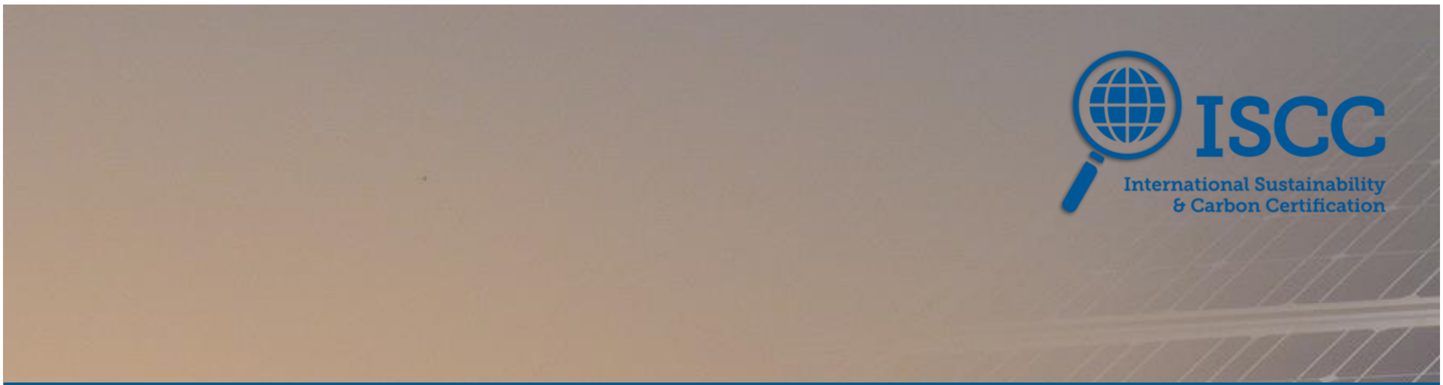

ISCC EU 205-1
Renewable Fuels of Non-Biological Origin (RFNBO) and Recycled Carbon Fuels (RCF)
Greenhouse Gas Emissions

Document Title: ISCC EU 205-1 Renewable Fuels of Non-Biological Origin (RFNBO) and Recycled Carbon Fuels (RCF) Greenhouse Gas Emissions

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Content

1. Introduction

Intention, Applicability, Legal background

For Renewable Fuels of Non-Biological Origin (RFNBO) and Recycled Carbon Fuels (RCF) certified under ISCC EU, the GHG emissions calculation methodology provided by the European Commission within the framework of the Renewable Energy Directive (EU) 2018/2001 (recast)[1] has to be followed. The ISCC EU System Document 205 "Greenhouse Gas Emissions" serves as basic system document for GHG calculations under ISCC EU. The document explains the options for stating GHG emissions along the supply chain and provides the methodology rules and guidelines for calculating and verifying GHG emissions and emission reduction.

However, due to their different nature when compared to biofuels, bioliquids or biomass fuels, RFNBOs and RCFs have to follow a slightly different, but comparable, GHG calculation methodology. Thus, this document outlines GHG calculation requirements for RFNBOs and RCFs, based on the Commission Delegated Regulation (EU) that specifies a methodology for assessing the greenhouse gas emissions savings from RFNBOs and RCFs.

2. Scope and Normative References

This document comprises the specific GHG calculation requirements when determining the emissions for RCFs and RFNBOs. It is valid in addition to the ISCC EU System Documents.

Delegated Regulation on GHG

The requirements are based on the Commission Delegated Regulation (EU) 2023/1185 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels (hereafter Commission Delegated Regulation on GHG RFNBOs). The legal basis for the delegated regulation is laid down in Art. 28(3) of the RED II. Beyond that, additional guidance published by the European Commission in the living document "Q&A for the certification of RFNBOs and RCF"[2] was also considered for the development of this System Document.

The specific requirements to produce RFNBOs and RCFs are laid down in ISCC EU Document 202-6 "Renewable Fuels of Non-Biological Origin and Recycled Carbon Fuels".

RFNBO definition

RFNBOs per definition are liquid or gaseous fuels whose energy content is derived from renewable sources other than biomass[3];

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[1] *In the following referred to as the RED II*
2 Q&A for the certification of RFNBOs and RCF, published on March 14th 2024, in the Voluntary Schemes webpage: https://energy.ec.europa.eu/topics/renewable-energy/bioenergy/voluntary-schemes_en, In the following referred to as Q&A RFNBOs
[3] *Art. 2(36) RED II, amended by the Commission Delegated Regulation 2023/2413*

RCFs per definition are liquid and gaseous fuels that are produced from liquid or solid waste streams of non-renewable origin which are not suitable for material recovery in accordance with Article 4 of Directive 2008/98/EC[4], or from waste processing gas and exhaust gas of non-renewable origin which are produced as an unavoidable and unintentional consequence of the production process in industrial installations.[5]

RCF definition

According to Article 29a (1) and Article 29a (2) of the amended RED II[6], the minimum GHG savings from the use of RFNBOs and RCFs respectively shall be at least 70%.

GHG emissions saving target

3. Calculation of GHG emissions for RFNBOs and RCFs under RED

Greenhouse gas emissions from the production and use of RFNBOs or RCFs shall be calculated as[7]:

GHG calculation formula

$$E = e_i + e_p + e_{td} + e_u - e_{ccs}$$

where:

E total emissions from the use of the fuel,

e_i e_i elastic + e_i rigid – $e_{ex\text{-}use}$: emissions from supply of inputs,

e_i elastic = emissions from elastic inputs,

e_i rigid = emissions from rigid inputs,

$e_{ex\text{-}use}$ = emissions from inputs' existing use or fate,

e_p emissions from processing,

e_{td} emissions from transport and distribution,

e_u emissions from fuel in use,

e_{ccs} emission savings from CO_2 capture and geological storage

The GHG emissions of RFNBOs and RCFs shall be expressed in g CO_2eq/MJ fuel and calculated by dividing each element of the formula by the total energy content of the originated fuel.

Unit of calculation

[4] *Directive 2008/98/EC on waste and repealing certain directives*

[5] *Art. 2(35) RED II.*

[6] *Directive (EU) 2023/2413 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards to the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652 (hereafter referred to as "revised RED II". The revised RED II is also known as RED III).)*

[7] *Annex to the Commission Delegated Regulation (EU) on establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels. In the following referred to as Commission Delegated Regulation on GHG RFNBOs*

For the calculation of GHG emissions from inputs for the production of RFNBOs and RCFs it is not necessary to apply a feedstock factor to convert the emissions into the respective final unit of g CO2eq/ MJ fuel, because all inputs are entering the process already with a respective energy value in MJ. The GHG emissions of the final fuel can directly be determined by dividing the total emissions of each formula element by the total amount of fuel stemming from the process.

Fuel blends

If a fuel is a mix of RFNBO, RCF and other fuels type, all fuel types shall be considered to have the same emissions intensity.

Co-processed fuels

In case of co-processed fuels where RFNBOs and RCFs are replacing a conventional input in a process the above rule is not applicable. In this case, a differentiation in the GHG calculation shall be made, based on the energetic value of the inputs. It shall be performed as:

> The part of the process that is based on the conventional input

> The part of the process that is based RFNBO or RCF, assuming that the process parts are otherwise identical.

A similar approach as the one above, i.e. distinction between processes, shall also be applied when RFNBOs and RCFs are processed together with biomass.

Calculation period

The GHG values may be calculated as an average for the entire production of fuels occurring during a period of at most one calendar month, with shorter periods also being allowed. When electricity qualifying as fully renewable according to the REDII guidelines is used in the process to enhance the heating value of the products and intermediate products, the time interval of the GHG calculation shall be aligned with the requirements for temporal correlation. This means that, until 31st of December 2029, GHG values will need to be calculated on a monthly basis and, after 2030, on an hourly basis.

GHG values which are calculated for individual time intervals can be used to calculate a GHG average for up to one month. Nevertheless, all individual values considered in the average must meet the 70% GHG savings threshold. Individual time interval values with emissions savings of less than 70% are not allowed to be considered for the monthly average.[8]

RFNBO and recycled carbon fuels fractions

If the originated fuel as output of the calculated process does not fully qualify as RFNBO or RCF, the respective shares of RFNBO or RCF in the output needs to be determined. This shall be done as follows:

1) For RFNBOs, the fraction shall be determined by dividing the relevant renewable energy input into the process to produce the RFNBO by the total energy inputs into the process:

[8] *Commission Delegated Regulation on GHG RFNBOs*

$$RFNBO\ \% = \frac{Input_{ren.energy}[MJ]}{Input_{total\ energy}[MJ]}$$

2) For RCFs, the share shall be determined by dividing the relevant energy input qualifying as a source for the production of RCFs by the total energy inputs into the process:

$$RCF\ \% = \frac{Input_{RCF\ sources}[MJ]}{Input_{total\ energy}[MJ]}$$

Energy input value

The relevant energy input value shall be determined in different ways in accordance with the input type. These can be:

1) For material inputs, the relevant energy is the lower heating value (LHV) of the material input that enters the molecular structure of the fuel.[9]
2) For electricity inputs that are used to enhance the heating value of the fuel or intermediate products, the relevant energy is the energy of the electricity.
3) For industrial off-gases, the relevant energy is the off-gas energy, based on the respective LHV.
4) For heat inputs that are used to enhance the heating value of the fuel or intermediate products, the relevant energy is the useful heat energy used to synthesize the fuel. Useful heat is defined as the total heat multiplied by the Carnot efficiency, as defined in Annex V, part C, point (1)(b) from the REDII. Therefore, relevant heat can be calculated as per:

$$Useful\ heat\ energy = C_h \cdot Q_{total}$$

where

Q_{total} total heat energy

C_h Carnot efficiency[10]

Carnot efficiency for useful heat at different temperatures can be calculated as per:

$$C_h = \frac{(T_h - T_0)}{T_h}$$

where

[9] *For material inputs containing water, the lower heating value is taken to be the lower heating value of the dry part of the material input (i.e. not taking into account the energy needed to evaporate the water). RFNBOs used as intermediate products for the production of conventional fuels are not considered.*

[10] *As defined in Annex V, part C, point (1)(b) of REDII.*

T_h temperature, measured in absolute temperature (kelvin) of the useful heat at point of delivery

T_0 temperature of surroundings, set at 273,15°K (0°C)

Other inputs are only considered when determining the emission intensity of the fuel.

In order to determine whether an input, such as electricity or heat, is contributing to the LHV of the produced RFNBO or RCF, the heating value of the inputs that enters the process and qualifies as an RFNBO should be compared to the heating value of the RFNBO the process yields. If the heating value of the RFNBO output that yields from the process exceeds the heating value of the RFNBO input, the heating value is increased and accordingly the electricity and heat is adding to the heating value of the fuel and must be considered as relevant energy.

Both electricity and heat are inputs which are also used to run processes within the RFNBO production facility. Therefore, if it is determined that electricity and heat are inputs which qualify as relevant inputs contributing to the lower heating value, it does not mean all the electricity and heat inputs will be considered as relevant inputs contributing to the lower heating value and, therefore, be relevant for calculating the different fuel shares. It is the responsibility of the system user to distinguish between the different input types and provide sufficient evidence during the audit.

Emission savings

The emission savings from RFNBOs and RCFs shall be calculated according to:

$$Savings = \frac{(E_F - E)}{E_F}$$

where

E total emissions from the use of RFNBO or RCF

E_F total emissions from fossil fuel comparator (94 gCO_2eq/MJ)[11].

3.1. Calculation methodology

3.1.1. Emissions from the supply of inputs (e_i)

Emissions from supply of inputs include emissions from different input types and shall be differentiated as: rigid inputs, elastic inputs and emissions from inputs' existing use or fate.

[11] *RED II*

3.1.1.1. Emissions from rigid inputs (e_i rigid)

Rigid inputs definition and scope

Rigid inputs (e_i rigid) are those whose supply cannot be expanded to meet additional demand. All inputs qualifying as a carbon source for the production of RCFs are rigid, as well as outputs produced in fixed ratio by an incorporated process[12] and which represent less than 10% of the economic value of the output. Outputs having an economic value of 10% or more are considered to be elastic. Biomass residues and other types of waste streams which are eligible as carbon source for RFNBOs and RCFs as per the ISCC EU RFNBOs and RCFs guidelines are considered as rigid inputs. Rigid inputs would therefore also include liquid or solid waste streams of non-renewable origin which are not suitable for material recovery or waste processing gas and exhaust gas of non-renewable origin which are produced as an unavoidable and unintentional consequence of the production process in industrial installations, as in the definition of RCFs.

Emissions from diversion or alternative use of rigid inputs

The calculated emissions from rigid inputs shall include the emissions from the diversion of those inputs from a previous or alternative use. Loss of production of electricity, heat or products that were previously generated using the input, and any additional emissions originating to the additional treatment of the input and transport, shall be included as well. For rigid inputs for which substitution effects are unknown, potential emissions from the alternative use shall be included according to the typical handling of these inputs in the region or country. The following guidance needs to be considered:

1) Emissions from the supply of rigid inputs shall be determined by multiplying the lost production of electricity, heat or other material with the relevant emission factor.

   a. For lost electricity production, emission factors for the grid electricity generation in the country where the displacement occurred should be used, determined according to the possibilities described for electricity in section 3.1.1.23.1.1.2.

$$EM_{lost\ el.\ prod} = lost\ electricity\ production\ \left[\frac{kWh}{year}\right] * EF_{country\ electricity\ mix}\left[\frac{kg\ CO2eq}{kWh}\right]$$

   b. For diverted materials, the emissions to be attributed to the replacement material are calculated as for material inputs in this methodology.

$$EM_{diverted\ mateials} = Diverted\ material\ \left[\frac{kg}{year}\right] * EF_{diverted\ material}\left[\frac{kg\ CO2eq}{kg}\right]$$

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[12] *Incorporated processes include processes that take place in the same industrial complex, or that supply the input via a dedicated supply infrastructure, or that supply more than half of the energy of all inputs to the production of the RFNBO or RCF.*

Production losses

Here, for all production losses under point 1) two different approaches can be applied, depending on the start of the production of the RFNBO or RCF:

For the first 20 years after the production start, the loss of electricity, heat or material as output shall be determined based on the average amount produced from the rigid input in the last three years prior to the RFNBO or RCF production start.

After 20 years of production, the loss of electricity, heat or material shall be determined based on the minimum energy performance standards assumed in best available technology (BAT) conclusions. Where the process is not covered by a BAT, the estimation of lost production shall be based on a comparable process applying state of the art technology.

2) In the case of rigid inputs that are intermediate streams in industrial processes, if the effect of diverting it for fuel production cannot be measured directly. This is applicable, for example, for coke oven gas, blast furnace gas in a steelwork, or refinery gas in an oil refinery. In such cases, the emissions due to the diversion of inputs shall be determined based on simulations of the plant operation before and after it is modified to produce RCFs. If the modification of the plant caused a reduction of output of some products, the emissions attributed to the rigid input shall include the emissions associated with replacing the lost products.

3) In the case of rigid inputs from new installations the impact of diverting the input from the most economical alternative use shall be considered. This is applicable, for example, for a new steelwork that uses its blast furnace gas for making RCFs. The emission implications are calculated according to the minimum energy performance standards assumed in the pertinent BAT conclusions. For industrial processes which are not covered by a BAT, the saved emissions shall be calculated based on the comparable process applying state of the art technology.

3.1.1.2. Emissions from elastic inputs (e_i elastic)

Elastic inputs definition and scope

Elastic inputs (e_i elastic) are those where the supply can be increased to meet extra demand. For example, petroleum products from refineries are in this category since refineries can alter the ratio of their products. Likewise, hydrogen, natural gas, CO_2 and electricity inputs can be considered as elastic.

Emissions from elastic inputs

The emissions from elastic inputs that are obtained in an incorporated process shall be calculated based on data of their actual production. This means emissions arising from the input production over the whole supply chain – including extraction of primary energy required to make the input, processing, and transportation emissions. Combustion emissions related to the carbon content of fuel inputs should not be included.[13]

Emission factor sources

When elastic inputs are not obtained from an incorporated process, the values of Table 1 and Table 2 can be applied[14]. If the input is not included in the list, emission factors can be found in reliable sources and latest versions of the JEC-WTW report, the ECOINVENT database, IPCC, IEA or government, and other reviewed sources such as the E3 and GEMIS database and peer reviewed publications.

Emissions from non-listed inputs

The supplier of each input for which the values are not yet shown in Table 1 and Table 2 shall calculate the emissions of the input[15] in accordance with the guidelines provided in this document, and then report such value to the following production step or final producer. The same rule applies to the suppliers of inputs further back in the supply chain.

Renewable electricity

Electricity qualifying as fully renewable as per Article 27(3) of RED II guidelines shall be attributed zero greenhouse gas emissions. Further guidelines on electricity which qualifies as renewable electricity are included in ISCC EU System Document 202-6 “Renewable Fuels of Non-Biological Origin (RFNBO)”.

Emissions from grid electricity

When grid electricity is used in the production of RFNBOs and RCFs that does not classify as fully renewable according to RED II, the alternatives listed below can be applied. It must be noted that the same approach shall be considered for a full calendar year.

GHG emissions shall be attributed emissions according to emission factors displayed in Table 5[16]Table 5 provides emission factors for electricity in the EU Member States. If the GHG intensity of electricity is determined at country level, these values shall be used for electricity sourced in the EU Member States until more recent data becomes available to determine the GHG intensity of sourced electricity.

1) Table 5. This is without prejudice to the assessment under State aid rules.

2) Alternatively, the following options shall be applied depending on the full load hours of the RFNBO and RCF production plant:

   (a) Where the number of full load hours the electrolyzer is producing is equal or lower than the number of hours in which the marginal price of electricity was set by installations producing renewable electricity or nuclear power plants in the preceding calendar year for which reliable data are available,

[13] If carbon intensities are taken from table 1 and 2, combustion emissions shall not be considered. This is because combustion emissions are counted in processing or in the combustion emissions of the final fuel.

[14] In case there are any updates to the values provided in Table 1 and 2 by the European Commission, these will be implemented into the ISCC EU scheme with immediate effect.

[15] Consistent with the above point related to elastic inputs, the emissions intensity shall not include emissions embedded in the carbon content of the supplied input.

16 In case there are any updates to the values provided in Table 5 by the European Commission, these will be implemented into the ISCC EU scheme with immediate effect.

grid electricity used in the production of RFNBOs and RCFs shall be attributed a GHG emissions value of zero g CO_2eq/MJ,

(b) Where the number of full load hours is higher than the threshold mentioned under 1), grid electricity used in the production of RFNBOs and RCFs shall be attributed a GHG value of 183 g CO_2eq/MJ,

If (b) is the selected method, it shall also be applied to electricity that is used to produce RFNBOs and RCFs and qualifies as fully renewable according to Article 27(3) of the REDII.

3) The GHG emissions value of the marginal unit generating electricity at the time of the production of RFNBOs and RCFs in the bidding zone may be used, if this information is publicly available and originates from the national transmission system operator.

Annex II of this document presents the methodology for the GHG calculation of emission intensity of electricity, which is also applicable at country level and at bidding zone level.

Sourcing of electricity qualifying as fully renewable is required for inputs which are contributing to the LHV of the RFNBO-output. Nevertheless, it is also possible to source fully renewable electricity for auxiliaries' electricity consumption in the RFNBO-production facility, for example power equipment that is required for the production or further processing of RFNBOs. This would enable considering the emission factor of 0 gCO2eq/MJ and, thus, reduce the final carbon intensity of the fuel. It shall be noted, however, that the reduced emission factor can only be considered for facilities which are directly producing RFNBOs, production of input materials which contribute to the LHV of RFNBO-fuels or production of other input materials which do not contribute to the LHV of RFNBO-fuels. In the latter case, however, the units producing other inputs must be located in the same plant as the RFNBO production they supply; and they should source electricity from the same source as the RFNBO production.

The following examples apply:

- Activities which are not eligible for considering 0 gCO2eq/MJ EF from the use of renewable electricity:
  - Water treatment which is happening off-site by a third party and received through the water grid;
  - CO_2 capturing processes performed off-site by a third party;
  - N_2 production occurring off-site;
  - Production of any other inputs which are imported to site (e.g. catalysts, other fuels).

- Activities which are eligible for considering 0 gCO2eq/MJ EF from the use of renewable electricity:
    - Water treatment which is happening on-site and dedicated to RFNBO production, even if owned by a different legal entity. Input is not transported through the public grid;
    - CO_2 capturing processes performed on-site and dedicated to RFNBO production, even if owned by a different legal entity. Input is not transported through the public grid;
    - N_2 production occurring on-site and dedicated to RFNBO production, even if owned by a different legal entity. Input is not transported through the public grid.

3.1.1.3. Emissions from existing use or fate (e_{ex-use})

Emissions from inputs' existing use or fate

Inputs' existing use or fate emissions (e_{ex-use}) include avoided emissions when using such input for fuel production. These emissions include CO_2 equivalent emissions that would have been emitted if the carbon incorporated in the chemical composition of the fuel was or would not being used for fuel production. Inputs such as electricity, heat and consumable materials used in the process of capturing CO_2 shall be accounted in the calculation.

For captured CO_2, <u>one of the following conditions</u> must be met:

1) The CO_2 has been captured from an activity listed under Annex I of the Directive 2003/87/EC[17], listed in Table 6this document. The captured CO_2 has also been taken into account upstream in an effective carbon pricing system and is incorporated in the chemical composition of the fuel before 2036; or 2041 for cases where CO_2 does not originate from the combustion of fuels for electricity generation. For captured CO_2 outside of the Member States, the effective carbon pricing system shall be a national and robust system. More details on effective carbon pricing system are described under Annex III;
2) CO_2 is captured from air;
3) The CO_2 has been captured from the production or combustion of biofuels, bioliquids or biomass fuels complying with the sustainability and GHG saving criteria and the CO_2 capture did not receive credits for emission savings from CO_2 capture and replacement, set out in Annex V and VI of RED II;
4) The CO_2 has been captured from the combustion of RFNBOs or RFCs, in compliance with the GHG savings criteria set out in Articles 25(2) and 28(5) from the REDII and Commission Delegated Regulation on GHG RFNBOs;

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[17] *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC*

5) The CO_2 has been captured from a geological source of CO_2 and has previously been released naturally.

It must be noted that the limiting dates mentioned in point 1) might be revised according to the respective implementation of climate targets for 2040, covered in Directive 2003/87/EC[18] and in accordance with Article 4(3) of the Regulation EU 2021/1119[19].

The following exclusions also apply for emissions from existing use or fate:

1) Captured CO_2 originating from fuel combusted deliberately with the goal of capturing the CO_2;

2) Captured CO_2 which has received emissions credit under other provisions of the law.

Residues-related emissions from existing use or fate

The above-mentioned phase-out dates, 2035 and 2040, are only applicable to CO_2. Apart from the CO_2 associated emissions, e_{ex-use} might also include emissions associated to waste avoidance when residual materials are used as an input. This is applicable in the case of RCFs. In this case, the emissions shall be calculated based on typical waste destination (e.g. landfilling, incineration) of the region in which the plant is located. In the case of waste which would otherwise be sent to landfill, all emissions that occur in the landfill including non-CO_2 emissions due to methane leakage could be considered. The fossil carbon incorporated in the composition of the fuel cannot be considered, however, as landfilled waste is not combusted.

CO as Carbon Source

In the case of carbon monoxide (CO) used as an input, it is treated like any other input that has an energy content. It would need to be determined whether CO is an elastic or a rigid input. If CO is considered an elastic input, the CO_2 equivalent of the CO contained in the carbon is not considered under e_{ex-use} as the emissions are not avoided (there is no relevant existing use). The only exceptions are cases where CO is an intermediate product and e_{ex-use} has already been determined in an earlier production step. In this case, the previously determined value for e_{ex-use} is kept and only the additional inputs for processing to CO are taken into account.

3.1.2. Emissions from processing (e_p)

Processing emissions

Processing emissions shall include all direct atmospheric emissions from the processing itself, from combustion, waste treatment and leakages. Such leakages can for example originate from the use of CO_2.

At this stage, hydrogen leakages shall be considered as an energy loss, with proportional increase of the emissions intensity. This is because the global

[18] *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC*

[19] *Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending regulations (EC) No 401/2009 and EU 2018/1999 ("European Climate Law")*

warming potential of hydrogen is not yet established in the Annex of the Commission Delegated Regulation on GHG RFNBOs.[20]

Relevant inputs

All types of elastic or rigid inputs and their respective emissions from its production and supply shall be included under e_i. Emissions from auxiliaries processing inputs, that are not incorporated in the fuel chemical composition, shall be included under e_i as well. This includes, but is not limited to, electricity used for processing, water, heat, among others. For these additional processing inputs GHG emissions are calculated by applying the respective emission factor covering upstream emissions from the production and supply of the input. The factors can come from the same sources as for the calculation of elastic input emissions in section 3.1.1.

Where the use of processing inputs results in direct atmospheric emissions, due to combustion for example, these emissions will then be accounted for under e_p.

3.1.3. Emissions from transport and distribution (e_{td}) and emissions from fuel in use (e_u)

Transport and distribution emissions

Emissions from transport and distribution shall include the emissions from storage and distribution of finished fuels. Transportation and storage related emissions of inputs e_i shall be included in the emissions attributed to the inputs. The methodology and formulas described in ISCC EU System Document 205 and based on RED II shall be applied.

Fuel in use emissions

Emissions from the fuel in use refer to the total combustion emissions of the fuel in use. Following paragraph 4 of Annex V of the RED II, the greenhouse gases to be considered are CO_2, N_2O and CH_4, for which the global warming potentials are described in Table 7.

Emission from the fuel in use (e_u) will always be positive if the combustion process yields CO_2, N_2O and CH_4 as greenhouse gases. This is independently from the carbon source input used for fuel production, if it is from biogenic origin or not. Combustion emissions can be taken from the values provided in Table 1 or calculated according to the $e_{ex\text{-}use}$ value. It is possible that emissions from $e_{ex\text{-}use}$ and e_u balance out. If a fuel does not yield the above-mentioned greenhouse gases during combustion, the combustion emissions are then considered to be zero. This is the case of hydrogen and ammonia.

[20] *Commission Delegated Regulation (EU) 2023/1185 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels*

3.1.4. Emissions savings from carbon capture and geological storage (e_{ccs})

If carbon emissions from the RFNBO or RCF production are permanently stored in accordance with Directive 2009/31/EC[21], these emissions may be considered as savings under e_{ccs} for the products of the process. Emissions from storage operations (including transport of the CO_2) have to be considered under e_p.

3.1.5. Allocation

Allocation of emissions

For processes generating co-products exported from the plant, which can range from fuels, chemicals, electricity, heat, mechanical energy, among others, GHG emissions shall also be attributed to these co-products, via an allocation factor (AF). The allocation shall be done at the end of the production process and where such co-products occur.

Consideration of co-products

Emissions to be allocated shall be e_i and fractions of e_p, e_{td} and e_{ccs} that take place up to and including the process where the co-products are produced. If any process or installation within the system boundary treats only one of the co-products, the emissions from such installation or process shall be attributed entirely to this co-product. If one of the co-products is an input for another process, the allocation shall be done first to determine the emissions of the input for the following process.

Energy content allocation

1) When the **ratio of products is fixed** and the **co-products are all fuels, electricity or heat,** allocation shall be done by energy content. This means:

$$AF_{co-product} = \frac{C_{co-product_i}[MJ]}{\sum_{i=1}^{n} C_{products_{i,n}}\,[MJ]}$$

where

AF allocation factor for co-product

i each relevant product of a process, including RFNBO or RCF product and all co-products

n total number of products i of a process, including RFNBO or RCF product and all co-products

C_{output_i} energy content of all products n in a process

[21] *Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EE.*

If heat is a co-product and exported, only the useful heat may be considered, following the RED II requirements[22]. All products and co-products with an energy content should be considered to be fuels.

Economic value allocation

2) When the **ratio of products is fixed** and some **co-products are materials with no energy content**, allocation shall be done by economic value. This means:

$$AF_{co-products} = \frac{V_{co-product_i}[Eur]}{\sum_{i=1}^{n} V_{products_{i,n}}\,[Eur]}$$

where

AF allocation factor for co-product

i each relevant produc of a process, including RFNBO or RCF product and all co-products

n total number of products i of a process, including RFNBO or RCF product and all co-products

V_{output_i} economic value of all products n in a process.

The economic value shall be the average factory-gate value of the last three years. If such data is not available, the value shall be estimated based on commodity prices minus transportation and storage costs.[23] While euros are indicated in the formula, any currency can be used to calculate the economic value of the products and co-products, as long as the same currency is used for all.

Physical causality allocation

3) If the **ratio of co-products can change** within the process, the allocation shall be done based on physical causality by determining the effect on the process' emissions of incrementing the output of just one co-product whilst keeping the other outputs constant. By doing this it can be shown how much the production of each co-product impacts the overall emission value of the process. The highest contributor determined will be allocated most of the emissions in the respective share.

Considering the above, in an RFNBO-H_2 production facility where the oxygen is used in other processes and not released to the atmosphere, the emissions should be allocated based on economical allocation. If the hydrogen is composed of products which are attributed the same emission intensity (for e.g. RCF and RFNBOs), an average price can be applied, based on weighted arithmetic average.

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[22] *Paragraph 16 of Annex V, part C of the RED II*

[23] *Note that it is the relative values of the co-products that matters, so general inflation is not an issue.*

4. Co-processing of RFNBOs and RCFs

As mentioned in chapter 3, when RFNBOs or RCFs are partially replacing a conventional input in fuel production, which will be the case of co-processing. This chapter aims to define the rules for GHG accounting in the case of co-processing, based on the rules defined by the "Q&A implementation of hydrogen delegated acts" published by the European Commission on June 27th, 2023, and updated on March 14th 2024.

The Commission Delegated Regulation on GHG RFNBOs defines a specific rule for calculating the emission intensity of RFNBOs stemming from a process where co-processing is applied. It allows to distinguish in the calculation of the GHG intensity on a proportional basis of the energetic value of inputs between:

(1) the part of the process that is based on the conventional input and

(2) the part of the process that is based on RFNBOs and RCFs, assuming that the process parts are otherwise identical.

For example, RFNBO-H_2 can be used to replace H_2 in a process to produce synthetic fuels, along with other inputs such as CO_2 and CO. In this case, if the 10% of RFNBO-H_2 can be considered to determine a virtual process for RFNBO production, which uses only 10% of the mentioned inputs. All hydrogen qualifying as RFNBO are used the virtual RFNBO process and the remaining portion is considered for the remaining 90% of the production. The process would also yield only 10% of the outputs – a proportional share of the RFNBO-H_2 input.

The above logic can be applied not only when RFNBO inputs are replacing conventional inputs in a process, but also for RCFs, biomass, renewable electricity, renewable heat, and CO_2 (including biogenic). While not all those inputs influence the RFNBO share, they could also support in reducing the emission intensity of the output as the entire output of the virtual process would have the same emission intensity.

To determine the share of output as described above, the following formula can be applied:

$$S_{RFNBO,out} = \frac{E_{RFNBO,in}}{E_{educts}}$$

Where

$S_{RFNBO,out}$	energy share of the product which can be counted as RFNBO
$E_{RFNBO,in}$	energy content of the RFNBO input only
E_{educts}	energy content of all "relevant" inputs (as defined in the DA).

With the calculated $S_{RFNBO,out}$, it is then possible to assess the emissions for the RFNBO output according to:

$$Em_{RFNBO} = \sum_{n} S_n \times e_{i,n} + e_p + e_{td} + e_u - e_{ccs}$$

Where

n each "relevant" input

S_n energy share of the input "n": $S_n = \frac{E_{n,in}}{E_{educts}}$

$e_{i,n}$ emissions intensity for the supply of the input "n"

Inputs qualifying as RFNBO can be attributed to this part of the virtually split process with the upper limit of the energy (or stoichiometric) ratio of the input entering the output (meaning the energetic share of all inputs must be respected also for the virtually split part).

As mentioned in section 3.1.3, CO_2 emissions related to fuel combustion must be counted in the term e_u and might be compensated by the term $e_{ex\ use}$, according to the CO_2 input source.

The share of RFNBOs in the output of the virtual process would be determined as set out in the shares' calculation, in chapter 3 of this document. When a process yields more than one output, each type of output would include the same share of RFNBOs, RCF and other fuels.[24] The ratio of different outputs of the virtual process should not differ from the share of outputs of the whole process. Also, as mentioned in chapter 3, it is possible to determine the emission intensity of the output over a period of at most one calendar month.

Applicability of the co-processing rules

The REDII defines that RFNBOs are counted towards the targets when used as intermediate products to produce conventional fuels.[25] This is the case then renewable hydrogen is used in refineries, for example in the hydro treatment process, where hydrogen is used to remove impurities and not adding to the final heating value of the produced fuels. Other examples of RFNBOs considered as intermediate products are the case of hydrogen used in HVO production or methanol used in diesel production, as defined in the Q&A RFNBOs. Considering these cases where RFNBO-H_2 are already counted towards the targets, such use of hydrogen is not further considered, and the above-mentioned rules do not apply. This is also in line with the rules for RFNBO and RCF shares calculation, defined on chapter 3.

If the output of a process is a hydrogen derivative that does not fully qualify as an RFNBO, accordingly, the share of RFNBO is also calculated considering the share of RFNBO hydrogen input at the step where RFNBO hydrogen is co-processed with other inputs. Such differentiation should also be applied if the processing steps take place in the same facility and the emission intensity

[24] In line with Article 30 of the RED II
[25] Article 25(1)(a) of the RED II

of inputs must be calculated and reported to the next production step or final fuel producer.

Processing of mixed biogenic and non-biogenic and non-recyclable waste into fuels is not considered as a form of co-processing. According to the GHG methodology, co-processing covers only cases where RFNBOs and RCF are replacing a conventional input in a process. As there is no replacement taking place, the rules for co-processing do not apply and the entire output from the process is considered to have the same emission intensity.

5. Annex I: Supplementing values for GHG calculation

Table 1: Standard values for elastic inputs calculation[26]

	Total emissions (gCO_2eq/MJ)	**Upstream emissions (gCO_2eq/MJ)**	**Combustion emissions (gCO_2eq/MJ)**
Natural gas	66.0	9.7	56.2
Diesel	95.1	21.9	73.2
Gasoline	93.3	19.9	73.4
Heavy fuel oil	94.2	13.6	80.6
Methanol	97.1	28.2	68.9
Hard coal	112.3	16.2	96.1
Lignite	116.7	1.7	115.0

[26] *Source: Annex to the Delegated Regulation on GHG*

Table 2: Standard values for elastic inputs calculation[27]

	g CO_2eq/ kg
Ammonia	2351.3
Calcium chloride (CaCl2)	38.8
Cyclohexane	723.0
Hydrochloric acid (HCl)	1061.1
Lubricants	947.0
Magnesium sulphate (MgSO4)	191.8
Nitrogen	56.4
Phosphoric acid (H3PO4)	3124.7
Potassium hydroxide (KOH)	419.1
Pure CaO for processes	1193.2
Sodium carbonate (Na2CO3)	1245.1
Sodium chloride (NaCl)	13.3
Sodium hydroxide (NaOH)	529.7
Sodium methoxide (Na(CH3O))	2425.5
SO2	53.3
Sulphuric acid (H2SO4)	217.5
Urea	1846.6

[27] *Source: Annex to the Commission Delegated Regulation on GHG RFNBOs*

Table 3: Default emission factors from stationary combustion of fuels g/MJ Fuel[28]

Note: Emissions related to CH_4 and N_2O marked as converted in the table below have already been multiplied by the GWP set out in Annex V, part C, point 4 in the RED II. The final CO_2eq of each fuel is the sum of CO_2 and CO_2eq of CH_4 and N_2O.

Solid fossil fuels					
Fuel	**CO_2**	**CH_4**	**CH_4 converted to $CO_{2\ eq}$**	**N_2O**	**N_2O converted to $CO_{2\ eq}$**
Anthracite	98,3	0,001	0,025	0,0015	0,447
Coking coal	94,6	0,001	0,025	0,0015	0,447
Other bituminous coal	94,6	0,001	0,025	0,0015	0,447
Sub-bituminous coal	96,1	0,001	0,025	0,0015	0,447
Lignite	101	0,001	0,025	0,0015	0,447
Patent fuel	97,5	0,001	0,025	0,0015	0,447
Coke oven coke	107	0,001	0,025	0,0015	0,447
Gas coke	107	0,001	0,025	0,0001	0,0298
Coal tar	80,7	0,001	0,025	0,0015	0,447
Brown coal briquettes	97,5	0,001	0,025	0,0015	0,447
Manufactured gases					
Fuel	**CO_2**	**CH_4**	**CH_4 converted to $CO_{2\ eq}$**	**N_2O**	**N_2O converted to $CO_{2\ eq}$**
Gas works gas	44,4	0,001	0,025	0,0001	0,0298
Coke oven gas	44,4	0,001	0,025	0,0001	0,0298
Blast furnace gas	260	0,001	0,025	0,0001	0,0298
Other recovered gases	182	0,001	0,025	0,0001	0,0298
Peat and peat products	106	0,001	0,025	0,0015	0,447
Oil shale and oil sands	73,3	0,003	0,075	0,0006	0,1788
Oil and petroleum products					
Fuel	**CO_2**	**CH_4**	**CH_4 converted to $CO_{2\ eq}$**	**N_2O**	**N_2O converted to $CO_{2\ eq}$**
Crude oil	73,3	0,003	0,075	0,0006	0,1788
Natural gas liquids	64,2	0,003	0,075	0,0006	0,1788
Refinery feedstocks	73,3	0,003	0,075	0,0006	0,1788
Additives and oxygenates	73,3	0,003	0,075	0,0006	0,1788
Other hydrocarbons	73,3	0,003	0,075	0,0006	0,1788
Refinery gas	57,6	0,001	0,025	0,0001	0,0298
Ethane	61,6	0,001	0,025	0,0001	0,0298

[28] *Source: IPCC Guidelines for National Greenhouse Gas Inventories, 2006*

Liquefied petroleum gases	63,1	0,001	0,025	0,0001	0,0298
Motor gasoline	69,3	0,003	0,075	0,0006	0,1788
Aviation gasoline	70	0,003	0,075	0,0006	0,1788
Gasoline-type jet fuel	70	0,003	0,075	0,0006	0,1788
Kerosene-type jet fuel	71,5	0,003	0,075	0,0006	0,1788
Other kerosene	71,5	0,003	0,075	0,0006	0,1788
Naphtha	73,3	0,003	0,075	0,0006	0,1788
Gas oil and diesel oil	74,1	0,003	0,075	0,0006	0,1788
Fuel oil	77,4	0,003	0,075	0,0006	0,1788
White spirit and SBP	73,3	0,003	0,075	0,0006	0,1788
Lubricants	73,3	0,003	0,075	0,0006	0,1788
Bitumen	80,7	0,003	0,075	0,0006	0,1788
Petroleum coke	97,5	0,003	0,075	0,0006	0,1788
Paraffin waxes	73,3	0,003	0,075	0,0006	0,1788
Other oil products	73,3	0,003	0,075	0,0006	0,1788
Natural gas	56,1	0,001	0,025	0,0001	0,0298
Waste					
Fuel	**CO_2**	**CH_4**	**CH_4 converted to $CO_{2\ eq}$**	**N_2O**	**N_2O converted to $CO_{2\ eq}$**
Industrial waste (non-renewable)	143	0,03	0,75	0,004	1,192
Non-renewable municipal waste	91,7	0,03	0,75	0,004	1,192
Fuels of biomass origin					
Fuel	**CO_2**	**CH_4**	**CH_4 converted to $CO_{2\ eq}$**	**N_2O**	**N_2O converted to $CO_{2\ eq}$**
Primary solid biofuels	0	0,03	0,75	0,004	1,192
Charcoal	0	0,2	5	0,004	1,192
Biogases	0	0,001	0,025	0,0001	0,0298
Renewable municipal waste	0	0,03	0,75	0,004	1,192
Pure biogasoline	0	0,003	0,075	0,0006	0,1788
Blended biogasoline	0	0,003	0,075	0,0006	0,1788
Pure biodiesels	0	0,003	0,075	0,0006	0,1788
Blended biodiesels	0	0,003	0,075	0,0006	0,1788
Pure bio jet kerosene	0	0,003	0,075	0,0006	0,1788

Blended bio jet kerosene	0	0,003	0,075	0,0006	0,1788
Other liquid biofuels	0	0,003	0,075	0,0006	0,1788

Table 4: Fuel upstream emission factors[29]

Fuel	**Emission factor [g CO_2eq/MJ fuel on a net calorific value]**
Hard coal	15.9
Brown coal	1.7
Peat	0
Coal gases	0
Petroleum Products	11.6
Natural gas	12.7
Solid biofuels	0.7
Liquid biofuels	46.8
Industrial Waste	0
Municipal waste	0
Biogases	13.7
Nuclear	1.2

[29] *Source: JEC Well-To-Wheels (WTW) report v5*

Table 5 provides emission factors for electricity in the EU Member States. If the GHG intensity of electricity is determined at country level, these values shall be used for electricity sourced in the EU Member States until more recent data becomes available to determine the GHG intensity of sourced electricity.[30]

Table 5: Emission factors for electricity in EU Member States (2020)[31]

Country	**Emission intensity of generated electricity (g CO_2eq/MJ)**
Austria	39.7
Belgium	56.7
Bulgaria	119.2
Croatia	55.4
Cyprus	206.6
Czechia	132.5
Denmark	27.1
Estonia	139.8
Finland	22.9
France	19.6
Germany	99.3
Greece	125.2
Hungary	72.9
Ireland	89.4
Italy	92.3
Latvia	39.4
Lithuania	57.7
Luxembourg	52.0
Malta	133.9
Netherlands	99.9
Poland	196.5
Portugal	61.6
Romania	86.1
Slovakia	45.6
Slovenia	70.1
Spain	54.1
Sweden	4.1

[30] *This data is valid as of February 2023. In case of updates, updated data will be made available by the European Commission on a regular basis. The updated reports can be found under the publications repository from JRC (https://publications.jrc.ec.europa.eu/repository/). ISCC will include such updates, when published, on its website.*

[31] *European Commission, Joint Research Centre (JRC) (2022)*

Table 6: Activities described in Annex I of Directive 2003/87/EC and that can be considered for CO_2 capture[32], amended by Directive 2023/959[33]

Energy activities	• Combustion of fuels in installations with a total rated thermal input exceeding 20 MW (except in installations for the incineration of hazardous or municipal waste) From 1 January 2024, combustion of fuels in installations for the incineration of municipal waste with a total rated thermal input exceeding 20 MW, for the purposes of Articles 14 and 15. • Refining of oil, where combustion units with a total rated thermal input exceeding 20 MW are operated • Coke ovens
Production and processing of ferrous materials	• Metal ore (including sulphide ore) roasting or sintering installations • Production of iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour
Mineral industry	• Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day; or lime in rotary kilns with a production capacity exceeding 50 tonnes per day; or in other furnaces with a production capacity exceeding 50 tonnes per day. • Production of primary aluminium or alumina • Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day, and/or with a kiln capacity exceeding 4 m^3 and with a setting density per kiln exceeding 300 kg/m^3

[32] *Source: Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, Annex I*

[33] *Source: Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system*

Other activities	• Industrial plants for the production of (a) pulp from timber or other fibrous materials (b) paper and board with a production capacity exceeding 20 tonnes per day • Drying or calcination of gypsum or production of plaster boards and other gypsum products, with a production capacity of calcined gypsum or dried secondary gypsum exceeding a total of 20 tonnes per day • Production of carbon black involving the carbonisation of organic substances such as oils, tars, cracker and distillation residues with a production capacity exceeding 50 tonnes per day • Production of hydrogen (H2) and synthesis gas with a production capacity exceeding 5 tonnes per day • Transport of greenhouse gases for geological storage in a storage site permitted under Directive 2009/31/EC, with the exclusion of those emissions covered by another activity under this Directive • Maritime transport Maritime transport activities covered by Regulation (EU) 2015/757 with the exception of the maritime transport activities covered by Article 2(1a) and, until 31 December 2026, Article 2(1b) of that Regulation

Table 7: Supporting information from the RED II

Global Warming Potential[34]	
CO_2	1
N_2O	298
CH_4	25
Lower Heating Values[35]	
Hydrogen from renewable sources	120 MJ/kg

[34] *Annex V of the RED II*
[35] *Annex III of the RED II*

6. Annex II: Calculation of GHG emission intensity of electricity on country or bidding zone level

GHG emission intensity of electricity

The GHG intensity of electricity shall be determined at a country level or at a bidding zone level. The latter can only be applied if the required data is publicly available. This annex describes the methodology which is applied for the carbon intensity calculation on country or bidding zone level. For an RFNBO or RCF calculation, the calculated values from Table 5 can be directly applied. The methodology below would also be applicable to determine the carbon intensity of electricity generated on site, in case multiple sources of electricity generation are in place and the methods described in 3.1.1.2 are not applicable.

The calculation of carbon intensity of electricity production shall take in consideration all primary energy sources for electricity generation, as well as type of plant, conversion efficiencies and own electricity consumption in the power plant. It shall include all carbon equivalent emissions associated with the fuel used for electricity production, including the supply and combustion. For such, the emission factors from fuel combustion and the upstream fuel emissions factors, as well as the number of different fuels used need to be accounted for.

Combustion emissions

Regarding the combustion emissions, greenhouse gases apart from CO_2 must be converted to the CO_2 e.q. by multiplying the GWPs introduced in the RED II. CO_2 emissions from the combustion of biomass fuels are not accounted for because of their biogenic origin, however emissions from CH_4 and N_2O shall still be considered.

For the calculation of GHG emissions intensity of electricity, the following formula shall be applied[36]:

$$CI = \frac{e_{gross\_prod}}{E_{net}}$$

Where,

CI — CO_2 equivalent emissions from electricity production (in $gCO_{2\ eq}$/MJ)

e_{gross_prod} — CO_2 equivalent emissions (in $gCO_{2\ eq}$)

E_{net} — Net electricity production

Gross electricity production

The factor CO_2 equivalent emissions (e_{gross_prod}) from gross electricity production shall be calculated as per:[37]

$$e_{gross\_prod} = \sum_{i=1}^{k} \left(c_{i-ups} + c_{i-comb}\right) * B_i$$

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[36] *Annex to the Commission Delegated Regulation on GHG RFNBOs*

[37] *Ibid.*

Where,

c_{i-ups} Upstream CO_2 equivalent emissions (in $gCO_{2\ eq}$/MJ)

c_{i-comb} CO_2 equivalent emission factors from fuel combustion (in $gCO_{2\ eq}$/MJ)

B_i Fuel consumption for electricity generation

$i = 1 \dots k$ Fuels used for electricity production

The values regarding upstream emissions shall include emissions from all the processes required until the fuel is ready, such as extraction, refining and transports, as well as cultivation, harvest, and transport for biomass fuels. The values shall be taken from JEC WTW v.5 and are displayed in Annex I of this document (Table 3 and Table 4). The emission factors for stationary combustion shall be taken from the IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006). Such values are displayed in Table 3.

Net electricity production

The net electricity production (E_{net}) shall be determined as per:[38]

$$E_{net} = E_{gross} - E_{own} - E_{pump}$$

Where,

E_{gross} Gross electricity production (MJ)

E_{own} Own internal electricity consumption in power plant (MJ)

E_{pump} Electricity for pumping (MJ)

Combined heat and electricity production

In the case of Combined Heat and Power (CHP), the fuels used for heat produced in CHP shall be accounted for by applying an average overall efficiency of 85%, while the rest shall be attributed to electricity generation. In the case of nuclear power plants, the conversion efficiency from nuclear heat shall be 33%. Data provided by Eurostat or a similar, accredited source can also be used.

Renewable electricity

Electricity production from renewables, such as hydro, solar, wind and geothermal, are not associated with any fuel. In addition, emissions from construction and decommissioning, as well as waste management of electricity producing facilities are not considered. Thus, the carbon equivalent emissions associated with renewable electricity production (wind, solar, hydro and geothermal) are considered to be equal to zero.

[38] *Ibid.*

7. Annex III: Rules for effective carbon pricing system

As mentioned in chapter 3.1.1.3, one of the condition to be met in order to qualify captured CO_2 as eligible for $e_{ex\text{-}use}$, is its accounting in an effective carbon pricing system. Accounting upstream in an effective carbon pricing system means that the emissions are subject to a carbon price when the RFNBOs or RCF is first produced. As concerns what is an effective carbon pricing system in this context, the system must meet the following minimum criteria ensuring effective enforcement, so each tonne emitted is paid for:

(i) have a robust monitoring, reporting and verification (MRV) process;
(ii) be binding on its participants;
(iii) be stable;
(iv) apply the carbon price at least on the whole sector producing the RFNBOs or RCFs;
(v) ensure stringent enforcement;
(vi) be government-led.

In addition, the design features of the system need to ensure that the carbon price is effective in achieving its purpose of leading to emission reductions in line with climate neutrality:

(i) in the case of an emissions trading system (ETS): with an absolute and ultimately declining cap aligned with the climate neutrality target of the country for achieving the country's Paris-aligned nationally determined (NDC).
(ii) in the case of a tax: with an increasing trajectory aligned with the climate neutrality target of the country for achieving the country's Paris-aligned NDC.
(iii) for both an ETS and a tax: without design features which render the cap or tax ineffective.

The criteria applied in this context to assess what is an effective carbon pricing system do not prejudge the recognition of a carbon price paid under the Carbon Border Adjustment Mechanism (CBAM).

At the time of this document publication, April 2024, the EU COM published a list of carbon pricing system fulfilling the aforementioned requirements:

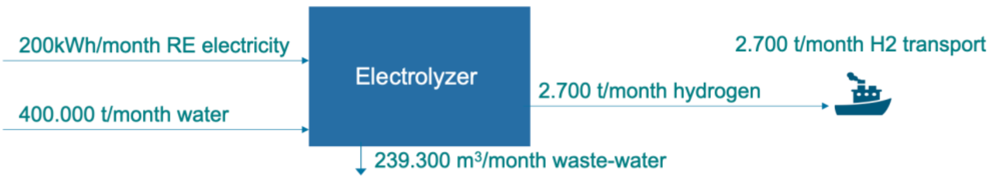
- European Union Emission Trading System (EU ETS)
- Swiss Emission trading System, Emissionshandelssystem der Schweiz (Swiss ET, CH EHS)
- United Kingdom Emission trading System (UK ETS)
- Other systems within which RFNBOs and RCFs are expected to be produced may request to be assessed

It should be noted that requests to assess the carbon pricing systems of specific countries regarding the compliance with the Commission Delegated Regulation on GHG RFNBOs, can be addressed to the European Commission by the relevant competent authorities. The same applies to carbon pricing systems at the sub-national level.

8. Annex IV: Example of different calculations under ISCC EU RFNBOs

In this chapter, different calculation examples for the methodology are displayed. Please note these are examples only, with ficticious numbers and supply chains. The sole purpose is to represent the correct applicability of the proposed formulas under the ISCC EU 205-1 and ISCC EU 205 documents. All emission factors used in the below examples are sourced from:

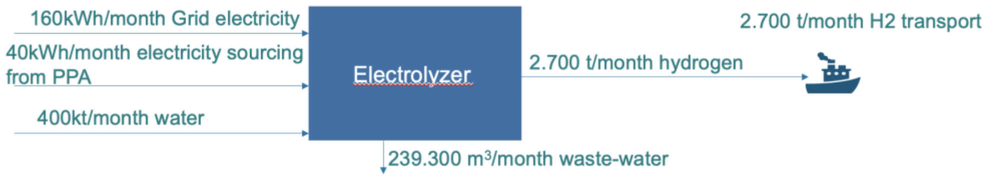
- ISCC EU 205 document;
- Commission Implementing Regulation (EU) 2022/996 of 14 June 2022 on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria;
- Commission Delegated Regulation on GHG RFNBOs.



$e_{i\ elastic}$		
Electricity from RE	200.000	kWh/month
Emission factor from RE electricity	0,00	g CO_2eq/MJ
Emission from RE electricity	0	g CO_2eq/MJ
Water	400.000	t/month
Emission factor from water	0,00030884	kg CO2eq/kg
Emissions from water	0,381	g CO_2eq/MJ
$e_{i\ rigid}$ and $e_{ex\ use}$: Not applicable		
e_p		
Wastewater	239.300	m^3/month
Emission factor from wastewater	0,36367	kg CO2eq/m3
Emissions from wastewater	0,27	g CO_2eq/MJ
Allocation factor: Only one product in supply chain		
AF	1	N/A

e_{td}		
Amount of product	2.700	t/month
Emission factor for maritime transport fuel	94,20	g CO_2eq/MJ
Efficiency of ship (Chemical/product tanker, 12,617 kt (fuel oil))	0,12	MJ/t.km
Total distance	150	km
Emissions from downstream transportation	0,014	g CO_2eq/MJ
e_u: Considered zero in case of H_2		
e_{CCS}: Not included in supply chain		
Total emissions		
GHG emissions fossil fuel	94,00	g CO_2eq/MJ
RFNBO-hydrogen GHG emission savings potential	93,34	g CO_2eq/MJ
RFNBO-hydrogen GHG-savings as compared to fossil fuel comparator	99,29	%

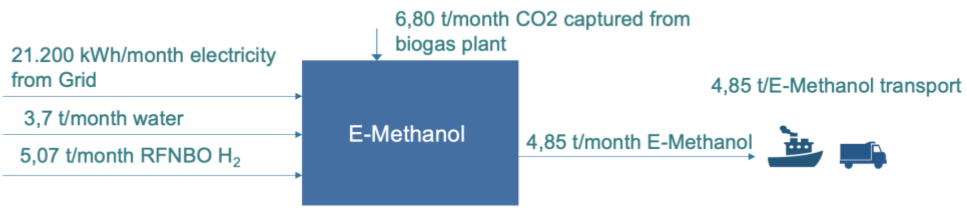
Example 2: RFNBO-H_2 production sourcing partly electricity compliant with ISCC 202-6 requirements and partly grid electricity



$e_{i\ elastic}$		
Electricity from sourcing PPA	40.000	kWh/month
Emission factor from sourcing PPA	0,00	g CO_2eq/MJ
Emission from sourcing PPA	0	g CO_2eq/MJ
Electricity from Grid (Netherlands)	160.000	kWh/month

Emission factor from Grid (Netherlands)	99,9	g CO_2eq/MJ
Emission from Grid (Netherlands)	0,1776	g CO_2eq/MJ
Water	400.000	t/month
Emission factor from water	0,00030884	kg CO2eq/kg
Emissions from water	0,381	g CO_2eq/MJ
$e_{i\ rigid}$ and $e_{ex\ use}$: Not applicable		
e_p		
Wastewater	239.300	m^3/month
Emission factor from wastewater	0,36367	kg CO2eq/m3
Emissions from wastewater	0,27	g CO_2eq/MJ
Allocation factor: Only one product in supply chain		
AF	1	N/A
e_{td}		
Amount of product	2.700	t/month
Emission factor for maritime transport fuel	94,20	g CO_2eq/MJ
Efficiency of ship (Chemical/product tanker, 12,617 kt (fuel oil))	0,12	MJ/t.km
Total distance	150	km
Emissions from downstream transportation	0,014	g CO_2eq/MJ
e_u: Considered zero in case of H_2		
e_{CCS}: Not included in supply chain		
Total emissions		
GHG emissions fossil fuel	94,00	g CO_2eq/MJ
RFNBO-hydrogen GHG emission savings potential	93,16	g CO_2eq/MJ
RFNBO-hydrogen GHG-savings as compared to fossil fuel comparator	99,11	%

Example 3: RFNBO-H_2 combined with a CO_2 source



$e_{i\ elastic}$		
Electricity from sourcing PPA	21.200	kWh/month
Emission factor from sourcing PPA	4,1	g CO_2eq/MJ
Emission from sourcing PPA	3,2	g CO_2eq/MJ
Water	3,7	t/month
Emission factor from water	0,00030884	kg CO2eq/kg
Emissions from water	0,011	g CO_2eq/MJ
RFNBO H_2	5,07	t/month
Emission factor for H_2	1,983	g CO2eq/MJ
LHV H_2	120	MJ/kg
Emission from RFNBO H_2	0,01	g CO2eq/MJ
$e_{i\ rigid}$: **Not applicable**		
$e_{ex\ use}$		
Emission from captured CO2	6,80	t/month
Emission factor	-	-
Emissions from existing use or fate	-70,97	g CO2eq/MJ
e_{td}- **Upstream transport emissions**		
Amount of product - H_2	5,07	t/month
Emission factor for diesel	95,10	g CO2eq/MJ
Efficiency of diesel truck (40t)	0,81	MJ/t.km
Maximum load of the mean	10	t/mean of transport

Total single distance loaded	100	Km
Emissions from Upstream transportation	0,39	g CO2eq/MJ
e_p : No processing emissions		
Allocation factor: Only one product in supply chain		
AF	1	N/A
e_{td} Downstream transport emissions		
Amount of product	4,85	t/month
Emission factor for maritime transport	0,12	g CO2eq/MJ
Efficiency of Ship (Chemical/product tanker, 12,617 kt (fuel oil))	94,20	MJ/t.km
Total Distance	1500	km
Emissions from Downstream transportation	0,85	g CO2eq/MJ
e_u		
Emissions from fuel in use	68,90	g CO2eq/MJ e-Methanol
e_{CCS}: Not included in supply chain		
Total emissions		
GHG emissions fossil fuel	94,00	g CO_2eq/MJ
RFNBO-hydrogen GHG emission savings potential	91,61	g CO_2eq/MJ
RFNBO-hydrogen GHG-savings as compared to fossil fuel comparator	97,64	%