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COMPET
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WORKING DOCUMENT

From:	General Secretariat of the Council
To:	Working Party on Shipping
N° prev. doc.:	12813/1/21 REV1
Subject:	Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC - Comments from Member States - Denmark

Delegations will find, attached, comments from **DENMARK** on the above subject

Council of the European Union

Brussels, 23 November 2021
(OR. en)

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TRANS 597
MAR 191
ENV 746
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ECO 108
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NOTE

From:	General Secretariat of the Council
To:	Delegations
Subject:	Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC – Presidency compromise

In the light of the Informal Videoconference of the members of the Working Party on Shipping held on 17 November 2021 and following oral or written comments expressed by the delegations, delegations will find in the Annex a revised Presidency compromise proposal[1] that, at this stage, exclusively introduces editorial and technical changes in the operative part of the text.[2]

Changes compared to document ST 12813/21 are indicated in grey-shaded **bold underlined** and deletions in grey-shaded ~~strikethrough~~.

[1] Please note that any drafting suggestion remains provisional at this stage, pending due legal review and adjustments.
[2] Please note that unchanged parts of the text are **not** necessarily acceptable or accepted as they currently stand but it is the view of the Presidency that they should not be addressed at this stage.

General comments by the Danish Government regarding annex 1 & II of FuelEU maritime and the non-paper issued by the precidency.

The Danish government welcomes and thanks the precidency's efforts on this very technical part of the new regulation. The Danish government takes a general scrunitiny reservation on the annexes and non-paper, as further questions still needs to be addressed before we can form a final opinion on this.

We have included a number of comments in the margin , as some of these are very text specific and therefore easier to understand in they are posted directly in the text. We do also have a few overall introductory comments for the presidency.

Like other MS, we are not convinced that the default value for electricity should be kept at zero, and reserve the right to revert with more comments on this specific part of the annexes at a later stage.

Secondly , we also share the concern raised by other MS regarding the bunker delivery notes, especially with regards to the ships bunkering outside of the EU, and fear we are creating an unfortunate problem for the ships/shipowner here as bunker hubs, especially outside the EU, could claim that their bunker delivery is a MARPOL required document and the note should therefore only include the MARPOL required information, and not those needed for FuelEU.

Thirdly, we know that RFNBOs will be very important in the future, as they have a real reduction potential. Therefore we do not oppose that the methodology for assessing greenhouse gas emission reductions from RFNBOs are carried out in a delegated act, but kindly encourage the Commission to commence this work, as we need to send clear signals to the industry about what technologies they should invest in for the future.

Finally, we want to thank the presidency for providing an overview of the basis for the various emission factors as listed in annex II and color coded in the non-paper. However, we want to stress to the Presidency and Commission, that values discussed at ESSF meetings, have neither been verifies nor approved yet, and therefore for the moment not a valid source. Moreover, it is very hard to really asses the validity overall of the emissions factors, when the references and are not better defined in the annex.

ANNEX

ANNEX I

METHODOLOGY FOR ESTABLISHING THE GREENHOUSE GAS INTENSITY LIMIT ON THE ENERGY USED ON-BOARD BY A SHIP

For the purpose of calculating the greenhouse gas intensity limit of the energy used on-board a ship, the following formula, referred to as Equation (1) shall apply:

GHG intensity index	WtT	TtW
$GHG\ intensity\ index\ \left[\frac{gCO2eq}{MJ}\right] =$	$\frac{\sum_i^{n\ fuel} M_i \times CO_{2eq\ WtT,i} \times LCV_i + \sum_k^c E_k \times CO_{2eq\ electricity,k}}{\sum_i^{n\ fuel} M_i \times LCV_i + \sum_k^c E_k}$	$+\frac{\sum_i^{n\ fuel}\sum_j^{m\ engine} M_{i,j} \times \left[\left(1 - \frac{1}{100} C_{\sout{engine}\ slip\ j}\right) \times \left(CO_{2eq,TtW,j}\right) + \left(\frac{1}{100} C_{\sout{engine}\ slip\ j} \times CO_{2eq\ TtW,\sout{slippage},j}\right)\right]}{\sum_i^{n\ fuel} M_i \times LCV_i + \sum_k^t E_k}$

Equation (1)

where the following formula is referred to as Equation (2):

$$CO_{2eq,TtW,j} = \left(C_{f\ CO_2,j} \times GWP_{CO_2} + C_{f\ CH_4,j} \times GWP_{CH_4} + C_{f\ N_2O,j} \times GWP_{N_2O}\right)_i$$ Equation (2)

Term	Explanation
i	Index corresponding to the fuels delivered to the ship in the reference period
j	Index corresponding to the fuel **consumer** ~~combustion~~ units on board the ship. For the purpose of this Regulation the **consumer** units considered are the main engine(s), auxiliary engine(s) ~~and fired oil~~ boilers**, fuels cells, waste incinerators**
k	Index corresponding to the **electrical charging** ~~connection~~ points (c) where electricity is supplied per connection point.
c	Index corresponding to the number of electrical charging points
m	Index corresponding to the number of ~~energy~~ **fuel** consumers
$M_{i,j}$	Mass of the specific fuel i oxidised in consumer j [gFuel]
E_k	Electricity delivered to the ship *per* **electrical charging** ~~connection~~ point k ~~if more than one~~ [MJ]
$CO_{2eq\ WtT,i}$	WtT GHG emission factor of fuel i [gCO_{2eq}/MJ]
$CO_{2eq\ electricity,k}$	WtT GHG emission factor associated to the electricity delivered to the ship at berth *per* **electrical charging** ~~connection~~ point k [gCO_{2eq}/MJ]
LCV_i	Lower Calorific Value of fuel i [MJ/gFuel]
$C_{\sout{engine}\ slip\ j}$	**E**~~ngine~~ **F**~~f~~uel slip~~page~~ (non-combusted fuel) coefficient as a percentage of the mass of the fuel i used by combustion unit j [%]. **C_{slip} includes fugitive emissions (emissions before the "engine") and slipped emissions (unburnt fuel, measured after the "engine").**
$C_{f\ CO_2,j}, C_{f\ CH_4,j}, C_{f\ N_2O,j}$	TtW GHG emission factors by combusted fuel in combustion unit j [gGHG/gFuel]
$CO_{2eq,TtW,j}$	TtW CO_2 equivalent emissions of combusted fuel i in **fuel consumer** ~~combustion unit~~ j [gCO_{2eq}/gFuel] $CO_{2eq,TtW,j} = \left(C_{cf\ CO_2,j} \times GWP_{CO_2} + C_{cf\ CH_4,j} \times GWP_{CH_4} + C_{cf\ N_2O,j} \times GWP_{N_2O}\right)_i$
$C_{sf\ CO_2,j}, C_{sf\ CH_4,j}, C_{sf\ N_2O,j}$	TtW GHG emissions factors by slipped fuel towards combustion unit j [gGHG/gFuel]

$CO_{2eq,TtWslip\sout{page},j}$	TtW CO_2 equivalent emissions of slipped fuel *i* towards combustion unit *j* [$gCO_2eq/gFuel$] $CO_{2eq,TtW\ slip\sout{page},j} = \left(C_{sf\ CO_2,j} \times GWP_{CO_2} + C_{sf\ CH_4,j} \times GWP_{CH_4} + C_{sf\ N_2O,j} \times GWP_{N_2O}\right)_i$ **where: $C_{sf\ CO2,j}$ and $C_{sf\ N2O,j}$ are set to zero.**
$GWP_{CO_2}, GWP_{CH_4}, GWP_{N_2O}$	CO_2, CH_4, N_2O Global Warming Potential over 100 years**, which are: $GWP_{CO_2} = 1$; $GWP_{CH_4} = 29.8$, $GWP_{N_2O} = 273$**

In the case of fossil fuels, the default values in Annex II shall be used.
For the purpose of this regulation the term $\sum_k^c E_k \times CO_{2eq\ electricity,k}$ in the numerator of Equation (1) shall be set to zero.

Method for determining [M_i]

The [M_i] mass of fuel shall be determined using the amount reported in accordance with the framework of the reporting under Regulation (EU) 2015/757 for voyages falling within the scope of this Regulation based on the chosen monitoring methodology by the company.

Method for determining WtT GHG factors

~~For non-fossil fuels, wherever values different from the default values in Annex II are used, these shall be based on relevant Bunker Delivery Notes (BDNs), for the fuels delivered to the ship in the reference period, for at least equal quantities of fuels as the one determined as being consumed in scope of the regulated journey in accordance with point A~~.

The WtT GHG ($CO_{2eq\ WtT,i}$) of the fuels (which are not fossils fuels) are established in Directive (EU) 2018/2001. The actual values, contained in the Directive that shall be used for the purpose of this Regulation, in accordance with the methodology, are those without combustion[1]. For those fuels for which pathways are not included in the Directive and for fossil fuels, the WtT GHG emission factors ($CO_{2eq\ WtT,i}$) default values are contained in Annex II.

For non-fossil fuels, wherever values different from the default values in Annex II are used, these shall be based on relevant Bunker Delivery Notes (BDNs), and need to be certified by an accredited certifier (under the relevant provisions made in Directive (EU 2018/2001) for the fuels delivered to the ship in the reference period, for at least equal quantities of fuels as the one determined as being consumed in scope of the regulated journey.

Fuel Bunker Delivery Note (BDN)

For the purposes of this regulation, relevant BDNs of fuels used on board shall contain at least the following information:

– product identification

– fuel mass [t]

[1] Reference is made to Directive (EU) 2018/2001, Annex V.C.1.(a) to the term e_u 'emissions from the fuel in use'

– fuel volume [m^3]

– fuel density [kg/m^3]

– WtT GHG emission factor for CO_2 (carbon factor) [$gCO_2/gFuel$] and for CO_{2eq} [$gCO_{2eq}/gFuel$] and related certificate[2]

– Lower Calorific Value [MJ/g] **of the fuel batch, including blends.**

BDN Electricity

For the purposes of this regulation, relevant BDNs for electricity delivered to the ship shall contain at least the following information:

– supplier: name, address, telephone, email, representative

– receiving ship: IMO number (MMSI), ship name, ship type, flag, ship representative

– port: name, location (LOCODE), terminal/ berth

– ~~connection~~ **electrical charging** point: OPS-SSE connection point, connection point details

– ~~connection~~ **electrical charging** time: date/time of commencement/finalisation

– energy supplied: power fraction allocated to supply point (if applicable) [kW], electricity consumption (kWh) for the billing period, peak power information (if available)

– metering

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 ($CO_{2eq,TtW,j}$) that shall be used to determine the GHG emissions are contained in Annex II. The CO_2 **c**~~C~~$_f$ factors shall be the ones established in Regulation (EU) 2015/757 and are reported in ~~the~~ Table ~~1~~ **1 of Annex II** for easy reference. For fuels whose factors are not included in the said regulation, default factors as contained in Annex II shall be used.

In accordance with its ~~compliance~~ **monitoring** plan referred to in Article ~~6~~ **7**and upon assessment by the verifier, other methods, such as direct CO_{2eq} measurement, laboratory testing, may be used if it enhances the overall accuracy of the calculation.

[2] This value is not required in case of fossil fuels referred to in Annex II. For all other fuels, including blends of fossil fuels, this value should be made available together with a separate certificate identifying the fuel production pathway.

Method for determining TtW fugitive emissions

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.

1. Methods for determining the reward factors linked to substitute sources of energy

In case substitute sources of energy are installed on board, a reward factor for substitute sources of energy can be applied. In case of wind power such reward factor is determined as follow:

Reward factor for substitute sources of energy- WIND (f_{wind})	$\frac{P_{Wind}}{P_{Tot}}$
0,99	0,1
0,97	0,2
0,95	$\geqslant$ 0,3

Where:

P_{Wind} is the installed power of a wind propulsion system

P_{Tot} is the total installed power on board of the ship

The ship GHG intensity index is then calculated by multiplying the result of Equation (1) by the reward factor.

2. Verification and Certification

Fuel Class	WtT	TtW
Fossil	Default values shall be used as provided in Table 1 of this Regulation	MRV Regulation CO_2 carbon factors shall be used for fuels for which such factor is provided For all other emissions factors, default values can be used as provided in Table 1 of this Regulation, alternatively Certified values by mean of laboratory testing or direct emissions measurements

Sustainable Renewable Fuels (Bio Liquids, Bio Gases, e-Fuels)	CO_{2eq} values as provided in RED II (without combustion) can be used for all fuels whose pathways are included in RED II, alternatively RED II approved certification scheme**, including voluntary schemes,** can be used	Emissions factors, default values can be used as provided in Table 1 of this Regulation, alternatively Certified values by mean of laboratory testing or direct emissions measurements.
Others (including electricity)	CO_{2eq} values as provided in RED II (without combustion) can be used for all fuels whose pathways are included in RED II, alternatively RED II approved certification scheme**, including voluntary schemes,** can be used	Emissions factors, default values can be used as provided in Table 1 of this Regulation, alternatively Certified values by mean of laboratory testing or direct emissions measurements.

ANNEX II

DEFAULT EMISSION FACTORS[1]

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

The **WtT** emissions factors of **liquid and gaseous** 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**, the WtT emissions factors for said Directive ~~the latter~~ are included in this Annex.**

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
	WtT			TtW				
Class / Feedstock	Pathway name	LCV $\left[\frac{MJ}{g}\right]$	$CO_{2eq\ WtT}$ $\left[\frac{gCO2eq}{MJ}\right]$	Energy Converter Class	$C_{f\ co_2}$ $\left[\frac{gCO2}{gFuel}\right]$	$C_{f\ CH_4}$ $\left[\frac{gCH_4}{gFuel}\right]$	$C_{f\ N_2O}$ $\left[\frac{gN_2O}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used by the engine
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	-
				Gas Turbine				
				Steam Turbines and Boilers				
				Aux Engines				
	LSFO	0,0405	13,2, crude 13,7 blend	ALL ICEs	3,1**5**1	0,00005	0,00018	-

[1] The Presidency is aware of the questions raised/concerns expressed by the Member States as regards this Annex. Therefore, a more in-depth reflection will be needed in this respect.

1	2	3	4	5	6	7	8	9
	WtT			**TtW**				
				Gas Turbine				
				Steam Turbines and Boilers				
				Aux Engines				
	ULSFO	0,0405	13,2	ALL ICEs	3,114	0,00005	0,00018	-
	VLSFO	0,041	13,2	ALL ICEs	3,206 MEPC245 (66) MRV Regulation	0,00005	0,00018	-
	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	-
	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	-
	LNG	0,0491	18.5[2] ~~20.9~~	LNG Otto (dual fuel medium speed)	2,75~~5~~ MEPC245 (66) Regulation (EU) 2015/757	0	0,00011	3,1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuel slow speed)				0~~,~~,2
				LBSI				~~N/A~~ -
	LPG	0,046	7,8	All ICEs	3,03 But~~h~~ane 3,00 Propane MEPC245 (66)	TBM	TBM	

[2] Please note that this figure was erroneously changed in doc. ST 12813/21 and it is not corrected, in line with Commission proposal. A more in-depht discussion on the values of this annex will be necessary at some point.

1	2	3	4	5	6	7	8	9
	WtT			**TtW**				
					Regulation (EU) 2015/757			
	H2 (natural gas)	0,12	132	Fuel Cells	0	0	-	**N/A**
				ICE	0	0	TBM	
	NH3 (natural gas)	0,0186	121	No engine	0	0	TBM	-
	Methanol (natural gas)	0,0199	31,3	All ICEs	1,375 MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	-
Liquid biofuels	Ethanol E100	0,0268	Ref. to Directive (EU) 2018/2001	All ICEs	1,913 MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	-
	Bio-diesel Main products / wastes / Feedstock mix	0,0372	Ref. to Directive (EU) 2018/2001	ALL ICEs	2,834	0,00005 TBM	0,00018 TBM	-
	HVO Main products / wastes / Feedstock mix	0,044	Ref. to Directive (EU) 2018/2001	ALL ICEs	3,115	0,00005	0,00018	-
	Bio-LNG Main products / wastes / Feedstock mix	0,05	Ref. to Directive (EU) 2018/2001	LNG Otto (dual fuel medium speed)	2,75~~5~~ MEPC245 (66), Regulation (EU) 2015/757	**0** ~~0,00005~~	**0.00011** ~~0,00018~~	3,1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuels)				0.2
				LBSI				N/A
Gas biofuels	Bio-H2 Main products / wastes /	0,12	N/A	Fuel Cells	0	0	0	-
				ICE	0	0	TBM	

1	2	3	4	5	6	7	8	9
	WtT			**TtW**				
	Feedstock mix							
Renewable Fuels of non-Biological Origin (RFNBO) **-** **(e- fuels)**	e-diesel	0,0427	Ref. to Directive (EU) 2018/2001)	ALL ICEs	3,206 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	e-methanol	0,0199	Ref. to Directive (EU) 2018/2001	All ICEs	1,375 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	e-LNG	0,0491	Ref. to Directive (EU) 2018/2001	LNG Otto (dual fuel medium speed)	2,755 MEPC245 (66) Regulation (EU) 2015/757	0	0,00011	3.1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuels)				0.2
				LBSI				N/A
	e-H2	0,12	3,6	Fuel Cells	0	0	0	-
				ICE	0	0	TBM	
	e-NH3	0,0186	0	No engine	0	N/A	TBM	N/A
	e-LPG							
	E-DME							
Others	Electricity	-	106,3 EU **ENERGY** MIX 2020 72 EU **ENERGY** MIX 2030	OPS	-	-	-	-

Column 1 identifies the class of the fuels namely Fossils, Liquid Biofuels, Gaseous Biofuels, e-Fuels;

Column 2 identifies the name or the pathway of the relevant fuels within the class. For the Liquid Biofuels, Gaseous Biofuels, RFNBO (e-Fuels) the values for the WtT section shall be taken from

Directive (EU) 2018/2001 (without combustion[3]); for fossils fuels only the default values in the table shall be used.

Column 3 contains the Lower Calorific Value of the fuels expressed in [MJ/g].

Column 4 contains the CO_{2eq} emissions values in [gCO_{2eq}/MJ]. For fossils fuels only the default values in the table shall be used. For all other fuels, (except were expressly indicated), values shall be calculated by using the methodology or the default values as per in Directive (EU) 2018/2001 deducted of the combustion emissions considering full oxidation of the fuel[4].

Column 5 identifies the main types/classes of energy converters such as 2 and 4 strokes Internal Combustion Engines (ICE) Diesel or Otto cycle, gas turbines, fuels cells etc.

Column 6 contains the emission factor C_f for CO_2 in [gCO_2/gfuel]. Emissions factors values as specified in the Regulation (EU) 2015/757 (or IMO MEPC245 (66) as amended) shall be used. For all those fuels not contained in Regulation (EU) 2015/757, the default values contained in the table should be used. Values certified ~~by a~~ by a**n accredited** ~~trusted~~ certifier (under the relevant provisions made in Directive (EU) 2018/2001) can be used in place of the default values.

Column 7 contains the emission factor C_f for methane in [gCH_4/gfuel]. Default values as contained in the table shall be used. Values certified by **an accredited certifier** ~~mean of testing~~ can be used in place of the default values. For LNG fuels C_f for methane are set to zero.

Column 8 contains the emission factor C_f for nitrous oxide in [gN_2O/gfuel]. Default values as contained in the table shall be used. Values certified by **an accredited certifier** ~~mean of testing~~ can be used in place of the default values.

Column 9 identifies the part of fuel lost as fugitive **and slip** emissions (C_{slip}) measure**d** as % of mass of fuel used by the specific energy converter. Default values as contained in the table shall be used. Values certified by **an accredited certifier** ~~mean of testing~~ can be used in place of the default values. For fuels such as LNG for which the fugitive emissions (slip) exists, the amount of fugitive emissions as presented in Table 1 is expressed in % of the mass of fuel used (Column 9). The values contained in Column 9 shall be used, in accordance with equation (1). The values of C_{slip} in Table (1) are calculated at 50% of the **full** engine load.

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3 Reference is made to Directive (EU) 2018/2001, Annex V.C.1.(a) to the term e_u 'emissions from the fuel in use'**. The methodology proposed in this Regulation accounts for the combustion of the fuels in the TtW part. For bio-derived fuels, the combustion emissions shall be subtracted by the WtT value. The e_u term is therefore zero for fossil fuels, while the value of the stoichiometric combustion for the bio-derived fuels should be subtracted in the WtT.**

4 Reference is made to Directive (EU) 2018/2001, Annex V.C.1.(a) to the term e_u 'emissions from the fuel in use'

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Courtesy translation

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Presidency non-paper - Annexes I and II of the FuelEU Maritime

This non-paper aims to inform the discussion on Annexes I and II of the FuelEU Maritime proposal and to formulate Presidency drafting proposals to amend these annexes.

Part 1 explains the calculation method underlying Annex I.

Part 2 presents proposed amendments to Annex II to clarify the implementation of the carbon intensity calculation for biofuels covered by the RED.

Part 3 illustrates the sources used by the Commission for the default factors in Annex II, using a colour code.

PART 1: DESCRIPTION OF METHODOLOGY FOR ESTABLISHING THE GREENHOUSE GAS EMISSION INTENSITY

A. Background

FuelEU Maritime

Annexes I and II of the FuelEU Maritime proposal define respectively the methodology for establishing the greenhouse gas (GHG) emission intensity of energy used on-board by a ship, and the default emission factors to be used for its numerical application.

The methodology provides for a clear separation of emissions on the well-to-tank ("WtT") and tank-to-wake ("TtW") sides, as defined in Equation (1) of Annex I:

GHG intensity index	WtT	TtW
GHG intensity	$\frac{\sum_i^{n\ fuel} M_i \times CO_{2eq\ WtT,i} \times LCV_i + \sum_k^c E_k \times CO_{2eq\ electricity,k}}{\sum_i^{n\ fuel} M_i \times LCV_i + \sum_k^c E_k}$	$+\frac{\sum_i^{n\ fuel}\sum_j^{m\ engine} M_{i,j} \times [\left(1 - \frac{1}{100} C_{engine\ slip\ j}\right) \times (CO_{2eq,TtW,j}) + (\frac{1}{100} C_{engine\ slip\ j} \times CO_{2eq\ TtW,slippage,j}}{\sum_i^{n\ fuel} M_i \times LCV_i + \sum_k^l E_k}$

$index\ \left[\frac{gCO2eq}{MJ}\right] =$		

With regard to the "WtT" part in particular, the methodology is based mainly, excluding shore-side electricity, on the GHG emission factor WtT, written $co_{2eq\,WtT}$ expressed in $\frac{gCO2eq}{MJ}$

This factor $co_{2eq\,WtT}$ is, **for fossil fuels**, given as a default numerical value in Column 4 of Table 1 in Annex II. These numerical values are, for each of these fossil fuels, the sum of the GHG emission intensities associated with the different stages of extraction, transport, refining and distribution of the fuel.

For **biofuels and synthetic fuels from renewable energy (RFNBO)**, Column 4 of Table 1 in Annex II simply refers generically to the Renewable Energy Directive (EU) 2018/2001 (RED). The explanation on Column 4 at the bottom of the table and footnote 3 provide some further explanation of the method of calculating the $co_{2eq\,WtT}$ factor, but it seems that further clarification of this method is necessary for clarity, both for understanding and legal certainty of the Annex.

RED

Biofuels

Annex V Part C of the RED provides that greenhouse gas emissions from the production and use of **biofuels** are equal to E, which shall be calculated as follows:

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr}$$

Where:

E	total emissions from the use of the fuel;
e_{ec}	emissions from the extraction or cultivation of raw materials
e_l	annualised emissions from carbon stock changes caused by land-use change (over 20 years)
e_p	emissions from processing
e_{td}	emissions from transport and distribution
e_u	emissions from the fuel in use
e_{sca}	emission savings from soil carbon accumulation via improved agricultural management
e_{ccs}	emission savings from CO_2 capture and geological storage
e_{ccr}	emission savings from CO_2 capture and replacement

One can note, regarding this formula, that the e_{ec} value in RED corresponds to the emissions resulting from the extraction or cultivation of raw materials. Annex V Part C paragraph 5 states that capture of CO2 in the cultivation of raw materials is not taken into account.

The e_u value in RED corresponds to possible emissions from the fuel in use. It is stated in Annex V Part C paragraph 13 that emissions from fuel in use e_u shall be taken to be zero for biofuels and bioliquids. *This is because since CO2 capture is not accounted for upstream, the CO2 emissions from the combustion of these feedstocks should not be accounted for.*

RFNBO

Article 28.5 of the RED provides for the specification, by 31 December 2021 at the latest, of the methodology for assessing greenhouse gas emission reductions from RFNBOs by means of a delegated act. This delegated act has not yet been proposed by the Commission, but may be proposed soon. The directive revising the RED in the Fit for 55 package incorporates the principle of this delegated act in Article 29a(3).

In addition, it can be noted that the Joint Research Centre (JRC) published in 2020 in the framework of the JEC Consortium its fifth report on WtT values, which already gives default values for some of the future production pathways[9].

B. Issues

The Presidency identified the following issues associated with the presentation of the annexes and the calculation of the $co_{2eq\,WtT}$ factor for **biofuels**:

- There is no clear reference, either to a numerical value or to a formula in RED, for the calculation of this factor.
- CO2 capture during feedstock cultivation should be included in the WtT part, as long as the emissions from the fuel in use are accounted for, which is the case in FuelEU Maritime, in the TtW part. This capture is not explicitely reflected in RED due to its integrated WtW approach.

The Presidency has identified, with regard to the calculation of the $co_{2eq\,WtT}$ factor for **RFNBOs**, the absence of a numerical value and formula in RED pending the associated delegated act. However, the Presidency proposes to rely on this delegated act when it becomes available, in order to ensure the best compatibility with RED.

[9] https://publications.jrc.ec.europa.eu/repository/handle/JRC119036

C. Proposal

In view of these issues, the Presidency proposes that Column 4 of Table 1 in Annex II should read as follows:

- For **biofuels**:

$$CO_{2eq\,WtT} = E - \frac{C_{f\,co_2}}{LCV}$$

Where E is defined in Annex V Part C of the RED, representing the greenhouse gas emissions resulting from the production and use of the biofuel.

Where $C_{f\,co_2}$ and LCV are defined in Columns 6 and 2 respectively of Table 1 of Annex II, the ratio between the two representing the CO2 emissions emitted in gCO2/MJ during perfect combustion of the biofuel, and thus reflecting the CO2 captured during cultivation.

- For **RFNBOs**, refer to a footnote stating :

To be defined in delegated act taken on basis of Article 28.5 of Directive (EU) 2018/2001 (or on basis of the corresponding provisions in the amended Directive, according to the progress of the co-legislators).

D. Example: "Rapeseed biodiesel"

The corresponding extract from Annex II is:

1	2	3	4	5	6	7	8	9
	WtT			TtW				
Class / Feedstock	Pathway name	LCV $\left[\frac{MJ}{g}\right]$	$CO_{2eq\,WtT}$ $\left[\frac{gCO2eq}{MJ}\right]$	Energy Converter Class	$C_{f\,co_2}$ $\left[\frac{gCO2}{gFuel}\right]$	$C_{f\,CH_4}$ $\left[\frac{gCH_4}{gFuel}\right]$	$C_{f\,N_2O}$ $\left[\frac{gN_2O}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used

1	2	3	4	5	6	7	8	9
	WtT			**TtW**				
								by the engine
Liquid biofuels	Bio-diesel Main products / wastes / Feedstock mix	0,0372	~~Ref. to Directive (EU) 2018/2001~~ $\boldsymbol{E - \frac{C_{f\,co_2}}{LCV}}$ **(Ref. to Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**	ALL ICEs	2,834	0,00005 TBM	0,00018 TBM	-

The corresponding extracts from RED are:

- from RED II (2018/2001) for example if we take *rape-seed bio-diesel* we have:

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr} \qquad \text{(RED II Annex V.C)}$$

Where:

E	total emissions from the use of the fuel;
e_{ec}	emissions from the extraction or cultivation of raw materials
e_l	annualised emissions from carbon stock changes caused by land-use change (over 20 years)
e_p	emissions from processing
e_{td}	emissions from transport and distribution
e_u	emissions from the fuel in use
e_{sca}	emission savings from soil carbon accumulation via improved agricultural management
e_{ccs}	emission savings from CO_2 capture and geological storage
e_{ccr}	emission savings from CO_2 capture and replacement

Total for cultivation, processing, transport and distribution

Biofuel and bioliquid production pathway	Greenhouse gas emissions – typical value (g CO_2eq/MJ)	Greenhouse gas emissions – default value (g CO_2eq/MJ)
rape seed biodiesel	45,5	50,1

With e_{ec} = 32 ; e_p = 16,3 ; e_{td} = 1,8 ; other values are null ; giving $\boldsymbol{E}$ = 50,1

In application of Annex I, we have, **on WtT part**:

$$GHG\ intensity\ index\ (WtT) = \frac{\sum_i^{n\ fuel} M_i \times CO_{2eq\ WtT,i} \times LCV_i + \sum_k^c E_k \times CO_{2eq\ electricity,k}}{\sum_i^{n\ fuel} M_i \times LCV_i + \sum_k^c E_k}$$

That is, for a single fuel:

$$GHG\ intensity\ index\ (WtT) = CO_{2eq\ WtT}$$

Where :

$$CO_{2eq\ WtT}(\frac{gCO2}{MJ}) = E - \frac{C_{f\ CO_2}}{LCV} = 50{,}1 - 2{,}834/0{,}0372 = -\ 26{,}1\ \frac{gCO2}{MJ}$$

In application of Annex I, we have, **on TtW part**:

$$GHG\ intensity\ index\ (TtW) = \frac{\sum_i^{n\ fuel}\sum_j^{m\ engine} M_{i,j} \times [\left(1 - \frac{1}{100} C_{engine\ slip\ j}\right) \times \left(CO_{2eq,TtW,j}\right) + (\frac{1}{100} C_{engine\ slip\ j} \times CO_{2eq\ TtW,slippage,j})]}{\sum_i^{n\ fuel} M_i \times LCV_i + \sum_k^l E_k}$$

That is, for only rapeseed biodiesel, for which $C_{engine\ slip}$ factor is null:

$$GHG\ intensity\ index\ (TtW) = \frac{CO_{2eq,TtW}}{LCV} = \frac{C_{f\ CO_2,j} \times GWP_{CO_2} + C_{f\ CH_4,j} \times GWP_{CH_4} + C_{f\ N_2O,j} \times GWP_{N_2O}}{LCV}$$

$$= \frac{2{,}834 * 1 + 0{,}00005 * 28 + 0{,}00018 * 265}{0{,}0372} = 77{,}5\ \frac{gCO2}{MJ}$$

We can conclude, **on the life cycle**, that:

$$\boxed{GHG\ intensity\ index = -26{,}1 + 77{,}5 = 51{,}4\ \frac{gCO2}{MJ}}$$

PART 2: PROPOSITIONS OF AMENDMENTS OF ANNEX II

New amendments to document ST 12813/21 REV 1 (last Slovenian Presidency compromise) highlighted in yellow

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 **WtT** emissions factors of **liquid and gaseous** 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**, the WtT emissions factors for the latter are included in this Annex**

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
	WtT				TtW			
Class / Feedstock	Pathway name	LCV $\left[\frac{MJ}{g}\right]$	$CO_{2eq\,WtT}$ $\left[\frac{gCO2eq}{MJ}\right]$	Energy Converter Class	$C_{f\,co_2}$ $\left[\frac{gCO2}{gFuel}\right]$	$C_{f\,CH_4}$ $\left[\frac{gCH_4}{gFuel}\right]$	$C_{f\,N_2O}$ $\left[\frac{gN_2O}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used by the engine
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	-
				Gas Turbine				
				Steam Turbines and Boilers				
				Aux Engines				
	LSFO	0,0405	13,2, crude 13,7 blend	ALL ICEs	3,1**5**1	0,00005	0,00018	-
				Gas Turbine				
				Steam Turbines				

1	2	3	4	5	6	7	8	9
	WtT				TtW			
				and Boilers				
				Aux Engines				
	ULSFO	0,0405	13,2	ALL ICEs	3,114	0,00005	0,00018	-
	VLSFO	0,041	13,2	ALL ICEs	3,206 MEPC245 (66) MRV Regulation	0,00005	0,00018	-
	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	-
	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	-
	LNG	0,0491	18.5[10] ~~20.9~~	LNG Otto (dual fuel medium speed)	2,75~~5~~ MEPC245 (66) Regulation (EU) 2015/757	0	0,00011	3,1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuel slow speed)				0~~.~~,2
				LBSI				~~N/A~~ -
	LPG	0,046	7,8	All ICEs	3,03 Buth~~a~~ne	TBM	TBM	-

[10] Please note that this figure was erroneously changed in doc. ST 12813/21 and it is not corrected, in line with Commission proposal. A more in-depht discussion on the values of this annex will be necessary at some point.

1	2	3	4	5	6	7	8	9
	WtT				TtW			
					3,00 Propane MEPC245 (66) Regulation (EU) 2015/757			
	H2 (natural gas)	0,12	132	Fuel Cells	0	0	-	N/A -
				ICE	0	0	TBM	
	NH3 (natural gas)	0,0186	121	No engine	0	0	TBM	-
	Methanol (natural gas)	0,0199	31,3	All ICEs	1,375 MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	-
Liquid biofuels	Ethanol E100	0,0268	$E - \frac{C_f\, co_2}{LCV}$ **(Ref. to Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**	All ICEs	1,913 MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	-
	Bio-diesel Main products / wastes / Feedstock mix	0,0372	$E - \frac{C_f\, co_2}{LCV}$ **(Ref. to Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**	ALL ICEs	2,834	0,00005 TBM	0,00018 TBM	-
	HVO Main products / wastes /	0,044	$E - \frac{C_f\, co_2}{LCV}$	ALL ICEs	3,115	0,00005	0,00018	-

1	2	3	4	5	6	7	8	9
	WtT				**TtW**			
	Feedstock mix		**(Ref. to Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**					
	Bio-LNG Main products / wastes / Feedstock mix	0,05	$E - \frac{C_{f\,co_2}}{LCV}$ **(Ref. to Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**	LNG Otto (dual fuel medium speed)	2,75~~5~~ MEPC245 (66), Regulation (EU) 2015/757	**0** ~~0,00005~~	**0,00011** ~~0,00018~~	3,1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuels)				0.2
				LBSI				N/A
Gas biofuels	Bio-H2 Main products / wastes / Feedstock mix	0,12	N/A	Fuel Cells	0	0	0	-
				ICE	0	0	TBM	
Renewable Fuels of non-Biological Origin (RFNBO) **-** **(e- fuels)**	e-diesel	0,0427	**[TBM]**	ALL ICEs	3,206 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	e-methanol	0,0199	**[TBM]**	All ICEs	1,375 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	e-LNG	0,0491	**[TBM]**	LNG Otto (dual fuel medium speed)	2,75~~5~~ MEPC245 (66) Regulation (EU) 2015/757	0	0,00011	3.1
				LNG Otto (dual fuel slow speed)				1,7

1	2	3	4	5	6	7	8	9
	WtT				TtW			
				LNG Diesel (dual fuels)				0.2
				LBSI				N/A
	e-H2	0,12	[3,6]	Fuel Cells	0	0	0	-
				ICE	0	0	TBM	
	e-NH3	0,0186	**[TBM]** ~~0~~	No engine	0	N/A	TBM	N/A
	e-LPG							-
	E-DME							-
Others	Electricity	-	106,3 EU **ENERGY** MIX 2020 72 EU **ENERGY** MIX 2030	OPS	-	-	-	-

Column 1 identifies the class of the fuels namely Fossils, Liquid Biofuels, Gaseous Biofuels, e-Fuels;

Column 2 identifies the name or the pathway of the relevant fuels within the class. ~~For the Liquid Biofuels, Gaseous Biofuels, RFNBO (e-Fuels) the values for the WtT section shall be taken from Directive (EU) 2018/2001 (without combustion[11]); for fossils fuels only the default values in the table shall be used.~~

Column 3 contains the Lower Calorific Value of the fuels expressed in [MJ/g].

Column 4 contains the **WtT** CO_{2eq} emissions values in [gCO_{2eq}/MJ]. For fossils fuels only the default values in the table shall be used. **For biofuels, the values for *E* indicated by Directive**

11 ~~Reference is made to Directive (EU) 2018/2001, Annex V.C.1.(a) to the term e_u 'emissions from the fuel in use'. The methodology proposed in this Regulation accounts for the combustion of the fuels in the TtW part. For bio-derived fuels, the combustion emissions shall be subtracted by the WtT value. The e_u term is therefore zero for fossil fuels, while the value of the stoichiometric combustion for the bio-derived fuels should be subtracted in the WtT.~~

(EU) 2018/2001, Annex V.C.1.(a), need to be adjusted by subtracting the ratio, of the values contained in column 6 (c_{f_CO2}) and column 3 (LCV). This is required to avoid double counting of emissions. Indeed, the values for *E* in Directive (EU) 2018/2001, Annex V.C.1.(a) take implicitly into account at the same time, in a unified WtW approach, both CO2 capture during feedstock cultivation (negative emissions) and its release during combustion (positive emissions), which are equal in absolute value. [This convention is notably reflected by the fact that the term eu 'emissions from the fuel in use' is taken equal to zero.] Whereas in this regulation, which separates the WtT and the TtW calculations, CO2 capture should be included in the WtT part, as long as the emissions during combustion are also accounted for in the TtW part.

~~For all other fuels, (except were expressly indicated), values shall be calculated by using the methodology or the default values as per in Directive (EU) 2018/2001 (deducted of the combustion emissions considering full oxidation of the fuel[12].~~

Column 5 identifies the main types/classes of energy converters such as 2 and 4 strokes Internal Combustion Engines (ICE) Diesel or Otto cycle, gas turbines, fuels cells etc.

Column 6 contains the emission factor C_f for CO_2 in [gCO_2/gfuel]. Emissions factors values as specified in the Regulation (EU) 2015/757 (or IMO MEPC245 (66) as amended) shall be used. For all those fuels not contained in Regulation (EU) 2015/757, the default values contained in the table should be used. Values certified ~~by a~~ by a**n accredited** ~~trusted~~ certifier (under the relevant provisions made in Directive (EU) 2018/2001) can be used in place of the default values.

Column 7 contains the emission factor C_f for methane in [gCH_4/gfuel]. Default values as contained in the table shall be used. Values certified by **an accredited certifier** ~~mean of testing~~ can be used in place of the default values. For LNG fuels C_f for methane are set to zero.

Column 8 contains the emission factor C_f for nitrous oxide in [gN_2O/gfuel]. Default values as contained in the table shall be used. Values certified by **an accredited certifier** ~~mean of testing~~ can be used in place of the default values.

Column 9 identifies the part of fuel lost as fugitive **and slip** emissions (C_{slip}) measure**d** as % of mass of fuel used by the specific energy converter. Default values as contained in the table shall be used. Values certified by **an accredited certifier** ~~mean of testing~~ can be used in place of the default values. For fuels such as LNG for which the fugitive emissions (slip) exists, the amount of fugitive emissions as presented in Table 1 is expressed in % of the mass of fuel used (Column 9). The values contained in Column 9 shall be used, in accordance with equation (1). The values of C_{slip} in Table (1) are calculated at 50% of the **full** engine load.

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12 ~~Reference is made to Directive (EU) 2018/2001, Annex V.C.1.(a) to the term e_u 'emissions from the fuel in use'~~

PART 3: ILLUSTRATION BY THE COMMISSION OF THE DIFFERENT SOURCES IN ANNEX II

Colour code:

Directive (EU) 2018/2001 in its up to date version	
IMO GHG studies (1 to 4) and tech. literature for LNG	
Regulation (EU) 2015/757 MRV	
ESSF SAPS	
5th JEC Study 2020 (values are presented along with a corresponding pathway label. The same study provides values also for other production pathways of the same fuel product).	
Miscellanea: technical, literature, self-evident (to be further discussed in ESSF)	

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
	WtT			**TtW**				
Class / Feedstock	**Pathway name**	LCV $\left[\frac{MJ}{g}\right]$	$CO_{2eq\,WtT}$ $\left[\frac{gCO2eq}{MJ}\right]$	**Energy Converter Class**	$C_{f\,co_2}$ $\left[\frac{gCO2}{gFuel}\right]$	$C_{f\,CH_4}$ $\left[\frac{gCH_4}{gFuel}\right]$	$C_{f\,N_2O}$ $\left[\frac{gN_2O}{gFuel}\right]$	C_{slip} As % of the mass of the fuel used by the engine
Fossil	HFO ISO 8217 Grades RME to RMK	0,0405	13,5	ALL ICEs	3,114 MEPC245 (66)	0,00005	0,00018	-
				Gas Turbine				

1	2	3	4	5	6	7	8	9
	WtT			TtW				
				Steam Turbines and Boilers	Regulation (EU) 2015/757			
				Aux Engines				
	LSFO	0,0405	13,2, crude 13,7 blend	ALL ICEs	3,151	0,00005	0,00018	-
				Gas Turbine				
				Steam Turbines and Boilers				
				Aux Engines				
	ULSFO	0,0405	13,2	ALL ICEs	3,114	0,00005	0,00018	-
	VLSFO	0,041	13,2	ALL ICEs	3,206 MEPC245 (66) MRV Regulation	0,00005	0,00018	-
	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	-
	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	-
	LNG	0,0491	18,5	LNG Otto (dual fuel medium speed)	2,755 MEPC245 (66)	0	0,00011	3,1
				LNG Otto (dual fuel slow speed)				1,7

1	2	3	4	5	6	7	8	9
	WtT			TtW				
				LNG Diesel (dual fuel slow speed)	Regulation (EU) 2015/757			0 ~~,~~2
				LBSI				~~N/A~~ -
	LPG	0,046	7,8	All ICEs	3,03 Buthane 3,00 Propane MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	-
	H2 (natural gas)	0,12	132 JEC Study GPLHx	Fuel Cells	0	0	-	~~N/A~~
				ICE	0	0	TBM	
	NH3 (natural gas)	0,0186	121	No engine	0	0	TBM	-
	Methanol (natural gas)	0,0199	31,3	All ICEs	1,375 MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	-
Liquid biofuels	Ethanol ~~E100~~ sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler)	0,0268 Ref. to Directive (EU) 2018/2001 Annex III	**-33.2** **Calculated as** $E - \frac{C_f\, co_2}{LCV}$ **(E from Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**	All ICEs	1,913 MEPC245 (66) Regulation (EU) 2015/757	TBM	TBM	-
	Bio-diesel ~~Main products /~~	0,0372 Ref. to Directive	**-26.1** **Calculated as**	ALL ICEs	2,834 (calculated)	0,00005 TBM	0,00018 TBM	-

1	2	3	4	5	6	7	8	9
	WtT			TtW				
	~~wastes / Feedstock mix~~ rape seed biodiesel	(EU) 2018/2001 Annex III	$E - \frac{C_f co_2}{LCV}$ (**E from Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**					
	HVO ~~Main products / wastes / Feedstock mix~~ hydrotreated vegetable oil from rape seed	0,044 Ref. to Directive (EU) 2018/2001 Annex III	**-20.7** **Calculated as** $E - \frac{C_f co_2}{LCV}$ (**E from Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**	ALL ICEs	3,115 (calculated)	0,00005	0,00018	-
	Bio-LNG ~~Main products / wastes / Feedstock mix~~ Manure – Maize 60 % - 40 % Case 3 Close digestate (12 to 18)	0,05 Ref. to Directive (EU) 2018/2001 Annex III	**-38.9** **Calculated as** $E - \frac{C_f co_2}{LCV}$ (**E from Directive (EU) 2018/2001** minus **(Value Column 6) / (Value Column 3))**	LNG Otto (dual fuel medium speed)	2,755 MEPC245 (66), Regulation (EU) 2015/757	0	0,00011	3,1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuels)				0.2
				LBSI				N/A
Gas biofuels	Bio-H2	0,12	N/A	Fuel Cells	0	0	~~0~~	-

1	2	3	4	5	6	7	8	9
	WtT			**TtW**				
	Main products / wastes / Feedstock mix			ICE	0	0	TBM	
Renewable Fuels of non-Biological Origin (RFNBO) **-** **(e- fuels)**	e-diesel	0,0427	**0.9** (Ref. to JEC Study RESD1) (footnote)	ALL ICEs	3,206 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	e-methanol	0,0199	**1.78** (Ref. to JEC Study REME1a) (footnote)	All ICEs	1,375 MEPC245 (66) Regulation (EU) 2015/757	0,00005	0,00018	-
	e-LNG	0,0491	**6.7** (Ref. to JEC Study RELG1a) (footnote)	LNG Otto (dual fuel medium speed)	2,755 MEPC245 (66) Regulation (EU) 2015/757	0	0,00011	3.1
				LNG Otto (dual fuel slow speed)				1,7
				LNG Diesel (dual fuels)				0.2
				LBSI				N/A
	e-H2	0,12	**4.3** (Ref. to JEC Study EMEL1/LH1) (footnote)	Fuel Cells	0	0	0	-
				ICE	0	0	TBM	
	e-NH3	0,0186	0	No engine	0	N/A	TBM	N/A
	e-LPG	To be done	To be done		To be done	To be done	To be done	-
	E-DME	To be done	To be done		To be done	To be done	To be done	-

1	2	3	4	5	6	7	8	9
	WtT			**TtW**				
Others	Electricity	-	106,3 EU **ENERGY** MIX 2020 72 EU **ENERGY** MIX 2030 JED Study [to be further discussed]	OPS	-	-	-	-