_F (t-CO_2/t-Fuel)	Source
Diesel/Gas Oil	ISO 8217 Grades DMX through DMB	42,700	0.8744	3.206	1
Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	41,200	0.8594	3.151	1
Heavy Fuel Oil (HFO)	ISO 8217 Grades RME through RMK	40,200	0.8493	3.114	1
Liquefied Petroleum Gas (LPG)	Propane	46,300	0.8182	3.000	1
	Butane	45,700	0.8264	3.030	1
Liquefied Natural Gas (LNG)		48,000	0.7500	2.750	1
Methanol		19,900	0.3750	1.375	1
Ethanol		26,800	0.5217	1.913	1
Biodiesel		27,000	-	1.912	2
Ethane		[46,400]	-	2.933	3
HVO		[44,000]	-	[TBD]	4
DME		[28,000]	-	[TBD]	4
FAME		[37,000]	-	[TBD]	4
Ammonia		18,600	0	0	
Hydrogen		120,000	0	0	
[...]					

Sources:
1: MEPC.308(73): *2018 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships*.
2: *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 2, Chapter 1.
3: According to method and calculation in MEPC 59/4/10 (SIGTTO).
4: Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, Annex III.

9 METHANE AND NITROUS OXIDE EMISSION FACTORS

9.1 [Placeholder for addition of engine specific factors]

PART IV: REVIEW AND INCLUSION OF NEW FUELS

10 CRITERIA AND PROCEDURE FOR RECOGNIZING STANDARDS

10.1 The labelling of fuels should be determined based on recognized international standards addressing the fuel and bunker supplier, listed in the appendix to these guidelines. Multiple standards can map to the same label as long as they have similar scope. New labels and categories can be added as necessary, taking into account future technology development.

10.2 In case the standards and certificates contain specific information relevant for the labelling, this should also be listed under “Relevant parts of the standard”.

10.3 The IMO should continuously identify and review international standards and map them to labels and categories. Proposals should be submitted to the Committee for consideration and include an assessment of the following criteria:

.1 Is the standard international and have at least a regional reach?

.2 Does the standard have clear certification procedures performed by independent certification bodies?

.3 Does the standard address the supply chain of the fuel and fuel supplier?

.4 Does the standard address sustainability aspects?

.5 Does the standard map to existing labels and sub-categories? If not, a justification for creating a new label or sub-category should be provided.

APPENDIX
LIST OF RECOGNIZED STANDARDS

Certificates from the following standards and parts of the standards are recognized as documentation for the specified label and sub-category:

Standard	Relevant parts of the standard	Main label	Sub-category

ANNEX 2

DRAFT AMENDMENTS TO MARPOL ANNEX VI

(New text is shown as underlined and text to be deleted as ~~strikethrough~~)

Appendix V Information to be included in the bunker delivery note

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10 Fuel Life cycle Label(s)***

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** The Fuel Life cycle Label shall be documented according to guidelines developed by the Organization. If no documentation is available, the Fuel Life cycle Label shall be “Fossil”. In case the fuel is a blend, all labels shall be listed, indicating the content of each fuel in % of total mass.

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ANNEX 3

WORK PLAN FOR FINALIZING DRAFT LIFE CYCLE GHG AND CARBON INTENSITY GUIDELINES FOR MARITIME FUELS

When	**Milestone**
ISWG-GHG 7/MEPC 75	First draft of guidelines
MEPC 76	First review of standards submitted to the Committee Interim guidelines adopted Approval of consequential amendments to MARPOL
MEPC 77	Review of standards submitted to the Committee Adoption of consequential amendments to MARPOL and relevant guidelines
MEPC 78	Review of standards submitted to the Committee Addition of method for calculating methane and nitrous oxide factors (Section 9) (pending work on VOC and methane slip measure) Adoption of guidelines
TBD	Application of guidelines (to be decided at adoption)
MEPC	Review of standards submitted to the Committee Keep guidelines under review

The need for intersessional working arrangements (e.g. Correspondence Groups or Working Groups) to be decided by the Committee.