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REDUCTION OF GHG EMISSIONS FROM SHIPS

Proposal for how to calculate Well-to-Wake carbon dioxide equivalent emissions using both GWP100 and GWP20 for comparative purposes as part of the LCA guidelines

Submitted by Solomon Islands, Pacific Environment and Inuit Circumpolar Council

SUMMARY

Executive summary:	This document contains a concrete proposal for how to calculate Well-to-Wake carbon dioxide equivalent emissions from marine fuels using both 100-year Global Warming Potential (GWP100) and 20-year Global Warming Potential (GWP20) for comparative purposes as part of the IMO LCA guidelines
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 12
Related documents:	MEPC 75/7/15; MEPC 78/INF.25; ISWG-GHG 11/WP.1/Rev.1; PPR 5/INF.16 and resolution MEPC.304(72)

Introduction

1 This document comments on the draft report of ISWG-GHG 11 to MEPC 78 (ISWG-GHG 11/WP.1/Rev.1).

2 At ISWG-GHG 11, Pacific Environment made an intervention, explaining why it is important to calculate, consider and compare Well-to-Wake (WtW) carbon dioxide equivalent emissions based on both 100-year Global Warming Potential (GWP100) and 20-year Global Warming Potential (GWP 20). Pacific Environment explained that the fuels that ships use emit pollutants with high GWP 20, such as methane and Black Carbon. Understanding both the long-term and near-term warming impacts of ship fuels will be important for policymaking and to achieve the goals of the Initial IMO Strategy (Resolution MEPC.304(72)), including being consistent with the Paris Agreement's temperature goals, which include efforts to limit warming to no more than 1.5°C. The IPCC's *Special Report on the impacts of global warming of 1.5°C* found that modelled pathways that limit global warming to 1.5°C with no or limited overshoot

involve deep reductions in emissions of methane and Black Carbon, 35% or more of both by 2050 relative to 2010, because of their strong near-term warming impacts.[1] The draft LCA guidelines should therefore explain how to calculate carbon dioxide equivalent emissions using both 100-year and 20-year Global Warming Potentials. Pacific Environment's full intervention is set out in annex 5 to ISWG-GHG 11/WP.1/Rev.1.

3 ISWG-GHG 11 agreed to further consider developing guidance on how to calculate carbon dioxide equivalent emissions based on GWP100 and adding GWP20 for comparative purposes as part of the draft LCA guidelines (ISWG-GHG 11/WP.1/Rev.1, paragraph 58).

4 Moreover, at ISWG-GHG 11, several delegations supported the inclusion in the draft LCA guidelines of a table containing default GWP100 and GWP20 values of the substances covered for comparison purposes (ISWG-GHG 11/WP.1/Rev.1, paragraph 50). The co-sponsors' proposal for such a table is presented in table 1 and described in paragraph 5.

A table containing GWP100 and GWP20 values

5 Table 1 contains the GWP100 and GWP20 values used in a briefing paper published by the International Council on Clean Transportation (ICCT), which the co-sponsors describe in detail in document MEPC 78/INF.25 (Solomon Islands et al.). The GWPs for carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are from the IPCC's Sixth Assessment Report.[2] The GWPs for Black Carbon (BC) are from Bond et al. (2013)[3] and were used by Comer et al. (2017) to estimate CO_2e emissions from BC emitted by ships.[4] The GWP100 value for BC was also used in the *Fourth IMO GHG Study 2020* (MEPC 75/7/15). This table could be included in the draft LCA guidelines as default GWP100 and GWP20 values, subject to review and revision, as appropriate.

Table 1: Global Warming Potentials for climate pollutants

Pollutant	100-year	20-year	Source
CO_2	1	1	Reference level
CH_4	29.8	82.5	IPCC AR6 Table 7.15
N_2O	273	273	IPCC AR6 Table 7.15
BC	900	3200	Bond et al. and Comer et al.

1 IPCC, 2018: *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)], https://www.ipcc.ch/sr15/.

2 Forster, P., T. Storelvmo, K. Armour, W. Collins, J. L. Dufresne, D. Frame, D. J. Lunt, T. Mauritsen, M. D. Palmer, M. Watanabe, M. Wild, H. Zhang, 2021, *The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)], (Cambridge University Press. 2021), www.ipcc.ch/report/sixth-assessment-report-working-group-i/.

3 Bond, T. C., et al., Bounding the role of black carbon in the climate system: A scientific assessment, *J. Geophys. Res. Atmos., 118* (2013) 5380–5552, https://doi.org/10.1002/jgrd.50171.

4 Comer, B., Olmer, N., Mao, X., Roy, B., and Rutherford, D. *Black carbon emissions and fuel use in global shipping, 2015*, (ICCT: Washington, DC, 2017), https://theicct.org/wp-content/uploads/2021/06/Global-Marine-BC-Inventory-2015_ICCT-Report_15122017_vF.pdf. This study was submitted in the annex to document PPR 5/INF.16.

Estimating WtW CO_2e emissions using both GWP100 and GWP20

6 As described in document MEPC 78/INF.25, the ICCT has applied the GWPs in table 1 to estimate WtW emission factors for marine fuels.

7 Well-to-Tank (WtT) emissions were calculated using emission factors from the United States' Argonne National Laboratory's Greenhouse Gases, Regulated Emissions and Energy Use in Transportation (GREET) model,[5] and energy content assumptions from the *Fourth IMO GHG Study 2020*. For VLSFO, which is not included in GREET or the *Fourth IMO GHG Study 2020*, the ICCT estimated its WtT emission factor by assuming that it is an 80/20 blend of MGO and HFO.

8 Tank-to-Wake (TtW) emissions were calculated based on combustion emissions, as well as un-combusted methane in the case of LNG, based on the emissions factors used in the *Fourth IMO GHG Study 2020* with two exceptions. First, the ICCT estimated emissions factors for VLSFO by assuming that it is an 80/20 blend of MGO and HFO. Second, the ICCT added scenarios that account for methane slip from the crankcases of Otto-cycle and lean-burn engines.

9 WtW emissions are the sum of the WtT and TtW emissions and they are shown in table 2. They vary depending on the fuel type, which affects WtT emissions, and by engine type, which affects TtW emissions. In the table, CO_2 accounts for only carbon dioxide emissions, whereas CO_2e100 and CO_2e20 account for emissions of CH_4, N_2O and BC, based on their GWP100 and GWP20, respectively.

Table 2: WtW carbon dioxide and carbon dioxide equivalent factors for fossil marine fuels (table 13 of the annex to document MEPC 78/INF.25)

Fuel type	Engine type	Well-to-wake (g/g fuel)		
		CO_2	CO_2e100	CO_2e20
HFO	SSD	3.545	3.892	4.559
	MSD	3.545	4.159	5.516
VLSFO	SSD	3.734	4.098	4.792
	MSD	3.734	4.366	5.749
MGO	SSD	3.782	4.016	4.372
	MSD	3.782	4.211	5.073
LNG	LNG-Otto-MS	3.280	4.930	7.801
	LNG-Otto-MS + crankcase	3.280	5.121	8.330
	LNG-Otto-SS	3.280	4.385	6.288
	LNG-Otto-SS + crankcase	3.280	4.586	6.845
	LNG-Diesel	3.280	3.940	5.008
	LBSI	3.280	4.663	7.060
	LBSI + crankcase	3.280	4.854	7.589
	Steam Turbine	3.280	3.859	4.856

5 https://greet.es.anl.gov

Proposals

10 The co-sponsors propose that table 1 above be used as default GWP100 and GWP20 values for comparison purposes for substances covered by the draft LCA guidelines, subject to review and revision by the LCA Expert Group and/or a Correspondence Group, if either or both are established by the Committee. The co-sponsors further propose that the substances covered by the draft LCA guidelines include CO_2, CH_4, N_2O and BC.

11 The co-sponsors propose that the variables in the equations in the draft LCA guidelines be modified such that carbon dioxide equivalent emissions can be calculated using both GWP100 and GWP20 for comparative purposes. This task could be taken up by the LCA Expert Group and/or Correspondence Group if either or both are established by the Committee.

Action requested of the Committee

12 The Committee is invited to consider the proposals in paragraphs 10 and 11 and take action, as appropriate.