Scheme principles for GHG calculation

Version EU 07

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1 Requirements for greenhouse gas emission savings

According to Revised Directive (EU) 2018/2001 the minimum greenhouse gas emission savings from the consumption of biofuels, biogas in the transport sector and bioliquids depends on the date the installation of the last interface becomes operational and is tiered according to the following structure:

- at least 50% for biofuels, biogas consumed in the transport sector, and bioliquids produced in installations in operation on or before 5 October 2015
- at least 60% for biofuels, biogas consumed in the transport sector, and bioliquids produced in installations starting operation from 6 October 2015 until 31 December 2020
- at least 65% for biofuels, biogas consumed in the transport sector, and bioliquids produced in installations starting operation from 1 January 2021
- The greenhouse gas emission savings (GHG emission savings) denotes the percentage of greenhouse gas emissions (GHG emissions) that could be saved by using biofuels, bioliquids and biomass fuels instead of fossil fuels

An installation is deemed to be in operation if it produces biofuels, bioliquids, or biomass fuels for the first time in accordance with its intended purpose after establishing that it is technically ready for operation. The date the installation became operational does not change if individual technical or structural parts are replaced after initial start-up. The last interface supplying biofuels, bioliquids or biomass fuels provides information on the date the installation became operational.

The listed minimum greenhouse gas emission savings must be met for the biofuel/bioliquid/biomass fuel to comply with the REDcert scheme requirements.

2 Definitions

In order to establish a common understanding of the terms and definitions used in these scheme principles, please refer to the REDcert-EU document *Definitions in the REDcert-EU scheme*.

3 Scheme principles for the greenhouse gas calculation

3.1 Methodology for greenhouse gas calculation

The total GHG emissions and GHG emission savings resulting from the use of biofuels, bioliquids and biomass fuels must be calculated in accordance with Article 31(1) to 31(3) of Revised Directive (EU) 2018/2001 and the Implementing Regulation (EU) 2022/996. Any updates to these regulations or additional guidance by the European Commission on specific technical aspects regarding the calculation rules will immediately enter into force in the REDcert scheme.

Greenhouse gas emissions from the production and use of transport fuels, biofuels, bioliquids and biomass fuels are to be calculated using the following formula:[1]

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

where:

E	total emissions from the use of the biofuels, bioliquids and biomass fuels
$\mathbf{e_{ec}}$	emissions from production of the relevant raw materials, and especially in cultivation and harvesting of the biomass from which the bioliquids are produced. Carbon captured in the cultivation of raw materials is not included.
$\mathbf{e_{l}}$	annualised emissions resulting from carbon-stock changes caused by land-use change
$\mathbf{e_{p}}$	emissions from processing
$\mathbf{e_{td}}$	emissions from transport and distribution
$\mathbf{e_{u}}$	emissions from the use of the biofuel/bioliquid/biomass fuel
$\mathbf{e_{sca}}$	emission saving from soil carbon accumulation via improved agricultural management
$\mathbf{e_{ccs}}$	emission saving from carbon capture and geological storage
$\mathbf{e_{ccr}}$	emission saving from carbon capture and replacement

Greenhouse gas emissions from biofuels/bioliquids/biomass fuels (E) are expressed in terms of grams of CO_2 equivalent per MJ of biofuel/bioliquid/biomass fuel [gCO_2eq/MJ]. Greenhouse gas emissions from raw materials and intermediate products are expressed in

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[1] in accordance with the methodology set out in Annex V and VI of Revised Directive (EU) 2018/2001

terms of grams of CO_2 equivalent per tonne of dry matter of raw materials and intermediate products [gCO_2eq/t dry].

Emissions from the manufacture of machinery and equipment are not taken into account. Emissions from the fuel in use (e_u) are to be assumed to be zero for biofuels/bioliquids/biomass fuels. Emissions of non-CO_2 greenhouse gases (N_2O and CH_4) from fuel use must be included in the e_u factor for liquid biofuels and biomass fuels (excluding biomethane for transport).

Economic operators must provide auditors with all the relevant information concerning the calculation of actual GHG emissions in advance of the planned audit. All data measured and collected on site which is relevant for the calculation of actual values must be documented and provided to the auditor for verification. This includes, if applicable, all information on the emission and conversion factors and default values applied and their reference sources, GHG emission calculations and evidence relating to the application of GHG emission saving credits (i.e. e_{sca}, e_{ccr}, e_{ccs}).

Information on GHG emissions must include accurate data on all relevant elements of the emission calculation formula (if applicable) according to Revised Directive (EU) 2018/2001, Annex V, Part C, No. 1, and Annex VI, Part B, No. 1.

The auditor must record and document the greenhouse gas emissions after allocation occurring at the audited site and, if necessary, the savings in the audit report or in accompanying documentation to show that the calculation has been thoroughly verified and understood.

Where the emissions deviate significantly **(≥ 10%) from typical values** or calculated actual values of emissions savings are abnormally high **(greater than 30% deviation from default values** according to Annex V Parts A and B and Annex VI Part A of Revised Directive (EU) 2018/2001), reasons must be given for the deviations in the audit report. If implausibilities result in the audit not being passed, REDcert must be informed in accordance with the valid scheme principles for neutral inspections.

Upon request, all information on the calculation of actual GHG emissions, the GHG emission savings and the audit report to submit to the European Commission or the competent national authorities must be provided to REDcert immediately.

The GHG emission savings of biofuels/bioliquids/biomass fuels must be determined using one of the following alternatives as stipulated in Revised Directive (EU) 2018/2001:

- using the default values (last interface)
- based on actual values calculated in accordance with the methodology in Revised Directive (EU) 2018/2001 (see the requirements below)
- using disaggregated default values
- using a combination of disaggregated and actual values.

For every phase in the production and supply chain, the use of (disaggregated) default values and/or all details used to determine the actual values (methodology, measurements, data sources for non-measured values) must be documented.

If actual values are not used, the amount of GHG emissions should not be transferred between various interfaces in the value chain because it is not possible to know whether this is a default value or an actual value in downstream phases. It is therefore the responsibility of downstream operators to include information about the (disaggregated) default GHG emission values for the final biofuel/bioliquid/biomass fuel when reporting to the member states.

3.2 Calculation using default values

Economic operators can use the default value for the GHG emission savings to provide proof of compliance with the greenhouse gas savings requirement if the production pathway is listed in Annex V, Part A and B and Annex VI, Part A and D of Revised Directive (EU) 2018/2001 and if the GHG emissions resulting from carbon-stock changes caused by land-use change (e_l value) are less than or equal to zero. Default values must be taken from Annex V, Part A and B and Annex VI, Part A and D of Revised Directive (EU) 2018/2001[2]. The European Commission may update the default values. Any updates will immediately enter into force in the REDcert scheme.

If a default value is to be used, it is determined by the last interface. In this case, it is sufficient for the upstream economic operators to simply indicate "use default value" or similar wording to the downstream economic operator.

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[2] Revised Directive (EU) 2018/2001

Default values listed in Annex V, Part A and B and Annex VI, Part A and D can only be applied if the process technology and feedstock used for the production of the biofuel/bioliquid/biomass fuel are consistent with their description and scope. If specific technologies are specified, the default values can only then be applied if this technology has actually been used. If necessary, both the process technology and the raw materials used must be specified. If compressed biomethane is used as a transport fuel, a value of 4.6 gCO_2eq/MJ biomethane needs to be added to the default values included in Annex VI.

3.3 Calculation using actual values

Actual values can be used for each phase in the value chain regardless of whether there is a default value or not.

Economic operators who want to report GHG emissions based on actual values must demonstrate their ability to correctly apply the GHG calculation methodology in accordance with Article 31(1) to 31(3) in conjunction with Annex V and Annex VI of Revised Directive (EU) 2018/2001, for example through appropriate training records or an interview by the auditor in the audit.

Actual values of emissions can only be determined at the point where they occur in the value chain (e.g. the actual values of emissions from cultivation (e_{ec}) can only be determined at the beginning of the value chain). Similarly, economic operators can only use the actual values for transport if the emissions from all relevant transport steps are taken into account. Actual values of emissions for processing can only be determined if the emissions of all processing steps are recorded and passed along through the chain of custody. Actual values must be calculated in accordance with the methodology described in Revised Directive (EU) 2018/2001, Part C of Annex V for biofuels and bioliquids and in Part B of Annex VI for biomass fuels.

For the emissions from the extraction or cultivation of raw materials (e_{ec}), economic operators may use a value calculated for a NUTS level 2 region or a region at a more disaggregated NUTS level[3] as an alternative to an individually calculated value, provided that

- the production of the raw material took place in that region, and

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[3] Consistent with EUROPEAN COMMISSION: Regulation (EC) 1059/2003 of the European Parliament and of the Council as level 2 regions of the classification of territorial units for statistics (NUTS) or as more disaggregated NUTS levels. Available at: www.ec.europa.eu/eurostat/de/web/nuts/overview (accessed on 30.10.2024)

- a Member State or a third country submitted a report pursuant with Article 31 (2) and (3), and
- the European Commission by means of implementing acts decided that the report contains accurate data for the purpose of measuring GHG-emissions in that region.[4]

NUTS-2 values are to be indicated in the unit gCO_2eq/kg of dry matter along the entire value chain. Consequently, they can only be considered input values to calculate and adjust individual cultivation emissions of the downstream interfaces. They are not suitable for specifying emissions from the cultivation phase in gCO_2eq/MJ of biomass fuel.

If no such NUTS-2 value exists in the region of cultivation, economic operators must either use an actual value or an existing disaggregated default value (s. chapter 3.4).

GHG emissions must be reported using the following units:

a) gCO_2eq/tonne dry matter for raw materials and intermediate products

b) g CO_2eq/MJ for final biofuels/bioliquids/biomass fuels

The greenhouse gases to be included in the GHG calculation are CO_2, N_2O and CH_4. To calculate the CO_2 equivalence, these gases are weighted as follows in accordance with Annex IX of Implementing Regulation (EU) 2022/996:

Greenhouse gas	**CO_2 equivalence**
CO_2	1
N_2O	265
CH_4	28

If these values or other relevant emission or conversion factors change, they apply in the REDcert scheme with immediate effect upon publication on the EUROPA website of the European Commission (here).

All GHG emissions (if relevant) associated with the incoming feedstock (upstream emissions from e_{ec}, e_l, e_p and e_{td}) must be adjusted to the respective intermediate product using the feedstock factor.

The following formula must be used to determine the feedstock factor in relation to the intermediate product:

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[4] Implementing acts on NUTS-2 values

$$\text{feedstock factor}_{\text{intermediatete}} = \frac{\text{mass}_{\text{feedstock}}}{\text{mass}_{\text{intermediate}}}$$

Ratio of kg of dry feedstock required to make 1 kg of dry intermediate product.

In addition to the upstream emissions, the emissions for the recipient that occur at the respective interface must be included.

Whenever a processing step yields co-products, emissions need to be allocated (see section 4.10 "Allocation of greenhouse gas emissions").

An example is provided below to illustrate how the feedstock factor intermediate product and allocation factor intermediate product are applied to emissions from cultivation (e_{ec}).

$$e_{ec}(\text{intermediate})\left|\left[\frac{gCO_2eq}{t_{dry}}\right]\right|_{ec} = e_{ec}(\text{feedstock}) \times \text{feedstock factor}_{\text{intermediate}} \times \text{allocation factor}_{\text{intermediate}}$$

The upstream emissions for the processing step from e_{ec}, e_l, e_p and e_{td} as well as the emissions to be included for this interface (if applicable) must be converted using the fuel feedstock factor (biofuel/bioliquid/biomass fuel), the fuel allocation factor (biofuel/bioliquid/biomass fuel) and the lower heating value (LHV) into the unit gCO_2eq/MJ of final fuel.

The following formula must be used to determine the fuel feedstock factor that describes the ratio of MJ feedstock required to make 1 MJ of fuel (biofuel/bioliquid/biomass fuel):

$$\text{fuel feedstock factor} = \frac{\text{feedstock [MJ]}}{\text{fuel [MJ]}}$$

Whenever a processing step yields co-products, emissions must be allocated (see section 4.10 "Allocation of greenhouse gas emissions").

When calculating the fuel feedstock factor, remember that the lower heating values per dry tonne must be used, while the lower heating values for wet biomass must be used for calculating the allocation factor, because this approach was also used for calculating the default values.

An example is provided below to illustrate how the fuel feedstock factor and fuel allocation factor are applied to emissions from cultivation (e_{ec}).

$$e_{ec}(\mathrm{fuel})\left[\frac{\mathrm{gCO_2eq}}{\mathrm{MJ_{fuel}}}\right]_{ec} = \frac{e_{ec}(\mathrm{feedstock})}{\mathrm{LHV}} \times \mathrm{feedstock\ factor_{fuel}} \times \mathrm{allocation\ factor_{fuel}}$$

For this calculation, feedstock factors based on plant data must be used.

Products that have a negative energy content are considered to have an energy content of zero and no allocation is made. See also Revised Directive (EU) 2018/2001, Annex V, Part C, No. 18 and Annex VI, Part B, No.18.

Once the last interface has determined the total GHG emissions for all elements (if applicable) of the formula in accordance with Revised Directive (EU) 2018/2001, Annex V, Part C, No. 1 and Annex VI, Part B No.1 in gCO_2eq/MJ of biofuel/bioliquid/biomass fuel, other or subsequent emissions for transport and distribution must be included, see section 4.5 "Requirements for calculating greenhouse gas emissions from transport and distribution (e_{td})". For information on the calculation of the greenhouse gas emission savings by the last interface, see section 4.11.

It is not necessary to include inputs in the calculation which have little or no effect on the result, e.g. low quantities of chemicals used in processing.[5] Inputs with little or no effects are those that have a calculated impact of less than 0.5% on the total emissions of the respective production unit.

All information on actual GHG emissions must be included in the GHG emission calculation for all elements of the formula in accordance with Revised Directive (EU) 2018/2001, Annex V and VI and passed along in the value chain (if applicable). It is therefore necessary to report the greenhouse gas emissions of e_{ec}, e_l, e_{sca}, e_p, e_{td}, e_{ccs} and e_{ccr} separately if relevant or applicable. This also applies to the elements of the formula, which are not included in the default values such as e_l, e_{sca}, e_{ccr} and e_{ccs}. If information necessary for the greenhouse gas calculation is missing, default values are to be used, and this must be clearly evident in the report.

If emissions are not recorded along the production pathway and the result is that downstream operators can no longer calculate actual emissions consistently, this must be clearly indicated in the delivery documents at the phase where this gap occurred, taking into account the accompanying documents.

To determine actual emissions, the values (emission factors, heating values, etc.) must be taken from Annex IX of the Implementing Regulation (EU) 2022/996.

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[5] Communication from the Commission on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels (2010/C 160/02)

3.4 Calculation using disaggregated default values

The Revised Directive (EU) 2018/2001 also provides disaggregated default values in accordance with Part D and E of Annex V and Part C of Annex VI, which relate to part of production and can be used in combination with actual values to calculate the GHG emissions.

It is important to note here that there are no default values for the component "land-use change" (e_l). If disaggregated default values are used for cultivation, GHG emissions from land-use changes always have to be added to them.

Disaggregated default values must be taken from Annex V and VI of Revised Directive (EU) 2018/2001 and can only be applied if the process technology and feedstock used for the production of the biofuel/bioliquid/biomass fuel are consistent with their description and scope. The list of (disaggregated) default values can be updated by the Commission. Any changes made by the European Commission to the (disaggregated) default values will immediately enter into force in the REDcert scheme.

The disaggregated default values may only be reported for final biofuels/bioliquids/biomass fuels, and they are applicable for certain elements in the supply chain. In the case of biofuels/bioliquids for the elements e_{ec}, e_p and e_{td} and in the case of biomass fuels for the elements cultivation, processing, treatment, transport, compression at the filling station and credit for manure/slurry use. If economic operators up to the last interface use the disaggregated default values, they have to specify "Use of disaggregated default value" on their delivery documents for example "Use of disaggregated default value for e_{ec}" or "Use of disaggregated default value for e_{td}". GHG emission data should only be included on documentation if actual values have been applied.

The (disaggregated) default values in Annex V and VI of Revised Directive (EU) 2018/2001 must be expressed in gCO_2eq/MJ of biofuel/bioliquid/biomass fuel. The values are based on the background data of the Joint Research Centre (JRC).

4 Requirements for calculating GHG emissions based on actual values

4.1 Requirements for calculating greenhouse gas emissions from the production of raw materials (e_{ec})

The GHG emissions from raw material production (e_{ec}) must include the sum of all emissions from the extraction or cultivation process itself, from the collection, drying and storage of raw materials, from waste and leakages, and from the production of chemicals or products used in extraction or cultivation and other relevant inputs.

To calculate e_{ec}, the following data is collected on site at a minimum, i.e. the respective values are taken from, e.g. company documents:

- quantity of P_2O_5, K_2O, CaO, mineral and organic N fertilisers as well as crop residues [kg ha^{-1} a^{-1}] – total quantity used annually (in the year of cultivation)
- quantity of chemicals (e.g. pesticides) [kg ha^{-1} a^{-1}] – total quantity used annually (in the year of cultivation)
- fuel consumption [l ha^{-1} a^{-1}] – total quantity of diesel used annually for, e.g. tractors and water pumps per hectare in the year of cultivation
- electricity consumption [kWh ha^{-1} a^{-1}] – total electricity consumption per hectare in the year of cultivation
- quantity and type of raw materials used [kg ha^{-1} a^{-1}]
- harvest yield [kg dry harvest yield ha^{-1} a^{-1}] – annual quantity of the main/co-product in kg dry per hectare in the year of cultivation. If drying took place, the dry content of the dried product must be included.

The method for collecting measured data and the measured data for the calculation of the GHG emissions must be documented to ensure that the calculations are also transparent. Actual emissions from cultivation can only be determined if GHG emissions relevant to the interface are recorded and consistently passed along through the production chain.

It must be kept in mind that the requirements above for calculations and formulas are examples. If other emissions are incurred, they must be recorded and included in the calculation. The data has to be placed in the formula in the right places.

The economic operator responsible calculates the GHG emissions for raw material production (e_{ec}) including the GHG emissions from cultivation and harvest of the raw material as well as the GHG emissions from production of chemicals or products used in cultivation by using input data in the following formula:

$$e_{ec} = \frac{(EM_{fertiliser} + EM_{pesticides} + EM_{fuel} + EM_{electricity} + EM_{N_2O} + EM_{seeds} + EM_{aglime})}{\text{harvest yield}_{\text{main product dry}}}$$

Where:

$$EM_{fertiliser}\left[\frac{gCO_2eq}{ha \times a}\right] = mass_{fertilizer} \times (EF_{production\ fertiliser} + EF_{field})$$

$$EM_{pesticides}\left[\frac{gCO_2eq}{ha \times a}\right] = mass_{pesticides} \times EF_{production\ pesticides}$$

$$EM_{fuel}\left[\frac{gCO_2eq}{ha \times a}\right] = volume_{fuel} \times EF_{fuel}$$

$$EM_{electricity}\left[\frac{gCO_2eq}{ha \times a}\right] = amount_{electricity} \times EF_{electricity}$$

$$EM_{N_2O}\left[\frac{gCO_2eq}{ha \times a}\right] = mass_{N_2O} \times GWP_{N_2O}$$

$$EM_{seeds}\left[\frac{gCO_2eq}{ha \times a}\right] = mass_{seeds} \times EF_{seed\ production}$$

$$EM_{aglime}\left[\frac{gCO_2eq}{ha \times a}\right] = mass_{aglime} \times (EF_{aglime\ production} + EF_{liming})$$

(EM = emissions, EF= emissions factor, GWP= global warming potential)

Where:

$EF_{production\ fertiliser}$	emission factor of the fertiliser production in [kgCO_2eq/kg fertiliser]
EF_{field}	emission factor of nitrous oxide (N_2O) in [kgCO_2eq/kg N fertiliser]
$EF_{production\ pesticide}$	emission factor pesticide production [gCO_2eq/kg pesticides]
EF_{fuel}	emission saving from carbon capture and replacement
$EF_{electricity}$	emission factor electricity (e.g. EU electricity mix) [gCO_2eq/kWh]

EF_{seeds}	emission factor seeding material production [kgCO2eq/kg seed]
$EF_{aglime\ production}$	emission factor aglime production [kgCO2eq/kg aglime]
EF_{liming}	liming emissions from actual lime use [kgCO2eq/kg aglime]

The GHG emissions from raw material production are specified in relation to the dry harvest yield or dry main product (gCO_2eq/t dry).

The formula below is to be used to specify the emissions of the dry matter in t:

$$e_{ec}(\text{main procuct}_{dry})\left[\frac{gCO_2eq}{t_{dry}}\right]=\frac{e_{ec}(\text{main product}_{wet})}{\text{1-moisture content}}$$

The moisture content is based on the delivery details. If it is missing or not known, it is based on the maximum value allowed in the supply contract.

The values (emission factors, heating values, etc.) in the table in Annex IX of the Implementing Regulation (EU) 2022/996 must be used to calculate e_{ec}. If an emission factor is not listed in Annex IX a scientific literature source or scientifically recognised database (e.g. ecoinvent database) can be used. However, if a standard value is included in Annex IX, it **must** be applied.

The data has to be placed in the formula in the right places. The source must be cited (in particular, the author, title, magazine, volume, year) when values are taken from scientific literature sources or scientifically recognised databases. The values taken from literature sources or databases must be based on scientific and peer-reviewed work – with the precondition that the data used lies within the commonly accepted data range when available

Life cycle greenhouse gas emissions from waste and residues, including straw, husks, corn cobs and nutshells, and residues from processing, including crude glycerine (unrefined glycerine), bagasse and all wastes and residues included in Annex IX of Revised Directive (EU) 2018/2001, are set to zero until these materials are collected, regardless of whether they are processed into intermediate products before being converted into the final product.[6] Materials can be classified as waste, residue or a co-product on the basis of the REDcert *Scheme principles for the production of biomass, biofuels, bioliquids and biomass fuels*.

How the above-mentioned formal elements are calculated was clarified with the entry into force of Implementing Regulation (EU) 2022/996 and is described in more detail below.

4.1.1 Emissions from fuel used by farm machinery (EM_{fuel})

The GHG emissions from crop cultivation (field preparation, seeding, fertiliser and pesticide application, harvesting, collection) include all emissions from the use of fuels (such as diesel oil, gasoline, heavy fuel oil, biofuels or other fuels) in farm machinery. Economic operators must duly document the amount of fuel use in farm machinery.

When determining the emissions of the fuel used by agricultural machinery (EM_{fuel}), appropriate emission factors must be used in accordance with Annex IX of Implementing Regulation (EU) 2022/996. If biofuels are used instead of conventional fuels, the default emission values set out Revised Directive (EU) 2018/2001 must be used.

4.1.2 Emissions from the production of fertilisers ($EM_{fertilisers}$) and pesticides ($EM_{pesticides}$)

The emissions from the use of chemical fertilisers and pesticides[7] for the cultivation of raw materials must include all related emissions from the manufacture of chemical fertilisers and pesticides. Economic operators must duly document the amount of the chemical fertilisers and pesticides, depending on the crop, local conditions and farming practices.

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[6] According to Annex V, Part C, point 18 and Annex VI, Part B, point 18 of Revised Directive (EU) 2018/2001.

[7] Pesticides includes all plant protection products, herbicides, insecticides, fungicides, etc.

Appropriate emission factors, including upstream emissions, must be used to account for the emissions from the production of chemical fertilisers and pesticides pursuant to Annex IX of Implementing Regulation (EU) 2022/996.

If the economic operator knows the factory producing the fertiliser and it falls under the EU Emissions Trading System (ETS), the economic operator can use the production emissions declared under ETS, adding the upstream emissions for natural gas, etc. Emissions from the transport of the fertilisers or pesticides must be included in the calculation using the emission factors listed in Annex IX to Implementing Regulation (EU) 2022/996. If the economic operator does not know the factory supplying the fertiliser, the standard values provided for in Annex IX are to be used.

4.1.3 Emissions from the production of seeding material

The calculation of cultivation emissions from the production of seeding material for crop cultivation is based on actual data on the seeding material used. Emission factors for the production and supply of seeding material can be used to account for emissions associated with the production of seeds as set out in Annex IX to Implementing Regulation (EU) 2022/996. For other seeds for which Annex IX of the Implementing Regulation (EU) 2022/996 does not list suitable values, literature values from the following hierarchy must be used:

1. version 5 of JEC-WTW report
2. ECONINVENT database
3. “official” sources, such as Intergovernmental Panel on Climate Change (IPCC), International Energy Agency (IEA) or governments
4. other reviewed sources of data, such as E3 database, GEMIS database
5. peer-reviewed publications
6. duly documented own estimates

4.1.4 Emissions from neutralisation of fertiliser acidification and the application of aglime

The emissions from the neutralisation of fertiliser acidification and application of aglime account for the CO_2 emissions from neutralisation of acidity from nitrogen fertilisers or from aglime reactions in the soil.

1) Emissions from neutralisation of fertiliser acidification

The emissions resulting from acidification caused by nitrogen fertiliser use in the field is accounted for in the emission calculation, based on the amount of nitrogen fertilisers used. For nitrate fertilisers, the emissions from the neutralisation of nitrogen fertilisers in the soil are 0.783 kg CO_2eq/kg N; for urea fertilisers, the neutralisation emissions are 0.806 kg eqCO_2/kg N.

2) Soil emissions from the application of aglime

Economic operators must duly document the amount of aglime fertiliser used. Emissions from the use of lime fertiliser must be calculated as follows:

a) On acid soils, where pH is less than 6.4, aglime is dissolved by soil acids to form predominantly CO_2 rather than bicarbonate, releasing almost all of the CO_2 into the aglime. The emission factor to be used for calculating emissions is 0.44 kg CO_2eq/kg $CaCO_3$ equivalent.

b) If soil pH is greater or equal to 6,4, an emission factor of 0.98/12,44 = 0.079 kg eqCO_2/(kg $CaCO_3$-equivalent) aglime applied must be taken into account in the calculation, in addition to the emissions due to the neutralisation of acidification caused by the fertiliser.

c) The liming emissions calculated following the rules in a) and b) above, may be greater than the fertiliser neutralisation emissions if the fertiliser acidification was neutralised by the applied aglime. In such a case, the fertiliser neutralisation emissions may be subtracted from the calculated liming emissions to avoid that its emissions are counted twice.

The emissions from fertiliser acidification may exceed the emissions from the application of aglime. In such a case, the subtraction would result in apparently negative net liming emissions because not all of the fertiliser acidity is neutralised by aglime but also partly by naturally occurring carbonates. In this case, the net liming emissions from the use of aglime are counted as zero. However, fertiliser acidification emissions that occur anyway must be maintained in line with point 1).

If data on actual aglime use is not available, the aglime use recommended by the Agricultural Lime Association must be assumed. The amount recommended by the Agricultural Lime Association is based on the type of crop, measured soil pH, soil type and type of liming material. The emissions resulting from the use of this amount of aglime must be determined according to the rules defined in a) and b) above. However, the subtraction according to c) is not permissible in this case, as the Recommended Amount of Agricultural Lime does not take into account the lime used to neutralise the fertiliser applied in the same year, so that double counting of emissions from the neutralisation of fertilisers is not possible.

4.1.5 Soil emissions (nitrous oxide N_2O) from crop cultivation (EM_{N_2O})

The N_2O emissions from managed soils are calculated following the IPCC methodology, including the "direct" and "indirect" N_2O emissions described there.[8] Disaggregated crop-specific emission factors for different environmental conditions (corresponding to Tier 2 of the IPCC methodology) must be used to calculate the N_2O emissions resulting from crop cultivation. Specific emission factors for different environmental conditions, soil conditions and different crops are to be taken into account. Economic operators could use validated models to calculate those emission factors provided that the models take these aspects into account. Another way to include these emissions is the Global Nitrous Oxide Calculator (GNOC) developed by the Joint Research Centre.[9] This tool is based on the formulas listed below and in the Annex of this document, whereby the naming conventions in the IPCC (2006) guidelines must be followed when it is used.

The total annual N_2O-N emissions produced from managed soils (N_2O_{total}-N) must be calculated as the sum of indirect and direct N_2O-N emissions.

$$N_2O_{total}\text{-}N = N_2O_{direct}\text{-}N + N_2O_{indirect}\text{-}N$$

where:

N_2O_{direct}	annual direct N_2O-N emissions produced from managed soils [kg N_2O-N/ha·a]

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[8] See 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, section 11 (www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_11_Ch11_N2O&CO2.pdf)

[9] Global Nitrous Oxide Calculator (GNOC) (https://gnoc.jrc.ec.europa.eu/)

$N_2O_{indirect}$	annual indirect N_2O-N emissions (that is to say, the annual amount of N_2O-N produced from atmospheric deposition of N volatilised from managed soils and annual amount of N_2O-N produced from leaching and run-off of N additions to managed soils in regions where leaching/run-off occurs) [kg N_2O-N/ha·a]

Direct N_2O emissions are N_2O emissions that arise due to the cultivation of the field and are emitted directly from the cultivated soil. The calculation of these emissions must be performed depending on the soil type (mineral or organic soil).

Soils are considered organic if they satisfy requirements 1 and 2, or 1 and 3 below:

- Thickness of 10 cm or more. A horizon less than 20 cm thick must have 12% or more organic carbon when mixed to a depth of 20 cm;
- If the soil is never saturated with water for more than a few days, and contains more than 20% (by weight) organic carbon (about 35% organic matter);
- If the soil is subject to water saturation episodes and has either:
    - at least 12% (by weight) organic carbon (about 20% organic matter) if it has no clay; or
    - at least 18% (by weight) organic carbon (about 30% organic matter) if it has 60% or more clay; or
    - an intermediate, proportional amount of organic carbon for intermediate amounts of clay.

The direct N_2O emissions are divided into two soil groupings, where the determination of nitrogen emissions is calculated differently. Section a and b describe the specific calculation methods for direct N_2O emissions for the respective soil type.

Calculation of direct N_2O emissions (N_2O_{Direct})

a) Calculation of direct N_2O emissions for mineral soils

$$N_2O_{Direct}\text{-}N = [(F_{SN} + F_{ON}) \cdot EF_{1ij}] + [F_{CR} \cdot E_{F1}]$$

where

F_{SN}	annual synthetic nitrogen fertiliser input [kg N/ha·a]
F_{ON}	annual animal manure N applied as fertiliser [kg N/ha·a]

F_{CR}	annual amount of N in crop residues (above ground and below ground) calculated according to the method described in chapter 5.1 [kg N/ha·a]
EF_{1ij}	Crop and site-specific emission factors for N_2O emissions from synthetic fertiliser and organic N application to mineral soils calculated according to the method described in this section [kg N_2O-N/kg N_{input}]
EF_1	0,01 [kg N_2O-N/kg N_{input}]

The crop and site-specific emission factor for N_2O emissions from the application of synthetic fertiliser and organic nitrogen to mineral soils (EF_{1ij}) is determined based on the following formula:

$$EF_{1ij} = \frac{E_{fert,ij} - E_{unfert,ij}}{N_{appl,ij}}$$

where

$E_{fert,ij}$	N_2O emissions (in kg N_2O-N/ha·a) based on the S&B model (described below), where fertiliser input is the actual nitrogen application rate (mineral fertiliser and slurry) for crop i at site j
$E_{unfert,ij}$	N_2O emissions of crop i at site j (in kg N_2O-N/ha·a) based on the S&B model (described below). The N application rate is set to zero, all the other parameters are kept the same.
$N_{appl,ij}$	N input from mineral fertiliser and manure (in kg N/ha·a) to crop i at location j

N_2O emissions from soils under agricultural use, in different agricultural fields under different environmental conditions and agricultural land use classes can be determined following the Stehfest and Bouwman (2006) statistical model (referred to as "the S&B model"):

$$E_{N_2O} = \exp(c + \sum ev$$

where

E_{N_2O}	N_2O emissions in kg N_2O-N/h·a (for each $E_{fert,ij}$ & $E_{unfert,ij}$)
c	Constant value (see Table 2 in chapter 5.2)
ev	Effect value for different emission drivers. The ev-values can be found in Table 2 in chapter 5.2.

Applying the S&B Model and considering all effect values, following formula results to calculate $E_{fert,ij}$ and $E_{unfert,ij}$ respectively:

$$E_{fert,ij} = \exp\left(c + 0.0038 \cdot (F_{SN} + F_{ON}) + ev_{soc} + ev_{ph} + ev_{tex} + ev_{clim} + ev_{veg} + ev_{expl}\right)$$

$$E_{unfert,ij} = \exp(c + ev_{soc} + ev_{pH} + ev_{tex} + ev_{clim} + ev_{veg} + ev_{expl})$$

The ev-values can be found in Table 2 in chapter 5.2.

b) Calculation of direct N_2O emissions for organic soils

$$N_2O_{Direct}\text{-}N = [(F_{SN} + F_{ON}) \cdot EF_1] + [F_{CR} \cdot EF_1] + [F_{OS,CG,Temp} \cdot EF_{2CG,Temp}] + [F_{CROS,CG,Trop} \cdot E_{2CG,Trop}]$$

where

F_{SN}	annual synthetic nitrogen fertiliser input; [kg N/ha·a]
F_{ON}	annual animal manure N applied as fertiliser [kg N/ha·a]
F_{CR}	annual amount of N in crop residues (above ground and below ground) calculated according to the method described in chapter 5.1 [kg N/ha·a]
$F_{OS,CG,Temp}$	annual area of managed/drained organic soils under cropland in temperate climate [ha/a]
$F_{OS,CG,Trop}$	annual area of managed/drained organic soils under cropland in tropical climate [ha/a]
EF_1	0.01 [kg N_2O-N/kg N_{input}]
$EF_{2CG,Temp}$	8 [kg N/ha·a] for temperate organic crop and grassland soils
$EF_{2CG,Trop}$	16 [kg N/ha·a] for tropical organic crop and grassland soils

Calculation of indirect N_2O emissions ($N_2O_{indirect}$-N)

Indirect N_2O emissions are N_2O emissions resulting from the volatilization or leaching of nitrogen-containing substances from cultivated fields. In contrast to direct emissions, the calculation of indirect N_2O emissions is independent of the managed soil type, and therefore the formula is applicable to any soil type.

$$N_2O_{indirect}\text{-}N = [((F_{SN} \cdot Frac_{GASF}) + (F_{ON} \cdot Frac_{GASM})) \cdot EF_4] + [(F_{SN} + F_{ON} + F_{CR}) \cdot Frac_{Leach\text{-}(H)} \cdot EF_5]$$

F_{SN}	annual synthetic nitrogen fertiliser input; [kg N/ha·a]
$Frac_{GASF}$	0.10 [(kg N NH_3–N + NO_x–N)/kg $N_{applied}$]. Volatilisation from synthetic fertiliser
F_{ON}	annual animal manure N applied as fertiliser [kg N/ha·a]
$Frac_{GASM}$	0.20 [(kg N NH_3–N + NO_x–N)/kg $N_{applied}$]. Volatilisation from all organic nitrogen fertilisers applied
EF_4	0.01 [kg N_2O–N/(kg N NH_3–N + NO_x–$N_{volatilised}$)]
F_{CR}	annual amount of N in crop residues (above ground and below ground) calculated according to the method described in chapter 5.1 [kg N/ha·a]
$Frac_{Leach-(H)}$	0.30 [kg N/(kg $N_{additions}$)]. N losses by leaching/run-off for regions where leaching/run-off occurs
EF_5	0,0075 [kg N_2O–N/(kg $N_{leaching/run-off}$)]

4.1.6 Emissions from the collection, drying and storage of raw materials

Emissions from the collection, drying and storage of raw materials include all emissions related to fuel use in the collection, drying and storage of raw materials.

1. Emissions from collection

Emissions from the collection of raw materials include all the emissions resulting from the collection of raw materials and their transport to storage. The emissions are calculated using appropriate emission factors for the type of fuel used (diesel oil, gasoline, heavy fuel oil, biofuels or other fuels).

2. Emissions from drying biomass

The cultivation emissions include emissions from drying before storage as well as from storage and handling of biomass feedstock. Data on energy use for drying before storage includes actual data on the drying process used to comply with the requirements of storage, depending on the biomass type, particle size, moisture content, weather conditions, etc. Appropriate emission factors in accordance with Annex IX to Implementing Regulation (EU) 2022/996, including upstream emissions, must be used to account for the emissions from the use of fuels to produce heat or electricity used for drying. Emissions for drying include only emissions for the drying process needed to ensure adequate storage of raw materials. The emissions do not include drying of materials during processing.

3. Accounting for emissions from the consumption of electricity in agriculture

When accounting for the consumption of electricity not produced within the fuel production plant, the GHG emissions intensity of the produced and distributed electricity is assumed to be equal to the average emission intensity of the produced and distributed electricity in a defined region, which can be at a NUTS-2 **(if available and recognised by the European Commission)** region or a national level. If national electric emission coefficients are used for the GHG intensity of the produced and distributed electricity, the values from Annex IX of Implementing Regulation (EU) 2022/996 must be used. By way of derogation from this rule, producers may use an average value for an individual electricity production plant for electricity produced by that plant if it is not connected to the electricity grid and sufficient information are available to derive an emission factor.

4.2 Requirements for calculating greenhouse gas emissions resulting from land-use change (e_l)

In the case of land-use changes (converted areas) that took place on or after the cut-off date of 1 January 2008 and on which cultivation is permitted, under Article 29 of Revised Directive (EU) 2018/2001, the accumulated GHG emissions resulting from the land-use changes must be calculated and added to the other emission values. The term "land use changes" refers to changes among the six land categories recognised by the IPCC (forest land, grassland, cropland, wetlands, settlements and other land). Cropland and perennial cropland are considered a single land use. Perennial crops are defined as multi-annual crops whose stem is usually not harvested annually such as short rotation coppice and oil palm. For all grassland it must be established whether the grassland would remain or cease to be grassland in the absence of human intervention. Neither natural highly biodiverse grassland nor non-natural highly biodiverse grassland may be used for the production of biofuels, bioliquids and biomass fuels (s. *Scheme principles for the production of biomass, bioliquids biofuels and biomass fuels*). The Commission may adopt implementing acts specifying in more detail the criteria for designating natural and non-natural high biodiversity grassland. Once these implementing acts have been adopted, the defined criteria apply with immediate effect in the REDcert scheme.

This means, for example, that a change from grassland to cropland is a land-use change, while a change from one crop (such as maize) to another (such as rapeseed) is not. Cropland includes fallow land (i.e. land set at rest for one or several years before being cultivated again). A change of management activities, tillage practice or manure input practice is not considered land-use change.

GHG emissions from changes in carbon stocks resulting from land-use change (e_l) are to be calculated in accordance with Revised Directive (EU) 2018/2001 and Commission Decision 2010/335/EU of 10 June 2010.[10]

Annualised GHG emissions from carbon stock changes caused by land-use change (e_l) are calculated by dividing total emissions equally over 20 years. These emissions are calculated as follows:

$$e_l = (CS_R - CS_A) \times 3.664 \times \frac{1}{20} \times \frac{1}{P} - e_B$$

Where:

e_l	annualised greenhouse gas emissions from carbon stock change due to land-use change (measured as mass (grams) of CO_2-equivalent per unit biofuel/bioliquid/biomass fuel energy (megajoules)). Cropland and perennial cropland are considered a single land use.
CS_R	the carbon stock per unit area associated with the reference land use (measured as mass (tonnes) of carbon per unit area, including both soil and vegetation). The land use of the reference areas is the land use in January 2008 or 20 years before the raw material was obtained, whichever was later.
CS_A	the carbon stock per unit area associated with the actual land use (measured as mass (tonnes) of carbon per unit area, including both soil and vegetation). In cases where the carbon stock accumulates over more than one year, the value attributed to CS_A is the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever is earlier.
3.664	the quotient obtained by dividing the molecular weight of CO_2 (44.010 g/mol) by the molecular weight of carbon (12.011 g/mol) in gCO_2eq/gC
P	the productivity of the crop (measured as biofuel, bioliquid or biomass fuel energy per unit area per year)
e_B	bonus of 29 gCO_2eq/MJ of biofuel, bioliquids or biomass fuel if the biomass is produced on restored degraded land under the following conditions: If proof is provided that the land: (a) was not in use for agriculture or any other activity in January 2008; and (b) is severely degraded land, including such land that was formerly in agricultural use.

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[10] Commission Decision 2010/335/EU of 10 June 2010 is due for review. Any changes will immediately enter into force in the REDcert-EU scheme.

The bonus of 29 gCO_2eq/MJ applies for a period of up to 20 years from the date the land was converted to agricultural use, provided that a gradual increase in carbon stocks as well as a sizable reduction in erosion phenomena for land falling under (b) are ensured.

"Severely degraded land" means land that, for a significant period of time, has either been significantly salinated or presented significantly low organic matter content and has been severely eroded. If e_l is not zero, the annualised GHG emissions from changes in carbon stocks due to land use must be transferred as the value of e_l in gCO_2eq/t of dry matter of biomass to the next economic operator. The biomass producer must therefore use the same formulas as above, where the productivity of the plant (P) is expressed in t of dry matter content of biomass per hectare per year for the calculation.

The Commission will review, by 31 December 2020, guidelines for the calculation of land carbon stocks drawing on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories – volume 4 and in accordance with Regulation (EU) 525/2013 and Regulation (EU) 2018/841 of the European Parliament and of the Council. The Commission guidelines serve as the basis for the calculation of land carbon stocks for the purposes of Revised Directive (EU) 2018/2001. The criteria defined in the directive apply with immediate effect in the REDcert scheme.

If proof is provided that the cropland was categorised as "cropland" before 1 January 2008 and no changes in land use occurred after the cut-off date of 1 January 2008, e_l equals "0".

4.3 Requirements for the use of aggregate and measured values for agricultural management

Measured or aggregate values may be used for agricultural management (e_{ec} and e_l). The following must be kept in mind when using aggregated values:

- Aggregated GHG values can be calculated for farms operating as a group in a specific region and on the condition that this is done at a more detailed level than at NUTS 2 or similar level.
- The aggregated values for cultivation must be calculated according to the methodology for e_{ec} as described in section 4.1 "Requirements for calculating greenhouse gas emissions from the production of raw materials (e_{ec})".
- Input data should be primarily based on official statistical data from government authorities if available and of good quality. Otherwise, statistical data published by independent agencies can be used. As a third option, the data can also be taken from

literary sources or databases based on scientific and peer-reviewed work – with the precondition that the data used lies within the commonly accepted data range when available

- The data used must be based on the most recent data available from the above-mentioned sources. The data must generally be updated on a regular basis, unless there is no significant variability of the data over time
- With respect to fertiliser use, the type and quantity of fertiliser typical for the crops in the respective region must be used.
- If a measured value for yields is used (as opposed to an aggregated value) for the calculations, a measured value for fertiliser input must also be used and vice-versa.

Economic operators must specify the methods and sources used to determine the input data (e.g. average values based on representative yields, fertiliser input, N_2O emissions and changes in the carbon stock).

4.4 Requirements for the calculation of emissions savings from soil carbon accumulation via improved agricultural management (e_{sca})

Management practices, accepted for the purpose of achieving emission savings from soil carbon accumulation, are referred to as "improved agricultural management practices" in the context of RED III. These include the following:

- shifting to reduced or zero-tillage
- improved crop rotations and/or cover crops, including crop residue management
- use of organic soil improver (e.g. compost, manure digestion residues) use of biochar

Similarly, the use of manure/slurry as a substrate for the production of biogas and biomethane is regarded as improved agricultural manure/slurry management, which contributes to emission savings by preventing diffuse field emissions and can therefore be counted with a credit of 45.05 gCO_2eq/MJ manure and 54 kg CO_2eq per ton of fresh matter according to Implementing Regulation (EU) 2022/996, Annex IX.

Farmers who want to be credited with emission savings from improved agricultural management practices must register in the REDcert registration portal as a "Farm with e_{sca} practices", specifying the e_{sca} practices they would like to use, and submit a commitment as part of the self-declaration, which constitutes a commitment to use these improved agricultural management practices for a period of at least 10 years.

Emission savings from improved agricultural management practices can only be taken into account if they do not risk to negatively affect biodiversity. Further, solid and verifiable evidence must be provided that more carbon has been sequestered in the soil, or if it can reasonably be assumed that this was the case during the period in which the raw materials in question were cultivated. At the same time, it is necessary to take into account the emissions resulting from the increased use of fertilisers and plant protection products associated with these practices. For this purpose, adequate evidence must be provided (e.g. through the farmer's field record) on the historic use of fertilisers or herbicide that is to be counted as the average for the three years before the application of the new agricultural practices. The contribution of nitrogen fixation crops used to reduce the need for additional fertilisers can be considered in the calculations.

The emission savings from the accumulation of carbon stock in the soil through improved agricultural management practices (e_{sca}) are to be calculated using the following formula:

$$e_{sca} = (CS_A - CS_R) \times 3.664 \times 10^6 \times \frac{1}{n} \times \frac{1}{P} - e_f$$

Where:

CS_R	mass of soil carbon stock per unit area associated with the reference crop management practice in [t/ha]
CS_A	mass of soil estimated carbon stock per unit area associated with the actual crop management practices after at least 10 years of application in [t/ha]
3.664	the quotient obtained by dividing the molecular weight of CO_2 (44.010 g/mol) by the molecular weight of carbon (12.011 g/mol) in gCO_2eq/gC
P	productivity of the crop (measured as MJ biofuel, bioliquid or biomass fuel energy per ha per year).
n	period (in years) of the cultivation of the crop considered
e_f	emissions from the increased fertilisers or herbicide use

If an economic operator only uses the improved management practices on part of the farm, the GHG emissions savings can only be claimed for the area covered by them. If an economic operator uses different improved management practices on a single farm, a claim of GHG emission savings must be calculated and claimed individually for each e_{sca} practice.

The improved management practice must be applied for a continuous minimum period of 3 years before the emissions saved by the improved agricultural management practice can be credited. The emission savings determined by the end of the third year can be accumulated and credited to the first consignment after crediting is allowed.

The maximum possible total value of the annual claim of emission savings is capped at 45 gCO_2eq/MJ biofuel, bioliquids or biomass fuel. This maximum value applies if biochar is used as organic soil improver alone or in combination with other eligible e_{sca} practices. If biochar is not used, the maximum annual cap referred to above is 25 gCO_2eq/MJ biofuel, bioliquid or biomass fuel.

4.4.1 Determining the CS_R and CS_A values

CS_R and CS_A can be determined for an area if the entire area has a similar climate and soil type as well as similar management history in terms of tillage and carbon input to soil. This means that the values can be determined for a specific farm as well as across farms. Fields that have the same soil and climate characteristics, similar management history in terms of tillage and carbon input to soil and that will be subject to the same improved management practice may be grouped, including those fields belonging to different farmers.

The calculation of the CS_R and CS_A values of an area must be based on measurements of soil carbon stocks by a certified laboratory. A list of laboratories with the relevant certification is provided by the European Commission and will be made available by REDcert at www.redcert.org after publication by the European Commission.

The following rules apply for sampling, measuring soil carbon stock and determining soil storage density:

- Application of representative sampling method
    - sampling must be carried out for each plot or field
    - At least one grab sample of 15 well distributed sub-samples per every 5 hectares or per field, whichever is smaller must be taken. The heterogeneity of the plot’s carbon content must be taken into account.
    - Fields smaller than 5 hectares with same climatic conditions, soil type, reference farming practice and improved agricultural management practice can be grouped together.
    - Sampling must be done either in spring before soil cultivation and fertilisation or in autumn, a minimum of 2 months after harvest.
    - The direct measurements of soil carbon stock changes must be taken for the first 30 cm of soil.

    - Sampling to determine the actual soil carbon content must be carried out at the same points used to measure the baseline of soil carbon content under identical conditions (especially soil moisture).
    - All data relevant for sampling must be documented in the sampling protocol.
- Measurement of soil carbon content:
    - The sub-samples must first be dried, sieved, and if necessary homogenised (e.g. by grinding)
    - If the combustion method is used, only organic carbon and not inorganic carbon is to be included.
- Determining dry bulk density:
    - Changes in bulk density over time must be taken into account.
    - If possible, bulk density should be measured using the tapping method, that is to say by mechanically tapping a cylinder into the soil. If the tapping method is not possible, a reliable method must be used instead.
    - The samples must be oven-dried prior to weighing.

Samples obtained according to these rules must be retained for at least 5 years after measurement. The same applies to the documentation of measurements.

The CS_R must be measured at the farm before the management practice changes in order to establish a baseline. After the CS_R baseline has been established, the increase in soil carbon can be determined using the Rothamsted carbon model (RothC)[11] or a model of a voluntary certification scheme recognised by the European Commission or determined by representative measurements. If the model of another voluntary certification system recognised by the European Commission is used, this must be documented in the audit report and communicated separately to REDcert. However, it is imperative that the CS_A value is measured at regular intervals no later than 5 years apart and no earlier than three years after implementation of the improved agricultural management practice. From the first measurement of the CS_A value, this constitutes the ultimate basis for determining the actual values of the increase in soil carbon stock. However, after further modelling to estimate the annual increase in soil carbon stocks is only permitted if the models used have been calibrated, based on the real CS_A value measured.

The RothC model is applicable in arable soils, grassland and woodland, but not in tundra, taiga or permanently waterlogged (top)soils. In monthly steps, total organic carbon (t ha^{-1}) as one of the output parameters may be computed on a year to centuries time

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[11] Rothhamsted carbon model www.rothamsted.ac.uk/rothamsted-carbon-model-rothc

scale. It may be run in “forward” mode, in which the already known input parameters compute the changes in soil organic matter. In the RothC model, incoming organic input is distinguished between one inactive compartment, which comprises the inert organic matter, and four active compartments consisting of decomposable plant material (DPM) and resistant plant material (RPM) which decay to microbial biomass and humified organic matter by a first order process with its own characteristic rate. The ratio between DPM and RPM estimates the decomposability of the incoming plant material and is used to be 1.44 for most agricultural crops and improved grassland.

To model the increase in soil carbon using the RothC model, the following data must be documented:

- Monthly rainfall in millimetres
- Monthly pan evaporation in millimetres
- Average monthly mean air temperature in °C
- Soil clay content in %
- An estimate of the decomposability of the crop grown (corresponds to the ratio of decomposable plant material to decomposition-resistant plant material). The approach to estimation must be plausible, based on literature data, and must always be conservative.
- Soil cover (“yes” or “no”)
- Monthly input of plant residues in (tC ha^{-1})
- Monthly input of farmyard manure in (tC ha^{-1})
- Depth of the sampled soil layer

The data used for modelling must be retained for the entire duration of the commitment.

The application of the above methodology (measurement and modelling) for determining the e_{sca} value and the calculation of the individual GHG emissions values and all documentation must be duly verified by the auditor during the audit and documented in audit reports.

4.4.2 Penalties in the event of non-fulfilment of the commitment as well as in the event of non-compliance

If a farmer or an economic operator fails to comply with the commitment signed by him, the e_{sca} value of the current year for the farmer or economic operator is added as emissions to the overall GHG emissions of the energy crop delivered. The farm or economic operator is not permitted to include an e_{sca} value in the GHG calculations for 5 years. This applies regardless of whether the non-compliance took place in the REDcert-EU scheme or in another voluntary certification scheme recognised by the European Commission.

If a commitment has been signed in the name of an economic operator on behalf of several farmers and one of these farmers withdraws early, the above-mentioned penalties apply only to the farm that does not comply with the improved farm management practice and not to all the commitments of the economic operator.

If it is determined during an audit or otherwise that the farm or the economic operator reporting emission savings through improved agricultural management practices does not meet the conditions for reporting these emission savings and this results in the withdrawal of the certificate, REDcert must be informed of the facts immediately.

All farmers who are prohibited from further crediting e_{sca} savings either due to a certificate withdrawal or due to non-fulfilment of the commitment will be listed on the REDcert website and all certification schemes recognised by the European Commission will be informed.

4.4.3 Farms or economic operators that have already implemented improved agricultural management practices

Farms or economic operators who are already engaged in eligible e_{sca} practices and have made respective e_{sca} claims before the entry into force of this Implementing Regulation (EU) 2022/996 may apply a cap of 45 gCO_2eq/MJ biofuel, bioliquid or biomass fuel in a transition period until the first measurement of the CS_A value (at the latest 5 years after the implementation of the improved agricultural management practice). In such a case, after the CS_A value is determined the first time, the measured five-year difference of the soil carbon stock will become a cap for the annual claims to be made in the following period of 5 years.

If the improved agricultural management practice has been applied for a period longer than 5 years prior to the entry into force of Implementing Regulation (EU) 2022/996 and emission savings have been reported, the soil carbon stock must be measured immediately.

If the first measurement of the carbon stock increase at the 5th year shows higher total annual carbon stock increase, compared to the annual claims made, the annual difference can be claimed in subsequent years to compensate for lower carbon stock increases. If the annual increase in soil carbon stocks and thus the annual emission savings shows a lower total annual soil carbon stock increase compared to the annual claims made, the annual difference has to be deducted accordingly in the subsequent years since the measured value of the increase in soil carbon stock corresponds to the increase within five years, it is possible to simplify by distributing the value obtained equally over the years.

If economic operators have implemented agricultural management practices (e_{sca}) consistently in the past but no previous e_{sca} claims were made, annual retroactive e_{sca} claims can be made but for no longer than 3 years prior to certification. Implementation of the improved agricultural management practice must be proven to the auditor during the audit (e.g. proof via the field register). In such a case, the estimate of the CS_R baseline can be based on a comparative measurement of a neighbouring or other field with similar climatic and soil conditions as well as similar field management history. If there is no available data from such a field, the CS_R must be based on modelling and the first CS_A measurement must done immediately, at the moment of commitment. The five-year measurement frequency described above then applies.

Emission savings from e_{sca} are only applicable if the measure to improve agricultural management was implemented after 1. January 2008.

The European Commission reserves the right to adapt the methodological approach for determining e_{sca} described in the Implementing Regulation (EU) 2022/996 and included in the REDcert documents. This can be done both in the context of Revised Directive (EU) 2018/2001 and in future legislation (e.g. the EU Carbon Management Initiative). Any changes will take effect immediately in the REDcert-EU scheme.

4.5 Requirements for calculating greenhouse gas emissions from transport and distribution (e_{td})

Emissions from transport and distribution (e_{td}) include emissions from the transport of raw materials and semi-finished products and from the storage and distribution of finished products. All emissions produced by the market supplier (e.g. the filling station) are also considered in this formula. Economic operators along the biofuel/bioliquid/biomass fuels supply chain that receive biomass calculate the GHG emissions from transport using the following formula:

$$e_{td}\left[\frac{gCO_2eq}{t_{dry}}\right]=\frac{\left(d_{\text{loaded}}\times K_{\text{loaded}}+d_{\text{empty}}\times K_{\text{empty}}\right)\times EF_{\text{fuel}}}{m_{\text{load dry}}}$$

specified in mass units in relation to dry matter content of the transported biomass (gCO_2eq/t dry). This formula applies analogously to all transport options and the energy consumed for them.

In addition to the means of transport used (e.g. 40-tonne diesel truck), the following data must also be available:

d_{loaded}	transport distance across which the biomass, biofuel, bioliquid or biomass fuel was transported [km]
d_{empty}	transport distance when the transport vehicle was empty (if the transport vehicle is not empty upon return, it does not have to be included) [km]
m_{load}	measured mass of the transported biomass, biofuel, bioliquid or biomass fuel [t dry]
EF_{fuel}	emission factor fuel [gCO_2eq/l]
K_{loaded}	fuel consumption of the means of transport used per km when loaded [l/km]
K_{empty}	fuel consumption of the transport vehicle used per km when empty [l/km]

It must be kept in mind that this formula only applies for a single transport step. If there are more transport steps, the corresponding emissions must be calculated individually. Actual transport emissions can only be determined if the information for the transport steps is recorded and consistently passed along through the production chain. If not, the actual value cannot be calculated. The GHG emissions already included for production and cultivation do not have to be included again in the calculation. Other emissions from transport and distribution have to be added to e_{td}.

Alternatively, the following formula can be used to calculate e_{td}:

$$e_{td}\left[\frac{gCO_2eq}{t_{dry}}\right]=\frac{m_{\text{load in transport vehicle}}\times d_{\text{transported}}\times EF_{\text{transport type}}}{m_{\text{load dry in transport vehicle}}}$$

Where:

$m_{\text{load in transport vehicle}}$	measured mass of the transported biomass, biofuel, bioliquid or biomass fuel [t]
$m_{\text{load dry in transport vehicle}}$	measured dry matter of the transported biomass, biofuel, bioliquid or biomass fuel [t dry]
$d_{\text{transported}}$	transport distance across which the biomass, biofuel, bioliquid or biomass fuel was transported [km]
$EF_{\text{transport type}}$	Emission factor of the specific transport type [$gCO_2eq\ t^{-1}\ km^{-1}$]

If loads are used with different transport types, the specific transport emissions must be determined for each transport type.

The values (emission factors, transport efficiencies, etc.) in Annex IX of Implementing Regulation (EU) 2022/996 must be used to calculate e_{td}. As the transport efficiencies listed in Annex IX of Implementing Regulation (EU) 2022/996 are based data published by the JRC which already take into account the return voyage (empty), no separate calculation of the return voyage is required when using the alternative formula.

If an emission factor is not listed in Annex IX a scientific literature source or scientifically recognised database (e.g. ecoinvent database) can be used. However, if a standard value is included in Annex IX, it **must** be applied.

If upstream transport is calculated, the actual GHG emissions must be divided by the amount of dry matter content of the transported biomass. Conversion plants calculate upstream transport emissions in gCO_2eq/t of dry matter content of the transported biomass. The upstream transport emissions therefore have to be adapted by applying a feedstock factor and an allocation factor to provide the GHG emissions for the product to the recipient (see section 2.3 "Calculation using actual values").

If biomethane is transported via the European gas grid, the economic operator injecting and transporting biomethane into the European gas grid must take gas losses of **0.01 gCH_4/MJ** into account.

The last interface is responsible for calculating the emissions from transport and distribution of the final product.

The GHG emissions related to the storage of biofuels, bioliquids and biomass fuels as well as the emissions produced by filling stations must also be included. These GHG emissions are based on use for electricity production It is possible that several storage facilities need to be included individually in the calculation for imported biofuels. For the calculation of the emissions produced by filling stations and depots, the values published by JRC[12] (**depot: 0.00084 MJ/MJ fuel, filling station: 0.0034 MJ/MJ fuel)** can be applied. It is important to note that these values must be multiplied by the current emission factor of the national electricity mix as listed in Annex IX of the Implementing Regulation (EU) 2022/996 to calculate the final emissions of the storage facility or filling station (e.g. storage emissions = 0.00084 MJ/MJ fuel x $EF_{electricity}$). These values apply to all biofuels (e.g. FAME, ethanol). However, the values are not applicable to biomethane for the transport sector because they do not take into account compression at the filling station.

4.6 Requirements for calculating greenhouse gas emissions from the use of biofuels/bioliquids/biomass fuels (e_u)

CO_2 emissions of the fuel in use (e_u) are taken to be zero for biofuels, bioliquids and biomass fuels. Emissions of non-CO_2 greenhouse gases (N_2O and CH_4) of the fuel in use must be included in the e_u factor for bioliquids and biomass fuels (excluding biomethane for transport sector). For biofuels and biomethane for transport, it is therefore not necessary to calculate emissions of the fuel in use (e_u). However, the calculation of non-CO_2 emissions from liquid biofuels is necessary and must be carried out in the form of a GHG emission savings calculation by the last interface (see section 4.11 "Calculating the green-house gas emission savings by the last interface").

4.7 Requirements for calculating greenhouse gas emissions from processing (e_p)

Emissions from processing (e_p) include emissions from the processing itself, from waste and leakage and from the production of chemicals or other products used for processing, including CO_2 emissions equivalent to the carbon content of fossil inputs regardless of whether they are combusted in the process. The following formula, which only applies for a single processing step, is used:

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[12] Edwards, R., O'Connell, A., Padella, M., Giuntoli, J., Koeble, R., Bulgheroni, C., Marelli, L., Lonza, L., Definition of input data to assess GHG default emissions from biofuels in EU legislation, Version 1d -2019, EUR 28349 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-02907-6, doi:10.2760/69179, JRC115952 (http://www.op.europa.eu/de/publication-detail/-/publication/7d6dd4ba-720a-11e9-9f05-01aa75ed71a1/language-en) (last accessed on 30.10.2024).

$$e_p = \frac{EM_{electricity} + EM_{heat} + EM_{production\ inputs} + EM_{wastewater}}{yield_{main\ product\ dry}}$$

specified in mass units in relation to the dry matter content of the main product (gCO_2eq/t dry). (EM= emissions;[13] EF= emission factor)

$$EM_{electricity}\left[\frac{gCO_2eq}{a}\right] = \text{electricity consumption} \times EF_{electricity}$$

$$EM_{heat}\left[\frac{gCO_2eq}{a}\right] = \text{fuel consumption} \times EF_{fuel}$$

$$EM_{production\ inputs}\left[\frac{gCO_2eq}{a}\right] = amount_{production\ inputs} \times EF_{production\ inputs}$$

$$EM_{wastewater}\left[\frac{gCO_2eq}{a}\right] = amount_{wastewater} \times EF_{wastewater}$$

$$yield_{main\ product\ dry}\left[\frac{t_{dry}}{a}\right] = \text{annual dry yield of the main product}$$

The formula below is to be used to specify the emissions of the dry matter in t:

$$e_p(\text{main product}_{dry})\left[\frac{gCO_2eq}{t_{dry}}\right] = \frac{e_p(\text{main product}_{wet})}{(1\text{-moisture content})}$$

To calculate the GHG emissions from processing (e_p), the following data at a minimum must be collected on site, i.e. the respective values are taken from, e.g. company documents:

electricity consumption	total electricity consumption per year [kWh a^{-1}]
heat generation	type of fuel/combustible used to produce steam (e.g. heating oil, gas, agricultural crop residues)
fuel consumption	total annual consumption of fuel for heat generation, (e.g. heating oil [kg], gas [kg], bagasse [kg]) [kg a^{-1}]
production of inputs	quantity of chemicals or additional products (inputs) used in processing [kg a^{-1}]

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[13] The term “EM” = emissions refers to the total emissions and not only to the emissions of the main product.

wastewater quantity	quantity of wastewater per year [l a^{-1}]
yield main product	annual harvest of the main product [kg a^{-1}]

Input data for calculating the processing emissions in the production chain must be measured or based on technical specifications of the processing facility. If the range of emissions for a group of processing facilities (which the respective facility belongs to) is known, the most conservative emission value (highest) for this group is to be used. Actual values of emissions for processing can only be determined if all the information about emissions relevant to the interface is recorded and consistently passed along through the production chain. Other emissions from processing have to be added to e_p. Biodiesel derived by transesterification of fats with methanol (FAME) are regarded in the Renewable Energy Directive as being 100% of renewable origin. Like other inputs, the carbon footprint of the methanol used in the esterification process needs to be taken into account in the calculation of the GHG emission intensity of the biofuel. This approach was also used to calculate the default values.

The values (emission factors, heating values, etc.) in the table in Annex IX of the Implementing Regulation (EU) 2022/996 must be used to calculate e_p.

In the case of biomethane liquefaction, if actual values for electricity, lubricant and propane consumption are not available, the consumption data from the JEC Well-to Tank report v5 can be used[14]. These values must be multiplied with the respective emission factor listed in Annex IX of the Implementing Regulation (EU) 2022/996.

If an emission factor is not listed in Annex IX a scientific literature source or scientifically recognised database (e.g. ecoinvent database) can be used. However, if a standard value is included in Annex IX, it **must** be applied.

The source must be cited for values taken from scientific literature sources or scientifically recognised databases. If there are different values from producers, the most conservative value must be used. It is also important to include the emissions arising from chemicals and energy that are also indirectly linked to the production of biofuels, bioliquids and biomass fuels.

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[14] JEC Well-to-Tank report v5: https://publications.jrc.ec.europa.eu/repository/handle/JRC119036 (accessed on Oktober 2023). The assumed process for methane liquefaction is described in the "CBM" Excel sheet, in any xxLGx pathway (for example OWLG1 in cell B83). If no actual data is available, the electricity and LPG consumption (OWLG1, cell E69 and E70) can be used and multiplied by their emission factors).

In accounting for the consumption of electricity not produced within the fuel plant, the GHG emission intensity of the production and distribution of that electricity is to be assumed to be equal to the average emission intensity of the production and distribution of electricity in the country where the processing takes place. The national emission intensities for grid electricity listed in Annex IX of Implementing Regulation (EU) 2022/996 must be used. If the emission intensity for grid electricity is not listed in Annex IX of Implementing Regulation (EU) 2022/996, the average national emission intensity of the country's electricity generation could be the appropriate choice.

If a fuel plant is operated solely with energy generated on site and there is no connection to the public electricity or heat grid (100% stand-alone solution), the corresponding individual GHG value can be used for the electricity or heat emission factor.

In practice, stand-alone solutions are more the exception than the rule. A grid connection is typically indispensable to ensure the production capability of the renewable energy or heat generation plant and to supply excess and non-regulated quantities of electricity/heat that could potentially jeopardise the infrastructure.

In the case that the renewable energy plant is connected to the electricity or heat grid and the fuel plant is operated solely or partially with the renewable energy generated on site, this can be considered in the accounting. This requires a suitable metering infrastructure that can clearly document the direction of energy flow and the electricity quantity. If this is a quantity of renewable energy produced, for example, by a wind turbine or a photovoltaic installation, the emission factor for electricity or heat can be set to 0. Guarantees of origin for electricity from renewable energy sources or other certificates are not applicable to reduce greenhouse gas emissions.

4.8 Requirements for calculating the emission saving from CO_2 capture and replacement (e_{ccr})

Emission savings from CO_2 capture and replacement (e_{ccr}) shall be related directly to the production of the biofuels, bioliquids or biomass fuels to which they are attributed and shall be limited to emissions avoided through the capture of CO_2 of which the carbon originates from biomass, and which is used to replace fossil-derived CO_2 in the production of commercial products and services.

Note that the option to credit emission savings by e_{ccr} is only possible if the biogenic CO_2 is used to replace fossil-derived CO_2 in the production of commercial products and services before 1. January 2036. This means that from 1. January 2036, it will no longer be possible to credit e_{ccr}.

To be able to claim these emission savings, the following proof must be provided:

- The purpose for which the captured CO_2 is used.
- The origin of the CO_2 that is replaced.
- The origin of the CO_2 that is captured.
- Information on emissions due to CO_2 capturing and processing

To supply evidence on the origin of the CO_2 that is replaced, operators using the captured CO_2 must specify how the CO_2 that is replaced was previously generated and state, in writing, that due to the replacement, emissions in that quantity are avoided.

The evidence must enable auditors to verify whether the requirements of Revised Directive (EU) 2018/2001 are met including that emissions are avoided.

In order to verify whether the captured CO_2 is used in commercial products and services to replace CO_2 produced from fossil raw materials, it is sufficient to verify whether the CO_2 has been sold to an economic operator who can be expected to have an economically viable use for the CO_2.

In this case, there is no need for the certifying company to provide evidence of the actual (end) use of the biogenic CO_2 to replace fossil-derived CO_2 on a case-by-case basis. However, verifiable objective evidence on the CO_2 quantities produced from biogenic carbon in defined time periods must be kept, whereby only those quantities can be credited that are sold on the market as directly commercially usable CO_2 or are used directly and are of biogenic origin.

The following parameters are to be considered when calculating the emission saving (e_{ccr}):

- produced quantity of biofuels, bioliquids or biomass fuels
- produced quantity of biogenic CO_2

The following are also to be determined in relation to the processing of CO_2 (e.g. separation and compression of CO_2):

- consumed quantity of energy (electricity, heat, etc.)
- consumed quantity of auxiliary materials
- other process-specific, energy-related input variables

This data, as well as further information on the greenhouse gas intensity of the substances/energies used, is required to calculate the emission savings using the formula element e_{ccr}.

The emissions saving e_{ccr}, specified in the unit g CO_2eq/MJ of fuel (biofuel, bioliquid, biomass fuel), is calculated as follows:

$$e_{ccr}\left[\frac{gCO_2eq}{MJ_{fuel}}\right] = \frac{\text{saved quanitity}_{CO_2} - \text{energy}_{\text{consumed}} \times EF - \text{mass}_{\text{auxilary materials}} \times EF}{\text{produced quantity}_{\text{fuel}} \times LHV_{\text{fuel}}}$$

The balancing period of the emission saving (e_{ccr}) must be linked to the GHG balancing period of the respective production pathway of the fuel.

If the CO_2 is not captured continuously, it may be appropriate to attribute different quantities of savings to biofuels, bioliquids or biomass fuels obtained from the same process.

However, a higher saving of CO_2 should never be allocated to a given batch of biofuels, bioliquids or biomass fuels per MJ than the savings from the average quantities of CO_2 in a hypothetical process which captures the total CO_2 from the process.

For example, it would not be justified to allocate different quantities of savings to different biofuels, bioliquids and biomass fuels obtained from the same process All biofuels, bioliquids or biomass fuels originating from the process are treated equally in this respect.

All emissions and information related to CO_2 capture and savings must be included in the greenhouse gas calculation and documentation and verified by the auditor. These include:

a) the purpose for which the captured CO_2 is used
b) the origin of the CO_2 that is replaced
c) the origin of the CO_2 that is captured
d) information on emissions due to capturing and processing of CO_2

For the purposes of (b), economic operators using captured CO_2 may state how the CO_2 that is replaced was previously generated and declare, in writing, that emissions equivalent to that quantity are avoided because of the replacement. That evidence is considered sufficient to verify compliance with the requirements of Revised Directive (EU) 2018/2001 and the avoidance of emissions.

If CO_2 is captured for the purposes of producing a renewable liquid and gaseous fuels of non-biological origin (RFNBO), the quantity of CO_2 captured may not be credited under e_{ccr}. This is also inadmissible if the CO_2 verifiably replaces CO_2 from fossil origin in the production of the RFNBO.

4.9 Requirements for calculating the emission savings from CO_2 capture and geological storage (e_{ccs})

Emission savings from carbon capture and geological storage (e_{ccs}) not already included in e_p is limited to emissions prevented by the **effective** capture and **safe** storage of emitted CO_2 directly linked to the extraction, transport, processing and distribution of fuel.

The following parameters are to be considered when calculating the emission saving (e_{ccs}):

- produced quantity of biofuels, bioliquids or biomass fuels
- produced quantity of biogenic CO_2

The following are also to be determined in relation to the processing of CO_2 (e.g. separation and compression of CO_2):

- consumed quantity of energy (electricity, heat, etc.)
- consumed quantity of auxiliary materials
- other process-specific, energy-related input variables

This data, as well as further information on the greenhouse gas intensity of the substances/energies used, is required to calculate the emission savings using the formula element e_{ccs}.

The emissions saving e_{ccs}, specified in the unit gCO_2eq/MJ of fuel (biofuel, bioliquid, biomass fuel), is calculated as follows

$$e_{ccs}\left[\frac{gCO_2eq}{MJ_{fuel}}\right] = \frac{\text{stored quanitity}_{CO_2} - \text{energy}_{consumed} \times EF - \text{mass}_{\text{auxilary materials}} \times EF}{\text{produced quantity}_{fuel} \times LHV_{fuel}}$$

Emission savings from carbon capture and geological storage (e_{ccs}) not already included in e_p is limited to emissions prevented by the capture and storage of emitted CO_2 directly associated with the production, transport, processing and distribution of biofuel, bioliquid and biomass fuel, if storage complies with Directive 2009/31/EC[15] on the geological storage of carbon dioxide. The balancing period of the emission saving (e_{ccs}) must be linked to the greenhouse gas balancing period of the respective production pathway of the fuel (biofuels,

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[15] Directive 2009/31/EC

bioliquids or biomass fuels). In the case of geological storage of CO_2, the certification body approved by REDcert must verify the evidence provided on the integrity of the storage site and the volume of the CO_2 stored. This verification must be part of the audit report that is uploaded to the REDcert database. In addition to the audit report, all evidence (including relevant documents) must also be provided to REDcert by the certification body after the certification process is completed. This evidence will be assessed by REDcert as part of the internal monitoring. The certification bodies are also obliged to provide the competent supervisory authorities access to the data to upon request.

Where a third party carries out the transport or geological storage of CO_2, proof of storage may be provided through the relevant contracts with and invoices of that third party.

If the CO_2 is not continuously captured, see section 4.8 "Requirements for calculating the emission saving from CO_2 capture and replacement (e_{ccr})".

4.10 Allocation of the greenhouse gas emissions

If other products ("co-products") are produced during a fuel production process in addition to the fuel, the total greenhouse gas emissions from the process are allocated between the biofuel, liquid biofuel and biomass fuel or intermediate product and the co-products according to their energy content (lower heating value). The portion of GHG emissions allocated to the respective elements of the formula according to Revised Directive (EU) 2018/2001, Annex V, Part C, No. 1 and Annex VI, Part B, No. 1 must be calculated using the following formula (if applicable):

$$e_{allocated} = \text{Sum of GHG emissions} \times \text{allocation factor}$$

The variable total GHG emissions in the formula above is the sum of all GHG gas emissions that are produced up to and including the process step in which the co-product is produced. The allocation involves the formula elements e_{ec} + e_l + e_{sca} + the shares of e_p, e_{td}, e_{ccs} and e_{ccr} up to and including the process step where a co-product is produced. If GHG emissions were already allocated to by-products in an earlier process step, the portion of these greenhouse gas emissions that was assigned to the respective intermediate product in the last process step is used for the total (total GHG).

Heat and electricity are generally excluded from allocation. The defined lower heating values (LHV) of both forms of energy (1 kWh/kWh) mathematically exclude an allocation based on the LHV. The greenhouse gas intensity of excess useful heat and electricity corresponds to the greenhouse gas intensity of the heat or electricity supplied for a fuel production process. It is determined by calculating the greenhouse gas intensity of all inputs to the cogeneration, conventional (i.e. boiler) or other installation supplying heat or electricity for a fuel production process and the emissions from that installation, including raw materials and CH_4 and N_2O emissions. The detailed calculation method to calculate the greenhouse gas intensity of excess useful heat and electricity is described in section 4.11 "Calculating the greenhouse gas emission savings by the last interface".

To calculate the allocation factor for intermediate products and fuels (biofuels, bioliquids, biomass fuels), the following data is collected at a minimum on site, i.e. the respective values are taken from, e.g. company documents:

- mass of intermediate product or fuel [kg dry]
- mass of the co-product [kg dry]

The formula for calculating the allocation factor for the intermediate product is as follows:

$$\text{allocation factor}_{\text{intermediate}} = \left[\frac{\text{energy content}_{\text{intermediate}}}{\text{energy content}_{\text{intermediate}} + \text{energy content}_{\text{co-products}}}\right]$$

The formula for calculating the allocation factor for fuels is as follows:

$$\text{allocation factor}_{\text{fuel}} = \left[\frac{\text{energy content}_{\text{fuel}}}{\text{energy content}_{\text{fuel}} + \text{energy content}_{\text{co-products}}}\right]$$

where:

$$\text{energy content}_{\text{fuel}}\ [\text{MJ}] = \text{yield}_{\text{fuel}}[\text{kg}] \times \text{LHV}_{\text{fuel}}\left[\frac{\text{MJ}}{\text{kg}}\right]$$

$$\text{energy content}_{\text{co-product}}\ [\text{MJ}] = \text{yield}_{\text{co-product}}[\text{kg}] \times \text{LHV}_{\text{co-product}}\left[\frac{\text{MJ}}{\text{kg}}\right]$$

The energy content is determined using the LHV and the yield. The LHV used in applying this rule should be that of the entire (co-)product, not of only the dry fraction of it.

No emissions shall be allocated to waste, agricultural crop residues and processing residues, since they are considered to have zero emissions until the point of their collection[16].

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[16] Similarly, if these materials are used as raw materials, they start with zero emissions at the collection point.

Allocation should be applied directly after a co-product (a substance that would normally be storable or tradable) and biofuel, bioliquid, biomass fuel or intermediate product are produced at a process step. This can be a process step within a plant after which further "downstream" processing takes place for either product. However, if downstream processing of the (co-) products concerned is interlinked (by material or energy feedback loops) with any upstream part of the processing, the system is considered a "refinery"[17] and allocation is applied at the points where each product has no further downstream processing that is interlinked by material or energy feedback loops with any upstream part of the processing.

All co-products that have no heating value and therefore do not fall under Annex V, Point 17 or Annex VI, Point 17 of the Revised Directive (EU) 2018/2001 must be taken into account when determining the allocation factor. The energy content of co-products with negative energy content is set to zero.

4.11 Calculating the greenhouse gas emission savings by the last interface

The last interface calculates the total GHG emissions "E" in gCO_2eq/MJ of fuel (biofuel, bioliquid and biomass fuels). If actual values are used, see section 3.3 "Calculation using actual values".

Greenhouse gas emissions, which are available in the unit gCO_2eq/t of dry feedstock, can be converted into the unit gCO_2eq/MJ of fuel using the following formula:

$$e_{ec}(\text{fuel})\left[\frac{gCO_2eq}{MJ_{\text{fuel}}}\right]_{ec} = \frac{e_{ec}(\text{feedstock})}{LHV} \times \text{feedstock factor}_{\text{fuel}} \times \text{allocation factor}_{\text{fuel}}$$

The GHG emission savings of the supplied fuel is then calculated compared to the respective reference value for fossil fuels/liquids:

The potential GHG emission savings of biofuels and biomass fuels for transport are calculated using the following formula:

$$\text{GHG emission savings} = \frac{(E_{F(t)} - E_B)}{E_{F(t)}}$$

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[17] See Communication of the European Commission (2010/C 160/02), Annex II

where:

EB	total emissions from the use of the biofuel/biomass fuel
$E_{F(t)}$	total emissions from the fossil fuel comparator for transport

The fossil fuel comparator ($E_{F(t)}$) must be set to 94 gCO_2eq/MJ of biofuel/biomass biofuel.

If the fossil fuel comparators change, the revised values are implemented in the scheme with immediate effect.

The greenhouse gas saving from the use of bioliquids to produce heat and electricity and/or cooling or excess useful heat and electricity compared to the respective fossil reference value can be calculated using the following formula:

$$\text{GHG-emission saving} = \frac{(EC_{F(h\&c,\ el)} - EC_{B(h\&c,\ el)})}{EC_{F(h\&c,el)}}$$

where:

$EC_{B(h\&c,el)}$	total emissions from the heat or electricity production
$EC_{F(h\&c,el)}$	total emissions from the fossil fuel comparator for useful heat or electricity

For bioliquids used to produce electricity or excess useful heat and electricity, the fossil fuel comparator ($EC_{F(el)}$) is 183 gCO_{2eq}/MJ of electricity.

For bioliquids used to produce useful heat or to produce heat or cooling or excess useful heat and electricity, the fossil fuel comparator ($EC_{F(el)}$) is 80 gCO_{2eq}/MJ of electricity.

If the fossil fuel comparators change, the revised values are implemented in the scheme with immediate effect.

Greenhouse gas emissions from biomass plants that supply only electricity, or excess electricity must be calculated as follows:

$$EC_h = \frac{E}{\eta_h}$$

$$EC_{el} = \frac{E}{\eta_{el}}$$

where:

$EC_{h,el}$	total greenhouse gas emissions from the final energy commodity

E	total greenhouse gas emissions of the bioliquid before end conversion or the total greenhouse gas emissions of biofuel, bioliquid or biomass fuel used to produce the excess useful heat and electricity
η_{el}	the electrical efficiency, defined as the annual electricity produced divided by the annual fuel input, based on its energy content
η_h	the heat efficiency, defined as the annual useful heat output divided by the annual fuel input, based on its energy content

When heating and cooling are co-generated with electricity in a single process, emissions are allocated between useful heat and generated electricity. For the purposes of this calculation, the actual efficiencies are used, defined as the annual mechanical energy, electricity and heat produced respectively divided by the annual energy input.

GHG emissions for electricity or mechanical energy are calculated as follows:

$$EC_{el} = \frac{E}{\eta_{el}} \left(\frac{C_{el} \cdot \eta_{el}}{C_{el} \cdot \eta_{el} + C_h \cdot \eta_h} \right)$$

The GHG emissions of useful heat produced in co-generation are calculated as follows:

$$EC_h = \frac{E}{\eta_h} \left(\frac{C_h \cdot \eta_h}{C_{el} \cdot \eta_{el} + C_h \cdot \eta_h} \right)$$

where:

$EC_{h,el}$	total greenhouse gas emissions from the final energy commodity
E	total greenhouse gas emissions of the bioliquid before end conversion
η_{el}	the electrical efficiency, defined as the annual electricity produced divided by the annual energy input, based on its energy content
η_h	the heat efficiency, defined as the annual useful heat output divided by the annual energy input, based on its energy content
C_{el}	fraction of exergy in the electricity, and/or mechanical energy, set to 100% (C_{el} = 1)
C_h	Carnot efficiency (fraction of exergy in the useful heat)

Exergy is the fraction of the total energy of a system or material flow that can do work when it is brought into thermodynamic equilibrium with its environment. In the case of the generation of electricity or mechanical energy, the REDcert scheme assumes that the exergy share is 100%, i.e. that there is no energy loss during the transmission through the grid until electricity is removed from the grid.

The useful part of the heat is determined by multiplying its energy content with the Carnot efficiency (C_h). The Carnot efficiency (C_h) is the highest theoretically possible efficiency in converting thermal energy into useful heat. It describes the ratio of useful heat to the amount of heat absorbed and is higher the greater the temperature difference between the useful heat at the point of delivery and its ambient temperature. Since neither absolute zero nor infinitely high temperatures can be reached, a Carnot efficiency of 100% is impossible.

Accordingly, the Carnot efficiency (C_h) for useful heat is defined as follows:

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

where:

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 Kelvin (0°C)

If excess heat is generated in the cogeneration process and used to heat buildings, at a temperature below 150°C, C_h (423,15 kelvin) can be set at 0,3546.

The following definitions apply for the calculation:

(a) "cogeneration" means the simultaneous generation in one process of thermal energy and electrical and/or mechanical energy

(b) "useful heat" means heat generated to satisfy an economical justifiable demand for heat, for heating or cooling purposes

(c) "economically justifiable demand" means the demand that does not exceed the needs for heat or cooling, and which would otherwise be satisfied at market conditions

For information on calculating GHG emissions of biogas by co-digestion of different substrates, see section 4.12 "Calculation of biogas co-digestion processing emissions".

4.12 Calculation of biogas co-digestion processing emissions

The total emissions from the use of a biomass fuel resulting from a co-digestion of different substrates must be calculated as a sum considering on pro rata the share of the respective inputs and their emission factors. This means that E is to be calculated as a single value for the whole amount of the biogas/biomethane, resulting from the co-digestion.

Balancing default values

If the calculation is based on default values, the calculation of E for biogas resulting from co-digestion must be performed as follows:

$$E = \sum_{1}^{n} S_n \times E_n$$

where:

E	greenhouse gas emissions per MJ biomethane produced from co-digestion of the defined mixture of substrates
S_n	share of feedstock n in energy content
E_n	emissions in gCO_2eq/MJ biomethane for the option as provided in Annex VI Part D of Directive (EU) 2018/2001

The share of feedstock n in the energy content is calculated as follows:

$$S_n = \frac{P_n \times W_n}{\sum_1^n P_n \times W_n}$$

where:

P_n	energy yield [MJ] per kilogram of wet input of feedstock n (*)
W_n	weighting factor of substrate n defined as:

$$W_n = \frac{I_n}{\sum_1^n I_n} \times \left(\frac{1 - AM_n}{1 - SM_n}\right)$$

where:

I_n	annual input to digester of substrate n [tonne of fresh matter]

AM_n	average annual moisture of substrate n [kg water/kg fresh matter]
SM_n	standard moisture for substrate n (**)

(*) The following values for P_n are used to calculate typical and default values:

$P_{(Maize)}$	4.16 [MJ biogas/kg wet maize at 65% moisture]
$P_{(Manure)}$	0.50 [MJ biogas/kg wet manure at 90% moisture]
$P_{(Biowaste)}$	3.41 [MJ biogas/kg wet biowaste at 76% moisture]

(**) The following values of the standard moisture for substrate SM_n are used:

$SM_{(Maize)}$	0.65 [kg water/kg fresh matter]
$SM_{(Manure)}$	0.90 [kg water/kg fresh matter]
$SM_{(Biowaste)}$	0.76 [kg water/kg fresh matter]

Changes to these values or calculation methods originating from Revised Directive (EU) 2018/2001, for example due to delegated acts of the European Commission to review and, if necessary, adjust the methods and values of Annex VI of Revised Directive (EU) 2018/2001, will take effect immediately in the REDcert scheme.

Balancing actual values:

If the calculation is based on actual values, the calculation of E for biogas resulting from co-digestion must be performed as follows:

$$E = \sum_{1}^{n} S_n \times (e_{ec,n} + e_{td,\ feedstock,n} + e_{l,n} - e_{sca,n}) + e_p + e_{td,\ Produkt} + e_u - e_{ccs} - e_{ccr}$$

where:

E	greenhouse gas emissions from the production of biomethane before conversion into electricity
S_n	share of feedstock n, in fraction of input to the digester
$e_{ec,n}$	emissions from the extraction or cultivation of feedstock n
$e_{td,feedstock,n}$	emissions from transport of feedstock n to the digester

$e_{l,n}$	annualised emissions from carbon stock changes caused by land use change, for feedstock n
e_{sca}	emission savings from improved agricultural management of feedstock n
e_{p}	emissions from processing
$e_{td,Product}$	emissions from transport and distribution of biogas and/or biomethane
e_{u}	emissions from the fuel in use, i.e. greenhouse gases emitted during combustion
e_{ccs}	emission savings from CO_2 capture and geological storage
e_{ccr}	emission savings from CO_2 capture and replacement

5 Annex

5.1 Determining the the annual amount of Nitrogen in above and below ground crop residues

To calculate N_2O_{direct}-N and $N_2O_{indirect}$-N multiple factors must be considered. One of these factors is the nitrogen input from above and below ground crop residues (F_{CR}) remaining on and in the managed soil. The nitrogen input from above and below ground crop residues must be determined crop specific following the systematic described below:

The nitrogen input from above and below ground crops residues must be determined for:

coconut and oil palm plantations by applying a fixed nitrogen input based on literature as IPCC (2006) provides no default calculation method for standard emission factors pursuant to Annex IX;

sugar beet and sugar cane according to IPCC (2006) Vol. 4 Chapter 11 Eq. 11.6, not considering below-ground residues and with the addition of Nitrogen input from vignasse and filter cake in the case of sugar cane using following formulae:

$$F_{CR} = Yield \cdot DRY \cdot (1 - Frac_{Burnt} \cdot C_f) \cdot [R_{AG} \cdot N_{AG} \cdot (1 - Frac_{Remove})] + F_{VF}$$

where:

Yield	fresh yield of the crop [kg/ha]
DRY	dry matter fraction of harvested product [$kg_{dry\ matter}$/($kg_{fresh\ weight}$]
$Frac_{Burnt}$	Fraction of crop area burnt annually [ha/ha]
C_f	Combustion factor [dimensionless]
R_{AG}	Ratio of above-ground residues, dry matter to harvested dry matter yield, for the crop [$kg_{dry\ matter}$/ $kg_{dry\ matter}$]
N_{AG}	N content of above-ground residues [kg N/$kg_{dry\ matter}$]
$Frac_{Remove}$	Frac-tion of aboveground residues removed from field [$kg_{dry\ matter}$/$kg_{above\ ground\ dry\ matter}$]
F_{VF}	Annual amount of N in sugar cane vignasse and filter cake returned to the field [kg N/ha], calculated as Yield·0,000508

for all other crops according to IPCC (2006) Vol. 4 Chapter 11 Eq. 11.7a 11.11, 11.12; the calculation must be performed by using the following formula:

$$F_{CR} = (1 - Frac_{Burnt} \cdot C_f) \cdot AG_{DM} \cdot N_{AG} \cdot (1 - Frac_{Remove}) + (AG_{DM} + Yield \cdot DRY) \cdot R_{BG\text{-}BIO} \cdot N_{BG}$$

where:

$Frac_{Burnt}$	of crop area burnt annually [ha/ha]
C_f	Combustion factor [dimensionless]
AG_{DM}	Above-ground residue dry matter [kg$_{\text{dry-matter}}$/ha]
N_{AG}	N content of above-ground residues [kg N/kg$_{\text{dry matter}}$]
$Frac_{Remove}$	Fraction of aboveground residues removed from field [kg$_{\text{dry matter}}$/kg$_{\text{above ground dry matter}}$]
Yield	annual fresh yield of the crop [kg/ha]
DRY	dry matter fraction of harvested product [kg$_{\text{dry matter}}$/(kg$_{\text{fresh weight}}$]
$R_{BG\text{-}BIO}$	Ratio of belowground residues to above-ground biomass [kg$_{\text{dry matter}}$/kg$_{\text{dry matter}}$]
N_{BG}	N content of below-ground residues [kg N/kg$_{\text{dry matter}}$]

Crop-specific parameters to calculate the nitrogen input from crop residues are listed in table 1 in chapter 5.2.

5.2 Tabulated values for the calculation of N_2O_{total}-N

Table 1: Crop-specific parameters to calculate nitrogen input from crop residues

Crop	**Calculation method**	**DRY**	**LHV**	**NAG**	**slope**	**intercept**	**RBG_BIO**	**NBG**	**C_f**	**RAG**	**Fixed amount**	**Data sources***
Barley	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.865	17	0.007	0.98	0.59	0.22	0.014	0.8			1,2
Cassava	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.302	16.15	0.019	0.1	1.06	0.2	0.014	0.8			1,2
Coconuts	Fixed N from crop residues	0.94	32.07								44	1,3
Cotton	No inform. on crop residues	0.91	22.64									
Maize	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.86	17.3	0.006	1.03	0.61	0.22	0.007	0.8			1,2
Oil palm fruit	Fixed N from crop residues	0.66	24								159	1,4
Rapeseed	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.91	26.976	0.011	1.5	0	0.19	0.017	0.8			1,5
Rye	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.86	17.1	0.005	1.09	0.88	0.22	0.011	0.8			1,6
Safflower seed	No inform.on crop residues	0.91	25.9									
Sorghum (grain)	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.89	17.3	0.007	0.88	1.33	0.22	0.006	0.8			1,7
Soybeans	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.87	23	0.008	0.93	1.35	0.19	0.087	0.8			1,8
Sugar beets	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.6	0.25	16.3	0.004					0.8	0.5		1,9
Sugar cane	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.6	0.275	19.6	0.004					0.8	0.43		1,10
Sunflower seed	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.9	26.4	0.007	2.1	0	0.22	0.007	0.8			1,11
Triticale	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.86	16.9	0.006	1.09	0.88	0.22	0.009	0.8			1,2
Wheat	IPCC (2006) Vol. 4 Ch. 11 Eq. 11.7a	0.84	17	0.006	1.51	0.52	0.24	0.009	0.9			1,2

1: References for parameters DRY and LHV see Appendix 1 of the JRC report “Definition of input data to assess GHG default emissions from biofuels in EU legislation”, version 1d - 2019, https://data.europa.eu/doi/10.2760/69179

2: IPCC (2006) Vol. 4 Chapter 11 Table 11.2 (Factor a=Slope, b=Intercept, N_{AG}, R_{BG-BIO} and N_{BG}) and Chapter 2 Table 2.6 (Factor Cf). For Cassava and Triticale, the general values for "Tubers" and

"Cereals" respectively, are considered.

3: Magat (2002), Mantiquilla et al. (1994), Koopmans and Koppejan (1998), Bethke (2008) (data compilation by W. Weindorf. Ludwig Boelkow Systemtechnik GmbH, Ottobrunn, Germany)

4: Schmidt (2007) (data compilation by R. Edwards, JRC, Ispra, Italy)

5 N_{AG} and N_{BG} from Trinsoutrot et al. (1999) Table 1. Residue to seed ratio and factor a is based on Scarlat et al. (2010) Table 1. Ratio of belowground residues to above-ground biomass ($R_{BG\text{-}BIO}$) assumed to be the same as for beans and pulses in IPCC (2006) Vol. 4 Chapter 11 Table 11.2.

6 IPCC (2006) Vol. 4 Chapter 11 Table 11.2, value for R_{BG_BIO} assumed to be similar to Grains

7: IPCC (2006) Vol. 4 Chapter 11 Table 11.2, value for R_{BG_BIO} assumed to be similar to Maize

8: IPCC (2006) Vol. 4 Chapter 11 Table 11.2, except N_{BG} which is underestimated in IPCC (2006) according Chudziak and Bauen (2013).

9: Due to lack of information on below-ground residues for sugar beet, a modified method was used which does not take into account the below-ground biomass. The value for R_{AG} and N content of above-ground residues was adopted from the EDGAR database (European Commission Joint Research Centre (JRC) / Netherlands Environmental Assessment Agency (PBL), 2010). However, there is large disagreement between the R_{AG} and N_{AG} values for Sugar beets applied in different countries (see Adolfsson, 2005).

10: Sugarcane is a semi-perennial crop. Sugarcane is typically replanted every six or seven years. For this period the root system remains alive. As IPCC (2006) does not provide default values, a modified method was used which does not take into account the below-ground biomass. The value for R_{AG} and N content of above-ground residues was adopted from the EDGAR database (European Commission Joint Research Centre (JRC) / Netherlands Environmental Assessment Agency (PBL), 2010).

11: Del Pino Machado, A.S. (2005) gives 0.0072 kg N per kg per dry matter of sunflower shoots. Corbeels et al. (2000) report a 0.0067 kg N per kg per dry matter in stalks. For GNOC a value of 0.007 kg N per kg above-ground residues dry matter was applied. Value - a - for the calculations of N input from crop residues according IPCC (2006) is based on the average of the "residue to crop production" values given for sunflower in Table 1 of Scarlat et al. (2010) Ratio of belowground residues to above-ground biomass and N_{BG} assumed to be the same as IPCC (2006) gives for maize.

Table 2: Constant and effect values for calculating N_2O emissions from agricultural field based on the S&B model

Constant value (c)	-1.516	
Parameter	Parameter class or unit	Effect value (ev)
Fertilizer Input		$0.0038 \cdot N_{\text{application rate}}\ [\frac{\text{kg N}}{\text{ha} \cdot \text{a}}]$
Soil organic C content (soc)	<1 %	0
	1-3 %	0.0526
	>3 %	0.6334
pH (ph)	<5.5	0
	5.5-7.3	-0.0693
	>7.3	-0.4836
Soil texture (tex)	Coarse	0
	Medium	-0.1528
	Fine	0.4312
Climate (clim)	Subtropical climate	0.6117
	Temperate continental climate	0
	Temperate oceanic climate	0.0226
	Tropical climate	-0.3022
Vegetation (veg)	Cereals	0
	Grass	-0.3502
	Legume	0.3783
	None	0.5870
	Other	0.4420
	Wetland rice	-0.8850
Length of experiment (expl)	1 yr	1.9910

6 Relevant documents

The documentation structure of the REDcert-EU scheme includes the following:

No.	Document	Published/revised
1	Scope and basic scheme requirements	The current version of the REDcert-EU scheme principles is published on the website at www.redcert.org.
2	Scheme principles for the production of biomass, bioliquids and biofuels	
3	Scheme principles for GHG calculation	
4	Scheme principles for mass balancing	
5	Scheme principles for neutral inspections	
6	System principles for integrity management	
7	Phase-specific checklists	
8	Definitions in the REDcert-EU scheme	
Revised Directive (EU) 2018/2001. Available via: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02018L2001-20240716		

REDcert reserves the right to create and publish additional supplementary scheme principles if necessary.

The legal EU regulations and provisions for sustainable biomass as well as biofuels and bioliquids including other relevant references that represent the basis of the REDcert-EU documentation are published separately on the REDcert website at www.redcert.org. When legal regulations are referenced, the most current version is always assumed.

7 Revision information for Version EU 06

Section	**Change**
General	**Reworded:** Revised Directive (EU) 2018/2001 instead of Directive (EU) 2018/2001 RED III instead of RED II
3.1	Where the emissions deviate significantly (≥ 10%) from typical values or calculated actual values of emissions savings are abnormally high (greater than 30% deviation from default values according to Annex V, Parts A and B of Directive (EU) 2018/2001), reasons must be given for the deviations in the audit report. If implausibilities result in the audit not being passed, REDcert must be informed in accordance with the valid system requirements for neutral inspections. **Changed to:** Where the emissions deviate significantly (≥ 10%) from typical values or calculated actual values of emissions savings are abnormally high (greater than 30% deviation from default values according to Annex V Parts A and B and Annex VI Part A of Revised Directive (EU) 2018/2001), reasons must be given for the deviations in the audit report. If implausibilities result in the audit not being passed, REDcert must be informed in accordance with the valid scheme principles for neutral inspections.
3.2	Default values must be taken from Annex V, Part A and B and Annex VI, Part A and D of Directive (EU) 2018/2001 as well as from the RED II Corrigenda of 25 September 2020. The European Commission may update the default values. Any updates will immediately enter into force in the REDcert scheme. **Changed to:** Default values must be taken from Annex V, Part A and B and Annex VI, Part A and D of Revised Directive (EU) 2018/2001. The European Commission may update the default values. Any updates will immediately enter into force in the REDcert scheme.
3.3 / 3.4	Economic operators may alternatively use a value for the emissions from the extraction, harvesting or cultivation of raw materials calculated for a NUTS level 2 region or a region at more at a more disaggregated NUTS level6, provided that ➢ the production of the raw material took place in that region, and

- a Member State or a third country submitted a report pursuant with Article 31 (2) and (3), and
- the European Commission by means of implementing acts decided that the report contains accurate data for the purpose of measuring GHG-emissions in that region.

NUTS-2 values are to be indicated in the unit gCO2eq/kg of dry matter along the entire production chain. These values are alternatives to the individually calculated values. They are published on the website of the European Commission and are not default values. Consequently, they can only be considered input values to calculate and adjust individual cultivation emissions of the downstream interfaces. They are not suitable for specifying emissions from the cultivation phase in gCO2eq/MJ of biomass fuel.

If no such NUTS-2 value exists in the region of cultivation, economic operators must either use an actual value or an existing disaggregated default value.

Moved from section 3.4 to section 3.3 and changed to:

For the emissions from the extraction or cultivation of raw materials (e_{ec}), economic operators may use a value calculated for a NUTS level 2 region or a region at a more disaggregated NUTS level as an alternative to an individually calculated value, provided that

- the production of the raw material took place in that region, and
- a Member State or a third country submitted a report pursuant with Article 31 (2) and (3), and
- the European Commission by means of implementing acts decided that the report contains accurate data for the purpose of measuring GHG-emissions in that region.

NUTS-2 values are to be indicated in the unit gCO$_2$eq/kg of dry matter along the entire value chain. Consequently, they can only be considered input values to calculate and adjust individual cultivation emissions of the downstream interfaces. They are not suitable for specifying emissions from the cultivation phase in gCO$_2$eq/MJ of biomass fuel.

<table>
<tr><td></td><td>If no such NUTS-2 value exists in the region of cultivation, economic operators must either use an actual value or an existing disaggregated default value (s. chapter 3.4).</td></tr>
<tr><td>3.3</td><td>The greenhouse gases to be included in the GHG calculation are CO_2, N_2O and CH_4. To calculate the CO2 equivalence, these gases are weighted as follows in accordance with the Annex V of Directive (EU) 2018/2001:
<table>
<tr><th>Greenhouse gas</th><th>CO_2 equivalence</th></tr>
<tr><td>CO_2</td><td>1</td></tr>
<tr><td>N_2O</td><td>298</td></tr>
<tr><td>CH_4</td><td>25</td></tr>
</table>

If these values or other relevant emission or conversion factors change in Directive (EU) 2018/2001, they apply in the REDcert scheme with immediate effect in the REDcert system upon publication on the EUROPA website of the European Commission.
Changed to:
The greenhouse gases to be included in the GHG calculation are CO_2, N_2O and CH_4. To calculate the CO_2 equivalence, these gases are weighted as follows in accordance with Annex IX of Implementing Regulation (EU) 2022/996:
<table>
<tr><th>Greenhouse gas</th><th>CO_2 equivalence</th></tr>
<tr><td>CO_2</td><td>1</td></tr>
<tr><td>N_2O</td><td>265</td></tr>
<tr><td>CH_4</td><td>28</td></tr>
</table>

If these values or other relevant emission or conversion factors change, they apply in the REDcert scheme with immediate effect upon publication on the EUROPA website of the European Commission (here).</td></tr>
<tr><td>4.1</td><td>Life cycle greenhouse gas emissions from waste and residues, including straw, husks, corn cobs and nutshells, and residues from processing, including crude glycerine (unrefined glycerine) and bagasse, are set to zero until these materials are collected, regard-less of whether they are</td></tr>
</table>

	processed into intermediate products before being converted into the final product. **Changed to:** Life cycle greenhouse gas emissions from waste and residues, including straw, husks, corn cobs and nutshells, and residues from processing, including crude glycerine (unrefined glycerine), bagasse and all wastes and residues included in Annex IX of Revised Directive (EU) 2018/2001, are set to zero until these materials are collected, regardless of whether they are processed into intermediate products before being converted into the final product.
4.4	[…], which contributes to emission savings by preventing diffuse field emissions and can therefore be counted with a credit of 45.05 gCO_2eq/MJ biogas and 54 kg CO_2eq per ton of fresh matter according to Implementing Regulation (EU) 2022/996, Annex IX. **Changed to:** […], which contributes to emission savings by preventing diffuse field emissions and can therefore be counted with a credit of 45.05 gCO_2eq/MJ manure and 54 kg CO_2eq per ton of fresh matter according to Implementing Regulation (EU) 2022/996, Annex IX. Emission savings from improved agricultural management practices can be taken into account if reliable and verifiable evidence is provided that more carbon has been sequestered in the soil, or if it can reasonably be assumed that this was the case during the peri-od in which the raw materials in question were cultivated. **Changed to:** Emission savings from improved agricultural management practices can only be taken into account if they do not risk to negatively affect biodiversity. Further, solid and verifiable evidence must be provided that more carbon has been sequestered in the soil, or if it can reasonably be assumed that this was the case during the period in which the raw materials in question were cultivated.
4.5	Alternative formula has been corrected. **Added:** As the transport efficiencies listed in Annex IX of Implementing Regulation (EU) 2022/996 are based data published by the JRC which already take into account the return voyage (empty), no separate

	calculation of the return voyage is required when using the alternative formula.
4.4 / 4.7	For gas losses, an emission factor of 0.17 gCH_4/MJ biomethane must be applied by the last interface. **Moved from section 4.7 to section 4.4 and changed to:** If biomethane is transported via the European gas grid, the economic operator injecting and transporting biomethane into the European gas grid must take gas losses of 0.01 gCH_4/MJ into account.
4.7	In accounting for the consumption of electricity not produced within the fuel plant, the GHG emission intensity of the production and distribution of that electricity is to be assumed to be equal to the average emission intensity of the production and distribution of electricity in a defined region: ➢ Where the EU is the defined region, the average EU emission intensity is the assumed reference level. ➢ In the case of third countries, where grids are often less linked-up across borders, the national average, e.g. could be the appropriate choice. **Changed to:** In accounting for the consumption of electricity not produced within the fuel plant, the GHG emission intensity of the production and distribution of that electricity is to be assumed to be equal to the average emission intensity of the production and distribution of electricity in the country where the processing takes place. The national emission intensities for grid electricity listed in Annex IX of Implementing Regulation (EU) 2022/996 must be used. If the emission intensity for grid electricity is not listed in Annex IX of Implementing Regulation (EU) 2022/996, the average national emission intensity of the country's electricity generation could be the appropriate choice.
4.8	The definition of this emissions saving in accordance with Annex V Part C No. 15 and Annex VI Part C No. 15 of the Directive (EU) 2018/2001 is: *"Emission savings from CO_2 capture and replacement (e_{ccr}) shall be related directly to the production of biomass fuel they are attributed to and shall be limited to emissions avoided through the capture of CO_2 of which the carbon originates from biomass, and which is used to replace fossil-derived CO_2 in production of commercial products and services."*

	Changed to: Emission savings from CO_2 capture and replacement (e_{ccr}) shall be related directly to the production of the biofuels, bioliquids or biomass fuels to which they are attributed and shall be limited to emissions avoided through the capture of CO_2 of which the carbon originates from biomass, and which is used to replace fossil-derived CO_2 in the production of commercial products and services. **Added:** Note that the option to credit emission savings by e_{ccr} is only possible if the biogenic CO_2 is used to replace fossil-derived CO_2 in the production of commercial products and services before 1. January 2036. This means that from 1. January 2036, it will no longer be possible to credit e_{ccr}.
4.10	**Added:** All co-products that have no heating value and therefore do not fall under Annex V, Point 17 or Annex VI, Point 17 of the Revised Directive (EU) 2018/2001 must be taken into account when determining the allocation factor.

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