Attachment

Definition of the Arctic

There are many definitions of “the Arctic”. Those relevant for shipping include the “geographic” Arctic; the AHDR and AMAP Arctic Council definitions, and the IMO’s Polar Code which covers only ice covered waters.

Much of the Arctic Council work which the EU is involved in, uses the 2004 AHDR definition. It was used throughout the EPRD study – except for the analysis of shipping emissions. The CAA proposes that the maritime boundaries of the AHDR definition be used for any analysis of ship emissions.

AHDR; The definition of the ‘Arctic’ is based on all marine waters included in the AHDR definition of the Arctic being “ the geographical area including all of Alaska, Canada North of 60°N, together with northern Quebec and Labrador, all of Greenland, the Faroe Islands, and Iceland, and the northernmost counties of Norway, Sweden and Finland, and in Russia the Murmansk Oblast, the Nenets, Yamalo-Nenets, Taimyr, and Chukotka autonomus okrugs, Vorkuta City in the Komi Republic, Norilsk and Igsrka in Krasnoyarsky Kray, and those parts of the Sakha Republic whose boundaries lie closest to the Arctic Circle”.

See pages 17/18 of the Arctic Council’s Arctic Human Development Report – AHDR
https://oaarchive.arctic-council.org/handle/11374/51
Also – EEA Report No 7/2017 The Arctic environment European perspectives on a changing Arctic

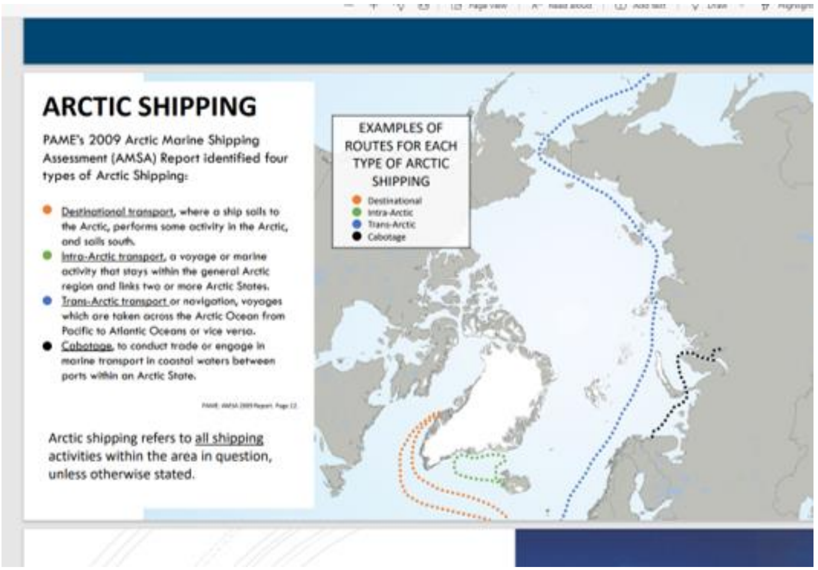
Calculating Arctic shipping CO2 and BC emissions
Based on the below, the CAA would suggest that emissions inventories based on the above AHDR marine boundaries assign the four types of arctic shipping emission as follows;

Ship emissions emitted within the AHDR maritime boundaries only.
Based on AIS data.
Destinational attribution: – to the country of the ship’s last departing port before entering AHDR defined waters.
Intra EU Arctic shipping: – ship voyages wholly with AHDR maritime boundaries – ship emissions attributed to the country of port of departure
Trans Arctic shipping: – emissions of ships within AHDR maritime boundaries allocated to the country of the last departing port before entering AHDR waters.
Cabotage: – respective domestic country emissions
It will be important that the EPRD analysis of these Intra AHDR emissions in addition to assigning attribution by country, record emission by the flag state of each ship. Beneficial owner data as per the exiting EPRD report would also be helpful.

All “Arctic” related ship emissions

- Attribution according to the EU MRV definition of a voyage “in or near the Arctic’ = emissions for the entire ship voyage if any part of that voyage enters AHDR marine boundaries.

In order to calculate an accurate share of EU CO_2 and BC Arctic-related emissions, this calculation needs to be done for all ships and then by country of attribution at least for the top emitting states



Emissions factors for black carbon can be as robust as CH4 emission EFs.

Proposals are also made to regulate black carbon in the Fuel EU Maritime GHG intensity standard for both WtT and TtW emissions, via the same process that the Commission itself proposes to include CH_4 and N20 in the GHG Intensity Standard, by including the relevant BC emission factors in Annex II and with black carbon being added in the Annex I formulas.
Set out below in a new Column 10 are the BC EFs that the CAA propose be included in Fuel EU Maritime Annex II.

Regarding possible concerns re measuring TtW (tank to wake) BC emissions at ship level, this issue relates just as much to the inclusion of TtW CH_4 emissions in Fuel EU Maritime as it would to TtW BC emissions and involves a compromise on both counts.

The Commission has included two sets of EFs for calculating CH_4 CO_2e in Refuel EU Maritime.
The first for traditional fossil fuels only (HFO through distillates in column 7 - see also below) are based on a fixed CH_4 EF of 0.00005. This accounts for the very small amounts of unburned methane from duel fuel diesel and steam engines.
These EFs were calculated a good time ago. Whether they were based on test bed engines or actual ship emissions is not clear. In any case the EFs – and so CH_4 emissions - are tiny <u>and a fixed EF conversion factor</u> irrespective of the fossil fuels, ship types and engines – loads, engine condition etc.

To get a sense of dimensions, 0.00005 gCH4/g fuel is equivalent to 0.005% methane slip.

The key issue, rather, is methane slip from LNG ship engines which could rise significantly especially given the Commission's belief that LNG, even though a fossil fuel, is an advisable route to decarbonise the sector.

The Commission (in column 7 of the below table which states the EF of 0.00005 for traditional fossil fuels) puts a figure of zero EF for LNG engines. Not because they don't give rise to methane slip. But rather the Commission has used a different methodology to calculate fugitive LNG methane slip – column 9 – where methane slip is ***calculated as according to a % of the mass of the fuel used by the engine****. In the real world this % is NOT a fixed % - neither for all engines nor for all engine loads/conditions etc. It's an overall intelligent best estimate according to the four types of LNG ship engines listed.

*Annex II says "Fugitive emissions are emissions caused by the amount of fuel that does not reach the combustion chamber of the combustion unit or that is not consumed by the energy converter because they are uncombusted, vented, or leaked from the system. For the purpose of this Regulation, fugitive emissions are taken into account as a percentage of the mass of the fuel used by the engine. The default values are contained in Annex II".

In addition to providing clarity on how to include CH4e in the shipping GHG Intensity standard, the assumptions described above to find a practical and workable solution to account for varying % of methane slip in different LNG engines under differing operational circumstances is in no way different to the approach that will be needed to include BC in EU Regulations.

The EFs – emission factors - that were used in the 2020 IMO 4th GHG study to account for ship BC emissions on a CO2e basis are best averages based on varying engine loads/conditions for each of the main engine types and then aggregated up. The EFs for BC proposed in column 10 of the table below suggest amendments to Annex II are based on a similar averaging approach set out in the comprehensive August 2021 ICCT update on WtW shipping CO2e - some of whose principal authors were also direct contributors to the IMO GHG 4 work. https://theicct.org/sites/default/files/publications/update-well-to-wake-co2-aug21.pdf

When including BC the same approach to calculate BC CO2e from reported fuel burn should be used.
Annex II makes clear that "in the case of fossil fuels, the default values in Annex II shall be used".

Method for determining TtW GHG factors;

"The TtW emissions are determined on the basis of the methodology contained in this Annex as provided in Equation (1) and Equation (2) For the purpose of this Regulation, the TtW GHG emission factors ($CO2eq,W,j$) that shall be used to determine the GHG emissions are contained in Annex II".

And importantly, "In accordance with its compliance plan …and upon assessment by the verifier, other methods, such as direct CO2eq measurement, laboratory testing, may be used if it enhances the overall accuracy of the calculation."

03 March 2022

CAA Proposed BC EFs in ANNEX II

Note. We do not understand the basis of the regulatory justification set out in Column 6 for VLSFO as both cited Regulations came into existence before VLSFO was invented. In addition there are no cited Regulations for LSFO or ULSFO.

ANNEX II

The emissions factors for fossils fuels contained in this Annex shall be used for the determination of the greenhouse gas intensity index referred to in Annex I of this Regulation.

The emissions factors of biofuels, biogas, renewable fuels of non-biological origin and recycled carbon fuels shall be determined according to the methodologies set out in Annex 5 part C of Directive (EU) 2018/2001.

In the table:

– TBM stands for To Be Measured

– N/A stands for Not Available

– The dash means not applicable

Table 1 – Default factors

1	2	3	4	5	6	7	8	9	10
	WtT			TtW					
Class / Feedstock	Pathway name	LCV $\left[\frac{MJ}{g}\right]$	$CO_{2eq\,WtT}$ $\left[\frac{gCO_2eq}{MJ}\right]$	Energy Converter Class	$C_{f\,CO_2}$ $\left[\frac{gCO_2}{gFuel}\right]$	$C_{f\,CH_4}$ $\left[\frac{gCH_4}{gFuel}\right]$	$C_{f\,N_2O}$ $\left[\frac{gN_2O}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used by the engine	CfBC [gBC/gfuel]

Fossil	HFO ISO 8217 Grades RME to RMK	0,0405	13,5	ALL ICEs	3,114 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-	**SSD 0.00019** **MSD 0.00049**
				Gas Turbine					
				Steam Turbines and Boilers					
				Aux Engines					
	LSFO	0,0405	13,2, crude 13,7 blend	ALL ICEs	3,114	0,00005	0,00018	-	**SSD 0.00019** **MSD 0.00049**
				Gas Turbine					
				Steam Turbines and Boilers					
				Aux Engines					
	ULSFO	0,0405	13,2	ALL ICEs	3,114	0,00005	0,00018	-	**SSD 0.00019** **MSD 0.00049**

1	2	3	4	5	6	7	8	9	10
	WtT			TtW					
	VLSFO	0,041	13,2	ALL ICEs	3,206 MEPC245 (66) MRV Regulation	0,00005	0,00018	-	**SSD 0.00019** **MSD 0.00049**
	LFO ISO 8217 Grades RMA to RMD	0,041	13,2	ALL ICEs	3,151 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-	**SSD 0.000019** **MSD 0.00049**
	MDO MGO ISO 8217 Grades DMX to DMB	0,0427	14,4	ALL ICEs	3,206 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-	**SSD 0.00004** **MSD 0.00026**
	LNG	0,0491	18,5	LNG Otto (dual fuel medium speed)	2,755 MEPC245 (66) Regulation (EU) 2015/757	0	0,00011	3,1	**0.00002**
				LNG Otto (dual fuel slow speed)				1,7	**0.00002**
				LNG Diesel (dual fuel slow speed)				0.2	**0.00001**
				LBSI				N/A	**0.00002**
				ICE	0	0	TBM		

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