RSB – ROUNDTABLE ON SUSTAINABLE BIOMATERIALS

# RSB Standard for EU Market Access

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## Introduction

Starting in **2010, producers, operators and traders of biofuels and bioliquids shall comply with the sustainability regime for biofuels and bioliquids (EU sustainability criteria for biofuels) as defined in EU Directive 2018/2001/EU on the promotion of the use of energy from renewable sources (RED II), to access the EU market and in the Fuel Quality Directive (2009/30/EC).**

The EU Commission can **recognise voluntary schemes (such as the RSB EU RED certification system) as sufficient proof that raw materials used to produce the biofuels consumed in EU Member States comply with the sustainability criteria laid down in the Directive. EU Member States are obliged to accept this proof of compliance in accordance with REDII Article 30(4).**

**The EU Commission may also recognise national schemes for compliance with the requirements set out in Directive 2018/2001/EU. As required by the RED II, RSB will not refuse mutual recognition with a recognised Member State's scheme as regards the verification of compliance with the mandatory sustainability criteria set out in Articles 29(2) to (7) and (10) and the GHG savings thresholds set in Article 25(2) of the RED II and with the criteria for certification of low ILUC-risk biofuels, bioliquids and biomass fuels set out in Delegated Regulation (EU) 2019/807 for the recognition of national schemes**

The objective of **RSB's Standard for EU Market Access [RSB-STD-11-001], is to guarantee compliance of the RSB EU RED certification system with the EU sustainability criteria for biofuels and bioliquids, in order to ensure recognition of the RSB EU RED certification system by the EU as proof of compliance of biofuels and bioliquids with the EU sustainability criteria as defined in Directive 2018/2001/EU on the promotion of the use of energy from renewable sources (EU RED) and in the Fuel Quality Directive (2009/30/EC). This version 4.0 of the standard takes into account all changes in this regulatory context as laid down in European Union's Directive 2015/1513 and 2018/2001.**

The **standard specifies the requirements for operations producing, converting, processing, trading and using biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels which have to be met in the RSB certification system, in addition to the RSB EU RED standards and procedures to be compliant with the EU sustainability criteria for renewable fuels and liquids. The standard also contains criteria for certification of low ILUC-risk biofuels, bioliquids and biomass fuels set out in Delegated Regulation (EU) 2019/807 for the recognition of national schemes.**

All **participating operators producing, converting, processing, trading biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels for use in the in the European Union shall comply with the provisions of this standard in addition to all other RSB EU RED standards and procedures.**

Product**s compliant with the RSB Standard on EU Market Access [RSB-STD-11-001] shall be clearly marked as being compliant with the EU sustainability criteria as defined in the EU Directive 2018/2001/EU on the promotion of the use of energy from renewable sources (EU RED) and in the Fuel Quality Directive (2009/30/EC).**

**Please see the full history of changes in Annex X of this Standard.**

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# A Intent of this standard

The standard specifies the requirements for operations producing, converting, processing, trading and using biomass / biofuels / bioliquids / biomass fuels / renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels which have to be met in the RSB EU RED certification system to be compliant with the EU sustainability criteria for Biofuels and bioliquids, as defined in the Directive 2018/2001/EU on the promotion of the use of energy from renewable sources (EU RED) and the EU Directive 2009/30/EC, which revises the EU Directive 98/70/EC (FQD).

Users of this standard shall ensure that the intent of the EU RED, FQD, and any other related documentation is met.

# B Scope of this standard

**This standard is an international standard and valid worldwide for all participating operators producing, converting, processing, trading biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels for use in the European Union.**

**It specifies the requirements for operations producing, converting, processing, trading and using fuels and liquids which have to be met within the RSB EU RED certification system in addition to the applicable provisions of all other RSB EU RED standards and procedures to be compliant with the RED and FQD.**

# C Status and effective date

This version 5.1 of this *RSB Standard for EU Market Access* shall be effective on 13h March 2024.

Whenever any contradiction or inconsistency exists between this version and previous versions of this standard, the latest version shall prevail. Any new version of this document will be notified immediately via email to all Participating Operators, Certification Bodies and RSB Accreditation Body.

# D Note on the use of this standard

All aspects of this standard are considered to be normative, including the intent scope, standard effective date, references, terms and definitions, tables and annexes, unless otherwise stated.

**Users implementing this standard shall ensure that the intent of this standard is met. To ensure that the intent of this standard is met users shall implement all of the requirements specified in this standard, and any and all additional measures necessary to achieve the intent of this standard.**

In the event of any inconsistency between this RSB Standard and the RSB Principles and Criteria [RSB-STD-01-001], this RSB Standard shall prevail.

## E References

Please see RSB's List of Documents and References [RSB-DOC-10-001] for the full list of RSB Standards and references.

## F Terms and definitions

For the purposes of this International Standard, the terms and definitions given in the Directive 2018/2001/EU on the promotion of the use of energy from renewable sources (EU RED II), and in the RSB Glossary of Terms [RSB-STD-01-002] shall apply.

## G Requirements

**1. General requirements for integration of EU sustainability criteria for biomass, biofuels and bioliquids in RSB EU RED certification system**

1. 1. The following standards and procedures shall apply in addition to this standard:

RSB Principles & Criteria [RSB-STD-01-001]

RSB EU RED Standard for Advanced Fuels based on wastes and residues [RSB-STD-11-001-01-010]

RSB Standard Amendment – RSB Requirements for woody biomass [RSB-SA-01]

RSB Procedure for Participating Operators [RSB-PRO-30-001]

RSB EU RED Procedure for Traceability (Chain of Custody) [RSB-PRO-11-001-20-001]

RSB Procedure for Communication & Claims [RSB-PRO-50-001]

RSB Procedure for Risk Management [RSB-PRO-60-001]

In the case of inconsistencies between standards, this RSB Standard for EU Market Access shall prevail.

1. 2. The participating operator using this standard shall comprehensively, consistently and transparently comply with the recast EU Renewable Energy Directive 2018/2001/EU.

Participating operators failing or unwilling to comply with the requirements set out by the EU Commission and Members states in full shall be respectively excluded from participating in EU RED certification.

1. 3. All participating operators producing, converting, processing, trading biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels for use in the European Union and recognition under EU RED and/or the EU Fuel Quality Directive shall comply with the provisions of this standard in addition to the RSB Principles &

Criteria and all other RSB EU RED standards and procedures.

1. 3. 1. Participating operators involved in primary production of biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels for use in the European Union shall include in their certification scope only operations involved in primary production of biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels which are near each other and which produce under substantially similar conditions with regard to the specific land use requirements for primary production detailed under section G.2 of this standard and with regard to the specific requirements for greenhouse gas (GHG) calculation detailed under section G.8 of this standard.

1. 3. 2. Participating operators involved in converting, processing, trading and/or otherwise handling biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels for use in the European Union shall include in their certification scope only operations involved in conversion, processing, trade and/or otherwise handling of biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels which have substantially similar/alike operational systems and products and are managed by a common management structure for the purpose of the scope of certification.

1. 4. In cases where this RSB Standard for EU Market Access [RSB-STD-11-001] and the RSB Principles & Criteria and/or other RSB standards and procedures specify requirements on the same or similar issues participating operators using this standard shall always ensure compliance with the more rigorous requirement, and at minimum with the requirement specified in this standard.

1. 5. In case of changes, additions and/or alterations to the EU sustainability criteria for biofuels and bioliquids or related requirements by the European Commission, the participating operator shall comprehensively, consistently and transparently implement the changed, added and/or altered requirements.

Please note: The RSB Secretariat communicates on a regular basis to the participating operators about additions and/or alterations to the EU sustainability criteria for biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels or related requirements by the European Commission, including details of lists on protected areas, and updates its documentation on a regular basis. Regardless of the communication, it remains the obligation of the participating operator to implement the changed, added and/or altered requirements, including any details of lists on protected areas, as soon as they are published and implemented by the European Commission.

1. 6. In case EU sustainability criteria for biomass/biofuels/bioliquids/biomass fuels are not fully covered by RSB EU RED standards and procedures, participating operators shall implement the EU sustainability criteria for biomass/biofuels/bioliquids/biomass fuels in addition to the RSB EU RED standards and procedures.

1. 7. Participating operators shall apply the EU sustainability criteria for biomass/biofuels/bioliquids/biomass fuels to raw material produced in the EU and to imports of raw materials into the EU used for production of biofuels/bioliquids/biomass fuels used in EU Member States.

1. 8. The lead auditor appointed shall identify any non-compliance with the mandatory requirements of the EU-RED as either a major non-compliance or critical non-compliance dependant on the nature of the non-compliance.

1. 9. All participating operators producing, converting, processing, trading biomass/biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport

fuels of non-biological origin and recycled carbon fuels product in compliance with this standard and other RSB EU RED standards and procedures shall clearly identify such biomass/biofuels/bioliquids/ biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels product as being compliant with the RSB EU RED Standard, and use the relevant RSB EU RED compliance claim, as defined in the RSB Procedure for Communication & Claims [RSB-PRO-50-001].

1. 10. Acceptance of material certified under other voluntary or national schemes in accordance with REDII Article 30(4).

RSB certified operators must accept material certified against other voluntary or national schemes as "EU RED compliant" material if the voluntary or national scheme has been recognised by the European Commission for the relevant scope (see also RSB-STD-11-001-20-001).

If material that is consisting of or derived from waste or residues has been certified under a voluntary system other than the RSB, the operator shall only accept this material as "EU RED compliant" if the requirements and the assurance system of this voluntary system has been benchmarked as equivalent to the RSB and the voluntary system has been recognised by the RSB.

1. 11. For (intermediary) products based on the conversion, processing, blending, trading, use or any handling by RSB Participating Operators of materials certified through a voluntary or national scheme other than the RSB the short claim shall be:

**"EU RED compliant Biomass"**

**"EU RED compliant Biofuel"**

"EU RED compliant Advanced Fuel"

or equivalent.

1. 12. Participating operators shall cooperate with the EU Commission and the competent authorities of the Member States, including granting access to the premises of POs where requested as well as making available to the Commission and the competent authorities of the Member States all information needed to fulfil their tasks under Directive (EU) 2018/2001.

Participating operators failing or unwilling to comply with the requirements set out by the EU Commission and Members states in full shall be respectively excluded from participating in EU RED certification.

**2. Specific land use requirements for agricultural biomass**

2. 1. Participating operators shall ensure and provide evidence that land with a high biodiversity value is not used for the primary production of agricultural biomass for biofuels, bioliquids and biomass fuels.

As per Directive 2018/2001/EC Article 29(3), land with high biodiversity value is land that had one of the following statuses on or after 1 January 2008, whether or not the land continues to have that status:

2. 1. 1. Primary forest and other wooded land, namely forest and other wooded land of native species, where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed;

2. 1. 2. Highly biodiverse forest and other wooded land, which is defined as species-rich and not degraded as per 2.1.5.4b and 2.1.5.4c, or has been identified as being highly biodiverse by the relevant competent authority;

2. 1. 3. Areas designated:

2. 1. 3. 1. By law or by the relevant competent authority for nature protection purposes; or

2. 1. 3. 2. For the protection of rare, threatened or endangered ecosystems or species, recognised by international agreements or included in lists drawn up by intergovernmental organizations or the International Union for the Conservation of Nature, subject to their recognition by the European Commission;

Unless evidence is provided that the production of that raw material in areas under 2.1.3.1 or 2.1.3.2 did not interfere with those nature protection purposes.

2. 1. 4. Natural highly bio-diverse grassland or non-natural highly bio-diverse grassland.

2. 1. 5. For the purpose of paragraph 2.1.4, the following definitions and criteria shall apply:

2. 1. 5. 1. 'Grassland' means terrestrial ecosystems dominated by herbaceous or shrub vegetation for at least 5 years continuously. It includes meadows or pasture that is cropped for hay but excludes land cultivated for other crop production and cropland lying temporarily fallow. It further excludes continuously forested areas as defined in Article 29(4)(b) of Directive 2018/2001/EC unless these are agroforestry systems which include land-use systems where trees are managed together with crops or animal production systems in agricultural settings. The dominance of herbaceous or shrub vegetation means that their combined ground cover is larger than the canopy cover of trees;

A managed pasture for more than 5 years continuously within agricultural rotation can be defined as cropland, if the area has been converted to cropland prior to January 2008 and can be assumed that the pasture is no longer productive and a change back to a crop/pasture rotation improves the soil carbon stock;

2. 1. 5. 2. 'Human intervention' means managed grazing, mowing, cutting, harvesting or burning;

2. 1. 5. 3. 'Natural highly biodiverse grassland' means grassland that:

a. would remain grassland in the absence of human intervention; and

b. maintains the natural species composition and ecological characteristics and processes;

2. 1. 5. 4. 'Non-natural highly biodiverse grassland' means grassland that:

2. 1. 5. 4. a. ceased, or would have ceased in the absence of human intervention, to be grassland; **and**

2. 1. 5. 4. b. is not degraded, that is to say it is not characterised by long-term loss of biodiversity due to for instance overgrazing, mechanical damage to the vegetation, soil erosion or loss of soil quality; **and**

2. 1. 5. 4. c. is species-rich, meaning:

i) a habitat of significant importance to critically endangered, endangered or vulnerable species as classified by the

International Union for the Conservation of Nature Red List of Threatened Species or other lists with a similar purpose for species or habitats laid down in national legislation or recognised by a competent national authority in the country of origin of the raw material; or

ii) a habitat of significant importance to endemic or restricted-range species; or

iii) a habitat of significant importance to intra-species genetic diversity; or

iv) a habitat of significant importance to globally significant concentrations of migratory species or congregatory species; or

v) a regionally or nationally significant or highly threatened or unique ecosystem;

**and**

2.1.5.4.d. has been identified as being highly biodiverse by the relevant competent authority.

**Note 1**: any land that is, or was, non-natural, highly biodiverse grassland in or after January 2008 may be used for fuels production on condition that harvesting of the raw material is necessary to preserve the status of the grassland as highly biodiverse grassland and that current management practices do not present a risk of causing biodiversity decline of the grassland.

**Note 2:** Participating Operators shall provide evidence that the harvesting of the raw material is necessary to preserve the highly biodiverse grassland status and that management practices do not present a risk of causing biodiversity decline of the grassland. Where Participating Operators are unable to provide this evidence, they shall provide evidence that they have been granted permission by the relevant competent authority, or designated agency, to harvest the raw material in order to preserve the highly biodiverse grassland status.

2.1.5.5. Without prejudice to the above, grasslands in the following geographic ranges shall always be regarded as highly biodiverse grassland:

2.1.5.5.1. habitats as listed in Annex I to Council Directive 92/43/EEC[1]

2.1.5.5.2. habitats of significant importance for animal and plant species of Union interest listed in Annexes II and IV to Directive 92/43/EEC;

2.1.5.5.3. habitats of significant importance for wild bird species listed in Annex I to Directive 2009/147/EC of the European Parliament and of the Council[2];

2.1.5.5.4. Where land remains grassland, or would have remained grassland in the absence of human intervention, and is located in any of the geographic ranges listed in Regulation (EU) No 1307/2014.

Highly biodiverse grassland in the European Union is not limited to the geographic ranges referred to under 2.1.5.5.1, 2.1.5.5.2 and 2.1.5.5.3. Other grassland might fulfil the criteria for highly biodiverse grassland set out in 2.1.5.4.

[1] http://eur-lex.europa.eu/legal-content/EN/AUTO/?uri=OJ:L:1992:206:TOC (page 7)
[2] http://eur-lex.europa.eu/legal-content/EN/AUTO/?uri=OJ:L:2010:020:TOC (page 7)

2. 1. 5. 6. For land that is located outside the areas referred to in 2.1.5.5.4., the Participating Operator shall provide evidence to demonstrate whether the grassland maintains, or would have maintained in the absence of human intervention, the natural species composition and ecological characteristics and processes. Where that is the case, the land shall be considered as being, or having been, natural, highly biodiverse grassland. Where grassland has already been converted to arable land and it is not possible to assess the characteristics of the land itself through information available from the national competent authorities or satellite imagery, such land shall be considered as not having been highly biodiverse grassland at the moment of conversion.

2. 1. 5. 7. Where evidence is provided that the harvesting of the raw material is necessary to preserve the grassland status, no further evidence to show compliance with Article 7b(3)(c)(ii) of Directive 98/70/EC and Article 17(3)(c)(ii) of Directive 2009/28/EC has to be provided.

**Note**: The definition of highly bio-diverse grassland contained in G.2.1.5.1 and G.2.1.5.2 is based on Commission Regulation (EU) No 1307/2014 (December 8, 2014)[3].

**Note to auditors:**

Assessing the biodiversity level of grasslands requires technical skills in the field of ecology. The lead auditor shall make sure the audit team has the necessary expertise in ecology, possibly through the participation of an independent expert in ecology, to support the verification of compliance with paragraphs G.2.1.4 and G.2.1.5 See also RSB's Requirements for Certification Bodies and Auditors [RSB-PRO-70].

The determination of "non-natural highly biodiverse grassland" shall be undertaken by the relevant competent authority.

A qualified member of the audit team shall determine whether an assessment of highly biodiverse grassland is necessary. If an assessment is necessary, it shall be conducted by an independent specialist who may be additional to the audit team. The assessment and result shall then be reviewed as part of the audit.

Based on the results of the screening and the Conservation Impact Assessment, the lead auditor shall decide whether an expert in ecology is needed on the team (e.g. if highly biodiverse grasslands were identified, either as previous land-use or in the vicinity of the area of operations). The expert could either be one of the auditors involved in the audit, if she/he has a demonstrated expertise in ecology, or an independent expert.

If the lead auditor decides not to include an expert in ecology (e.g. the screening did not trigger any impact assessment), but the field visit reveals that there is a risk that highly biodiverse grasslands or any other conservation value were not adequately identified, the lead auditor shall suspend the audit until an expert in ecology is able to participate and conduct his/her own assessment of highly biodiverse grassland and other conservation values, which shall be part of the audit documentation.

2. 2. Participating operators shall ensure and provide evidence that land with high-carbon stock is not used for the primary production of agricultural biomass for

[3] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1307&from=EN

biofuels, bioliquids and biomass fuels.

As per Directive 2018/2001/EC Article 29(4), land with high carbon stock is land that had one of the following statuses on 1 January 2008 and no longer has that status:

2. 2. 1. wetland that is covered with or saturated by water permanently or for a significant part of the year, unless evidence is provided that the primary production of raw material (biomass) did and/or does not compromise the wetland status;

2. 2. 2. continuously forested areas spanning more than one (1) hectare with trees higher than five (5) meters and a canopy cover of more than 30 %, or trees able to reach those thresholds in situ;

2. 2. 3. land spanning more than one (1) hectare with trees higher than five (5) meters and a canopy cover of between 10% and 30 %, or trees able to reach those thresholds in situ, unless evidence is provided that the carbon stock of the area before and after conversion is such that, when GHG calculation is made according to Part C, Annex V of Directive 2018/2001/EC (see Annex I Part A or Part B), the GHG savings according to Paragraph 10, Article 29 of Directive 2018/2001/EC (see G.7.2.1 to G.7.2.6) would be fulfilled.

2. 3. Participating operators shall ensure and provide evidence that peatland is not used for the primary production of agricultural biomass for biofuels, bioliquids and biomass fuels (Directive 2018/2001/EC Article 29(5), unless evidence is provided that the cultivation and harvesting of that raw material does not involve drainage of previously undrained soil.

2. 4. For the purpose of paragraph G.2.2.2, the term ‘continuously forested area’ is defined in Directive 2018/2001/EC as land spanning more than one hectare with trees higher than five metres and a canopy cover of more than 30 %, or trees able to reach those thresholds in situ. It does not include land that is predominantly under agricultural or urban land use[4].

2. 5. Requirements G2.1 to G.2.2 do not apply to biofuels, bioliquids or biomass fuels produced from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues.

2. 6. Evidence of verification against requirements under G.2 should reflect seasonal changes within a year.

## 3. Specific requirements for Low ILUC risk[5] feedstocks

Indirect land use change (ILUC) can occur when land previously devoted to food or feed production is converted to produce biomass for biofuels, bioliquids and biomass fuels. In that case, food and feed demand still needs to be satisfied, which may lead to the extension of agricultural land into areas with high carbon stock such as forests, wetlands and peat land, causing additional greenhouse gas emissions.

The Directive 2018/2001/EU defines low ILUC risk biofuels, bioliquids and biomass fuels as “*biofuels, bioliquids and biomass fuels, the feedstock of which was produced within schemes which avoid displacement effects of food and feed-crop based biofuels, bioliquids and biomass fuels through improved agricultural*

[4] Land under agricultural use in this context refers to tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations and agroforestry systems when crops are grown under tree cover.

[5] The Directive sets national limits, which will gradually decrease to zero by 2030, for high ILUC-risk fuels. These limits will affect the amount of these fuels that can be counted when calculating the overall national share of renewables and the share of renewables in transport. Therefore, Member States will still be able to import and use fuels affected by the limits, but they will not be able to consider them as renewable energy and therefore they will not be able either to count them for their renewable targets.

*practices as well as through the cultivation of crops on areas which were previously not used for cultivation of crops, and which were produced in accordance with the sustainability criteria for biofuels, bioliquids and biomass fuels laid down in Article 29 Requirements for operators producing feedstock with high indirect land-use change-risk feedstock for which a significant expansion of the production area into land with high-carbon stock is observed."*

Through Delegated Act C(2019) 2055, the Directive sets out specific criteria both for:

1. determining the high ILUC risk feedstock for which a significant expansion of the production area into land with high carbon stock is observed; and

2. certifying low ILUC risk biofuels, bioliquids and biomass fuels.

3. 1. Requirements for identifying high ILUC risk feedstock

Operators should apply the criteria set out in Article 3 of Delegated Act C(2019) 2055 based on information included in the Annex to the Delegated Act, to determine the high indirect land-use change-risk feedstock for which a significant expansion of the production area into land with high-carbon stock is observed. See Annex IV of this Standard for requirements.

3. 2. Requirements for certification of low ILUC risk biofuels, bioliquids and biomass fuels

Biofuels, bioliquids and biomass fuels may only be certified as low indirect land-use change-risk if all of the following criteria are met:

*(a) the biofuel, bioliquid and biomass fuel complies with the sustainability and greenhouse gas emissions saving criteria set out in this Standard;*

*(b) the biofuel, bioliquid and biomass fuel has been produced from additional feedstock obtained through additionality measures that meet the specific criteria set out in Article 5 of Delegated Act C(2019) 2055 (see G.3.2.1 below);*

*(c) the evidence needed to identify the additional feedstock and substantiate claims regarding the production of additional feedstock is duly collected and thoroughly documented by the PO.*

POs shall provide evidence to demonstrate compliance with point (c) of G.3.2. This shall at least include information on the additionality measures taken to produce additional feedstock, the delineated areas on which these measures have been applied and the average yield achieved from the land where these measures have been applied over the 3-year period immediately preceding the year when the additionality measure was applied.

3. 2. 1. Biofuels, bioliquids and biomass fuels may only be certified as low indirect land-use change-risk fuels if:

A. The additionality measures to produce the additional feedstock meet at least one of the following conditions:

*they become financially attractive or face no barrier preventing their implementation only because the biofuels, bioliquids and biomass fuels produced from the additional feedstock can be counted towards the targets* *for renewable energy under Directive 2009/28/EC or Directive (EU) 2018/2001;*

*they allow for cultivation of food and feed crops on unused, abandoned land or severely degraded land;*

*they are applied by smallholders;*

B. The additionality measures are taken no longer than 10 years before the certification of the biofuels, bioliquids and biomass fuels as low indirect land-use change-risk fuels.

POs shall provide evidence to demonstrate compliance with G.3.2.1 A and B.

3. 2. 2. To qualify as *unused* or *abandoned* land, POs shall provide evidence that for a consecutive period of at least 5 years before the start of cultivation of the feedstock, the delineated land areas were used neither for the cultivation of food and feed crops or other energy crops nor for the cultivation of any substantial amount of fodder for grazing animals.

3. 2. 3. To qualify as *abandoned* land, POs shall provide additional evidence that food or feed crops were once grown on the delineated area before the consecutive period referred to in 3.2.2. That evidence shall also prove that the production ceased for biophysical or socioeconomic reasons.

3. 2. 4. 1. Biophysical changes which adversely affect the growing of food and feed crops may include, but are not limited to, the following events:

(a) an increased frequency of severe weather events such as droughts, storms or floods;

(b) changes in seasonal temperature patterns which affect plant phenology;

(c) increased pests and diseases;

(d) damage to irrigation systems;

(e) damage to soil such as severe salination, depletion of organic matter and erosion rendering them “severely degraded”.

3. 2. 5. 2. Socioeconomic factors adversely affecting the economic viability of production, leading to the abandonment of the land may include, but are not limited to, the following events:

(a) changes in market prices: (for example increased input or labour costs, or both, or reductions in the price fetched by finished crops);

(b) labour becoming unavailable (for example as a result of migration);

(c) failure of the supply chain (for example through the closure of a local market or a transport link);

(d) disputes about ownership (for example in the context of inheritance);

(e) political instability (for example confiscation or nationalization of the land).

3. 2. 6. To qualify as *severely degraded* land, POs shall submit soil test results, as applicable:

in the case of salinisation, the results of testing by a qualified agronomist of the electroconductivity of the soil using the saturated paste method;

in the case of low soil organic matter, results from an appropriate number of samples of soil from the delineated plot, determined by a qualified agronomist, using the dry combustion method;
in the case of severe erosion, at least 25% of the delineated plot shall have been eroded as determined by a qualified agronomist, supported by photographs.

3. 2. 7. Where a delineated area qualifies as *unused* land, it shall pass an additionality test as set out in point (4) of Annex VIII of this Standard (Annex VIII of the Implementing Regulation on Voluntary Schemes) in order to be eligible for low ILUC-risk certification. Delineated areas that qualify as abandoned or severely degraded land shall not be required to pass the additionality test in order to be eligible for low ILUC-risk certification. In the case of production on unused, abandoned or degraded land, the dynamic yield baseline shall be set to zero with no trend line.

3. 2. 8. POs shall submit to auditors a management plan containing the minimum information set out in Annex VIII. The management plan shall describe additionality measures, established and document a dynamic yield baseline, describe the additionality test, and identify any sustainability risks stemming from the implementation of the additionality measures. The management plan shall form the basis of the baseline assessment.

3. 2. 9. The baseline audit, the results of the additionality test, and the dynamic yield baseline shall be valid for 10 years from the starting year of the implementation of the additionality measure.

3. 2. 10. Determining additional biomass for yield increase measures:

The ‘additional biomass’ eligible for low ILUC-risk certification shall be the additional amount of feedstock produced in a clearly delineated area compared to the dynamic yield baseline as a direct result of applying an additionality measure.
The dynamic yield baseline shall be established by setting out a starting point, based on historical yield from the delineated plot, and a trend line based on global yield trends for the feedstock, which shall be determined in accordance with the principles set out in Annex VII.
The actual yield for a delineated plot after implementation of the additionality measure shall be compared against the baseline referred to paragraph 2. The difference between the actual yield and the dynamic yield baseline is the additional feedstock eligible to be claimed as low ILUC-risk.

3. 2. 11. In order to demonstrate that a consignment is to be considered as a low indirect land use change-risk biofuel, bioliquid or biomass fuel, POs shall use the mass balance system set out in Article 30(1) of Directive 2018/2001/EU.

4.

**PLEASE NOTE SECTION 4 IS STILL IN DRAFT FORMAT AND THEREFORE NOT ELIGIBLE FOR USE IN CERTIFICATION.**

**Specific requirements for forest biomass**

4. 1. Primary forest biomass (roundwood) is not accepted for RSB EU RED certification. For definitions of roundwood and all accepted forest residue material categories and related requirements, the PO should refer to the RSB Standard Amendment for woody biomass [RSB-SA-01].

Please note: Short Rotation Woody Coppice is classified under RSB EU RED as a perennial crop[6].

4. 2. All requirements for residues from forest biomass laid out in the RSB EU RED Standard for Advanced Fuels [RSB-STD-11-001-01-010] shall be complied with.

4. 3. All requirements from the RSB Standard Amendment on Woody Biomass [RSB-SA-01] shall be complied with.

**5. PLEASE NOTE SECTION 5 IS STILL IN DRAFT FORMAT AND THEREFORE NOT ELIGIBLE FOR USE IN CERTIFICATION.**

**Specific requirements for recycled carbon fuels (RCFs) and renewable liquid and gaseous transport fuels of non-biological origin (RFNBOs)**

5. 1. The electricity used for the production of RFNBOs shall be of renewable origin, according to the definition described in the item xx.

**5. 2. Requirements for producing RFNBOs from partially renewable electricity**

5. 2. 1. The participating operator must demonstrate that the RFNBO facility is sourcing renewable electricity for hydrogen production from an installation that came into operation no earlier than 36 months before the electrolyser.

5. 2. 2. The participating operator must demonstrate that the installation supplying electricity for hydrogen production through a direct connection always supply renewable electricity. Hydrogen produced from non-renewable electricity is not considered renewable and must not be used for RFNBOs production.

**5. 3. Requirements for sourcing electricity from directly connected installations**

The renewable electricity obtained from direct connection can be counted as a fully renewable if the participating operator shows evidence to prove that:

5. 3. 1. The installations generating renewable electricity are connected to the installation producing renewable liquid and gaseous transport fuel of non-biological origin via a direct line, or the renewable electricity production and production of renewable liquid and gaseous transport fuel of non-biological origin take place within the same installation;

5. 3. 2. The installations generating renewable electricity came into operation not earlier than 36 months before the installation producing renewable liquid and gaseous transport fuel of non-biological origin;

***Please note:** When additional production capacity is added to an existing installation producing renewable liquid and gaseous transport fuel of non-biological origin, the added capacity is considered to be part of the existing installation, as long as the capacity is added at the same site and no later than 36 months after the initial installation came into operation.*

5. 3. 3. The installation generating renewable electricity is not connected to the grid. However, in case of the installation being connected to the grid, the participating operator must ensure that no electricity has been taken from the grid to produce RFNBOs using a smart metering system that

[6] According to Directive 2018/2001/EU, perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm.

measures the electricity flow.

**5. 4. Requirements for sourcing renewable electricity from the grid:**

The renewable electricity taken from the grid can be counted as a fully renewable if the participating operator provides evidence in one of the following four scenarios:

5. 4. 1. **Scenario 1**

The installation producing RFNBOs is located in a bidding zone where the average proportion of renewable electricity exceeded 90% in the previous calendar year and the production of RFNBOs does not exceed a maximum number of hours set in relation to the proportion of renewable electricity in the bidding zone “quote”. The maximum number of hours must be calculated as follow:

$$Number\ Hours_{max} = Hours_{cy} \times S_{RE}$$

Where:

**$Hours_{cy}$**: total number of hours in calendar year

**$S_{RE}$:** Average share of Renewable Electricity reported for the bidding zone where the RFNBO is produced.

The average share of Renewable Electricity must be calculated as follow:

$$S_{RE} = \frac{C_{RE}}{T_E}$$

Where:

**$C_{RE}$:** the Gross final consumption of renewable electricity in the bidding zones, calculated according to the rules described in Article 7(2) of Directive (EU) 2018/2001, i.e., the quantity of electricity produced in a Member State from renewable sources, including the production of electricity from renewables self-consumers and renewable energy communities and excluding the production of electricity in pumped storage units from water that has previously been pumped uphill.

**$T_E$:** the gross electricity production from all energy sources as described in Annex B to Regulation (EC) 1099/2008, except from water previously pumped uphill, plus imports minus exports of electricity to the bidding zone.

***Please note:***

- *Where bidding zones are identical to countries, the latest data on the renewable electricity that has been published by Eurostat are to be used for EU Member States and the latest data on the share of renewable electricity that has been published by the IEA for third countries. When IEA* *data is not available, data from the nation statistical institutes may be used. Where bidding zones are not identical to countries, data from official national statistics have to be used that have been derived in line with the methodology applied for determining the RES-E share in the SHARES tool.*

*Once the average share of renewable electricity exceeds 90% in a calendar year, it shall be continued to be considered to be higher than 90% for the subsequent five calendar years.*

5. 4. 2. **Scenario 2:**

The installation producing the RFNBO is located in a bidding zone where the emission intensity of electricity is lower than 18 gCO2eq/MJ and the following requirements are met:

The participating operator (fuel producer) must conclude directly, or via intermediaries, one or more renewables power purchase agreements with economic operators producing renewable electricity in one or more installations generating renewable electricity for an amount that is at least equivalent to the amount of electricity that is claimed as fully renewable for hydrogen production and the electricity claimed is effectively produced in this or these installations.

The participating operator must demonstrate the conditions on temporal and geographical correlation, according to sections 5.6 and 5.7 of this Standard.

The emission intensity of electricity shall be determined following the approach for calculating the average carbon intensity of grid electricity in the methodology for determining the greenhouse gas emissions savings described in the section 5.12 of this Standard.

***Please note:*** *Once the emission intensity of electricity is lower than 18 gCO2eq/MJ in a calendar year, the average emission intensity of electricity shall be continued to be considered to be lower than 18 gCO2eq/MJ for the subsequent five calendar years.*

5. 4. 3. **Scenario 3**

The electricity used to produce RFNBO is consumed during an imbalance settlement period and the participating operator (fuel producer) shall demonstrate, based on evidence from the national transmission system operator, that:

power-generating installations using renewable energy sources were redispatched downwards in accordance with Article 13 of Regulation (EU) 2019/943;

the electricity consumed for the production of RFNBO reduced the need for redispatching by a corresponding amount.

5. 4. 4. **Scenario 4**

Where the conditions described in the scenarios 1, 2 and 3 above are not met, fuel producers may count electricity taken from the grid as fully renewable if it complies with the conditions on additionality, temporal correlation and geographic correlation, according to sections 5.5, 5.6 or 5.7 of this Standard, respectively.

**5. 5. Requirements for additionality**

To demonstrate the additionality condition the participating operator must prove that:

5. 5. 1. The amount of renewable electricity produced in their own installations is at least equivalent to the amount of electricity claimed as fully renewable;

*OR*

Have concluded directly, or via intermediaries, one or more renewables power purchase agreements with economic operators producing renewable electricity in one or more installations for an amount of renewable electricity that is at least equivalent to the amount of electricity that is claimed as fully renewable, and the electricity claimed is effectively produced in this or these installations.

5. 5. 2. The participating operator must demonstrate compliance with the following requirements for renewable installations generating renewable electricity:

The installation generating renewable electricity came into operation not earlier than 36 months before the installation producing the RFNBO.

Whenever additional production capacity is added to an existing installation producing RFNBO, the added capacity shall be considered to have come into operation at the same time as the initial installation, provided that the capacity is added at the same site and the addition takes place no later than 36 months after the initial installation came into operation.

Whenever using renewable power purchase agreements, the installation generating renewable electricity shall be considered to have come into operation at the same time as the installation producing the RFNBO under a new renewables power purchase agreement.

The installation generating renewable electricity has not received support in the form of operating aid or investment aid, excluding support received by installations before their repowering, financial support for land or for grid connections, support that does not constitute net support, such as support that is fully repaid and support for installations generating renewable electricity that are supplying installations producing renewable liquid and gaseous transport fuel of non-biological origin used for research, testing and demonstration.

***Please note:*** *The requirements described above (Section 5.5.2) shall not apply until 1 January 2038 to installations producing RFNBOs that come into operation before 1 January 2028. This exemption shall not apply to capacity added after 1 January 2028 for the production of RFNBOs.*

**5. 6. Requirements for temporal correlation**

To demonstrate the temporal correlation, the participating operator must prove that:

5. 6. 1. **Until 31 December 2029**, the RFNBO is produced during the **same calendar month** as the renewable electricity produced under the

renewables power purchase agreement or from renewable electricity from a new storage asset that is located behind the same network connection point as the electrolyser or the installation generating renewable electricity, that has been charged during the same calendar month in which the electricity under the renewables power purchase agreement has been produced.

**From 1 January 2030**, the RFNBO is produced during the **same one-hour period** as the renewable electricity produced under the renewables power purchase agreement or from renewable electricity from a new storage asset that is located behind the same network connection point as the electrolyser or the installation generating renewable electricity, that has been charged during the same one-hour period in which the electricity under the renewables power purchase agreement has been produced.

***Please note:** Member States may apply this requirement from 1 July 2027 for RFNBOs produced in their territory.*

5. 6. 2. The RFNBO is produced during a one-hour period where the clearing price of electricity resulting from single day-ahead market coupling in the bidding zone, as referred to in Article 39 (2), point (a) of Commission Regulation (EU) 2015/1222[7], is lower or equal to EUR 20 per MWh or lower than 0,36 times the price of an allowance to emit one tonne of carbon dioxide equivalent during the relevant period for the purpose of meeting the requirements of Directive 2003/87/EC of the European Parliament and of the Council[8].

## 5. 7. Requirements for geographic correlation

To demonstrate the geographical correlation, the participating operator must prove that at least one of the following requirements are fulfilled:

5. 7. 1. The installation generating renewable electricity under the renewables power purchase agreement is located, or was located at the time when it came into operation, in the same bidding zone as the electrolyser;

5. 7. 2. The installation generating renewable electricity is located in an interconnected bidding zone, including in another Member State, and electricity prices in the relevant time period on the day-ahead market referred to in Section 5.6 in the interconnected bidding zone is equal or higher than in the bidding zone where the RFNBO is produced.

5. 7. 3. The installation generating renewable electricity under the renewables power purchase agreement is located in an offshore bidding zone that is interconnected with the bidding zone where the electrolyser is located.

***Please note:** Member States may introduce additional criteria concerning the location of electrolysers and the installation producing renewable*

[7] Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (OJ L 197, 25.7.2015, p. 24).

[8] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ L 275, 25.10.2003, p. 32).

*electricity, in order to ensure compatibility of capacity additions with the national planning of the hydrogen and electricity grid. Any additional criteria shall have no negative impact on the functioning of the internal electricity market.*

## 5. 8. Implementation of equivalent rules in third countries

Where reference is made to bidding zone and imbalance settlement period, concepts that exist in the European Union but not in all other countries, participation operators in third countries must rely on equivalent concepts provided the objective this Standard is maintained and the requirements are implemented based on the most similar concept existing in the third country concerned.

5. 8. 1. The following requirements must be applied for the implementation of concepts and scenarios similar to **bidding zones**:

5. 8. 1. 1. For the location of the electrolyser, market regulations applied must be similar to the rules set out for bidding zones in Regulation (EU) 2019/943 (please see the section Terms and Definitions in this Standard), i.e, there must be rules requiring establishing hourly prices for electricity in a geographical area. If such rules are in place, the geographical area for which the prices are established should be considered as a bidding zone for the purpose of the implementation of this Standard.

OR

If the rules for establishing hourly prices for electricity in a geographical area are not in place, it should be the evaluated if the electricity network in the country of production is integrated or whether there are several separated networks.

If there are several networks, each network must be considered as a bidding zone for the purpose of the implementation of this Standard.

If the electricity network of the country is integrated and there are no geographically differentiated electricity prices, the whole country must be considered as one bidding zone for the purpose of the implementation of this Standard.

5. 8. 1. 2. Whenever the scenario requires certain conditions to be met related to the concept of a bidding zone e.g., on the average proportion of renewable electricity (Section 5.4.1), the emission intensity of electricity (Section 5.4.2) or the price of electricity (Sections 5.6.2 and 5.7) the conditions can only be considered as fulfilled if compliance can be demonstrated based on reliable data from official sources.

5. 8. 2. The following requirements must be applied for the implementation of rules on **curtailment** in third countries:

5. 8. 2. 1. Electricity taken from the grid may be counted as fully renewable during an imbalance settlement period during which the fuel producer can demonstrate, based on evidence from the national transmission system

operator, that:

power-generating installations using renewable energy sources were redispatched downwards in accordance with Article 13 of Regulation (EU) 2019/943,

*AND*

the electricity consumed for the production of renewable liquid and gaseous transport fuel of non-biological origin reduced the need for redispatching by a corresponding amount.

***Please note:*** *RFNBOs producers will likely rely on these rules only in exceptional cases and a misuse of the provision can only be avoided by following the rules thoroughly. An implementation of this provision in third countries will therefore only be feasible if it set out entities adopting the tasks of national transmission system operators as well as rules for redispatching.*

**5. 9. Requirements for combination of electricity sourcing options**

5. 9. 1. Fuel producers may combine different options to source renewable electricity provided the way the electricity is sourced is fully documented in line with the requirements set out in the Section 5.11 of this Standard. This applies also for electricity sourced during the same time interval. For each way of sourcing electricity, the dedicated rules apply. If for instance an electrolyser is fed with 50% electricity that counts as fully renewable and 50% electricity that is only 40% renewable, 70% of the total hydrogen produced will be renewable. The remaining 30% cannot be made renewable by applying the rules of the RFNBO delegated act, and consequently of this Standard.

**5. 10. Requirements for Cancellation of Guarantee of Origin (GOs)**

5. 10. 1. The RFNBO delegated act does not set out rules for the use of Guarantees of Origin (GOs) and the use of GOs is not required to implement the requirements of the hydrogen delegated acts. However, the participating operator producing RFNBOs can demonstrate via cancelling the required number of GOs that at least an equivalent amount of electricity that is claimed as fully renewable has been produced by the installations producing renewable electricity under the renewable PPA.

5. 10. 2. If using GOs, the participating operator must follow the requirements set out on Article 19 of the Directive (EU) 2018/2001 and therefore apply where GOs have been issued or are used. Based on that, the following requirements and guidelines are applicable:

5. 10. 2. 1. Member States shall ensure that the same unit of energy from renewable sources is taken into account only once.

5. 10. 2. 2. A GOs shall be of the standard size of 1 MWh. No more than one GO shall be issued in respect of each unit of energy produced.

5. 10. 2. 3. The participating operator must demonstrate that is using valid GOs. Guarantees of origin shall be valid for 12 months after the production of the renewable energy unit. Member States shall ensure that all guarantees of origin that have not been cancelled expire at the latest 18 months after the production of the energy unit.

5. 10. 2. 4. Member States shall not recognise guarantees of origins issued by a third country except where the Union has concluded an agreement with that third country on mutual recognition of guarantees of origin issued in the Union and compatible guarantees of origin systems established in that third country, and only where there is direct import or export of energy.

5. 10. 2. 5. The guarantee of origin for renewable electricity used to produce RFNBOs shall specify at least:

the energy source from which the energy was produced and the start and end dates of production;

the identity, location, type and capacity of the installation where the energy was produced;

whether the installation has benefited from investment support and whether the unit of energy has benefited in any other way from a national support scheme, and the type of support scheme;

the date on which the installation became operational;

the date and country of issue and a unique identification number.

5. 10. 2. 6. The participating operator must demonstrate the cancellation of the GOs after use of renewable electricity to produce hydrogen. The amount of GOs cancelled must correspond to the volume of renewable electricity used under the renewable PPA. The cancellation of the respective GOs should be done by the competent body designated by the Member States or by the producer of the hydrogen. The issuance, transfer and cancellation of guarantees of origin shall be supervised by Member States or designated competent bodies shall supervise the issuance, transfer and cancellation of guarantees of origin. The designated competent bodies shall not have overlapping geographical responsibilities, and shall be independent of production, trade and supply activities.

**5. 11. Requirements for data storage and management**

The participating operator (fuel producer) shall provide reliable information demonstrating that all requirements set out in Sections 5.2 to 5.7 are complied with, including for each hour as relevant:

5. 11. 1. The amount of electricity used to RFNBO, further detailed as follows:

5. 11. 1. 1. the amount of electricity sourced from the grid that does not count as fully renewable as well as the proportion of renewable electricity;

5. 11. 1. 2. the amount of electricity that counts as fully renewable because it has been obtained from a direct connection to an installation generating renewable electricity as set out in Section 5.3;

5. 11. 1. 3. the amount of electricity sourced from the grid that counts as fully renewable in accordance with the criteria set out in Section 5.4.1;

5. 11. 1. 4. the amount of electricity that counts as fully renewable in accordance with the criteria set out in Section 5.4.2;

5. 11. 1. 5. the amount of electricity that counts as fully renewable in accordance with the criteria set out in Section 5.4.3;

5. 11. 1. 6. the amount of electricity that counts as fully renewable in accordance with the criteria set out in Section 5.4.4;

5. 11. 2. The amount of renewable electricity generated by the installations generating renewable electricity, regardless of whether they are directly connected to an electrolyser and regardless of whether the renewable electricity is used for the production of the RFNBO or for other purposes.

5. 11. 3. The amounts of renewable and non-renewable liquid and gaseous transport fuel of non-biological origin produced by the fuel producer.

**5. 12. Requirements for greenhouse gas emissions calculation**

5. 12. 1. The greenhouse gas emissions accounting methodology should take into account the full life-cycle emissions from producing RFNBOs and RCFs and be based on objective and non-discriminatory criteria.

5. 12. 2. RFNBOs and RCFs can be produced in various processes, which may yield a mixture of different types of fuels. The methodology to assess the greenhouse gas emissions savings should therefore be able to derive the actual emission savings from those processes, including processes that yield both RFNBO and RCF.

5. 12. 3. To determine the greenhouse gas emissions intensity of RFNBOs and RCFs it is necessary to calculate the share of the energy content of such fuels in the output of a process. For this purpose, the fraction of each type of fuel should be determined by dividing the relevant energy input for the type of fuel in question by the total relevant energy inputs into the process. In case of the production of RFNBOs, it is necessary to determine whether the relevant electricity input should be considered as fully renewable. The relevant electricity input should be counted as fully renewable if the provisions under Article 27(3) fifth and sixth subparagraph of Directive (EU) 2018/2001 are fulfilled. Otherwise, the average share of electricity from renewable sources in the country of production, as measured two years before the year in question, should be used to determine the share of renewable energy. In case of the production of RCFs, only liquid or solid waste streams of non-renewable origin which are not suitable for material recovery in accordance with Article 4 of Directive 2008/98/EC of the European Parliament and of the Council(4) and waste processing gas and exhaust gas of non-renewable origin which are produced as an unavoidable and unintentional consequence of the production process in industrial installations can be considered as relevant energy input for the production of RCFs.

5. 12. 4. The main objective of promoting RCFs is to reduce greenhouse gas emissions by improving the efficiency of use of eligible feedstock compared to present uses. Given that feedstock that can be used to produce RCFs may already have been in use to produce energy, it is appropriate to take the greenhouse gas emissions resulting from the diversion of the use of those rigid inputs from its current use into account when calculating greenhouse gas emissions. The same should apply for rigid inputs obtained from incorporated processes and used to produce RFNBOs.

5. 12. 5. If the electricity used to produce RFNBO is taken from the electricity grid and is not considered as fully renewable, the average carbon intensity of electricity consumed in the Member State where the fuel is produced should be applied, given that that best describes the greenhouse gas intensity of the whole process. Alternatively, electricity taken from the electricity grid that is used in the

production process of RFNBO and RCF that does not qualify as fully renewable according to Article 27(3) of Directive (EU) 2018/2001, could be attributed greenhouse gas emissions values depending on the number of full load hours the installation producing RFNBO and RCF is operating. If the electricity used to produce RFNBO is considered fully renewable according to the rules set out in Article 27 of Directive (EU) 2018/2001, a carbon intensity of zero should be applied to this electricity supply.

5. 12. 6. The greenhouse gas emissions savings shall be at least 70%, for RFNBOs produced in installations from 1 January 2021.

5. 12. 7. The greenhouse gas emissions savings from the use of RCFs shall be at least 70%.

**Note:** whenever the European Commission updates the minimum required GHG thresholds, these will be applicable in the RSB EU RED Certification process with immediate effect.

5. 12. 8. The greenhouse gas emissions savings from RFNBOs and from RCFs shall be determined in accordance with the methodology set out in the Annex I, Part C of this Standard.

5. 12. 9. The fossil fuel comparator for RFNBOs and RCFs should be set at 94 gCO2eq/MJ in line with the value set out for biofuels and bioliquids in Directive (EU) 2018/2001.

## 5. 13. Requirements for source of carbon

5. 13. 1. The origin of carbon used for the production of RFNBOs and RCFs is not relevant for determining emission savings of such fuels in the short term, as currently many carbon sources are available and can be captured while making progress on decarbonisation.

In an economy on a trajectory towards climate neutrality by 2050, sources of carbon that can be captured should become scarce in the medium- to long-term, increasingly restricted to CO2 emissions that are hardest to abate. In addition, the continued use of RFNBO and RCF that contain carbon from non-sustainable fuel is not compatible with a trajectory towards climate neutrality by 2050 as it would entail the continued use of non-sustainable fuels and their related emissions. Therefore, capturing of emissions from non-sustainable fuels should not be considered as avoiding emissions indefinitely when determining the greenhouse gas emissions savings from the use of RFNBOs and RCFs.

Captured emissions from the combustion of non-sustainable fuels for the production of electricity should be considered avoided emissions up to 2035, as most should be abated by that date, while emissions from other uses of non-sustainable fuels should be considered avoided emissions up to 2040, as these emissions will remain longer.

**Note 1**: These dates will be subject to review in light of the implementation in the sectors covered by Directive 2003/87/EC of the European Parliament and of the Council(2) of the Union-wide climate target for 2040. The Union-wide climate target for 2040 is to be proposed by the Commission at the latest within six months of the first global stocktake carried out under the Paris Agreement, in accordance with Regulation (EU) 2021/1119 of the European Parliament and of the Council(3). The implementation of the target in Directive 2003/87/EC will further determine the expected scarcity of emissions in each sector.

**Note 2:** Further details about source of carbon and eligibility are presented in Annex I, Part C, of this Standard.

5. 13. 2. Emissions from activities listed in Annex I to Directive 2003/87/EC, namely from

industrial processes or from the combustion of non-sustainable fuels, should be prevented, even if they could be captured and used to produce RFNBOs and RCFs. These emissions are subject to carbon pricing to incentivise abating the emissions from non-sustainable fuels in the first place.

Therefore, where such emissions are not taken into account upstream through an effective carbon pricing, those emissions must be accounted for and should not be considered as being avoided.

5. 13. 3. Credits should not be granted for capturing CO2 which has already been taken into account under other provisions of Union law. Therefore, that kind of captured CO2 should not be considered as being avoided when determining the emissions from the inputs' existing use or fate.

**6. PLEASE NOTE SECTION 6 IS STILL IN DRAFT FORMAT AND THEREFORE NOT ELIGIBLE FOR USE IN CERTIFICATION.**

**Specific requirements for co-processing**

6. 1. Economic operators co-processing biomass may develop and use a company-specific or process-specific testing method to determine the carbon-based share of bio-content that is adapted to their particular factory design and feedstock mix. That main testing method shall be based on either mass or energy balance, yield methods, or radiocarbon (14C) testing (i.e. radiocarbon detecting through Accelerator Mass Spectrometry (AMS) or Liquid Scintillation Counting (LSC) method) of the outputs, as indicated in items 6.1.1-6.1.3 of this Standard.

6. 1. 1. If a mass balance method is used, the economic operator shall perform the full mass balance analysis of the total mass of inputs and outputs. The mass balance method shall ensure that the bio-content of all outputs is proportional to the bio-content of the inputs and that the share of biogenic material identified by the radiocarbon 14C testing results is allocated to each output. Different conversion factors shall be applied for each output that most accurately correspond to the measured bio-content through the radiocarbon 14C testing results. The output shall take into account the mass lost in off-gases, in liquid industrial wastewaters and in solid residues. The mass balance method shall include additional analytic characterization of feedstocks and products, such as ultimate and proximate analyses of system mass flows.

**Note:** if a mass balance method is used as the main method, the economic operators shall take into account in the calculation the moisture and other non-fuel impurities in their feedstock as well as in the outputs of their production process.

6. 1. 2. If an energy balance method is used, the energy share of biogenic content in all outputs from a co-processing step in an oil refinery shall be determined as being equal to the energy share of the biogenic content at the refinery input. The energy balance method shall record the energy content in the biomass and the fossil feedstocks and the process energy entering the co-processing facility. The energy content of both biomass and fossil feedstocks shall be calculated by using the mass of the feedstock and its lower heating value (LHV, measured in MJ per kg). The bio-fraction, calculated as bio energy input divided by total energy input, shall be applied to all fuel outputs, which result from co-processing, in order to determine the bio-content in the final fuels produced. Different conversion factors shall be applied for each output that best correspond to the measured bio-content through the radiocarbon 14C testing results.

6. 1. 3. Where a yield method is used, economic operators may use one of the two methods described below in order to obtain a yield factor to be applied to the common process of the fuel production:

(a) Yield Method A. The yields of the various products shall be first observed and recorded when the processing units operate with only pure fossil feedstock or, for specific applications (e.g. limited concentrations) on pilot scale units representative of the commercial scale ones. Then, a share of biomass feedstocks shall be added to the input stream and the incremental effect on the yields shall be observed and recorded. The bio-content shall be then attributed to each product in proportion to the increase in its production. Each yield factor shall only be valid for the reference inputs and process conditions, for which the yield factor had been established. Economic operators may define different yield factors to refer to different processes and operating conditions. Member States, in accordance with the rules stipulated in this Regulation, may define the yield factors that economic operators have to use on their territory. If different yield factors are used, a radiocarbon 14C test shall be carried out each time a new yield factor is used and the correlation between reference inputs and process conditions shall be checked and, if needed, updated.

(b) Yield Method B. This method shall establish a relationship between the bio-input and the bio-output of a co-processing unit. The conversion factor shall be determined by running several batches of feedstock at known co-processing conditions, including a full characterization of inputs and outputs of the system. After having determined this yield factor correlation, it can be applied to the biogenic feedstock of the same type and quality that is used in the same co-processing unit working at the same operating conditions.

**Note 1:** Participating operators may only use yield method as a main method if the system is kept under reference operating conditions defined by them, including for feedstock quality. If participating operators use a yield method, they shall use the radiocarbon 14C testing as a control method to verify its yield factor at least whenever they change the reference operating conditions and in accordance with items 6.1.3.1 – 6.1.3.5 below.

**Note 2:** the participating operator shall demonstrate the continuous operation of the plant at known co-processing conditions by running each specific bio-input through 14C testing, used to calculate its specific conversion factor.

6. 1. 3. 1. When carrying out radiocarbon (14C) testing, participating operators shall apply the Accelerator Mass Spectrometry (AMS) method. However, they may alternatively apply Liquid Scintillation Counting (LSC) method if the bio-share is expected to be at least 1 volume % and if the sample is suitable for this testing method, especially regarding particles present in the liquid.

6. 1. 3. 2. Participating operators shall ensure that, when conducting a radiocarbon 14C test, the type of radiocarbon 14C test selected can reliably detect and quantify the bio-share. They shall provide details on the accuracy and precision of the results.

6. 1. 3. 3. The radiocarbon 14C testing shall also quantify any loss of carbon from biogenic origin due to the process of removing oxygen from the biogenic feedstock by making a comparison of biogenic and fossil carbon in the inputs and output products.

6. 1. 3. 4. If the radiocarbon 14C testing, when used as a second verification testing method of the bio-content in an output, shows a deviation of more than 1 % in absolute terms, compared to the results of the main method used by the economic operator, the values of the radiocarbon 14C testing shall

be considered valid. In the first year of application of this methodology, the economic operators can apply an increased deviation of 3 % instead of 1 % in absolute terms, until they fine-tune their system of testing methods. In addition, the economic operator shall review its main testing methods to correct any system errors leading to such deviation and respectively calibrate the testing method if needed.

6. 1. 3. 5. The frequency for carrying out the main testing method and the radiocarbon 14C testing method when used as a second verification testing method shall be determined by taking into account the complexity and variability of the key parameters of the co-processing, in such a way as to ensure that at any time the claims of the bio-content reflect their actual shares. The economic operators shall perform the calculation of the bio-content share at least for each batch or consignment. Unless a method is applied that can map the operating conditions related to carbon content in the output for each batch or consignment, the radiocarbon 14C testing method shall be carried out every time that there is a change by more than 5 %, compared to the baseline conditions, in the feedstock composition in terms of the share of biogenic input or the amount of hydrogen and catalyst inputs in the total mass, the process parameters in terms of process temperature in absolute [K] or process pressure in absolute pressure [Pa] or the product composition. An elemental analysis of carbon, oxygen and nitrogen, together with an analysis of the water and solids content, shall be provided as a basis for assessing the parameters of the product composition. In all cases, the radiocarbon 14C testing method shall be carried out at least once every 4 months.

6. 2. Participating operators shall consider the whole refinery, the installation treating bioliquids and fossil oil or the installation co-processing waste inputs as system boundaries independently from the testing method used. Blending of co-processed fuels with other fuels shall be considered as being outside the system boundaries. The radiocarbon (14C) testing shall be done before the fuels produced through co-processing are further blended with other fossil fuels or biofuels that were not part of the co-processing itself.

6. 3. When participating operators report co-processing results, they shall provide details on the accuracy and precision of the testing method used. Participating operators shall account for and report any inaccuracies in their measurements of flows or heating values as part of their main testing method. Participating operators shall apply the same testing method to different processing units of the same refinery, the installation treating bioliquids and fossil oil or the installation co-processing waste inputs. If these units are not connected and there are no flows between them, economic operators may apply different testing methods. In the case of installations co-processing waste-based inputs, this methodology and verification through radiocarbon (14C) testing can be applied only if a reliable and representative set of samples can be performed at the level of the inputs that allow to establish the bio content in the total inputs.

6. 4. Participating operators shall ensure that the detection limit of the testing method selected can effectively measure the expected share of biofuels or biogas in the process.

6. 5. When participating operators report co-processing results using a main testing method other than one based on radiocarbon (14C) testing, they shall use radiocarbon (14C) testing of the outputs as a regular way of verifying the correctness of the performance of their system and the results of the main testing method used. Verification through radiocarbon (14C) testing shall be required for all outputs claiming a carbon-based bio-content.

6. 6. Participating operators shall thoroughly document the amounts and types of

biomass entering the common process where biomass is processed with fossil fuels, as well as the amounts of biofuel and biogas that are produced from that biomass. In addition, participating operators shall substantiate that information with evidence, including the results of the main control testing method set out in paragraph 1 and the results of the verification method set out in item 6.5. above or item 6.7 below in case of establishing the share of hydrogen of biological origin.

**6. 7. Establishing the share of hydrogen of biological origin**

6. 7. 1. If the production system co-processes renewable hydrogen of biological origin, economic operators shall document and provide evidence about the origin of the hydrogen as well as a proof that the hydrogen entering the hydrotreater or other co-processing unit:

(a) has not been counted as a renewable energy elsewhere in order to avoid double-counting, and

(b) has been incorporated into the final fuel and not simply used to remove impurities.

6. 7. 2. Participating operators may use a common refinery elemental analysis such as CHN (Carbon, Hydrogen, Nitrogen) test to quantify the hydrogen content of the material before and after hydro treating as a way to document if there is any increase in hydrogen content of the fuel. Participating operators may account any such increase as an additional biofuel or biogas in the output. The biological origin of the hydrogen used in hydro treating or co-processing shall be certified for its biological origin by the supplier or the economic operators themselves, in case they are also producers before use.

**6. 8. Record keeping, process control, auditing and reporting of deviations**

6. 8. 1. When Participating operators claim there is a specific share of biofuels or biogas in the fuel they put on the market, they shall keep samples for at least two years as well as records of measurement data and calculations. Participating operators shall provide certification bodies and their auditors with full access to such samples, records and other evidence. Participating operators shall prepare a detailed description of the main testing method they used, including an indication of its accuracy and precision as also verified through the application the radiocarbon 14C testing and together with a procedure for its application.

6. 8. 2. In order to avoid the risks of deviations and facilitate retrospective audit verification of the accuracy of claims made by refineries or other co-processing installation on the bio-share in their fuels, economic operators shall apply an overall mass balance system that indicates the biogenic share of input and output. They shall perform this mass balance calculation in parallel to the main testing method in order to check and compare the results of both methods on assessing the bio-share in final fuels produced.

6. 8. 3. If within the boundaries of the refinery or other co-processing installation, economic operators mix the output of co-processing with other fuels, they shall use a mass balance system that allows consignments of fuels produced resulting from biomass, being processed with fossil fuels in a common process, to be mixed with other fuels, while providing adequate information about the characteristics and sizes of the consignments, in accordance with Article 30 of Directive (EU) 2018/2001.

6. 8. 4. Any deviations identified by the auditors of certification bodies in the shares of biofuels or biogas in the fuel that participating operators put on the market shall be treated as major non-conformities and immediately notified to the voluntary schemes or other certification schemes that verify compliance of the fuel resulting from biomass with the sustainability and the greenhouse gas emissions saving

criteria laid down in Article 29(2) to (7) and (10) of Directive (EU) 2018/2001.

6. 8. 5. The competent authorities of Member States may also verify the claims of economic operators about the share of biofuels or biogas in the fuels they put on the market by using the methods referred to in items 6.1.3.1-6.1.3.5 and 6.8 of this Standard. Any deviations identified as a result of these control checks shall be immediately notified to the certification body and the voluntary scheme or other certification scheme that have certified the claims.

6. 8. 6. In case of such notifications made either by certification bodies or the competent authorities of the Member States, the certification scheme concerned shall be obliged to take immediate action by investigating the case. If their investigation confirms the findings of the certification body or the competent authority of the Member State, the certification scheme shall treat the deviations as a major non-conformity and immediately suspend the certificate of the economic operator.

6. 8. 7. In order to rectify the accuracy of the claims, the lower values established by the control checks shall be used as a basis for recalculating the claims. In addition, the participating operator shall be urged by the certification schemes to review its testing methods to correct, inter alia, any system errors leading to such deviations.

6. 8. 8. The effectiveness of the measures taken by the economic operator shall be validated by another audit of the certification body before the suspension of its certificate can be lifted.

6. 9. Additional rules on co-processing of renewable liquid and gaseous transport fuels of non-biological origin shall follow the methodology detailed in the EU report about implementation of hydrogen delegated acts[9] (as indicated in Annex I, part F of this Standard).

## 7. Specific requirements for chain of custody tracking

7. 1. The participating operator shall implement the RSB EU RED Procedure for Traceability (Chain of Custody) [RSB-STD-11-001-20-001] and select one of the chain of custody tracking models "identity of product preserved", "segregation of product" or "mass balance of product".

7. 1. 1. The participating operator using the chain of custody tracking model "segregation of product" shall mix batches of RSB EU RED certified material only at the level of one site and assign the associated product documentation to the mix of RSB EU RED certified material.

7. 1. 2. The participating operator using the chain of custody tracking model "mass balance of product" shall mix batches of RSB EU RED certified material or EU RED certified material and other product only at the level of one site and assign the associated product documentation for each batch of RSB EU RED certified material or EU RED certified material in the product mix to the product mix at the level of the site.

7. 2. The participating operator shall only aggregate batches of RSB EU RED certified material or EU RED certified material in the associated product documentation if the GHG emissions savings of the final biofuels/bioliquids product are at least:

7. 2. 1. 50%, for biofuels, bioliquids and biogas consumed in the transport sector, produced in installations which started operation on or before 5 October 2015.

7. 2. 2. 60%, for biofuels, bioliquids and biogas consumed in the transport sector, produced in installations which started operation from 6 October 2015 until 31

[9] Reference: https://energy.ec.europa.eu/system/files/2023-07/2023_07_26_Document_Certification_questions.pdf

December 2020.

7. 2. 3. 65%, for biofuels, bioliquids and biogas consumed in the transport sector, produced in installations which started operation from 1 January 2021.

7. 2. 4. 70%, for renewable liquid and gaseous transport fuels of non-biological origin produced in installations from 1 January 2021.[10]

7. 2. 5. 70%, for electricity, heating and cooling production from biomass fuels used in installations from 1 January 2021 until 31 December 2025.

7. 2. 6. 80%, for electricity, heating and cooling production from biomass fuels used in installations starting operation from 1 January 2026.

Note: An installation shall be considered to be in operation once the physical production of fuel, heat or cooling, or electricity has started (i.e. once the production of fuels including biofuels, biogas or bioliquids, or production of heat, cooling or electricity from biomass fuels has started).

7. 3. Whenever the participating operator aggregates batches of certified material with different GHG emission values, the participating operator shall not average the GHG emissions savings but either:

a. assign to the entire resulting batch the GHG emissions savings of the batch with the lowest GHG emissions savings

or

b. track the GHG values individually.

Note: In the “segregation of product” and the “mass balance of product” chain of custody tracking models different batches of physical biomass/biofuels/bioliquids may be merged, while the product documentation associated with each batch is kept separate. This provision refers to also merging product documentation of batches of biomass/biofuels/bioliquids.

7. 4. The participating operator shall track for each batch of RSB EU RED certified material or EU RED certified material the product documentation described in the RSB EU RED Standard for Traceability [RSB-STD-11-001-20-001], as well as the following information:

7. 4. 1. the type of feedstock (raw material);

7. 4. 2. the country of origin of the feedstock;

7. 4. 3. whether:

7. 4. 3. 1. primary production took place outside the European Community, or

7. 4. 3. 2. primary production took place in an area which is included in the list of areas the European Member States will submit to the European Commission by 31 March 2010 (see RED Art. 19 paragraph 2, NUTS2[11] areas), or

7. 4. 3. 3. the fuels/liquids were produced from waste or residues other than residues from agriculture, aquaculture or fisheries, or

7. 4. 3. 4. the fuels/liquids were produced from other raw materials or from raw

[10] Whenever the European Commission updates the minimum required GHG thresholds, these will be applicable in the RSB EU RED Certification process with immediate effect.

[11] NUTS2 areas: regions specified in Annex I to regulation (EC) No. 1059/2003. An interactive Map of the regions is available at http://ec.europa.eu/eurostat/nuts/home_regions_en.html

materials for which no default values or disaggregated default values are available;

7. 4. 4. the types of processes used for production, processing or conversion of biomass to biofuels/bioliquids;

7. 4. 5. the date (dd/mm/yyyy) that the installation producing the fuel/liquid became in operation.

7. 5. The final processor (i.e. the participating operator conducting the final processing/conversion step from biomass to biofuel/bioliquid) shall determine/calculate the GHG emissions savings of the final biofuels/bioliquids product, and document the calculation.

The final processor can include GHG calculations which have been performed and provided by participating operators supplying feedstocks or intermediate products and which cover the GHG emission of the complete GHG balance of these products. The final processor shall ensure that such feedstocks or intermediate products supplied are accompanied by the documented calculation of the complete GHG balance of these products.

7. 6. Following the calculation of the GHG emissions savings of the final biofuels/bioliquids product the final processor shall only assign one of the compliance claims in accordance with points G.1.11 and G.1.12 of this standard above to a batch of RSB EU RED certified material or EU RED certified material in the associated product documentation if:

7. 6. 1. the batch of RSB EU RED certified material or EU RED certified material was produced in compliance with the RSB EU RED standards and procedures and the RSB EU RED certification system and with this standard and the EU RED; **<u>and</u>**

7. 6. 2. the batch of RSB certified material or EU RED certified material was identified with an RSB EU RED compliance claim or EU RED compliance claim as defined in points G.1.11 and G.1.12 of this standard above before calculation of the GHG emissions savings of the final biofuels/bioliquids product; **<u>and</u>**

7. 6. 3. the batch of RSB EU RED certified material or EU RED certified material is accompanied by the documented information specified in section G.7.4 of this standard above; **<u>and</u>**

7. 6. 4. the GHG emissions savings of the final biofuels/bioliquids product are at least:

7. 6. 4. 1. 50%, for biofuels, bioliquids and biogas consumed in the transport sector, produced in installations which started operation on or before 5 October 2015.

7. 6. 4. 2. 60%, for biofuels, bioliquids and biogas consumed in the transport sector, produced in installations which started operation from 6 October 2015 until 31 December 2020.

7. 6. 4. 3. 65%, for biofuels, bioliquids and biogas consumed in the transport sector, produced in installations which started operation from 1 January 2021.

7. 6. 4. 4. 70%, for renewable liquid and gaseous transport fuels of non-biological origin produced in installations from 1 January 2021[12].

[12] By 1 January 2021, the Commission shall adopt a delegated act to establish appropriate minimum thresholds for greenhouse gas emissions savings of recycled carbon fuels through a life-cycle assessment that takes into account the specificities of each fuel.
**Whenever the European Commission updates the minimum required GHG thresholds, these will be applicable in the RSB EU RED Certification process with immediate effect.**

7. 6. 4. 5. 70%, for electricity, heating and cooling production from biomass fuels used in installations from 1 January 2021 until 31 December 2025.

7. 6. 4. 6. 80%, for electricity, heating and cooling production from biomass fuels used in installations starting operation from 1 January 2026.

Please note: An installation shall be considered to be in operation once the physical production of biofuels, biogas consumed in the transport sector and bioliquids, and the physical production of heating and cooling and electricity from biomass fuels has started.

Please note: Guidance to requirements G.7.6.4.1. to G.7.6.4.6.: The dates refer to the dates when the compliance claims in accordance with point G.1.11. of this standard above is assigned to a batch of RSB certified material in the associated product documentation, rather than the dates when the biomass for the biofuels and bioliquids was produced. In other words, biofuels/bioliquids entering the EU market on or after the given date **will have to meet the GHG emission savings threshold** in order to qualify for the RSB claim "EU RED compliant biofuel", **regardless of whether the biofuels/bioliquids were produced before that date**.

7. 7. The final processor and participating operators which follow the final processor in the value chain shall track the product characteristics in accordance with point G.7.4. of this standard above and the GHG emissions savings calculated by the final processor and forward the product characteristics in accordance with section G.7.4. of this standard above and the GHG emissions savings to the customer when forwarding RSB EU RED certified material or EU RED certified material.

7. 8. All mass balance data shall be made available to the auditor in advance of the planned audit.

## 8. Requirements for conducting and verifying calculations of greenhouse gas (GHG) savings

### 8. 1. General Requirements

8. 1. 1. The calculation of GHG emission savings of biofuels/ bioliquids/ biomass fuels against fossil fuels shall follow the methodology detailed in the Directive 2018/2001/EU (see Annex I of this Standard).

8. 1. 2. GHG emission savings of biofuels/ bioliquids/ biomass fuels against fossil fuels shall be determined based on default values (see Annex II) or calculated based on disaggregated default values and/or actual values.

### 8. 2. Specific requirements for the use of default values

Default values shall only be used for the calculation of GHG emission savings of biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels against fossil fuels, if

8. 2. 1. the fuel/liquid is listed in Annex II of this standard, and

8. 2. 2. no net emissions from carbon stock change ($e_l$) due to land-use change were caused in primary production (see Annex I Part A or Part B, points 7-10 of this Standard), and

8. 2. 3. biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels

of non-biological origin and recycled carbon fuels were produced from raw materials which complied with the product characteristic listed under point G.7.4.3.1. or point G.7.4.3.2. or point G.7.4.3.3. of this standard, and

8. 2. 4. if the process technology and feedstock used for the production of the biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels match their description and scope indicated in the listing in Annex II .

8. 2. 4. 1. If the fuel production pathway specifies the process fuel, the auditor shall verify that no other fuel was used for the processing step;

8. 2. 4. 2. For palm oil or biofuel derived from palm oil, the auditor shall verify that

- the Palm Oil Mill Effluent (POME) is treated in a gas-tight digester system equipped with methane capture, and
- the methane is either used for energy generation purposes or flared.

8. 2. 5. in the case of biomass fuels specifically also match the transport distance as specified in Annex III part C.

8. 2. 6. Disaggregated default values in combination with actual values or actual values may be used for the calculation of GHG emission savings of biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels against fossil fuels.

8. 2. 7. Where biomethane is used as compressed biomethane as a transport fuel, a value of 4.6 g CO2eq/MJ biomethane must be added to the relevant default value.

**8. 3. Specific requirements for the use of actual values**

8. 3. 1. Actual values shall be used for the calculation of GHG emission savings of biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels against fossil fuels where disaggregated default values are not available, and may be used instead of disaggregated default values where available. Actual values can only be calculated when all relevant information is available and transmitted through the chain of custody.

8. 3. 2. Actual values of emissions from cultivation, including of emission savings ($e_{sca}$) where applicable, shall be determined at the origin of the chain of custody, i.e. biomass production. *All relevant information*[13] concerning the calculation of actual GHG emissions including emissions savings ($e_{sca}$) shall be made available to the auditor in advance of the planned audit.

8. 3. 3. In accordance with Article 31(4) of Directive (EU) 2018/2001, average values for cultivation can be used only when declared as accurate by the EU Commission. In case no such values exist, participating operators may use either the disaggregated default values in Annex III of this standard (Annex V of Directive (EU) 2018/2001) or actual values, calculated in line with the this standard.

8. 3. 4. Actual values of emissions from transport can only be determined if emissions of all transport steps are recorded and transmitted through the chain of custody. If operators use an actual value for transport, all relevant transport

[13] This includes input data and any relevant evidence, information on the emission factors and standard values applied and their reference sources, GHG emission calculations and evidence relating to the application of GHG emission saving credits ($e_{sca}$).

steps shall be taken into account. *All relevant information*[14] concerning the calculation of actual GHG emissions shall be made available to the auditor in advance of the planned audit. In the case that no data are available for all transport steps of the supply chain, the use of actual values for transport is not allowed.

8. 3. 5. Actual values of emissions from processing can only be determined if emissions of all processing steps are recorded and transmitted through the chain of custody. If operators use actual values for processing, all relevant processing steps shall be taken into account. *All relevant information*[15] concerning the calculation of actual GHG emissions shall be made available to the auditor in advance of the planned audit. In the case that no data are available for all processing steps of the supply chain, the use of actual values for processing steps is not allowed

8. 3. 6. For the purpose of actual value GHG emission calculations, whenever available, the standard calculation values published in Annex IX of the IR shall be applied. In case alternative values are chosen, this must be justified and clearly highlighted in the documentation of the calculations.

8. 3. 7. If at any point of the chain of custody emissions have occurred and are not recorded, so that the calculation of an actual value is no longer feasible for operators downstream in the chain of custody, this must be clearly indicated in the delivery notes.

8. 3. 8. Information on actual GHG emissions has to be provided for all relevant elements of the GHG emission calculation formula. 'Relevant' refers in this context to elements for which reporting is obligatory (e.g. $e_l$ in case of land use change), all elements for which actual values should be used instead of disaggregated default values and all elements related to emission savings (if applicable).

In all cases, auditors will check the PO's capability to conduct actual value calculations. Participating Operators **may only make actual GHG values claims** after **the** capability to conduct **actual value calculations** has been verified by an auditor **during an audit.**

**8. 4. Specific provisions for the calculation of GHG emissions throughout the chain of custody**

8. 4. 1. Whenever actual values are calculated at each step of the chain of custody, the additional emissions from transport and/or processing shall be added to $e_p$ and/or $e_{td}$.

8. 4. 2. GHG emissions from any land use change that has occurred since 1 January 2008 shall be taken into account in the greenhouse gas calculation, according to Commission Decision 2010/335/EU of 10 June 2010 on guidelines for the calculation of land carbon stocks.

8. 4. 3. Actual values shall be used for the calculation of GHG emission savings of biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels against fossil fuels, if biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels were produced from raw materials which complied with the product characteristic listed under point

[14] This includes input data and any relevant evidence, information on the emission factors and standard values applied and their reference sources.

[15] This includes input data and any relevant evidence, information on the emission factors and standard values applied and their reference sources, GHG emission calculations and evidence relating to the application of GHG emission saving credits ($e_{CCr}$, $e_{CCS}$).

G.7.4.3.4. of this standard.

8. 4. 4. Actual values shall be calculated in accordance with the applicable provisions of Annex I, Part A (for biofuels and bioliquids) or Annex I, Part B (for biomass fuels), and Annexes V, VI and VII (for all fuels) to this standard. This shall include documenting all details of determining actual values (e.g. methodology and measurements used, etc.).

8. 4. 5. Actual values for emissions from processing steps in the production chain must be measured or based on technical specifications of the processing facility.

If the range of emissions values for a group of processing facilities to which the facility concerned belongs is available, the most conservative number of that group shall be used.

8. 4. 6. Economic operators shall make reference to the method and source used for determining actual values.

8. 4. 7. For the purpose of actual GHG emission calculations, whenever available, the standard calculation values published in Annex IX of Implementing Regulation (EU) 2022/996[16] shall be applied. Where not available, emission factors (standard calculation values) shall be taken from the Ecoinvent database[17]. In the case alternative values are chosen this must be duly justified.

Please note: For liquefied NG or biomethane, in JEC Well-to-Tank report v5, there are available calculations for both the options of liquefaction for sea transport and at the refuelling station. These figures may be reviewed upwards as a result of the upcoming update of Annexes V and VI of RED II in order to take fully into account the real fugitive emissions. The assumed process for methane liquefaction is described for example 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. For the electricity emission factors, the values from Annex IX the IR on sustainability certification can be used. See: https://publications.jrc.ec.europa.eu/repository/handle/JRC119036.

For gas losses, the 2019 report which contains the calculations to obtain the default values in RED II contains an emission factor of 0.17 g CH4/MJ NG supplied. See: https://op.europa.eu/en/publication-detail/-/publication/7d6dd4ba-720a-11e9-9f05- 01aa75ed71a1

8. 4. 8. Participating operators shall document the use of default values, disaggregated default values and/or the calculation and use of actual values. This shall include all details of determining actual values (e.g. references to appropriate/acceptable data sources).

8. 4. 9. GHG emission savings of biofuels/bioliquids/biomass fuels/ renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels against fossil fuels shall be based on default values or calculated based on disaggregated default values and/or actual values. Actual values shall be determined by using any calculator recognised by the EU Commission for this purpose or by carrying out an individual calculation.[18]

## 8. 5. Specific requirements for transmitting information about GHG emissions

[16] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0996
[17] http://www.ecoinvent.org/database/database.html
[18] https://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes

8. 5. 1. GHG emissions shall be reported using the appropriate units, i.e. g $CO_{2eq}$/dry-ton for raw materials and intermediary products and g $CO_{2eq}$/MJ for final fuels. To receive information on emissions per dry-ton feedstock the following formula has to be applied:

$$e_{ec}feedstock_a\left[\frac{gCO_2eq}{kg_{dry}}\right]=\frac{e_{ec}\,feedstock_a\,\left[\frac{gCO_2eq}{kg_{moist}}\right]}{(1-moisture\ content)}$$

Whereas the moisture content shall be the value measured upon delivery. If the moisture content is not known, the maximum value allowed per delivery contract shall be used.

8. 5. 2. Actual values shall only be transmitted to the customer if all relevant process and transport steps have been included. If the operator cannot guarantee that all relevant process and transport emissions are included in the calculation of an actual value, actual values must not be transmitted. The operator shall state on the delivery notes that the calculation of actual values is not feasible for downstream operators.

8. 5. 3. If (disaggregated) default values are used, information on GHG emission may only be reported for final fuels. If relevant, information on process technology and the raw material used shall be specified. Upstream operators shall state “default value” (or “disaggregated $e_p$/$e_t$ default value” for disaggregated values) on the delivery note.

**8. 6. Requirements for calculating aggregate values**

When calculating aggregate values for emissions of cultivation outside the European Union:

8. 6. 1. Average GHG values for farmers operating as a group in a certain region may be calculated, provided that this takes place on a more fine-grained than a NUTS2 or equivalent level and where the units have similar production systems and types of crops.

8. 6. 2. Operators shall calculate aggregate values for cultivation following the methodology for $e_{ec}$ as defined in Annex I.

8. 6. 3. Input data should primarily be based on official statistical data from government bodies if available and of good quality. If not available, statistical data published by independent bodies may be used. As a third option, the numbers may be based on scientifically peer-reviewed work, with the precondition that data used lies within the commonly accepted data range when available.

8. 6. 4. The data used shall be based on the most recent available data from the above-mentioned sources. Typically, the data should be updated over time, unless there is no significant variability of the data over time.

8. 6. 5. For fertiliser use, the typical type and quantity of fertiliser used for the crop in the region concerned shall be used.

8. 6. 6. If a measured value for yields is used (as opposed to an aggregated value) for the calculations, it is required to also use a measured value for fertiliser input and vice versa.

8. 7. **Requirements on calculating energy content (LHV)**

8. 7. 1. Feedstocks for the production of biogas for transport and advanced biofuels listed in Annex VI of this standard may be considered to be twice their energy content.

8. 7. 2. Renewable electricity shall be considered to be four times its energy content when supplied to road vehicles and may be considered to be 1.5 times its energy content when supplied to rail transport.

8. 7. 3. With the exception of fuels produced from food and feed crops, fuels supplied in the aviation and maritime sectors shall be considered to be 1.2 times their energy content.

8. 7. 4. Energy content (LHV) of fuels used in the transport sector shall be obtained from Annex III of Directive (EU) 2018/2001. For transport fuels not included in Annex III, Member States shall use the relevant European Standards Organisation (ESO) standards in order to determine the calorific values of fuels. Where no ESO standard has been adopted for that purpose, Member States shall use the relevant International Organization for Standardisation (ISO) standards.

# Annex I: Methodology for GHG calculation

## Annex I, Part A : biofuels and bioliquids (Source: Directive 2018/2001/EU Annex V, part C)

1. Greenhouse gas **emissions** from the production and use of biofuels and bioliquids shall be calculated as:

(a) greenhouse gas emissions from the production and use of biofuels shall be calculated as:

$$E = e_{ec} + e_{l} + e_{p} + e_{td} + e_{u} - e_{sca} - e_{ccs} - e_{ccr}$$

Where:

| | | |
|---|---|---|
| E | = | total emissions from the use of the fuel; |
| $e_{ec}$ | = | emissions from the extraction or cultivation of raw materials; |
| $e_{l}$ | = | annualised emissions from carbon stock changes caused by land-use change; |
| $e_{p}$ | = | emissions from processing; |
| $e_{td}$ | = | emissions from transport and distribution; |
| $e_{u}$ | = | emissions from the fuel in use; |
| $e_{sca}$ | = | emission saving from soil carbon accumulation via improved agricultural management; |
| $e_{ccs}$ | = | emission saving from carbon capture and geological storage; |
| $e_{ccr}$ | = | emission saving from carbon capture and replacement; and |

Emissions from the manufacture of machinery and equipment shall not be taken into account.

(b) Greenhouse gas emissions from the production and use of bioliquids shall be calculated as for biofuels (E), but with the extension necessary for including the energy conversion to electricity and/or heat and cooling produced, as follows:

(i) For energy installations delivering only heat:

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

(ii) For energy installations delivering only electricity:

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

Where:

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

E = total greenhouse gas emissions of the bioliquid before end-conversion

$\eta_{el}$ = The electrical efficiency, defined as the annual electricity produced divided by the annual bioliquid input based on its energy content.

$\eta_{h}$ = The heat efficiency, defined as the annual useful heat output divided by the annual bioliquid input based on its energy content.

(iii) For the electricity or mechanical energy coming from energy installations delivering useful heat together with electricity and/or mechanical energy:

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

(iv) For the useful heat coming from energy installations delivering heat together with electricity and/or mechanical energy:

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

Where:

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

E = total greenhouse gas emissions of the bioliquid before end-conversion

$\eta_{el}$ = The electrical efficiency, defined as the annual electricity produced divided by the annual fuel input based on its energy content.

$\eta_h$ = The heat efficiency, defined as the annual useful heat output divided by the annual fuel 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).

The Carnot efficiency, $C_h$, for useful heat at different temperatures is defined as:

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

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 (equal to 0 °C)

If the excess heat is exported for heating of buildings, at a temperature below 150 °C (423,15 kelvin), $C_h$ can alternatively be defined as follows:

$C_h$ = Carnot efficiency in heat at 150 °C (423,15 kelvin), which is: 0,3546

For the purposes of that calculation, the following definitions apply:

(a) ‘cogeneration’ means the simultaneous generation in one process of thermal energy and electricity and/or mechanical energy;

(b) ‘useful heat’ means heat generated to satisfy an economical justifiable demand for heat, for heating and 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.

2. Greenhouse gas emissions from fuels, E, shall be expressed as follows:

(a) greenhouse gas emissions from biofuels, E, shall be expressed in terms of grams of $CO_2$ equivalent per MJ of fuel, g $CO_2$eq/MJ.

(b) greenhouse gas emissions from bioliquids, EC, in terms of grams of $CO_2$ equivalent per MJ of final energy commodity (heat or electricity), g $CO_2$eq/MJ.

When heating and cooling are co-generated with electricity, emissions shall be allocated between heat and electricity (as under 1(b) in this Annex), irrespective if the heat is used for actual heating purposes or for cooling.

The emissions of a raw material or intermediate shall be calculated and provided in kg $CO_{2eq}$/dry-t of product.

To receive information on emissions per dry-ton feedstock ($e_{ec}$) the following formula shall be applied:

$$e_{ec}feedstock_a\left[\frac{gCO_2eq}{kg_{dry}}\right]=\frac{e_{ec}\ feedstock_a\ \left[\frac{gCO_2eq}{kg_{moist}}\right]}{(1-moisture\ content)}$$

The moisture content shall be the value measured upon delivery. If the moisture content is not known, the maximum value allowed per delivery contract shall be used.

3. The emissions of a raw material or intermediate shall include the emissions of all inputs and raw materials including the emissions of the previous step in the chain. The operators along the chain of custody shall add the additional emissions from transport and/or processing to $e_p$ and/or $e_{td}$ respectively (please see the formula for $e_p$ in point 11 and for $e_{td}$ in point 12).

In addition, the operators along the chain of custody shall apply a *feedstock factor* to all emissions to take energy losses into account.

Whenever a processing step yields co-products, emissions shall be allocated in proportion to the lower heating value (LHV) of the products and co-products (*allocation factor*, see also point 18).

The following formula applies to emissions from cultivation when processing intermediate products:

$$e_{ec}intermediate\ product_a\left[\frac{gCO_2eq}{t_{dry}}\right]=e_{ec}feedstock_a\left[\frac{gCO_2eq}{t_{dry}}\right]*Feedstock\ factor_a*Allocation\ factor\ intermediate\ product_a$$

Where:

$$Allocation\ factor_a:\left[\frac{Energy\ in\ intermediate\ product_a}{Energy\ in\ intermediate\ products\ +\ co-products}\right]$$

$$Feedstock\ factor_a:\ \begin{matrix}Ratio\ of\ MJ\ feedstock\ required\ to\ make\ 1\ MJ\ of\\ intermediate\ product\end{matrix}$$

At the last processing step, additionally, the operator shall convert the emission value into the unit $gCO_{2eq}$/MJ of final biofuel.

The following formula applies to emissions from cultivation:

$$e_{ec}fuel_a \left[\frac{gCO_2eq}{MJ\ fuel}\right] = \frac{e_{ec}feedstock_a\left[\frac{gCO_2eq}{t_{dry}}\right]}{LHV_a\left[\frac{MJ\ feedstock}{t\ dry\ feedstock}\right]} * feedstock\ factor_a * Allocation\ factor\ fuel_a$$

Where:

$$Allocation\ factor\ fuel_a : \left[\frac{Energy\ in\ fuel}{Energy\ in\ fuel\ +\ Energy\ in\ co-products}\right]$$

$$Feedstock\ factor_a: Ratio\ of\ MJ\ feedstock\ required\ to\ make\ 1\ MJ\ of\ fuel$$

Emissions per dry-ton feedstock shall be calculated as follows:

$$e_{ec}feedstock_a \left[\frac{gCO_2eq}{t_{dry}}\right] = \frac{e_{ec}feedstock_a\left[\frac{gCO_2eq}{t_{moist}}\right]}{(1-moisture\ content)}$$

Similarly, also the values for $e_{p,}$ $e_{td,}$ and $e_l$ shall be adjusted.

Feedstock factors shall be based on plant data and the LHV for dry-ton feedstock shall be applied. Allocation factors shall be based on plant data and the LHV for wet-ton feedstock shall be applied.

4. Greenhouse gas emission **saving** from biofuels and bioliquids shall be calculated as:

(a) greenhouse gas emissions savings from biofuels:

SAVING = $(E_F - E_B)/E_F$

where

$E_B$ = total emissions from the biofuel or bioliquid; and

$E_F$ = total emissions from the fossil fuel comparator.

(b) greenhouse gas emissions savings from heat and cooling, and electricity being generated from bioliquids:

SAVING = $(EC_{F(h\&c,el)} - EC_{B(h\&c,el)})/EC_{F(h\&c,el)}$

Where

$EC_{B(h\&c,el)}$ = total emissions from the heat or electricity; and

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

5. The greenhouse gases taken into account for the purposes of point 1 shall be $CO_2$, $N_2O$ and $CH_4$. For the purpose of calculating $CO_2$ equivalence, those gases shall be valued

as follows:

$CO_2$ : 1

$N_2O$ : 298

$CH_4$ : 25

6. Emissions from the extraction or cultivation of raw materials, $e_{ec}$, shall 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.

**Participating Operators shall use the Methodology for determining the emissions from the extraction or cultivation of raw materials ($e_{ec}$), as specified in Annex V of this Standard.**

The capture of $CO_2$ in the cultivation of raw materials shall be excluded. Estimates of emissions from agriculture biomass cultivation may be derived from the use of regional averages for cultivation emissions included in the reports referred to in Article 31(4) of Directive 2018/2001 (EU) or the information on the disaggregated default values for cultivation emissions included in this Annex, as an alternative to using actual values. In the absence of relevant information it is permitted to calculate averages based on local farming practices based, for instance, on data of a group of farms, as an alternative to using actual values.

Estimates of emissions from cultivation and harvesting of forestry biomass may be derived from the use of averages for cultivation and harvesting emissions calculated for geographical areas at national level, as an alternative to using actual values.

Operators may use either measured or aggregate values (please see G.8.3.3. and G.8.3.4).

When using actual values, economic operators shall make reference to the method and source used for determining actual values (e.g. average values based on representative yields, fertiliser input, $N_2O$ emissions and changes in carbon stock).

The *participating operator* determines the GHG emissions resulting from *primary production* $e_{ec}$ including all activities necessary for or related to *primary production* of raw material (*biomass*) as well as all inputs used by applying *actual values* in the following formula:

in [kg $CO_2$eq / kg of product]

As a rule product yield shall be determined as:

1. the actual product realised in a particular harvest in kg/ha averaged over the extent of the individual operation (production) site for crops which are harvested annually; or
2. the actual product yield realised in the preceding 12 month period in kg/ha averaged over the extent of the individual operation (production) site for crops which are harvested more than once per year or which are harvested continuously.

The calculation of the emissions of fertilisers, pesticides and mechanical work is performed by multiplying the actual amount (provided by the operator) with the emission factor:

$$Emission_{fertilizer}\left[\frac{kgCO_2eq}{ha*yr}\right] = fertilizer\left[\frac{kg}{ha*yr}\right]*emission\_factor_{production\_fertilizer}\left[\frac{kgCO_2eq}{kg}\right]$$

$$Emission_{pesticide}\left[\frac{kgCO_2eq}{ha*yr}\right] = pesticide\left[\frac{kg}{ha*yr}\right]*emission\_factor_{production\_pesticide}\left[\frac{kgCO_2eq}{kg}\right]$$

$$Emission_{mechanical\_work}\left[\frac{kgCO_2eq}{ha*yr}\right] = mechanical\_work\left[\frac{l\_diesel}{ha*yr}\right]*emission\_factor_{diesel}\left[\frac{kgCO_2eq}{l}\right]$$

$$E_{electricity}\left[\frac{kgCO_{2eq}}{ha}\right] = electricity\left[\frac{kWh}{ha}\right]*emission\_factor_{electricity}\left[\frac{kgCO_{2eq}}{kWh}\right]$$

7. Annualised emissions from carbon stock changes caused by land-use change, $e_l$, shall be calculated by dividing total emissions equally over 20 years. For the calculation of those emissions the following rule shall be applied:

$e_l = (CS_R – CS_A) \times 3,664 \times 1/20 \times 1/P – e_B$

or preferrably

$$e_l'\left[\frac{kgCO_{2eq}}{kg_{product(crop)}}\right] = \frac{CS_R\left[\frac{kgC}{ha}\right] - CS_A\left[\frac{kgC}{ha}\right]}{yield_{main\_product(crop)}\left[\frac{kg}{ha*yr}\right] \bullet 20[yr]} \bullet 3,664 - e_B'$$

in [kg $CO_2$ / kg of product]

[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) is equal to 3,664.]

where:

| | | |
|---|---|---|
| $e_l$ | = | annualised greenhouse gas emissions from carbon stock change due to land-use change (measured as mass of $CO_2$-equivalent per unit biofuel or bioliquid energy); “Cropland”[19] and “perennial cropland”[20] shall be regarded as one land use; |
| $C_{SR}$ | = | the carbon stock per unit area associated with the reference land use (measured as mass of carbon per unit area, including both soil and vegetation). The reference land use shall be the land use in January 2008 or 20 years before the raw material was obtained, whichever was the later; |
| $C_{SA}$ | = | the carbon stock per unit area associated with the actual land use (measured as mass of carbon per unit area, including both soil and vegetation). In cases where the carbon stock accumulates over more than |

[19] Cropland as defined by IPCC.

[20] Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm.

one year, the value attributed to CSA shall be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier;

*P* = the productivity of the crop (measured as biofuel or bioliquid energy per unit area per year); and

$e_B$ = bonus of 29 $gCO_{2eq}$/MJ biofuel or bioliquid if biomass is obtained from restored degraded land under the conditions provided for in point 8.

$e_B$ is expressed in *kg $CO_2$eq/kg product (crop).* When applying the bonus the participating operator shall document the used conversion and allocation factors (from kg crop to MJ final biofuel/bioliquid), e.g.: 1 MJ of Biodiesel from palm oil corresponds to 8 kg of fresh fruit bunches.

When using actual values, economic operators shall make reference to the method and source used for determining actual values (e.g. values based on representative yields, fertiliser input, N2O emissions and changes in carbon stock).

Land use change should be understood as referring to changes in terms of land cover between the six land categories used by the IPCC (forest land, grassland, cropland, wetlands, settlements and other land). Cropland and perennial[21] cropland shall be regarded as one land use. 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.

8. The bonus of 29 $gCO_{2eq}$/MJ shall be attributed if evidence 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

The bonus of 29 $gCO_{2eq}$/MJ shall apply for a period of up to 20 years from the date of conversion of the land to agricultural use, provided that a steady increase in carbon stocks as well as a sizable reduction in erosion phenomena for land falling under (b) are ensured.

9. '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

10. **The Commission guidelines shall serve as the basis for the calculation of land carbon stocks for the purposes of *EU RED*. See 2010/335/EU - Commission Decision of 10 June 2010 on guidelines for the calculation of land carbon stocks in accordance with point 10 of Part C of Annex V to Directive 2018/2001/EU.**

Available at https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:151:0019:0041:EN:PDF

[21] Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm

*The Commission shall review, by 31 December 2020, guidelines for the calculation of land carbon stocks (1) drawing on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories – volume 4 and in accordance with Regulation (EU) No 525/2013 and Regulation (EU) 2018/841 of the European Parliament and of the Council (2). The Commission guidelines shall serve as the basis for the calculation of land carbon stocks for the purposes of this Directive.*

11. Emissions from processing, $e_p$, shall include emissions from the processing itself; from waste and leakages; and from the production of chemicals or products used in processing including the CO2 emissions corresponding to the carbon contents of fossil inputs, whether or not actually combusted in the process. Processing may be divided into several locally separate process steps, each producing a different product. $e_p$ subsumes such different processing steps taking different conversion and allocation factors into consideration.

Actual values for emissions from processing steps ($e_p$ in the methodology) in the production chain must be measured or based on technical specifications of the processing facility. When the range of emissions values for a group of processing facilities to which the facility concerned belongs is available, the most conservative number of that group shall be used.

The emissions shall be calculated for each processing step individually using the formula below and summed up.

In accounting for the consumption of electricity not produced within the fuel production plant, the greenhouse gas emission intensity of the production and distribution of that electricity shall be assumed to be equal to the average emission intensity of the production and distribution of electricity in a defined region. By derogation from this rule, producers may use an average value for an individual electricity production plant for electricity produced by that plant, if that plant is not connected to the electricity grid.

Emissions from processing shall include emissions from drying of interim products and materials where relevant.

The *participating operator* determines the GHG emissions resulting from processing $e_p$, including all activities necessary for or related to processing and all GHG emissions resulting from wastes (including waste water) as well as all inputs used by applying *actual values* in the following formula:

$$e_p' = \frac{emission_{\substack{electricty\\consumption}}\left[\frac{kgCO_2}{yr}\right] + emission_{\substack{heat\\production}}\left[\frac{kgCO_2}{yr}\right] + emission_{\substack{operating\\material}}\left[\frac{kgCO_2}{yr}\right] + emission_{effluent}\left[\frac{kgCO_2}{yr}\right]}{product\ yield_{\substack{main\\product(crop)}}\left[\frac{kg_{produc\,yield}}{yr}\right]}$$

in [kg $CO_2$eq / kg of product]

$$emission_{\substack{electricty\\consumption}}\left[\frac{kgCO_2}{yr}\right] = emission\_factor_{\substack{electricty\\mix}}\left[\frac{kgCO_2}{kWh}\right] * electricity\_consumption\left[\frac{kWh}{yr}\right]$$

$$emission_{\substack{heat\\generation}}\left[\frac{kgCO_2eq}{yr}\right] = emission\_factor_{\substack{heat\\generation}}\left[\frac{kgCO_2eq}{MJ}\right] * heat\_generation\left[\frac{MJ}{yr}\right].$$

$$emission_{\substack{operating\\materials}}\left[\frac{kgCO_2eq}{yr}\right] = emission\_factor_{\substack{operating\\materials}}\left[\frac{kgCO_2eq}{kg}\right] * operating\_materials\left[\frac{kg}{yr}\right]$$

$$emission_{effluents}\left[\frac{kgCO_2eq}{yr}\right] = emission\_factor_{effluent}\left[\frac{kgCO_2eq}{kg}\right] * effluent\left[\frac{kg}{yr}\right]$$

The emission factor of the effluent is taken from point 5 for $CO_2$, $CH_4$ and $N_2O$. For other effluents, these emission factors are the climate change factors of IPCC with a timeframe of 100 years.

[IPCC 2006: IPCC guidelines for national greenhouse gas inventories. L. B. Simon Eggleston, Kyoko Miwa, Todd Ngara and Kiyoto Tanabe. Kanagawa]

The actual amount of energy and material requirements shall be provided by the operator.

The Directive requires the use of the average emission intensity for a "defined region". If electricity is consumed from the grid, the emission factor of the national electricity mix shall be used.

12. Emissions from transport and distribution, $e_{td}$, shall include emissions from the transport of raw and semi-finished materials and from the storage and distribution of finished materials. Transport may be divided into several locally separate transport steps. $e_{td}$ subsumes all of the transport steps.

Emissions from transport and distribution to be taken into account under point 6 shall not be covered by this point.

The *participating operator* determines the GHG emissions resulting from transport $e_{td}$, including all transport steps used by applying *actual values* in the following formula:

$$e_{td} = e_{tr} + e_{st} + e_{fl}$$

$$e_{tr} = \frac{TD_{vehicle}[km] * TQ[kg] * EF_{transport}\left[\frac{kgCO_2}{tkm}\right]}{TQ\,[kg]}$$

$$e_{st} = \mathrm{E}_{storage}\left[\frac{\mathrm{MJ}}{\mathrm{MJ}_{\mathrm{fuel}}}\right] * \frac{1}{3.6}\left[\frac{\mathrm{kWh}}{\mathrm{MJ}}\right] * EF_{electricity}\left[\frac{kgCO_2}{kWh}\right] * ED\left[\frac{MJ_{fuel}}{kg}\right]$$

$$e_{fl} = E_{filling}\left[\frac{\mathrm{MJ}}{\mathrm{MJ}_{\mathrm{fuel}}}\right] * \frac{1}{3.6}\left[\frac{\mathrm{kWh}}{\mathrm{MJ}}\right] * EF_{electricity}\left[\frac{kgCO_2}{kWh}\right] * ED\left[\frac{MJ_{fuel}}{kg}\right]$$

in [kg $CO_2$ / kg of product]

With

TD: transport distance

TQ: transported quantity of biomass / bioliquid / biofuel

$EF_{transport}$: emission factor for transport; taken from the ecoinvent database (without infrastructure). They are specific for the different types of vehicle and take into account the average load of the vehicle.

$EF_{electricity}$ : emission factor for electricity at the location of storage or filling

ED: energy density of fuel

$E_{storage}$: electricity used at storage facilities: user-given actual value or, alternatively: standard value of 0.00084 MJ/MJ-fuel (JRC, 2008)

$E_{filling}$: electricity used at filling station: standard value of 0.0034 MJ/MJ-fuel (JRC, 2008)

Source for $E_{storage}$ and $E_{filling}$: JRC, "Input data relevant to calculating default GHG emissions according to RE Directive Methodology", 2008)

13. Emissions from the fuel in use, $e_u$, shall be taken to be zero for biofuels and bioliquids.

14. Emission saving from soil carbon accumulation via improved agricultural management ($e_{sca}$)

14. 1. All calculations of $e_{sca}$ shall follow the requirements set out in Annex VI of this Standard.

14. 2. The operator shall provide evidence that the practices for improved agricultural management are applied, such as

- Shifting to reduced or zero-tillage;
- Improved crop rotation and /or cover crops, including crop residue management;
- Improved fertiliser or manure management;
- Use of soil improver (e.g. compost)

14. 3. Emission savings from such improvements can only be taken into account if evidence is provided that the soil carbon has increased, or solid and verifiable evidence is provided that it can be reasonably be expected to have increased over the period in which the raw material concerned were cultivated while taking into account the emissions where such practices lead to increased fertiliser and herbicide use.

Measurement of soil carbon can constitute such evidence, e.g. by a first measurement in advance of the cultivation and subsequent ones at regular intervals several years apart. In such a case, before the second measurement is available, increase in soil carbon would be estimated using a relevant scientific basis. From the second measurement onwards, the measurements would constitute the basis for determining the existence of an increase in soil carbon and its magnitude.

14. 4. Emission savings $e_{sca}$ may only be applied for measures undertaken after 1 January 2008.

15. Emission saving from carbon capture and geological storage $e_{ccs}$, that have not already been accounted for in $e_p$, shall be limited to emissions avoided through the capture and storage of emitted $CO_2$ directly related to the extraction, transport, processing and distribution of fuel:

15. 1. The operator shall provide evidence that the emission saving relates directly to the production of the biofuel they are attributed to. If the $CO_2$ is not captured continuously, the operator may deviate from this approach and attribute different amounts of savings to biofuel obtained from the same process. However, in no case a higher amount of savings shall be allocated to a given batch of biofuel than the average amount of $CO_2$ captured per MJ of biofuel in a hypothetical

process where the entire $CO_2$ stemming from the production process is captured.

15. 2. For the calculation of $e_{ccs}$ the operator shall take emissions into account resulting from the energy consumed and inputs used for capturing, processing and storing of the $CO_2$ (by applying the appropriate emission factors)

The emission savings $e_{ccs}$ [kg $CO_{2eq}$/MJ] are calculated as follows:

$$e_{ccs} = \frac{CO_2\, stored\, [kg] - \text{energy consumed}[MWh] * EF\left[\frac{kgCO_{2eq}}{MWh}\right] - operating\ materials\ [kg] * EF\ \frac{kg\ CO_{2eq}}{kg}}{\text{biofuel produced}\ [kg] *\ LHV_{biofuel}\left[\frac{MJ}{kg}\right]}$$

15. 3. The operator shall provide evidence that the carbon is effectively captured and safely stored. A temporary storage (e.g. construction material) is not eligible for $e_{ccs}$.

15. 4. The operator shall demonstrate to the auditor that the storage facility is in good condition and without leakages.

16. Emission saving from carbon capture and replacement, $e_{ccr}$, 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 $CO_2$ used in commercial products and services.

16. 1. The operator shall provide evidence that the carbon captured originates from biomass and replaces fossil-derived $CO_2$ used in commercial products and services.

16. 2. The operator shall provide evidence that the emission saved relates directly to the production of the biofuel they are attributed to. If the $CO_2$ is not captured continuously, the operator may deviate from this approach and attribute different amounts of savings to biofuel obtained from the same process. However, in no case a higher amount of savings shall be allocated to a given batch of biofuel than the average amount of $CO_2$ captured per MJ of biofuel in a hypothetical process where the entire $CO_2$ stemming from the production process is captured.

16. 3. For the calculation of $e_{ccr}$ the operator shall take emissions into account resulting from the energy consumed and inputs used for capturing and processing of the $CO_2$ (by applying the appropriate emission factors)

The emission savings $e_{ccr}$ [kg $CO_{2eq}$/MJ] are calculated as follows:

$$e_{ccr} = \frac{CO_2\, used\, [kg] - \text{energy consumed}[MWh] * EF\left[\frac{kgCO_{2eq}}{MWh}\right] - operating\ materials\ [kg] * EF\ \frac{kg\ CO_{2eq}}{kg}}{\text{biofuel produced}\ [kg] *\ LHV_{biofuel}\left[\frac{MJ}{kg}\right]}$$

(EF: emission factor)

16. 4. The operator shall provide evidence that the captured $CO_2$ is used in commercial products and services to replace fossil-derived $CO_2$, i.e. information from the buyer of the $CO_2$ is required showing how the $CO_2$ that is replaced was generated previously and declaring that due to the replacement emissions of that quantity are avoided.

Auditors are not required to conduct audits on the premises of the buyer unless there is a reasonable suspicion that the information provided is incorrect.

17. Where a cogeneration unit – providing heat and/or electricity to a fuel production process for which emissions are being calculated – produces excess electricity and/or excess useful heat, the greenhouse gas emissions shall be divided between the electricity and the useful heat according to the temperature of the heat (which reflects the usefulness (utility) of the heat). The useful part of the heat is found by multiplying its energy content with the Carnot efficiency, $C_h$, calculated 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 (equal to 0°C)

If the excess heat is exported for heating of buildings, at a temperature below 150°C (423,15 kelvin), $C_h$ can alternatively be defined as follows:

$C_h$ = Carnot efficiency in heat at 150°C (423,15 kelvin), which is: 0,3546

For the purposes of that calculation, the actual efficiencies shall be used, defined as the annual mechanical energy, electricity and heat produced respectively divided by the annual energy input.

For the purposes of that calculation, the following definitions apply:

(a) 'cogeneration' shall mean the simultaneous generation in one process of thermal energy and electrical and/or mechanical energy;

(b) 'useful heat' shall mean heat generated to satisfy an economical justifiable demand for heat, for heating or cooling purposes;

(c) 'economically justifiable demand' shall mean the demand that does not exceed the needs for heat or cooling and which would otherwise be satisfied at market conditions.

18. Where a fuel production process produces, in combination, the fuel for which emissions are being calculated and one or more other products (co-products), greenhouse gas emissions shall be divided between the fuel or its intermediate product and the co-products in proportion to their energy content (determined by lower heating value in the case of co-products other than electricity).

The *participating operator* determines the allocation factor for GHG emissions savings for co-products by applying actual values in the following formula:

$$allocation \quad factor = \frac{energy \ yield_{main\,product}[MJ]}{energy \ yield_{main\,product}[MJ] + energy \ yield_{co-products}[MJ]}$$

no dimension

The energy yields are calculated by multiplying the quantity of product or co-product with the specific energy content.

The participating operator shall document the used lower heating values, the source of the values (own measurement or literature), and whether the values refer to dry mass or to fresh substance.

The lower heating value used in applying this rule should be that of the entire (co-) product, not of only the dry fraction of it. For the purpose of this calculation, feedstock factors based on plant data have to be applied. Please note that for the calculation of the feedstock factor the LHV values per dry ton need to be applied while for the calculation of the allocation factor LHV values for wet biomass need to be used as this approach was also applied for the calculation of the default values.

The greenhouse gas intensity of excess useful heat or excess electricity is the same as the greenhouse gas intensity of heat or electricity delivered to the fuel production process and is determined from calculating the greenhouse intensity of all inputs and emissions, including the feedstock and $CH_4$ and $N_2O$ emissions, to and from the cogeneration unit, boiler or other apparatus delivering heat or electricity to the fuel production process. In the case of cogeneration of electricity and heat, the calculation is performed following point 17.

No emissions shall be allocated to agricultural crop residues and processing residues, since they are considered to have zero emissions until the point of their collection, nor to waste. Co-products that have a negative energy content shall be considered to have an energy content of zero for the purposes of the calculation.

Allocation should be applied directly after a co-product (a substance that would normally be storable or tradable) and biofuel/bioliquid/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" 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.

[references European Commission (10 June 2010). Communication from the Commission on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels – Annex II. 16 pages.]

19. For the purposes of the calculation referred to in point 18, the emissions to be divided shall be $e_{ec}$ + $e_{l}$ + $e_{sca}$ + those fractions of $e_{p}$, $e_{td}$, $e_{ccs}$ and $e_{eccr}$ that take place up to and including the process step at which a co-product is produced. If any allocation to co-products has taken place at an earlier process step in the life-cycle, the fraction of those emissions assigned in the last such process step to the intermediate fuel product shall be used for those purposes instead of the total of those emissions.

If GHG emissions are allocated to a *co-product, participating operators* shall document and describe the character of this co-product in order to justify its distinction to agricultural crop residues and/or residues from processing.

In the case of biofuels and bioliquids, all co-products, including electricity that does not fall under the scope of point 17, shall be taken into account for the purposes of that calculation, except for agricultural crop residues, including straw, bagasse, husks, cobs and nut shells. Co-products that have a negative energy content shall be considered to have an energy content of zero for the purpose of the calculation.

Wastes and residues, including tree tops and branches, straw, husks, cobs and nut shells, and residues from processing, including crude glycerine (glycerine that is not refined) and bagasse, shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection[22] of those materials irrespectively of whether they are processed to interim products before being transformed into the final product.

[22] In this context, the “point of collection” is the point where the waste or the residue arises in the first place (e.g. for used cooking oil this would be the restaurants or plants producing the fried products. In the case of household used cooking oil, this would be the first collector, which could be a private company or a municipality).

In the case of fuels produced in refineries, other than the combination of processing plants with boilers or cogeneration units providing heat and/or electricity to the processing plant, the unit of analysis for the purposes of the calculation referred to in point 18 shall be the refinery.

20. For biofuels, for the purposes of the calculation referred to in point 4, the fossil fuel comparator $E_F$ shall be 94 $gCO_{2eq}$/MJ.

For bioliquids used for electricity production, for the purposes of the calculation referred to in point 4, the fossil fuel comparator $E_F$ shall be 183 $gCO_{2eq}$/MJ.

For bioliquids used for the production of useful heat, as well as for the production of heating and/or cooling, for the purposes of the calculation referred to in point 4, the fossil fuel comparator $E_F$ shall be 80 $gCO_{2eq}$/MJ.

## Annex I, Part B : Methodology for GHG calculation: biomass fuels

(Source: Directive 2018/2001/EU Annex VI part B)

1. Greenhouse gas **emissions** from the production and use of biomass fuels shall be calculated as follows:

(a) greenhouse gas emissions from the production and use of biomass fuels before conversion into electricity, heating and cooling shall be calculated as:

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

Where:

| | | |
|---|---|---|
| E | = | total emissions from the production of the fuel before energy conversion; |
| $e_{ec}$ | = | emissions from the extraction or cultivation of raw materials; |
| $e_l$ | = | annualised emissions from carbon stock changes caused by land-use change; |
| $e_p$ | = | emissions from processing; |
| $e_{td}$ | = | emissions from transport and distribution; |
| $e_u$ | = | emissions from the fuel in use; |
| $e_{sca}$ | = | emission saving from soil carbon accumulation via improved agricultural management; |
| $e_{ccs}$ | = | emission saving from carbon capture and geological storage; |
| $e_{ccr}$ | = | emission saving from carbon capture and replacement; and |

Emissions from the manufacture of machinery and equipment shall not be taken into account.

(b) The total emission factor of the biomass fuels resulting from a co-digestion of different substrates shall be calculated as a sum and taking into account on prorata the share of the respective inputs and their emission factors. Therefore, the GHG value needs to be calculated as a single value for the whole amount of the biogas/ bio methane, resulting from the co-digestion. In the case of co-digestion of different substrates in a biogas plant for the production of biogas or biomethane, the typical and default values of greenhouse gas emissions shall be calculated as:

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

Where:

*E* = greenhouse gas emissions per MJ biogas or biomethane produced from co-digestion of the defined mixture of substrates

$S_n$ = Share of feedstock n in energy content

$E_n$ = Emission in g $CO_2$/MJ for pathway n as provided in Annex 2.4 of this Standard (from Annex VI Part D of Directive (EU) 2018/2001)[23]

[23] For animal manure used as substrate, a bonus of 45 g CO2eq/MJ manure (– 54 kg CO2eq/t fresh matter) is added for improved agricultural and manure management.

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

Where:

$P_n$ = energy yield [MJ] per kilogram of wet input of feedstock n

Note: The following values of $P_n$ shall be used for calculating typical and default values:

P(Maize): 4.16 [$MJ_{biogas}/kg_{\text{wet maize @ 65 \% moisture}}$]

P(Manure): 0.50 [$MJ_{biogas}/kg_{\text{wet manure @ 90 \% moisture}}$]

P(Biowaste) 3.41 [$MJ_{biogas}/kg_{\text{wet biowaste @ 76 \% moisture}}$]

$W_n$ = weighting factor of substrate n defined as:

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

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

Note: The following values of the standard moisture for substrate $SM_n$ shall be 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]

(c) The total emission factor of the biomass fuels resulting from a co-digestion of different substrates shall be calculated as a sum and taking into account on prorata the share of the respective inputs and their emission factors. Therefore, the GHG value needs to be calculated as a single value for the whole amount of the biogas/ bio methane, resulting from the co-digestion. In the case of co-digestion of n substrates in a biogas plant for the production of electricity or biomethane, actual greenhouse gas emissions of biogas and biomethane are calculated as follows:

$$E = \sum_1^n S_n \cdot (e_{ec,n} + e_{td,feedstock,n} + e_{l,n} - e_{sca,n}) + e_p + e_{td,product} + e_u - e_{ccs} - e_{ccr}$$

Where:

E = total emissions from the production of the biogas or biomethane before energy conversion;

$S_n$ = 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[24];

$e_p$ = emissions from processing;

$e_{td,product}$ = emissions from transport and distribution of biogas and/or biomethane;

$e_u$ = emissions from the fuel in use, that is greenhouse gases emitted during combustion;

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

$e_{ccr}$ = emission savings from $CO_2$ capture and replacement.

(d) Greenhouse gas emissions from the use of biomass fuels in producing electricity, heat and cooling, including the energy conversion to electricity and/or hear or cooling produced, shall be calculated as follows:

(i) For energy installations delivering only heat:

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

(ii) For energy installations delivering only electricity:

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

Where:

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

E = total greenhouse gas emissions of the fuel before end-conversion

$\eta_{el}$ = The electrical efficiency, defined as the annual electricity produced divided by the annual bioliquid input based on its energy content.

$\eta_h$ = The heat efficiency, defined as the annual useful heat output divided by the annual fuel input based on its energy content.

(iii) For the electricity or mechanical energy coming from energy installations delivering useful heat together with electricity and/or mechanical energy:

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

(iv) For the useful heat coming from energy installations delivering heat together with electricity and/or mechanical energy:

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

Where:

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

E = total greenhouse gas emissions of the fuel before end-conversion

$\eta_{el}$ = The electrical efficiency, defined as the annual electricity produced divided by the

[24] For $e_{sca}$ a bonus of 45 g $CO_2$eq/MJ manure shall be attributed for improved agricultural and manure management in the case animal manure is used as a substrate for the production of biogas and biomethane.

annual fuel input based on its energy content.

$\eta_h$ = The heat efficiency, defined as the annual useful heat output divided by the annual fuel 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).

The Carnot efficiency, $C_h$, for useful heat at different temperatures is defined as:

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

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 (equal to 0 °C)

If the excess heat is exported for heating of buildings, at a temperature below 150 °C (423,15 kelvin), $C_h$ can alternatively be defined as follows:

$C_h$ = Carnot efficiency in heat at 150 °C (423,15 kelvin), which is: 0,3546

For the purposes of that calculation, the following definitions apply:

(a) 'cogeneration' means the simultaneous generation in one process of thermal energy and electricity and/or mechanical energy;

(b) 'useful heat' means heat generated to satisfy an economical justifiable demand for heat, for heating and 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.

2. Greenhouse gas emissions from biomass fuels, E, shall be expressed as follows:

(a) greenhouse gas emissions from biofuels, E, shall be expressed in terms of grams of $CO_2$ equivalent per MJ of biomass fuel, g $CO_2$eq/MJ.

(b) greenhouse gas emissions from heating or electricity, produced from biomass fuels, EC, shall be expressed in terms of grams of $CO_2$ equivalent per MJ of final energy commodity (heat or electricity), g $CO_2$eq/MJ.

When heating and cooling are co-generated with electricity, emissions shall be allocated between heat and electricity (as under 1(d) in this Annex), irrespective if the heat is used for actual heating purposes or for cooling[25].

The emissions of a raw material or intermediate shall be calculated and provided in kg

[25] Heat or waste heat is used to generate cooling (chilled air or water) through absorption chillers. Therefore, it is appropriate to calculate only the emissions associated to the heat produced, per MJ of heat, irrespectively if the end-use of the heat is actual heating or cooling via absorption chillers.

$CO_{2eq}$/dry-t of product.

To receive information on emissions per dry-ton feedstock ($e_{ec}$) the following formula shall be applied:

$$e_{ec} feedstock_a \left[\frac{gCO_2eq}{kg_{dry}}\right] = \frac{e_{ec}\ feedstock_a\ \left[\frac{gCO_2eq}{kg_{moist}}\right]}{(1 - moisture\ content)}$$

The moisture content shall be the value measured upon delivery. If the moisture content is not known, the maximum value allowed per delivery contract shall be used.

3. The emissions of a raw material or intermediate shall include the emissions of all inputs and raw materials including the emissions of the previous step in the chain. The operators along the chain of custody shall add the additional emissions from transport and/or processing to $e_p$ and/or $e_{td}$ respectively (please see the formula for $e_p$ in point 11 and for $e_{td}$ in point 12).

In addition, the operators along the chain of custody shall apply a *feedstock factor* to all emissions to take energy losses into account.

Whenever a processing step yields co-products, emissions shall be allocated in proportion to the lower heating value (LHV) of the products and co-products (*allocation factor*, see also point 18).

The following formula applies to emissions from cultivation when processing intermediate products:

$$e_{ec} intermediate\ product_a \left[\frac{gCO_2eq}{t_{dry}}\right] = e_{ec} feedstock_a \left[\frac{gCO_2eq}{t_{dry}}\right] * Feedstock\ factor_a * Allocation\ factor\ intermediate\ product_a$$

Where:

$$Allocation\ factor_a : \left[\frac{Energy\ in\ intermediate\ product_a}{Energy\ in\ intermediate\ \ products\ +\ Energy\ in\ co - produ\right.$$

*Feedstock factor$_a$:* $[Ratio\ of\ MJ\ feedstock\ required\ to\ make\ 1\ MJ\ of\ intermediate\ \ product]$

At the last processing step, additionally, the operator shall convert the emission value into the unit $gCO_{2eq}$/MJ of final biomass fuel.

The following formula applies to emissions from cultivation:

$$e_{ec} fuel_a \left[\frac{gCO_2eq}{MJ\ fuel}\right] = \frac{e_{ec} feedstock_a \left[\frac{gCO_2eq}{t_{dry}}\right]}{LHV_a \left[\frac{MJ\ feedstock}{t\ dry\ feedstock}\right]} * feedstock\ factor_a * Allocation\ factor\ fuel_a$$

Where:

$$Allocation\ factor\ fuel_a : \left[\frac{Energy\ in\ fuel}{Energy\ in\ fuel\ +\ Energy\ in\ co - products}\right]$$

*Feedstock factor$_a$:* $[Ratio\ of\ MJ\ feedstock\ required\ to\ make\ 1\ MJ\ of\ fuel]$

Emissions per dry-ton feedstock shall be calculated as follows:

$$e_{ec}feedstock_a\left[\frac{gCO_2eq}{t_{dry}}\right]=\frac{e_{ec}feedstock_a\left[\frac{gCO_2eq}{t_{moist}}\right]}{(1-moisture\ content)}$$

Similarly, also the values for $e_p$, $e_{td}$, and $e_l$ shall be adjusted.

Feedstock factors shall be based on plant data and the LHV for dry-ton feedstock shall be applied. Allocation factors shall be based on plant data and the LHV for wet-ton feedstock shall be applied.

4. Greenhouse gas emission **savings** from biomass fuels shall be calculated as:

(a) greenhouse gas emissions savings from biomass fuels used as transport fuels:

SAVING = $(E_{F(t)} – E_B)/E_{F(t)}$

where

$E_B$ = total emissions from the biomass fuels used as transport fuels; and

$E_{F(t)}$ = total emissions from the fossil fuel comparator for transport

(b) greenhouse gas emissions savings from heat and cooling, and electricity being generated from biomass fuels:

SAVING = $(EC_{F(h\&c,el)} – EC_{B(h\&c,el)})/EC_{F(h\&c,el)}$

Where

$EC_{B(h\&c,el)}$ = total emissions from the heat or electricity; and

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

5. The greenhouse gases taken into account for the purposes of point 1 shall be $CO_2$, $N_2O$ and $CH_4$. For the purpose of calculating $CO_2$ equivalence, those gases shall be valued as follows:

$CO_2$ : 1

$N_2O$ : 298

$CH_4$ : 25

6. Emissions from the extraction or cultivation of raw materials, $e_{ec}$, shall 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.

**Participating Operators shall use the Methodology for determining the emissions from the extraction or cultivation of raw materials ($e_{ec}$), as specified in Annex V of this Standard.**

The capture of $CO_2$ in the cultivation of raw materials shall be excluded. Estimates of emissions from agriculture biomass cultivation may be derived from the use of regional averages for cultivation emissions included in the reports referred to in Article 31(4) of Directive 2018/2001 (EU) or the information on the disaggregated default values for cultivation emissions included in this Annex, as an alternative to using actual values. In the absence of relevant information it is allowed to calculate averages based on local farming practises based for instance on data of a group of farms, as an alternative to using actual values.

Estimates of emissions from cultivation and harvesting of forestry biomass may be derived from the use of averages for cultivation and harvesting emissions calculated for geographical areas at national level, as an alternative to using actual values.

Operators may use either measured or aggregate values (please see 8.3.3. and 8.3.4). When using actual values, economic operators shall make reference to the method and source used for determining actual values (e.g. average values based on representative yields, fertiliser input, $N_2O$ emissions and changes in carbon stock).

The *participating operator* determines the GHG emissions resulting from *primary production* $e_{ec}$ including all activities necessary for or related to *primary production* of raw material (*biomass*) as well as all inputs used by applying *actual values* in the following formula:

in [kg $CO_2$eq / kg of product]

As a rule product yield shall be determined as:

3. the actual product realised in a particular harvest in kg/ha averaged over the extent of the individual operation (production) site for crops which are harvested annually; or
4. the actual product yield realised in the preceding 12 month period in kg/ha averaged over the extent of the individual operation (production) site for crops which are harvested more than once per year or which are harvested continuously.

The calculation of the emissions of fertilisers, pesticides and mechanical work is performed by multiplying the actual amount (provided by the operator) with the emission factor:

$$Emission_{fertilizer}\left[\frac{kgCO_2eq}{ha*yr}\right] = fertilizer\left[\frac{kg}{ha*yr}\right]*emission\_factor_{production\_fertilizer}\left[\frac{kgCO_2eq}{kg}\right]$$

$$Emission_{pesticide}\left[\frac{kgCO_2eq}{ha*yr}\right] = pesticide\left[\frac{kg}{ha*yr}\right]*emission\_factor_{production\_pesticide}\left[\frac{kgCO_2eq}{kg}\right]$$

$$Emission_{mechanical\_work}\left[\frac{kgCO_2eq}{ha*yr}\right] = mechanical\_work\left[\frac{l\_diesel}{ha*yr}\right]*emission\_factor_{diesel}\left[\frac{kgCO_2eq}{l}\right]$$

$$E_{electricity}\left[\frac{kgCO_{2eq}}{ha}\right] = electricity\left[\frac{kWh}{ha}\right]*\ emission\_factor_{electricity}\left[\frac{kgCO_{2eq}}{kWh}\right]$$

7. Annualised emissions from carbon stock changes caused by land-use change, $e_l$, shall be calculated by dividing total emissions equally over 20 years. For the calculation of those emissions the following rule shall be applied:

$e_l = (CS_R – CS_A) \times 3{,}664 \times 1/20 \times 1/P – e_B$

or preferrably

$$e_l'\left[\frac{kgCO_{2eq}}{kg_{product(crop)}}\right] = \frac{CS_R\left[\frac{kgC}{ha}\right] - CS_A\left[\frac{kgC}{ha}\right]}{yield_{main\_product(crop)}\left[\frac{kg}{ha * yr}\right] \bullet 20[yr]} \bullet 3{,}664 - e_B'$$

in [kg $CO_2$ / kg of product]

[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) is equal to 3,664.]

where:

| | | |
|---|---|---|
| $e_l$ | = | annualised greenhouse gas emissions from carbon stock change due to land-use change (measured as mass of $CO_2$-equivalent per unit biofuel or bioliquid energy); “Cropland”[26] and “perennial cropland”[27] shall be regarded as one land use; |
| $C_{SR}$ | = | the carbon stock per unit area associated with the reference land use (measured as mass of carbon per unit area, including both soil and vegetation). The reference land use shall be the land use in January 2008 or 20 years before the raw material was obtained, whichever was the later; |
| $C_{SA}$ | = | the carbon stock per unit area associated with the actual land use (measured as mass 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 CSA shall be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier; |
| $P$ | = | the productivity of the crop (measured as biomass energy per unit area per year); and |
| $e_B$ | = | bonus of 29 $gCO_{2eq}$/MJ biomass fuel if biomass is obtained from restored degraded land under the conditions provided for in point 8. |

$e_B$ is expressed in *kg $CO_2$eq/kg product (crop).* When applying the bonus the participating operator shall document the used conversion and allocation factors (from kg crop to MJ final biofuel/bioliquid), e.g.: 1 MJ of biomass from palm kernel shells corresponds to 8 kg of fresh fruit bunches.

When using actual values, economic operators shall make reference to the method and source used for determining actual values (e.g. values based on representative yields, fertiliser input, $N_2O$ emissions and changes in carbon stock).

Land use change should be understood as referring to changes in terms of land cover

[26] Cropland as defined by IPCC.

[27] Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm.

between the six land categories used by the IPCC (forest land, grassland, cropland, wetlands, settlements and other land). Cropland and perennial[28] cropland shall be regarded as one land use. 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.

8. The bonus of 29 $gCO_{2eq}$/MJ shall be attributed if evidence 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

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

9. '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

10. **The Commission guidelines shall serve as the basis for the calculation of land carbon stocks for the purposes of *EU RED*. See 2010/335/EU - Commission Decision of 10 June 2010 on guidelines for the calculation of land carbon stocks in accordance with point 10 of Part C of Annex V to Directive 2018/2001/EU.**

    Available at https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:151:0019:0041:EN:PDF

    *The Commission shall review, by 31 December 2020, guidelines for the calculation of land carbon stocks (2010/335/EU) drawing on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories – volume 4 and in accordance with Regulation (EU) No 525/2013 and Regulation (EU) 2018/841 of the European Parliament and of the Council (Regulation 2018/841/EU). The Commission guidelines shall serve as the basis for the calculation of land carbon stocks for the purposes of this Directive.*

11. Emissions from processing, $e_p$, shall include emissions from the processing itself; from waste and leakages; and from the production of chemicals or products used in processing including the $CO_2$ emissions corresponding to the carbon contents of fossil inputs, whether or not actually combusted in the process. Processing may be divided into several locally separate process steps, each producing a different product. $e_p$ subsumes such different processing steps taking different conversion and allocation factors into consideration.

    Actual values for emissions from processing steps ($e_p$ in the methodology) in the production chain must be measured or based on technical specifications of the processing facility. When the range of emissions values for a group of processing

[28] Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm

facilities to which the facility concerned belongs is available, the most conservative number of that group shall be used.

The emissions shall be calculated for each processing step individually using the formula below and summed up.

In accounting for the consumption of electricity not produced within the solid or gaseous biomass fuel production plant, the greenhouse gas emission intensity of the production and distribution of that electricity shall be assumed to be equal to the average emission intensity of the production and distribution of electricity in a defined region. By derogation from this rule, producers may use an average value for an individual electricity production plant for electricity produced by that plant, if that plant is not connected to the electricity grid.

Emissions from processing shall include emissions from drying of interim products and materials where relevant.

The *participating operator* determines the GHG emissions resulting from processing $e_p$, including all activities necessary for or related to processing and all GHG emissions resulting from wastes (including waste water) as well as all inputs used by applying *actual values* in the following formula:

$$e_p' = \frac{emission_{\substack{electricty\\consumption}}\left[\frac{kgCO_2}{yr}\right] + emission_{\substack{heat\\production}}\left[\frac{kgCO_2}{yr}\right] + emission_{\substack{operating\\material}}\left[\frac{kgCO_2}{yr}\right] + emission_{effluent}\left[\frac{kgCO_2}{yr}\right]}{product\ yield_{\substack{main\\product(crop)}}\left[\frac{kg_{producyield}}{yr}\right]}$$

in [kg $CO_2$eq / kg of product]

$$emission_{\substack{electricty\\consumption}}\left[\frac{kgCO_2}{yr}\right] = emission\_factor_{\substack{electricty\\mix}}\left[\frac{kgCO_2}{kWh}\right] * electricity\_consumption\left[\frac{kWh}{yr}\right]$$

$$emission_{\substack{heat\\generation}}\left[\frac{kgCO_2eq}{yr}\right] = emission\_factor_{\substack{heat\\generation}}\left[\frac{kgCO_2eq}{MJ}\right] * heat\_generation\left[\frac{MJ}{yr}\right].$$

$$emission_{\substack{operating\\materials}}\left[\frac{kgCO_2eq}{yr}\right] = emission\_factor_{\substack{operating\\materials}}\left[\frac{kgCO_2eq}{kg}\right] * operating\_materials\left[\frac{kg}{yr}\right]$$

$$emission_{effluents}\left[\frac{kgCO_2eq}{yr}\right] = emission\_factor_{effluent}\left[\frac{kgCO_2eq}{kg}\right] * effluent\left[\frac{kg}{yr}\right]$$

The emission factor of the effluent is taken from point 5 for $CO_2$, $CH_4$ and $N_2O$. For other effluents, these emission factors are the climate change factors of IPCC with a timeframe of 100 years.

[IPCC 2006: IPCC guidelines for national greenhouse gas inventories. L. B. Simon Eggleston, Kyoko Miwa, Todd Ngara and Kiyoto Tanabe. Kanagawa]

The actual amount of energy and material requirements shall be provided by the operator.

The Directive requires the use of the average emission intensity for a "defined region". In the case of the EU the most logical choice is the whole EU. In the case of third countries, where grids are often less linked-up across borders, the national average could be the appropriate choice. [references European Commission (10 June 2010). Communication from the Commission on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels – Annex II. 16 pages.]

12. Emissions from transport and distribution, $e_{td}$, shall include emissions from the transport of raw and semi-finished materials and from the storage and distribution of finished materials. Transport may be divided into several locally separate transport steps. $e_{td}$ subsumes all of the transport steps.

Emissions from transport and distribution to be taken into account under point 6 shall not be covered by this point.

The *participating operator* determines the GHG emissions resulting from transport $e_{td}$, including all transport steps used by applying *actual values* in the following formula:

$$e_{td} = e_{tr} + e_{st} + e_{fl}$$

$$e_{tr} = \frac{TD_{vehicle}[km] * TQ[kg] * EF_{transport}\left[\frac{kgCO_2}{tkm}\right]}{TQ\,[kg]}$$

$$e_{st} = \mathrm{E}_{storage}\left[\frac{\mathrm{MJ}}{\mathrm{MJ}_{\mathrm{fuel}}}\right] * \frac{1}{3.6}\left[\frac{\mathrm{kWh}}{\mathrm{MJ}}\right] * EF_{electricity}\left[\frac{kgCO_2}{kWh}\right] * ED\left[\frac{MJ_{fuel}}{kg}\right]$$

$$e_{fl} = E_{filling}\left[\frac{\mathrm{MJ}}{\mathrm{MJ}_{\mathrm{fuel}}}\right] * \frac{1}{3.6}\left[\frac{\mathrm{kWh}}{\mathrm{MJ}}\right] * EF_{electricity}\left[\frac{kgCO_2}{kWh}\right] * ED\left[\frac{MJ_{fuel}}{kg}\right]$$

in [kg $CO_2$ / kg of product]

With

TD: transport distance

TQ: transported quantity of biomass / bioliquid / biofuel

$EF_{transport}$: emission factor for transport; taken from the ecoinvent database (without infrastructure). They are specific for the different types of vehicle and take into account the average load of the vehicle.

$EF_{electricity}$ : emission factor for electricity at the location of storage or filling

ED: energy density of fuel

$E_{storage}$: electricity used at storage facilities: user-given actual value or, alternatively: standard value of 0.00084 MJ/MJ-fuel (JRC, 2008)

$E_{filling}$: electricity used at filling station: standard value of 0.0034 MJ/MJ-fuel (JRC, 2008)

Source for $E_{storage}$ and $E_{filling}$: JRC, "Input data relevant to calculating default GHG emissions according to RE Directive Methodology", 2008)

13. Emissions from the fuel in use, $e_u$, shall be taken to be zero for biomass fuels. Emissions of non-$CO_2$ greenhouse gases ($CH_4$ and $N_2O$) from the fuel in use shall be included in the $e_u$ factor.

14. Emission saving from soil carbon accumulation via improved agricultural management ($e_{sca}$)

14. 1. All calculations of $e_{sca}$ shall follow the requirements set out in Annex VI of this

Standard.

14. 2. The operator shall provide evidence that the practices for improved agricultural management are applied, such as

- Shifting to reduced or zero-tillage;
- Improved crop rotation and /or cover crops, including crop residue management;
- Improved fertiliser or manure management;
- Use of soil improver (e.g. compost)

14. 3. Emission savings from such improvements can only be taken into account if evidence is provided that the soil carbon has increased, or solid and verifiable evidence is provided that it can be reasonably be expected to have increased over the period in which the raw material concerned were cultivated while taking into account the emissions where such practices lead to increased fertiliser and herbicide use.

Measurement of soil carbon can constitute such evidence, e.g. by a first measurement in advance of the cultivation and subsequent ones at regular intervals several years apart. In such a case, before the second measurement is available, increase in soil carbon would be estimated using a relevant scientific basis. From the second measurement onwards, the measurements would constitute the basis for determining the existence of an increase in soil carbon and its magnitude.

14. 4. Emission savings $e_{sca}$ may only be applied for measures undertaken after 1 January 2008.

15. Emission saving from carbon capture and geological storage $e_{ccs}$, that have not already been accounted for in $e_p$, shall be limited to emissions avoided through the capture and storage of emitted $CO_2$ directly related to the extraction, transport, processing and distribution of fuel:

15. 1. The operator shall provide evidence that the emission saving relates directly to the production of the biomass fuel they are attributed to. If the $CO_2$ is not captured continuously, the operator may deviate from this approach and attribute different amounts of savings to biomass fuel obtained from the same process. However, in no case a higher amount of savings shall be allocated to a given batch of biomass fuel than the average amount of $CO_2$ captured per MJ of biomass fuel in a hypothetical process where the entire $CO_2$ stemming from the production process is captured.

15. 2. For the calculation of $e_{ccs}$ the operator shall take emissions into account resulting from the energy consumed and inputs used for capturing, processing and storing of the $CO_2$ (by applying the appropriate emission factors)

The emission savings $e_{ccs}$ [kg $CO_{2eq}$/MJ] are calculated as follows:

$$e_{ccs} = \frac{CO_2\ stored\ [kg] - \text{energy consumed}[MWh] * EF\left[\frac{kgCO_{2eq}}{MWh}\right] - operating\ materials\ [kg] * EF\ \frac{kg\ CO_{2eq}}{kg}}{\text{biomass fuel produced } [kg] *\ LHV_{biofuel}\left[\frac{MJ}{kg}\right]}$$

15. 3. The operator shall provide evidence that the carbon is effectively captured and safely stored. A temporary storage (e.g. construction material) is not eligible for $e_{ccs}$.

15. 4. The operator shall demonstrate to the auditor that the storage facility is in good condition and without leakages.

16. Emission savings from carbon capture and replacement, $e_{ccr}$, 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 $CO_2$ used in commercial products and services.

16. 1. The operator shall provide evidence that the carbon captured originates from biomass and replaces fossil-derived $CO_2$ used in commercial products and services.

16. 2. The operator shall provide evidence that the emission saved relates directly to the production of the biomass fuel they are attributed to. If the $CO_2$ is not captured continuously, the operator may deviate from this approach and attribute different amounts of savings to biomass fuel obtained from the same process. However, in no case a higher amount of savings shall be allocated to a given batch of biomass fuel than the average amount of $CO_2$ captured per MJ of biomass fuel in a hypothetical process where the entire $CO_2$ stemming from the production process is captured.

16. 3. For the calculation of $e_{ccr}$ the operator shall take emissions into account resulting from the energy consumed and inputs used for capturing and processing of the $CO_2$ (by applying the appropriate emission factors)

The emission savings $e_{ccr}$ [kg $CO_{2eq}$/MJ] are calculated as follows:

$$e_{ccr} = \frac{CO_2\ used\ [kg] - \text{energy consumed}[MWh] * EF\left[\frac{kgCO_{2eq}}{MWh}\right] - operating\ materials\ [kg] * EF\ \frac{kg\ CO_{2eq}}{kg}}{\text{biomass fuel produced}\ [kg] *\ LHV_{biofuel}\left[\frac{MJ}{kg}\right]}$$

(EF: emission factor)

16. 4. The operator shall provide evidence that the captured $CO_2$ is used in commercial products and services to replace fossil-derived $CO_2$, i.e. information from the buyer of the $CO_2$ is required showing how the $CO_2$ that is replaced was generated previously and declaring that due to the replacement emissions of that quantity are avoided.

Auditors are not required to conduct audits on the premises of the buyer unless there is a reasonable suspicion that the information provided is incorrect.

17. Where a cogeneration unit – providing heat and/or electricity to a biomass fuel production process for which emissions are being calculated – produces excess electricity and/or excess useful heat, the greenhouse gas emissions shall be divided between the electricity and the useful heat according to the temperature of the heat (which reflects the usefulness (utility) of the heat). The useful part of the heat is found by multiplying its energy content with the Carnot efficiency, $C_h$, calculated 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 (equal to 0°C)

If the excess heat is exported for heating of buildings, at a temperature below 150°C (423,15 kelvin), $C_h$ can alternatively be defined as follows:

$C_h$ = Carnot efficiency in heat at 150°C (423,15 kelvin), which is: 0,3546

For the purposes of that calculation, the actual efficiencies shall be used, defined as the annual mechanical energy, electricity and heat produced respectively divided by the annual energy input.

For the purposes of that calculation, the following definitions apply:

(a) ‘cogeneration’ shall mean the simultaneous generation in one process of thermal energy and electrical and/or mechanical energy;

(b) ‘useful heat’ shall mean heat generated to satisfy an economical justifiable demand for heat, for heating or cooling purposes;

(c) ‘economically justifiable demand’ shall mean the demand that does not exceed the needs for heat or cooling and which would otherwise be satisfied at market conditions.

18. Where a biomass fuel production process produces, in combination, the fuel for which emissions are being calculated and one or more other products (co-products), greenhouse gas emissions shall be divided between the fuel or its intermediate product and the co-products in proportion to their energy content (determined by lower heating value in the case of co-products other than electricity and heat).

The *participating operator* determines the allocation factor for GHG emissions savings for co-products by applying actual values in the following formula:

$$allocation\quad factor = \frac{energy\ yield_{main\ product}[MJ]}{energy\ yield_{main\ product}[MJ] + energy\ yield_{co-products}[MJ]}$$

no dimension

The energy yields are calculated by multiplying the quantity of product or co-product with the specific energy content.

The participating operator shall document the used lower heating values, the source of the values (own measurement or literature), and whether the values refer to dry mass or to fresh substance.

The lower heating value used in applying this rule should be that of the entire (co-) product, not of only the dry fraction of it. For the purpose of this calculation, feedstock factors based on plant data have to be applied. Please note that for the calculation of the feedstock factor the LHV values per dry ton need to be applied while for the calculation of the allocation factor LHV values for wet biomass need to be used as this approach was also applied for the calculation of the default values.

The greenhouse gas intensity of excess useful heat or excess electricity is the same as the greenhouse gas intensity of heat or electricity delivered to the biomass fuel production process and is determined from calculating the greenhouse intensity of all inputs and emissions, including the feedstock and $CH_4$ and $N_2O$ emissions, to and from the cogeneration unit, boiler or other apparatus delivering heat or electricity to the biomass fuel production process. In the case of cogeneration of electricity and heat, the calculation is performed following point 17.

Allocation should be applied directly after a co-product (a substance that would normally be storable or tradable) and biomass fuel/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" 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.

[references European Commission (10 June 2010). Communication from the Commission on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels – Annex II. 16 pages.]

19. For the purposes of the calculation referred to in point 18, the emissions to be divided shall be $e_{ec}$ + $e_l$ + $e_{sca}$ + those fractions of $e_p$, $e_{td}$, $e_{ccs}$ and $e_{eccr}$ that take place up to and including the process step at which a co-product is produced. If any allocation to co-products has taken place at an earlier process step in the life-cycle, the fraction of those emissions assigned in the last such process step to the intermediate fuel product shall be used for those purposes instead of the total of those emissions.

If GHG emissions are allocated to a *co-product, participating operators* shall document and describe the character of this co-product in order to justify its distinction to agricultural crop residues and/or residues from processing.

In the case of biogas and biomethane, all co-products shall be taken into account for the purposes of that calculation. No emissions shall be allocated to agricultural crop residues and processing residues, since they are considered to have zero emissions until the point of their collection, nor to waste. Co-products that have a negative energy content shall be considered to have an energy content of zero for the purposes of the calculation.

Wastes and residues, including tree tops and branches, straw, husks, cobs and nut shells, and residues from processing, including crude glycerine (glycerine that is not refined) and bagasse, shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection[29] of those materials irrespectively of whether they are processed to interim products before being transformed into the final product.

In the case of biomass fuels produced in refineries, other than the combination of processing plants with boilers or cogeneration units providing heat and/or electricity to the processing plant, the unit of analysis for the purposes of the calculation referred to in point 18 shall be the refinery.

20. For biomass fuels used for electricity production, for the purposes of the calculation referred to in point 4, the fossil fuel comparator $E_{F(el)}$ shall be 183 $gCO_{2eq}$/MJ electricity or 212 $gCO_{2eq}$/MJ electricity for the outermost regions[30].

For biomass fuels used for the production of useful heat, as well as for the production of heating and/or cooling, for the purposes of the calculation referred to in point 4, the fossil fuel comparator $E_{F(h)}$ shall be 80 $gCO_{2eq}$/MJ.

For biomass fuels used for the production of useful heat, in which a direct physical substitution of coal can be demonstrated, for the purposes of the calculation referred to in point 4, the fossil fuel comparator $E_{F(h)}$ shall be 124 $gCO_{2eq}$/MJ.

For biomass fuels used as transport fuels, for the purposes of the calculation referred to in point 4, the fossil fuel comparator $E_{F(t)}$ shall be 94 $gCO_{2eq}$/MJ.

[29] In this context, the “point of collection” is the point where the waste or the residue arises in the first place (e.g. for used cooking oil this would be the restaurants or plants producing the fried products. In the case of household used cooking oil, this would be the first collector, which could be a private company or a municipality).

[30] Outermost regions as referred to in Article 349 in the Treaty on the Functioning of the European Union (TFEU)

## Annex I, Part C : Methodology for determining greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin (RFNBO) and from recycled carbon fuels (RCF)

1. Greenhouse gas emissions from the production and use of RFNBO or RCF shall be calculated as follows:

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

where:

$E$ = total emissions from the use of the fuel ($gCO_2eq$ / MJ fuel)

$e_i = e_{i\,elastic} + e_{i\,rigid} - e_{ex-use}$: emissions from supply of inputs ($gCO_2eq$ / MJ fuel)

$e_{i\,elastic}$ = emissions from elastic inputs ($gCO_2eq$ / MJ fuel)

$e_{i\,rigid}$ = emissions from rigid inputs ($gCO_2eq$ / MJ fuel)

$e_{ex-use}$ = emissions from inputs' existing use or fate ($gCO_2eq$ / MJ fuel)

$e_p$ = emissions from processing ($gCO_2eq$ / MJ fuel)

$e_{td}$ = emissions from transport and distribution ($gCO_2eq$ / MJ fuel)

$e_u$ = emissions from combusting the fuel in its end-use ($gCO_2eq$ / MJ fuel)

$e_{ccs}$ = emission savings from carbon capture and geological storage ($gCO_2eq$ / MJ fuel)

Emissions from the manufacture of machinery and equipment shall not be taken into account.

The greenhouse gas emissions intensity of RFNBOs or RCFs shall be determined by dividing the total emissions of the process covering each element of the formula by the total amount of fuel stemming from the process and shall be expressed in terms of grams of $CO_2$ equivalent per MJ of fuel (g $CO_2eq$/MJ fuel). If a fuel is a mix of RFNBO, RCF and other fuels, all (fuel) types shall be considered to have the same emission intensity.

The exception to this rule is the case of co-processing where RFNBO and RCF are only partially replacing a conventional input in a process.

In such a situation it shall be distinguished in the calculation of the greenhouse gas emissions intensity on a proportional basis of the energetic value of inputs between:

- the part of the process that is based on the conventional input, and
- the part of the process that is based on RFNBO and RCF assuming that the process parts are otherwise identical.

An analogous distinction between processes shall be applied where RFNBO and RCF are processed together with biomass.

The greenhouse gas emissions intensity may be calculated as an average for the entire production of fuels occurring during a period of at most one calendar month but may also be calculated for shorter time intervals. Where electricity qualifying as fully renewable according to the methodology set out in Directive 2018/2001 is used as input that enhances the heating value of the fuel or intermediate products, the time interval shall be in line with the requirements applying for temporal correlation. Where relevant, greenhouse gas emissions intensity values calculated for individual time intervals may then be used to calculate an average greenhouse gas emissions intensity for a period of up to one month, provided that the individual values calculated for each time period meet the minimum savings threshold of 70%.

2. Greenhouse gas emission savings from RFNBO or from RCF shall be calculated as follows:

Savings = $(E_F - E) / E_F$

where:

E = total emissions from the use of RFNBO or RCF.

$E_F$ = total emissions from the fossil fuel comparator.

For all RFNBOs and RCFs, the total emissions from the fossil fuel comparator shall be 94 gCO2eq/MJ.

3. If the output of a process does not fully qualify as RFNBO or RCF, their respective shares in the total output shall be determined as follows:

(a) the fraction of RFNBO shall be determined by dividing the relevant renewable energy input intothe process by the total relevant energy inputs into the process.

(b) the fraction of RCF shall be determined by dividing the relevant energy input qualifying as a source for the production of RCF into the process by the total relevant energy inputs into the process.

The relevant energy for material inputs is the lower heating value of the material input that enters into the molecular structure of the fuel[31].

For electricity inputs that are used to enhance the heating value of the fuel or intermediate products, the relevant energy is the energy of the electricity.

For industrial off-gases, it is the energy in the off-gas based on their lower heating value. In case of heat that is used to enhance the heating value of the fuel or intermediate product, the relevant energy is the useful energy in the heat that is used to synthesise the fuel. Useful heat is the total heat energy multiplied by the Carnot efficiency, as defined in Annex V, part C, point (1)(b) of Directive (EU) 2018/2001 (also indicated in Annex I, Part A, of this Standard). Other inputs are only taken into account when determining the emission intensity of the fuel.

4. When determining emissions from supply of inputs, it shall be distinguished between elastic inputs and rigid inputs. Rigid inputs are those whose supply cannot be expanded to meet extra demand. Thus, all inputs qualifying as a carbon source for the production

[31] For material inputs containing water, the lower heating value is taken to be the lower heating value of the dry part of the material input (i.e. not taking into account the energy needed to evaporate the water). Renewable liquid and gaseous transport fuels of non-biological origin used as intermediate products for the production of conventional fuels are not considered.

of RCF are rigid, as well as outputs produced in fixed ratio by an incorporated process[32] and which represent less than 10% of the economic value of the output. If it represents 10% or more of the economic value, it shall be treated as elastic. In principle, elastic inputs are those whose supply can be increased to meet extra demand. Petroleum products from refineries fall into this category because refineries can change the ratio of their products.

5. Electricity qualifying as fully renewable according to Article 27(3) of Directive 2018/2001, shall be attributed zero greenhouse gas emissions.

6. One of the three following alternative methods shall be applied during each calendar year to attribute greenhouse gas emissions values to the electricity taken from the grid that does not qualify as fully renewable according to Article 27(3) of Directive (EU) 2018/2001 and is used to produce RFNBOs and RCFs:

   (a) greenhouse gas emissions values shall be attributed according to Annex I, Part E, of this Standard. This is without prejudice to the assessment under State aid rules;

   (b) greenhouse gas emissions values shall be attributed depending on the number of full load hours the installation producing RFNBO and RCF is operating. Where the number of full load hours is equal or lower than the number of hours in which the marginal price of electricity was set by installations producing renewable electricity or nuclear power plants in the preceding calendar year for which reliable data are available, grid electricity used in the production process of RFNBO and RCF shall be attributed a greenhouse gas emissions value of zero g CO2eq/MJ. Where this number of full load hours is exceeded, grid electricity used in the production process of renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels shall be attributed a greenhouse gas emissions value of 183 g CO2eq/MJ; or

   (c) the greenhouse gas emissions value of the marginal unit generating electricity at the time of the production of the RFNBO in the bidding zone may be used if this information is publicly available from the national transmission system operator.

   If the method set in point (b) above is used, it shall also be applied to electricity that is used to produce RFNBO and RCF and qualifies as fully renewable according to Article 27(3) of Directive (EU) 2018/2001.

7. GHG emissions of elastic inputs that are obtained from an incorporated process shall be determined based on data from their actual production process. This shall include all emissions arising due to their production over the whole supply chain (including emissions arising from the extraction of the primary energy required to make the input, processing of the input and transportation of the input). Combustion emissions related to the carbon content of fuel inputs shall not be included[33].

   However, GHG emissions from the elastic inputs that are not obtained from an incorporated process shall be determined based on the values included in Annex I, Part D of this Standard. If the input is not included in the list, information of the emission

[32] Incorporated processes include processes that take place in the same industrial complex, or that supply the input via a dedicated supply infrastructure, or that supply more than half of the energy of all inputs to the production of the renewable liquid and gaseous transport fuel of non-biological origin or recycled carbon fuel.

[33] If carbon intensities are taken from the table in Annex I, Part D, combustion emissions shall not be considered. This is because combustion emissions are counted in processing or in the combustion emissions of the final fuel.

intensity may be drawn from the latest version of the JEC-WTW report, the ECOINVENT database, official sources such as the IPCC, IEA or government, other reviewed sources such as the E3 and GEMIS database and peer reviewed publications.

8. The supplier of each input, excluding those where the values are taken from Annex I, Part D of this Standard, shall calculate the emissions intensity[34] of the input following the procedures in this Annex I, Part C, and report the value to the next production step or final fuel producer. The same rule applies to the suppliers of inputs further back in the supply chain.

9. Emissions from rigid inputs shall include the emissions resulting from the diversion of those inputs from a previous or alternative use. These emissions shall take into account the loss of production of electricity, heat or products that were previously generated using the input as well as any emissions due to additional treatment of the input and transport. The following rules shall apply:

   (a) Emissions attributed to the supply of rigid inputs shall be determined by multiplying the lost production of electricity, heat or other products, with the relevant emission factor. In case of lost electricity production, the emission factors to consider are for grid electricity generation in the country where the displacement occurred determined according to the appropriate methodology set out under points 5 or 6 above. In case of diverted material, the emissions to be attributed to the replacement material are calculated as for material inputs in this methodology. For the first 20 years after the start of production of RFNBO or RCF, the loss of production of electricity, heat and material shall be determined based on the average amount of electricity and heat that was produced from the rigid input over the last three years before the start of production of RFNBO or RCF. After 20 years of production, the loss of production of electricity, heat or other products shall be determined based on the minimum energy performance standards assumed in pertinent best available technology (BAT) conclusions. Where the process is not covered by a BAT, the estimation of lost production shall be based on a comparable process applying state of the art technology.

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

   (c) where the process makes use of rigid inputs from new installations such as a new steelworks that uses its blast furnace gas for making RCF, the impact of diverting the input from the most economic alternative use shall be taken into account. Then the emission implications are calculated according to the minimum energy performance standards assumed in the pertinent BAT conclusions. For industrial processes which are not covered by a BAT, the saved emissions shall be calculated on the basis of the comparable process applying state of the art technology.

10. Emissions from existing use or fate include all emissions in the existing use or fate of the input that are avoided when the may countinput is used for fuel production. These

[34] Consistent with point 6, the emissions intensity shall not include the emissions embedded in the carbon content of the supplied input.

emissions shall include the $CO_2$ equivalent of the carbon incorporated in the chemical composition of the fuel that would have otherwise been emitted as CO2 into the atmosphere. This includes $CO_2$ that was captured and incorporated into the fuel provided that at least one of the following conditions is fulfilled:

(a) The $CO_2$ has been captured from an activity listed under Annex I of Directive 2003/87/EC[35] and has been taken into account upstream in an effective carbon pricing system and is incorporated in the chemical composition of the fuel before 2036. This date shall be extended to 2041 in other cases than $CO_2$ stemming from the combustion of fuels for electricity generation; or

(b) The $CO_2$ has been captured from the air; or

(c) The captured $CO_2$ stems from the production or the combustion of biofuels, bioliquids or biomass fuels complying with the sustainability and greenhouse gas saving criteria and the $CO_2$ capture did not receive credits for emission savings from $CO_2$ capture and replacement, set out in Annex V[36] and VI[37] of Directive (EU) 2018/2001; or

(d) The captured CO2 stems from the combustion of RFNBO or RCF complying with the greenhouse gas saving criteria, set out in Article 25(2) and Article 28(5) of Directive (EU) 2018/2001 and this Annex I, Part C; or

(e) The captured $CO_2$ stems from a geological source of $CO_2$ and the $CO_2$ was previously released naturally.

Captured CO2, stemming from a fuel that is deliberately combusted for the specific purpose of producing the CO2, and CO2, the capture of which has received an emissions credit under other provisions of the law, shall not be included.

[35] Annex I of Directive 2003/87/EC: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32003L0087&qid=1698176728700#d1e32-42-1

[36] Annex V of Directive (EU) 2018/2001: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L2001&qid=1698176856967#d1e32-147-1

[37] Annex VI of Directive (EU) 2018/2001: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L2001&qid=1698176856967#d1e32-172-1

Emissions associated with the inputs like electricity and heat and consumable materials used in the capture process of CO2 shall be included in the calculation of emissions attributed to inputs.

11. The dates established in point 10(a) will be subject to review considering the implementation in the sectors covered by Directive 2003/87/EC of the Union-wide climate target for 2040 established in accordance with Article 4(3) of Regulation (EU) 2021/1119.

12. Emissions from processing shall include direct atmospheric emissions from the processing itself, from waste treatment and from leakages.

13. Emissions from combustion of the fuel refer to the total combustion emissions of the fuel in use.

14. The greenhouse gases taken into account in emissions calculations, and their carbon dioxide equivalents, shall be the same as specified in paragraph 4 of Annex V, part C, of Directive (EU) 2018/2001 (also indicated here in Annex I, Part A, paragraph 5).

15. Where a process yields multiple co-products such as fuels or chemicals, as well as energy co-products such as heat, electricity or mechanical energy exported from the plant, greenhouse gas emissions shall be allocated to these co-products applying the following approaches in the following manner:

(a) the allocation shall be conducted at the end of the process that produces the co-products. The emissions allocated shall include the emissions from the process itself, as well as the emissions attributed to inputs to the process.

(b) the emissions to be allocated shall be $e_i$ plus any fractions of $e_p$, $e_{tp}$ and $e_{ccs}$ that take place up to and including the process step at which the co-products are produced. If an input into the process is itself a co-product of another process, the allocation at the other process shall be done first to establish the emissions to be attributed to the input.

(c) if any installation inside the project boundary treats only one of the project's co-products, then the emissions from that installation shall be ascribed entirely to that co-product.

(d) where the process allows to change the ratio of the co-products produced, the allocation shall be done based on physical causality by determining the effect on the process' emissions of incrementing the output of just one co-product whilst keeping the other outputs constant.

(e) where the ratio of the products is fixed and the co-products are all fuels, electricity or heat, the allocation shall be done by energy content. If allocation concerns exported heat on the basis of the energy content, only the useful part of the heat may be considered, as defined in paragraph 16 of Directive 2018/2001 Annex V, part C (also indicated here in Annex I, Part A, paragraph 17).

(f) where the ratio of the products is fixed and some co-products are materials with no energy content, the allocation shall be done by the economic value of the co-products. The economic value considered shall be the average factory-gate value of the products over the last three years. If such data is not available, the value shall be estimated from commodity prices minus the cost of transport and storage[38].

16. Emissions from transport and distribution shall include emissions from the storage and distribution of the finished fuels. Emissions attributed to inputs $e_i$ shall include emissions from their associated transport and storage.

17. Where a process for making RFNBO or RCF produces carbon emissions that are permanently stored in accordance with Directive 2009/31/EC[39] on the geological storage of carbon dioxide, this may be credited to the products of the process as a reduction in emissions under $e_{ccs}$. Emissions arising due to the storage operation (including transport of the carbon dioxide) will also need to be taken into account under $e_p$.

## Annex I, Part D : 'Standard values' for greenhouse gas emission intensities of elastic inputs

The GHG intensities of inputs, other than electricity, are shown in the tables below.

**Table I. GHG intensity of fuels**

| Inputs | Total emissions gCO$_2$eq/MJ | Upstream emissions gCO$_2$eq/MJ | Combustion emissions gCO$_2$eq/MJ |
|---|---|---|---|
| **Natural gas** | 66.0 | 9.7 | 56.2 |
| **Diesel** | 95.1 | 21.9 | 73.2 |
| **Gasoline** | 93.3 | 19.9 | 73.4 |
| **Heavy fuel oil** | 94.2 | 13.6 | 80.6 |
| **Methanol** | 97.1 | 28.2 | 68.9 |
| **Hard coal** | 112.3 | 16.2 | 96.1 |
| **Lignite** | 116.7 | 1.7 | 115.0 |

**Table II. GHG intensity of other inputs.**

| Inputs | GHG intensities gCO$_2$eq/kg |
|---|---|
| **Ammonia** | 2351.3 |
| **Calcium chloride ($CaCl_2$)** | 38.8 |
| **Cyclohexane** | 723.0 |
| **Hydrochloric acid (HCl)** | 1061.1 |
| **Lubricants** | 947.0 |
| **Magnesium sulphate ($MgSO_4$)** | 191.8 |

[38] Note that it is the relative values of the co-products that matters, so general inflation is not an issue
[39] Directive 2009/31/EC: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009L0031&qid=1698178095546

| | |
|---|---|
| **Nitrogen** | 56.4 |
| **Phosphoric acid ($H_3PO_4$)** | 3124.7 |
| **Potassium hydroxide (KOH)** | 419.1 |
| **Pure CaO for processes** | 1193.2 |
| **Sodium carbonate ($Na_2CO_3$)** | 1245.1 |
| **Sodium chloride (NaCl)** | 13.3 |
| **Sodium hydroxide (NaOH)** | 529.7 |
| **Sodium methoxide ($Na(CH_3O)$)** | 2425.5 |
| **$SO_2$** | 53.3 |
| **Sulphuric acid ($H_2SO_4$)** | 217.5 |
| **Urea** | 1846.6 |

## Annex I, Part E : Methodology for GHG emission intensity of electricity

The greenhouse gas emission intensity of electricity shall be determined at the level of countries or at the level of bidding zones. The greenhouse gas emission intensity of electricity may be determined at the level of bidding zones only if the required data are publicly available. The calculation of the carbon intensity of electricity, expressed as g CO2 eq / kWh electricity, shall consider all potential primary energy sources for electricity generation, type of plant, conversion efficiencies, and own electricity consumption in the power plant.

The calculation shall consider all carbon equivalent emissions, associated with the combustion and supply of the fuels used for electricity production. This relies on the amount of different fuels used in the electricity production facilities and the emission factors from fuel combustion and the upstream fuel emission factors.

Greenhouse Gases other than CO2 shall be converted to CO2eq by multiplying their Global Warming Potential (GWP) relative to CO2 over the 100-year time horizon as set out in Annex V, part C, point 4 to Directive (EU) 2018/2001 (also indicated here in Annex I, Part A, paragraph 5). Because of their biogenic origin, CO2 emissions from the combustion of biomass fuels are not accounted for, but emissions of CH4 and N2O shall be accounted for.

For the calculation of the GHG emissions from fuels combustion, the IPCC default emission factors for stationary combustion in the energy industries shall be used (IPCC 2006). The upstream emissions shall include emissions from all the processes and phases required to make the fuel ready to supply the electricity; including those resulting from the extraction, refining and transport of the fuel used for electricity production.

In addition, all the upstream emissions from the cultivation, harvesting, collection, processing, and transport of biomass shall be considered. Peat and the components of waste materials that are from fossil origins shall be treated as a fossil fuel.

The fuels used for gross electricity production in electricity only plants are determined based on the electricity production and the efficiency of conversion to electricity. In the case of Combined Heat and Power (CHP), the fuels used for heat produced in CHP shall be counted by considering alternative heat production with average overall efficiencies of 85%, while the rest shall be attributed to electricity generation.

For nuclear power plants, the conversion efficiency from nuclear heat shall be assumed to be 33% or data provided by Eurostat or a similar, accredited source.

No fuels are associated with electricity production from renewables that include hydro, solar, wind and geothermal. The emissions from the construction and decommissioning and waste management of electricity producing facilities are not considered. Thus, the carbon equivalent emissions associated with the renewable electricity (wind, solar, hydro and geothermal) production are considered to be equal to zero.

The CO2 equivalent emissions from gross electricity production shall include upstream emissions from JEC WTW v5 (Prussi et al, 2020)[40] listed in Table 3 and the default emission factors for stationary combustion from IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006)[41] listed in Tables 2.2-2.5. The upstream emissions for supplying the fuel used shall be calculated applying the JEC WTW v5 upstream emission factors (Prussi et al, 2020).

The calculation of the carbon intensity of electricity shall be done following the formula:

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

Where:

$e_{gross\_prod}$: CO2 equivalent emissions $[gCO_2eq]$

$c_{i-ups}$: upstream CO2 equivalent emission factors $\left[\frac{gCO_{2eq}}{MJ}\right]$

$c_{i-comb}$: CO2 equivalent emission factors from fuels combustion $\left[\frac{gCO_{2eq}}{MJ}\right]$

$B_i$: fuel consumption for electricity generation $[MJ]$

$i$=1$\cdots k$: fuels used for electricity production

The amount of net electricity production is determined by the gross electricity production, own electricity consumption in the power plant and the electricity losses in pump storage.

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

Where:

$E_{net}$: net electricity production $[MJ]$
$E_{gross}$: gross electricity production $[MJ]$
$E_{own}$: own internal electricity consumption in power plant $[MJ]$
$E_{pump}$: electricity for pumping $[MJ]$

The carbon intensity of net produced electricity shall be the total gross GHG emissions for producing or using the net electricity:

$$CI = \frac{e_{gross-prod}}{E_{net}}$$

Where:

[40] JEC WTW Report v5: https://publications.jrc.ec.europa.eu/repository/handle/JRC121213
[41] IPCC Guidelines for National Greenhouse Gas Inventories, Stationary Combustion: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf

$CI$ = $CO_2$ equivalent emissions from electricity production $\left[\frac{gCO_{2eq}}{MJ}\right]$

### Electricity production and fuel consumption data

Data on electricity production and fuel consumption shall be sourced from IEA Data and statistics that provides data on energy balances and electricity produced using various fuels, e.g. from IEA website, Data and Statistic section (“Energy Statistics Data Browser“)[42].

For EU member states, Eurostat data are more detailed and can be used instead. Where the greenhouse gas emission intensity is established at the level of bidding zones, data from official national statistics of the same level of detail as the IEA data shall be used. Fuel consumption data shall include available data at the highest level of detail available from national statistics: solid fossil fuels, manufactured gases, peat and peat products, oil shale and oil sands, oil and petroleum products, natural gas, renewables and biofuels, non-renewable waste and nuclear. Renewables and biofuels include biofuels, renewable municipal waste, hydro, ocean, geothermal, wind, solar and heat pumps.

[42] Example: https://www.iea.org/data-and-statistics/data-tools/energy-statistics-data-browser?country=GERMANY&energy=Coal&year=202.

## Input data from literature sources

**Table 1. Default emissions factors for stationary combustion [g/MJ fuel on a net calorific value]**

| Fuel | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|
| ***Solid fossil fuels*** | | | |
| Anthracite | 98,3 | 0,001 | 0,0015 |
| Coking coal | 94,6 | 0,001 | 0,0015 |
| Other bituminous coal | 94,6 | 0,001 | 0,0015 |
| Sub-bituminous coal | 96,1 | 0,001 | 0,0015 |
| Lignite | 101 | 0,001 | 0,0015 |
| Patent fuel | 97,5 | 0,001 | 0,0015 |
| Coke oven coke | 107 | 0,001 | 0,0015 |
| Gas coke | 107 | 0,001 | 0,0001 |
| Coal tar | 80,7 | 0,001 | 0,0015 |
| Brown coal briquettes | 97,5 | 0,001 | 0,0015 |
| ***Manufactured gases*** | | | |
| Gas works gas | 44,4 | 0,001 | 0,0001 |
| Coke oven gas | 44,4 | 0,001 | 0,0001 |
| Blast furnace gas | 260 | 0,001 | 0,0001 |
| Other recovered gases | 182 | 0,001 | 0,0001 |
| **Peat and peat products** | 106 | 0,001 | 0,0015 |
| **Oil shale and oil sands** | 73,3 | 0,003 | 0,0006 |
| ***Oil and petroleum products*** | | | |
| Crude oil | 73,3 | 0,003 | 0,0006 |
| Natural gas liquids | 64,2 | 0,003 | 0,0006 |
| Refinery feedstocks | 73,3 | 0,003 | 0,0006 |
| Additives and oxygenates | 73,3 | 0,003 | 0,0006 |
| Other hydrocarbons | 73,3 | 0,003 | 0,0006 |
| Refinery gas | 57,6 | 0,001 | 0,0001 |
| Ethane | 61,6 | 0,001 | 0,0001 |
| Liquefied petroleum gases | 63,1 | 0,001 | 0,0001 |
| Motor gasoline | 69,3 | 0,003 | 0,0006 |
| Aviation gasoline | 70 | 0,003 | 0,0006 |
| Gasoline-type jet fuel | 70 | 0,003 | 0,0006 |
| Kerosene-type jet fuel | 71,5 | 0,003 | 0,0006 |

| | | | |
|---|---|---|---|
| Other kerosene | 71,5 | 0,003 | 0,0006 |
| Naphtha | 73,3 | 0,003 | 0,0006 |
| Gas oil and diesel oil | 74,1 | 0,003 | 0,0006 |
| Fuel oil | 77,4 | 0,003 | 0,0006 |
| White spirit and SBP | 73,3 | 0,003 | 0,0006 |
| Lubricants | 73,3 | 0,003 | 0,0006 |
| Bitumen | 80,7 | 0,003 | 0,0006 |
| Petroleum coke | 97,5 | 0,003 | 0,0006 |
| Paraffin waxes | 73,3 | 0,003 | 0,0006 |
| Other oil products | 73,3 | 0,003 | 0,0006 |
| Natural gas | 56,1 | 0,001 | 0,0001 |
| ***Waste*** | | | |
| Industrial waste (non-renewable) | 143 | 0,03 | 0,004 |
| Non-renewable municipal waste | 91,7 | 0,03 | 0,004 |
| Note: values have to be multiplied with GWP factors set out in Annex V, part C, point 4 to Directive (EU) 2018/2001. *Source:* IPCC, 2006. | | | |

**Table 2. Default emissions factors for stationary combustion of fuels of biomass origin [g/MJ fuel on a net calorific value]**

| Fuel | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|
| Primary solid biofuels | 0 | 0,03 | 0,004 |
| Charcoal | 0 | 0,2 | 0,004 |
| Biogases | 0 | 0,001 | 0,0001 |
| Renewable municipal waste | 0 | 0,03 | 0,004 |
| Pure biogasoline | 0 | 0,003 | 0,0006 |
| Blended biogasoline | 0 | 0,003 | 0,0006 |
| Pure biodiesels | 0 | 0,003 | 0,0006 |
| Blended biodiesels | 0 | 0,003 | 0,0006 |
| Pure bio jet kerosene | 0 | 0,003 | 0,0006 |
| Blended bio jet kerosene | 0 | 0,003 | 0,0006 |
| Other liquid biofuels | 0 | 0,003 | 0,0006 |
| *Source*: IPCC, 2006. | | | |

**Table 3. Fuel upstream emission factors [gCO2eq/MJ fuel on a net calorific value]**

| Fuel | Emission factor |
|---|---|
| Hard coal | 15,9 |

| | |
|---|---|
| Brown coal | 1,7 |
| Peat | 0 |
| Coal gases | 0 |
| Petroleum Products | 11,6 |
| Natural gas | 12,7 |
| Solid biofuels | 0,7 |
| Liquid biofuels | 46,8 |
| Industrial Waste | 0 |
| Municipal waste | 0 |
| Biogases | 13,7 |
| Nuclear | 1,2 |
| *Source*: JEC WTW v5. | |

Table A includes the values for the GHG emission intensity of electricity at country level in the European Union. If the greenhouse gas emission intensity of electricity is determined at country level, these values shall be used for electricity sourced in the European Union until more recent data becomes available to determine the emission intensity of electricity[43].

**Table A. Emission intensity of electricity in the European Union 2020.**

| Country | Emission intensity of generated electricity ($gCO_2eq/MJ$) |
|---|---|
| Austria | 39,7 |
| Belgium | 56,7 |
| Bulgaria | 119,2 |
| Cyprus | 206,6 |
| Czechia | 132,5 |
| Germany | 99,3 |
| Denmark | 27,1 |
| Estonia | 139,8 |
| Greece | 125,2 |
| Spain | 54,1 |
| Finland | 22,9 |
| France | 19,6 |
| Croatia | 55,4 |
| Hungary | 72,9 |
| Ireland | 89,4 |

[43] Updated data will be made available by the European Commission on a regular basis.

| | |
|---|---|
| Italy | 92,3 |
| Latvia | 39,4 |
| Lithuania | 57,7 |
| Luxembourg | 52,0 |
| Malta | 133,9 |
| Netherlands | 99,9 |
| Poland | 196,5 |
| Portugal | 61,6 |
| Romania | 86,1 |
| Slovakia | 45,6 |
| Slovenia | 70,1 |
| Sweden | 4,1 |
| *Source*: JRC, 2022. | |

## Annex I, Part F : Implementation of the rules on co-processing of RFNBOs

RFNBOs may be produced in processes which rely, next to renewable hydrogen, also on other inputs including fossil fuels, recycled carbon fuels, and biomass. This Annex I, Part F, aims to provide information on how the relevant provisions set out in the RED and the GHG methodology set out in accordance with Article 28(5) of the Directive 2018/2001 should be implemented to derive the share of RFNBOs in the output of the process as well as the achieved emission savings.

The GHG methodology sets out a specific rule for calculating the emission intensity of RFNBOs stemming from a process where co-processing is applied. It allows to distinguish in the calculation of the greenhouse gas emissions intensity on a proportional basis of the energetic value of inputs between:
(1) the part of the process that is based on the conventional input, and
(2) the part of the process that is based on renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels assuming that the process parts are otherwise identical.
If for instance a process uses $H_2$, CO, $CO_2$ as well as other energy inputs to produce synthetic fuels and the producer intends to replace 20% of the $H_2$ with $H_2$ qualifying as RFNBO, it would be possible to determine the emission intensity of the produced synthetic fuels assuming a virtual process which uses only 20% of all inputs mentioned above (20% of each input). In this example, all hydrogen qualifying as RFNBO (which is 20% of the total $H_2$ input) would be used in the virtual process, and the other 80% of the hydrogen (all non-RFNBO) would be used in the other process which uses 80% of all inputs. Such process would also yield only 20% of the output, but only the energy share of RFNBO hydrogen in the input would be considered an RFNBO. It would be possible to replace in this virtual process more than one input. Not only RFNBOs but also RCF, biomass, renewable electricity, renewable heat and $CO_2$ (including biogenic) could be used for this purpose. While the use of RCF and biomass would not add to the share of RFNBOs in the output, they could reduce the emission intensity of the output as the entire output of the virtual process would have the same emission intensity.

$$S_{RFNBO,out} = \frac{E_{RFNBO,in}}{E_{educts}} \quad (1)$$

Where:

$S_{RFNBO,out}$: energy share of the product that can be counted as RFNBO.

$E_{RFNBO,in}$: energy content of the RFNBO input only.

$E_{educts}$: energy content of all “relevant” inputs (as defined in the DA).

For instance, as stated above, if 20% of the energy of the "relevant” inputs comes from hydrogen that qualifies as renewable, 20% of the output can be claimed as RFNBO.

For the share calculated above, it is possible to virtually split the process and determine the emissions for the RFNBO only as follows:

$$\boldsymbol{Em_{RFNBO} = \Sigma_n s_n \cdot ei_n + e_p + e_{tp} - e_u - e_{ccs}} \quad (2)$$

Where:

$Em_{RFNBO}$: total emissions assigned to RFNBO.

*n*: each “relevant” input.

$s_n$: energy share of the input “*n*”, where:

$$s_n = \frac{E_{n,in}}{E_{educts}}$$

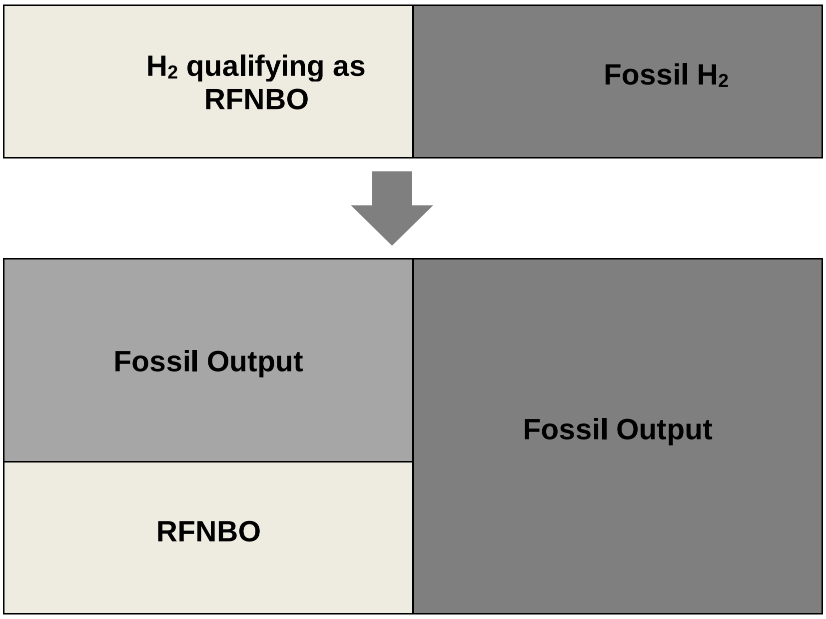
$\boldsymbol{ei_n}$: emissions intensity for the supply of the input “*n*”.

Inputs qualifying as RFNBO can be attributed to this part of the virtually split process with the upper limit of the energy (or stoichiometric) ratio of the input entering into the output (meaning the energetic share of all inputs has to be respected also for the virtually split part).
$CO_2$ emissions from fuel combustion have to be counted in the term $e_u$. If non-fossil carbon enters into the molecule of the output, those emissions might be compensated by the $e_{ex}$ use included in $e_i$ for those non-fossil inputs. The share of RFNBOs in the output of the virtual process would be determined as set out under point 3 of the Annex to the GHG methodology related to Delegated Act (EU) 2023/1086.
If the process yields more than one output, each type of output would include the same share of RFNBOs, RCF and other fuels in line with Article 30(2) of the RED[44]. The ratio of different outputs of the virtual process should not differ from the share of outputs of the whole process. In accordance with point 1 of the Annex to the GHG methodology related to Delegated Act (EU) 2023/108, 6it is possible to determine the emission intensity of the output over a period of at most one calendar month.

**Example of process with several inputs:**

| | |
|---|---|
| **Fossil Input 1** | **Fossil Input 1** |
| **Fossil Input 2** | **Fossil Input 2** |
| **Fossil Input 3** | **Fossil Input 3** |

[44] The described approach applies only for the production of RFNBOs and RCF. For determining emission savings and produced amounts of biofuels the relevant provisions Annex V to the Directive and the delegated act in co-processing bio biomass in a common process with fossil fuels apply.


H2 qualifying as RFNBO
Fossil H2
Fossil Output
RFNBO
Fossil Output

# Annex II: Typical and default values

*NOTE:* Whenever the European Commission updates the RED default/disaggregate default values, these will be applicable in the RSB EU RED Certification process with immediate effect.

## Annex II, Part A: Typical and default values for biofuels if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex V, part A)

| Biofuel production pathway | Greenhouse gas emissions saving – typical value | Greenhouse gas emissions saving – default value |
|---|---|---|
| sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler) | 67 % | 59 % |
| sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler) | 77 % | 73 % |
| sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*)) | 73 % | 68 % |
| sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*)) | 79 % | 76 % |
| sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*)) | 58 % | 47 % |
| sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*)) | 71 % | 64 % |
| corn (maize) ethanol (natural gas as process fuel in conventional boiler) | 48 % | 40 % |
| corn (maize) ethanol, (natural gas as process fuel in CHP plant (*)) | 55 % | 48 % |
| corn (maize) ethanol (lignite as process fuel in CHP plant (*)) | 40 % | 28 % |
| corn (maize) ethanol (forest residues as process fuel in CHP plant (*)) | 69 % | 68 % |
| other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler) | 47 % | 38 % |
| other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*)) | 53 % | 46 % |
| other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*)) | 37 % | 24 % |
| other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*)) | 67 % | 67 % |

## Annex II, Part A continued: Typical and default values for biofuels if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex V, part A)

| Biofuel production pathway | Greenhouse gas emissions saving – typical value | Greenhouse gas emissions saving – default value |
|---|---|---|
| sugar cane ethanol | 70 % | 70 % |
| the part from renewable sources of ethyl-tertio-butyl-ether (ETBE) | Equal to that of the ethanol production pathway used | |
| the part from renewable sources of tertiary-amyl-ethyl-ether (TAEE) | Equal to that of the ethanol production pathway used | |
| rape seed biodiesel | 52 % | 47 % |
| sunflower biodiesel | 57 % | 52 % |
| soybean biodiesel | 55 % | 50 % |
| palm oil biodiesel (open effluent pond) | 33 % | 20 % |
| palm oil biodiesel (process with methane capture at oil mill) | 51 % | 45 % |
| waste cooking oil biodiesel | 88 % | 84 % |
| animal fats from rendering biodiesel (**) | 84 % | 78 % |
| hydrotreated vegetable oil from rape seed | 51 % | 47 % |
| hydrotreated vegetable oil from sunflower | 58 % | 54 % |
| hydrotreated vegetable oil from soybean | 55 % | 51 % |
| hydrotreated vegetable oil from palm oil (open effluent pond) | 34 % | 22 % |
| hydrotreated vegetable oil from palm oil (process with methane capture at oil mill) | 53 % | 49 % |
| hydrotreated oil from waste cooking oil | 87 % | 83 % |
| hydrotreated oil from animal fats from rendering (**) | 83 % | 77 % |
| pure vegetable oil from rape seed | 59 % | 57 % |
| pure vegetable oil from sunflower | 65 % | 64 % |
| pure vegetable oil from soybean | 63 % | 61 % |
| pure vegetable oil from palm oil (open effluent pond) | 40 % | 30 % |
| pure vegetable oil from palm oil (process with methane capture at oil mill) | 59 % | 57 % |
| pure oil from waste cooking oil | 98 % | 98 % |

(*) Default values for processes using CHP are valid only if all the process heat is supplied by CHP.

(**) Applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009 of the European Parliament and of the Council ([1]), for which emissions related to hygenisation as part of the rendering are not considered.

## Annex II, Part B: Estimated typical and default values for future biofuels that were not on the market or were on the market only in negligible quantities in 2016, if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex V, part B)

| Biofuel production pathway | Greenhouse gas emissions saving - typical value | Greenhouse gas emissions saving - default value |
|---|---|---|
| wheat straw ethanol | 85 % | 83 % |
| waste wood Fischer-Tropsch diesel in free-standing plant | 83 % | 83 % |
| farmed wood Fischer-Tropsch diesel in free-standing plant | 82 % | 82 % |
| waste wood Fischer-Tropsch petrol in free-standing plant | 83 % | 83 % |
| farmed wood Fischer-Tropsch petrol in free-standing plant | 82 % | 82 % |
| waste wood dimethylether (DME) in free-standing plant | 84 % | 84 % |
| farmed wood dimethylether (DME) in free-standing plant | 83 % | 83 % |
| waste wood methanol in free-standing plant | 84 % | 84 % |
| farmed wood methanol in free-standing plant | 83 % | 83 % |
| Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill | 89 % | 89 % |
| Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill | 89 % | 89 % |
| dimethylether (DME) from black-liquor gasification integrated with pulp mill | 89 % | 89 % |
| Methanol from black-liquor gasification integrated with pulp mill | 89 % | 89 % |
| the part from renewable sources of methyl-tertio-butyl-ether (MTBE) | Equal to that of the methanol production pathway used | |

(1) Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) (OJ L 300, 14.11.2009, p. 1).

## Annex II, Part C: Typical and default values of greenhouse gas emissions savings for biomass fuels **if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex VI, part A)**

| WOODCHIPS | | | | | |
|---|---|---|---|---|---|
| Biomass fuel production system | Transport distance | Greenhouse gas emissions savings –typical value | | Greenhouse gas emissions savings – default value | |
| | | Heat | Electricity | Heat | Electricity |
| Woodchips from forest residues | 1 to 500 km | 93 % | 89 % | 91 % | 87 % |
| | 500 to 2 500 km | 89 % | 84 % | 87 % | 81 % |
| | 2 500 to 10 000 km | 82 % | 73 % | 78 % | 67 % |
| | Above 10 000 km | 67 % | 51 % | 60 % | 41 % |
| Woodchips from short rotation coppice (Eucalyptus) | 2 500 to 10 000 km | 77 % | 65 % | 73 % | 60 % |
| Woodchips from short rotation coppice (Poplar – Fertilised) | 1 to 500 km | 89 % | 83 % | 87 % | 81 % |
| | 500 to 2 500 km | 85 % | 78 % | 84 % | 76 % |
| | 2 500 to 10 000 km | 78 % | 67 % | 74 % | 62 % |
| | Above 10 000 km | 63 % | 45 % | 57 % | 35 % |
| Woodchips from short rotation coppice (Poplar – No fertilisation) | 1 to 500 km | 91 % | 87 % | 90 % | 85 % |
| | 500 to 2 500 km | 88 % | 82 % | 86 % | 79 % |
| | 2 500 to 10 000 km | 80 % | 70 % | 77 % | 65 % |
| | Above 10 000 km | 65 % | 48 % | 59 % | 39 % |
| Woodchips from stemwood | 1 to 500 km | 93 % | 89 % | 92 % | 88 % |
| | 500 to 2 500 km | 90 % | 85 % | 88 % | 82 % |
| | 2 500 to 10 000 km | 82 % | 73 % | 79 % | 68 % |
| | Above 10 000 km | 67 % | 51 % | 61 % | 42 % |
| Woodchips from industry residues | 1 to 500 km | 94 % | 92 % | 93 % | 90 % |
| | 500 to 2 500 km | 91 % | 87 % | 90 % | 85 % |
| | 2 500 to 10 000 km | 83 % | 75 % | 80 % | 71 % |
| | Above 10 000 km | 69 % | 54 % | 63 % | 44 % |

## Annex II, Part C continued: Typical and default values of greenhouse gas emissions savings for biomass fuels **if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex VI, part A)**

| WOOD PELLETS (*) | | | | | | |
|---|---|---|---|---|---|---|
| Biomass fuel production system | | Transport distance | Greenhouse gas emissions savings – typical value | | Greenhouse gas emissions savings – default value | |
| | | | Heat | Electricity | Heat | Electricity |
| Wood briquettes or pellets from forest residues | Case 1 | 1 to 500 km | 58 % | 37 % | 49 % | 24 % |
| | | 500 to 2 500 km | 58 % | 37 % | 49 % | 25 % |
| | | 2 500 to 10 000 km | 55 % | 34 % | 47 % | 21 % |
| | | Above 10 000 km | 50 % | 26 % | 40 % | 11 % |
| | Case 2a | 1 to 500 km | 77 % | 66 % | 72 % | 59 % |
| | | 500 to 2 500 km | 77 % | 66 % | 72 % | 59 % |
| | | 2 500 to 10 000 km | 75 % | 62 % | 70 % | 55 % |
| | | Above 10 000 km | 69 % | 54 % | 63 % | 45 % |
| | Case 3a | 1 to 500 km | 92 % | 88 % | 90 % | 85 % |
| | | 500 to 2 500 km | 92 % | 88 % | 90 % | 86 % |
| | | 2 500 to 10 000 km | 90 % | 85 % | 88 % | 81 % |
| | | Above 10 000 km | 84 % | 76 % | 81 % | 72 % |
| Wood briquettes or pellets from short rotation coppice (Eucalyptus) | Case 1 | 2 500 to 10 000 km | 52 % | 28 % | 43 % | 15 % |
| | Case 2a | 2 500 to 10 000 km | 70 % | 56 % | 66 % | 49 % |
| | Case 3a | 2 500 to 10 000 km | 85 % | 78 % | 83 % | 75 % |
| Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised) | Case 1 | 1 to 500 km | 54 % | 32 % | 46 % | 20 % |
| | | 500 to 10 000 km | 52 % | 29 % | 44 % | 16 % |
| | | Above 10 000 km | 47 % | 21 % | 37 % | 7 % |
| | Case 2a | 1 to 500 km | 73 % | 60 % | 69 % | 54 % |
| | | 500 to 10 000 km | 71 % | 57 % | 67 % | 50 % |
| | | Above 10 000 km | 66 % | 49 % | 60 % | 41 % |
| | Case 3a | 1 to 500 km | 88 % | 82 % | 87 % | 81 % |
| | | 500 to 10 000 km | 86 % | 79 % | 84 % | 77 % |
| | | Above 10 000 km | 80 % | 71 % | 78 % | 67 % |

## Annex II, Part C continued: Typical and default values of greenhouse gas emissions savings for biomass fuels if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex VI, part A)

| WOOD PELLETS (*) | | | | | | |
|---|---|---|---|---|---|---|
| Biomass fuel production system | | Transport distance | Greenhouse gas emissions savings – typical value | | Greenhouse gas emissions savings – default value | |
| | | | Heat | Electricity | Heat | Electricity |
| Wood briquettes or pellets from short rotation coppice (Poplar – No fertilisation) | Case 1 | 1 to 500 km | 56 % | 35 % | 48 % | 23 % |
| | | 500 to 10 000 km | 54 % | 32 % | 46 % | 20 % |
| | | Above 10 000 km | 49 % | 24 % | 40 % | 10 % |
| | Case 2a | 1 to 500 km | 76 % | 64 % | 72 % | 58 % |
| | | 500 to 10 000 km | 74 % | 61 % | 69 % | 54 % |
| | | Above 10 000 km | 68 % | 53 % | 63 % | 45 % |
| | Case 3a | 1 to 500 km | 91 % | 86 % | 90 % | 85 % |
| | | 500 to 10 000 km | 89 % | 83 % | 87 % | 81 % |
| | | Above 10 000 km | 83 % | 75 % | 81 % | 71 % |
| Stemwood | Case 1 | 1 to 500 km | 57 % | 37 % | 49 % | 24 % |
| | | 500 to 2 500 km | 58 % | 37 % | 49 % | 25 % |
| | | 2 500 to 10 000 km | 55 % | 34 % | 47 % | 21 % |
| | | Above 10 000 km | 50 % | 26 % | 40 % | 11 % |
| | Case 2a | 1 to 500 km | 77 % | 66 % | 73 % | 60 % |
| | | 500 to 2 500 km | 77 % | 66 % | 73 % | 60 % |
| | | 2 500 to 10 000 km | 75 % | 63 % | 70 % | 56 % |
| | | Above 10 000 km | 70 % | 55 % | 64 % | 46 % |
| | Case 3a | 1 to 500 km | 92 % | 88 % | 91 % | 86 % |
| | | 500 to 2 500 km | 92 % | 88 % | 91 % | 87 % |
| | | 2 500 to 10 000 km | 90 % | 85 % | 88 % | 83 % |
| | | Above 10 000 km | 84 % | 77 % | 82 % | 73 % |
| Wood briquettes or pellets from wood industry residues | Case 1 | 1 to 500 km | 75 % | 62 % | 69 % | 55 % |
| | | 500 to 2 500 km | 75 % | 62 % | 70 % | 55 % |
| | | 2 500 to 10 000 km | 72 % | 59 % | 67 % | 51 % |
| | | Above 10 000 km | 67 % | 51 % | 61 % | 42 % |
| | Case 2a | 1 to 500 km | 87 % | 80 % | 84 % | 76 % |
| | | 500 to 2 500 km | 87 % | 80 % | 84 % | 77 % |
| | | 2 500 to 10 000 km | 85 % | 77 % | 82 % | 73 % |
| | | Above 10 000 km | 79 % | 69 % | 75 % | 63 % |

## Annex II, Part C continued: Typical and default values of greenhouse gas emissions savings for biomass fuels if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex VI, part A)

| WOOD PELLETS (*) | | | | | | |
|---|---|---|---|---|---|---|
| Biomass fuel production system | | Transport distance | Greenhouse gas emissions savings – typical value | | Greenhouse gas emissions savings – default value | |
| | | | Heat | Electricity | Heat | Electricity |
| | Case 3a | 1 to 500 km | 95 % | 93 % | 94 % | 91 % |
| | | 500 to 2 500 km | 95 % | 93 % | 94 % | 92 % |
| | | 2 500 to 10 000 km | 93 % | 90 % | 92 % | 88 % |
| | | Above 10 000 km | 88 % | 82 % | 85 % | 78 % |

(*) Case 1 refers to processes in which a natural gas boiler is used to provide the process heat to the pellet mill. Electricity for the pellet mill is supplied from the grid;
Case 2a refers to processes in which a woodchips boiler, fed with pre-dried chips, is used to provide process heat. Electricity for the pellet mill is supplied from the grid;
Case 3a refers to processes in which a CHP, fed with pre-dried woodchips, is used to provide electricity and heat to the pellet mill.

| AGRICULTURE PATHWAYS | | | | | |
|---|---|---|---|---|---|
| Biomass fuel production system | Transport distance | Greenhouse gas emissions savings – typical value | | Greenhouse gas emissions savings – default value | |
| | | Heat | Electricity | Heat | Electricity |
| Agricultural Residues with density < 0,2 t/m³ (*) | 1 to 500 km | 95 % | 92 % | 93 % | 90 % |
| | 500 to 2 500 km | 89 % | 83 % | 86 % | 80 % |
| | 2 500 to 10 000 km | 77 % | 66 % | 73 % | 60 % |
| | Above 10 000 km | 57 % | 36 % | 48 % | 23 % |
| Agricultural Residues with density > 0,2 t/m³ (**) | 1 to 500 km | 95 % | 92 % | 93 % | 90 % |
| | 500 to 2 500 km | 93 % | 89 % | 92 % | 87 % |
| | 2 500 to 10 000 km | 88 % | 82 % | 85 % | 78 % |
| | Above 10 000 km | 78 % | 68 % | 74 % | 61 % |
| Straw pellets | 1 to 500 km | 88 % | 82 % | 85 % | 78 % |
| | 500 to 10 000 km | 86 % | 79 % | 83 % | 74 % |
| | Above 10 000 km | 80 % | 70 % | 76 % | 64 % |
| Bagasse briquettes | 500 to 10 000 km | 93 % | 89 % | 91 % | 87 % |
| | Above 10 000 km | 87 % | 81 % | 85 % | 77 % |
| Palm Kernel Meal | Above 10 000 km | 20 % | -18 % | 11 % | -33 % |

## Annex II, Part C continued: Typical and default values of greenhouse gas emissions savings for biomass fuels **if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex VI, part A)**

| AGRICULTURE PATHWAYS | | | | | |
|---|---|---|---|---|---|
| Biomass fuel production system | Transport distance | Greenhouse gas emissions savings – typical value | | Greenhouse gas emissions savings – default value | |
| | | Heat | Electricity | Heat | Electricity |
| Palm Kernel Meal (no $CH_4$ emissions from oil mill) | Above 10 000 km | 46 % | 20 % | 42 % | 14 % |

(*) This group of materials includes agricultural residues with a low bulk density and it comprises materials such as straw bales, oat hulls, rice husks and sugar cane bagasse bales (not exhaustive list).

(**) The group of agricultural residues with higher bulk density includes materials such as corn cobs, nut shells, soybean hulls, palm kernel shells (not exhaustive list).

| BIOGAS FOR ELECTRICITY (*) | | | | |
|---|---|---|---|---|
| Biogas production system | | Technological option | Greenhouse gas emissions savings – typical value | Greenhouse gas emissions savings – default value |
| Wet manure ([1]) | Case 1 | Open digestate ([2]) | 146 % | 94 % |
| | | Close digestate ([3]) | 246 % | 240 % |
| | Case 2 | Open digestate | 136 % | 85 % |
| | | Close digestate | 227 % | 219 % |
| | Case 3 | Open digestate | 142 % | 86 % |
| | | Close digestate | 243 % | 235 % |
| Maize whole plant ([4]) | Case 1 | Open digestate | 36 % | 21 % |
| | | Close digestate | 59 % | 53 % |
| | Case 2 | Open digestate | 34 % | 18 % |
| | | Close digestate | 55 % | 47 % |
| | Case 3 | Open digestate | 28 % | 10 % |
| | | Close digestate | 52 % | 43 % |

([1]) The values for biogas production from manure include negative emissions for emissions saved from raw manure management. The value of $e_{sca}$ considered is equal to – 45 g $CO_2$eq/MJ manure used in anaerobic digestion.

([2]) Open storage of digestate accounts for additional emissions of $CH_4$ and $N_2O$. The magnitude of those emissions changes with ambient conditions, substrate types and the digestion efficiency.

([3]) Close storage means that the digestate resulting from the digestion process is stored in a gas-tight tank and that the additional biogas released during storage is considered to be recovered for production of additional electricity or biomethane. No greenhouse gas emissions are included in that process.

([4]) Maize whole plant means maize harvested as fodder and ensiled for preservation.

## Annex II, Part C continued: Typical and default values of greenhouse gas emissions savings for biomass fuels if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex VI, part A)

| BIOGAS FOR ELECTRICITY (*) | | | | |
|---|---|---|---|---|
| Biogas production system | | Technological option | Greenhouse gas emissions savings – typical value | Greenhouse gas emissions savings – default value |
| Biowaste | Case 1 | Open digestate | 47 % | 26 % |
| | | Close digestate | 84 % | 78 % |
| | Case 2 | Open digestate | 43 % | 21 % |
| | | Close digestate | 77 % | 68 % |
| | Case 3 | Open digestate | 38 % | 14 % |
| | | Close digestate | 76 % | 66 % |

(*) Case 1 refers to pathways in which electricity and heat required in the process are supplied by the CHP engine itself.
Case 2 refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by the CHP engine itself. In some Member States, operators are not allowed to claim the gross production for subsidies and case 1 is the more likely configuration.
Case 3 refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by a biogas boiler. This case applies to some installations in which the CHP engine is not on-site and biogas is sold (but not upgraded to biomethane).

| BIOGAS FOR ELECTRICITY – MIXTURES OF MANURE AND MAIZE | | | | |
|---|---|---|---|---|
| Biogas production system | | Technological option | Greenhouse gas emissions savings – typical value | Greenhouse gas emissions savings – default value |
| Manure – Maize 80 % - 20 % | Case 1 | Open digestate | 72 % | 45 % |
| | | Close digestate | 120 % | 114 % |
| | Case 2 | Open digestate | 67 % | 40 % |
| | | Close digestate | 111 % | 103 % |
| | Case 3 | Open digestate | 65 % | 35 % |
| | | Close digestate | 114 % | 106 % |
| Manure – Maize 70 % - 30 % | Case 1 | Open digestate | 60 % | 37 % |
| | | Close digestate | 100 % | 94 % |
| | Case 2 | Open digestate | 57 % | 32 % |
| | | Close digestate | 93 % | 85 % |
| | Case 3 | Open digestate | 53 % | 27 % |
| | | Close digestate | 94 % | 85 % |

## Annex II, Part C continued: Typical and default values of greenhouse gas emissions savings for biomass fuels if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex VI, part A)

| BIOGAS FOR ELECTRICITY – MIXTURES OF MANURE AND MAIZE | | | | |
|---|---|---|---|---|
| Biogas production system | | Technological option | Greenhouse gas emissions savings – typical value | Greenhouse gas emissions savings – default value |
| Manure – Maize 60 % - 40 % | Case 1 | Open digestate | 53 % | 32 % |
| | | Close digestate | 88 % | 82 % |
| | Case 2 | Open digestate | 50 % | 28 % |
| | | Close digestate | 82 % | 73 % |
| | Case 3 | Open digestate | 46 % | 22 % |
| | | Close digestate | 81 % | 72 % |

| BIOMETHANE FOR TRANSPORT (*) | | | |
|---|---|---|---|
| Biomethane production system | Technological options | Greenhouse gas emissions savings – typical value | Greenhouse gas emissions savings – default value |
| Wet manure | Open digestate, no off-gas combustion | 117 % | 72 % |
| | Open digestate, off-gas combustion | 133 % | 94 % |
| | Close digestate, no off-gas combustion | 190 % | 179 % |
| | Close digestate, off-gas combustion | 206 % | 202 % |
| Maize whole plant | Open digestate, no off-gas combustion | 35 % | 17 % |
| | Open digestate, off-gas combustion | 51 % | 39 % |
| | Close digestate, no off-gas combustion | 52 % | 41 % |
| | Close digestate, off-gas combustion | 68 % | 63 % |
| Biowaste | Open digestate, no off-gas combustion | 43 % | 20 % |
| | Open digestate, off-gas combustion | 59 % | 42 % |
| | Close digestate, no off-gas combustion | 70 % | 58 % |
| | Close digestate, off-gas combustion | 86 % | 80 % |

(*) The greenhouse gas emissions savings for biomethane only refer to compressed biomethane relative to the fossil fuel comparator for transport of 94 g $CO_2$eq/MJ.

## Annex II, Part C continued: Typical and default values of greenhouse gas emissions savings for biomass fuels **if produced with no net carbon emissions from land-use change (source: Directive (EU) 2018/2001 Annex VI, part A)**

| BIOMETHANE – MIXTURES OF MANURE AND MAIZE (*) | | | |
|---|---|---|---|
| Biomethane production system | Technological options | Greenhouse gas emissions savings – typical value | Greenhouse gas emissions savings – default value |
| Manure – Maize 80 % - 20 % | Open digestate, no off-gas combustion (1) | 62 % | 35 % |
| | Open digestate, off-gas combustion (2) | 78 % | 57 % |
| | Close digestate, no off-gas combustion | 97 % | 86 % |
| | Close digestate, off-gas combustion | 113 % | 108 % |
| Manure – Maize 70 % - 30 % | Open digestate, no off-gas combustion | 53 % | 29 % |
| | Open digestate, off-gas combustion | 69 % | 51 % |
| | Close digestate, no off-gas combustion | 83 % | 71 % |
| | Close digestate, off-gas combustion | 99 % | 94 % |
| Manure – Maize 60 % - 40 % | Open digestate, no off-gas combustion | 48 % | 25 % |
| | Open digestate, off-gas combustion | 64 % | 48 % |
| | Close digestate, no off-gas combustion | 74 % | 62 % |
| | Close digestate, off-gas combustion | 90 % | 84 % |

(*) The greenhouse gas emissions savings for biomethane only refer to compressed biomethane relative to the fossil fuel comparator for transport of 94 g $CO_2$eq/MJ.

## Annex II, Part D : STANDARD VALUES" FOR GREENHOUSE GAS EMISSION INTENSITIES OF ELASTIC INPUTS

# Annex III: Disaggregated Default Values

## Annex III, Part A: Disaggregated *default values for biofuels and bioliquids*

**(Source: Directive (EU) 2018/2001 Annex V, part D)**

***NOTE:* Whenever the European Commission update the RED default/disaggregate default values, these will be applicable in the RSB EU RED Certification process with immediate effect.**

### Disaggregated default values for cultivation: $e_{ec}$ as defined in Annex I, Part A of this standard

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| sugar beet ethanol | 9,6 | 9,6 |
| corn (maize) ethanol | 25,5 | 25,5 |
| other cereals excluding corn (maize) ethanol | 27,0 | 27,0 |
| sugar cane ethanol | 17,1 | 17,1 |
| the part from renewable sources of ETBE | Equal to that of the ethanol production pathway used | |
| the part from renewable sources of TAEE | Equal to that of the ethanol production pathway used | |
| rape seed biodiesel | 32,0 | 32,0 |
| sunflower biodiesel | 26,1 | 26,1 |
| soybean biodiesel | 21,2 | 21,2 |
| palm oil biodiesel | 26,0 | 26,0 |
| waste cooking oil biodiesel | 0 | 0 |
| animal fats from rendering biodiesel (**) | 0 | 0 |
| hydrotreated vegetable oil from rape seed | 33,4 | 33,4 |
| hydrotreated vegetable oil from sunflower | 26,9 | 26,9 |
| hydrotreated vegetable oil from soybean | 22,1 | 22,1 |
| hydrotreated vegetable oil from palm oil | 27,3 | 27,3 |
| hydrotreated oil from waste cooking oil | 0 | 0 |
| hydrotreated oil from animal fats from rendering (**) | 0 | 0 |
| pure vegetable oil from rape seed | 33,4 | 33,4 |
| pure vegetable oil from sunflower | 27,2 | 27,2 |
| pure vegetable oil from soybean | 22,2 | 22,2 |
| pure vegetable oil from palm oil | 27,1 | 27,1 |
| pure oil from waste cooking oil | 0 | 0 |

(**) Applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.

## Annex III, Part A continued: Disaggregated *default values for biofuels and bioliquids*

### Disaggregated default values for processing:

### $e_p$ as defined in Annex I, Part A of this standard

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler) | 18,8 | 26,3 |
| sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler) | 9,7 | 13,6 |
| sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*)) | 13,2 | 18,5 |
| sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*)) | 7,6 | 10,6 |
| sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*)) | 27,4 | 38,3 |
| sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*)) | 15,7 | 22,0 |
| corn (maize) ethanol (natural gas as process fuel in conventional boiler) | 20,8 | 29,1 |
| corn (maize) ethanol, (natural gas as process fuel in CHP plant (*)) | 14,8 | 20,8 |
| corn (maize) ethanol (lignite as process fuel in CHP plant (*)) | 28,6 | 40,1 |
| corn (maize) ethanol (forest residues as process fuel in CHP plant (*)) | 1,8 | 2,6 |
| other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler) | 21,0 | 29,3 |
| other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*)) | 15,1 | 21,1 |
| other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*)) | 30,3 | 42,5 |
| other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*)) | 1,5 | 2,2 |
| sugar cane ethanol | 1,3 | 1,8 |
| the part from renewable sources of ETBE | Equal to that of the ethanol production pathway used | |

## Annex III, Part A continued: Disaggregated *default values for biofuels and bioliquids*

### Disaggregated default values for processing:
### $e_p$ as defined in Annex I, Part A of this standard

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$) | Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$) |
|---|---|---|
| the part from renewable sources of TAEE | Equal to that of the ethanol production pathway used | |
| rape seed biodiesel | 11,7 | 16,3 |
| sunflower biodiesel | 11,8 | 16,5 |
| soybean biodiesel | 12,1 | 16,9 |
| palm oil biodiesel (open effluent pond) | 30,4 | 42,6 |
| palm oil biodiesel (process with methane capture at oil mill) | 13,2 | 18,5 |
| waste cooking oil biodiesel | 9,3 | 13,0 |
| animal fats from rendering biodiesel (**) | 13,6 | 19,1 |
| hydrotreated vegetable oil from rape seed | 10,7 | 15,0 |
| hydrotreated vegetable oil from sunflower | 10,5 | 14,7 |
| hydrotreated vegetable oil from soybean | 10,9 | 15,2 |
| hydrotreated vegetable oil from palm oil (open effluent pond) | 27,8 | 38,9 |
| hydrotreated vegetable oil from palm oil (process with methane capture at oil mill) | 9,7 | 13,6 |
| hydrotreated oil from waste cooking oil | 10,2 | 14,3 |
| hydrotreated oil from animal fats from rendering (**) | 14,5 | 20,3 |
| pure vegetable oil from rape seed | 3,7 | 5,2 |
| pure vegetable oil from sunflower | 3,8 | 5,4 |
| pure vegetable oil from soybean | 4,2 | 5,9 |
| pure vegetable oil from palm oil (open effluent pond) | 22,6 | 31,7 |
| pure vegetable oil from palm oil (process with methane capture at oil mill) | 4,7 | 6,5 |
| pure oil from waste cooking oil | 0,6 | 0,8 |

(*) Default values for processes using CHP are valid only if all the process heat is supplied by CHP.
(**) Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.

## Annex III, Part A continued: Disaggregated *default values for biofuels and bioliquids*

### Disaggregated default values for transport and distribution: $e_{td}$ as defined in Annex I, Part A of this standard

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler) | 2,3 | 2,3 |
| sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler) | 2,3 | 2,3 |
| sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*)) | 2,3 | 2,3 |
| sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*)) | 2,3 | 2,3 |
| sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*)) | 2,3 | 2,3 |
| sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*)) | 2,3 | 2,3 |
| corn (maize) ethanol (natural gas as process fuel in CHP plant (*)) | 2,2 | 2,2 |
| corn (maize) ethanol (natural gas as process fuel in conventional boiler) | 2,2 | 2,2 |
| corn (maize) ethanol (lignite as process fuel in CHP plant (*)) | 2,2 | 2,2 |
| corn (maize) ethanol (forest residues as process fuel in CHP plant (*)) | 2,2 | 2,2 |
| other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler) | 2,2 | 2,2 |
| other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*)) | 2,2 | 2,2 |
| other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*)) | 2,2 | 2,2 |
| other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*)) | 2,2 | 2,2 |
| sugar cane ethanol | 9,7 | 9,7 |
| the part from renewable sources of ETBE | Equal to that of the ethanol production pathway used | |

## Annex III, Part A continued: Disaggregated *default values for biofuels and bioliquids*

### Disaggregated default values for transport and distribution: $e_{td}$ as defined in Annex I, Part A of this standard

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| the part from renewable sources of TAEE | Equal to that of the ethanol production pathway used | |
| rape seed biodiesel | 11,7 | 16,3 |
| sunflower biodiesel | 11,8 | 16,5 |
| soybean biodiesel | 12,1 | 16,9 |
| palm oil biodiesel (open effluent pond) | 30,4 | 42,6 |
| palm oil biodiesel (process with methane capture at oil mill) | 13,2 | 18,5 |
| waste cooking oil biodiesel | 9,3 | 13,0 |
| animal fats from rendering biodiesel (**) | 13,6 | 19,1 |
| hydrotreated vegetable oil from rape seed | 10,7 | 15,0 |
| hydrotreated vegetable oil from sunflower | 10,5 | 14,7 |
| hydrotreated vegetable oil from soybean | 10,9 | 15,2 |
| hydrotreated vegetable oil from palm oil (open effluent pond) | 27,8 | 38,9 |
| hydrotreated vegetable oil from palm oil (process with methane capture at oil mill) | 9,7 | 13,6 |
| hydrotreated oil from waste cooking oil | 10,2 | 14,3 |
| hydrotreated oil from animal fats from rendering (**) | 14,5 | 20,3 |
| pure vegetable oil from rape seed | 3,7 | 5,2 |
| pure vegetable oil from sunflower | 3,8 | 5,4 |
| pure vegetable oil from soybean | 4,2 | 5,9 |
| pure vegetable oil from palm oil (open effluent pond) | 22,6 | 31,7 |
| pure vegetable oil from palm oil (process with methane capture at oil mill) | 4,7 | 6,5 |
| pure oil from waste cooking oil | 0,6 | 0,8 |

(*) Default values for processes using CHP are valid only if all the process heat is supplied by CHP.
(**) Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.

## Annex III, Part A continued: Disaggregated *default values for biofuels and bioliquids*

### Total default values for cultivation, processing, transport and distribution

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| sugar beet ethanol (no biogas from slop, natural gas as process fuel in conventional boiler) | 30,7 | 38,2 |
| sugar beet ethanol (with biogas from slop, natural gas as process fuel in conventional boiler) | 21,6 | 25,5 |
| sugar beet ethanol (no biogas from slop, natural gas as process fuel in CHP plant (*)) | 25,1 | 30,4 |
| sugar beet ethanol (with biogas from slop, natural gas as process fuel in CHP plant (*)) | 19,5 | 22,5 |
| sugar beet ethanol (no biogas from slop, lignite as process fuel in CHP plant (*)) | 39,3 | 50,2 |
| sugar beet ethanol (with biogas from slop, lignite as process fuel in CHP plant (*)) | 27,6 | 33,9 |
| corn (maize) ethanol (natural gas as process fuel in conventional boiler) | 48,5 | 56,8 |
| corn (maize) ethanol, (natural gas as process fuel in CHP plant (*)) | 42,5 | 48,5 |
| corn (maize) ethanol (lignite as process fuel in CHP plant (*)) | 56,3 | 67,8 |
| corn (maize) ethanol (forest residues as process fuel in CHP plant (*)) | 29,5 | 30,3 |
| other cereals excluding maize ethanol (natural gas as process fuel in conventional boiler) | 50,2 | 58,5 |
| other cereals excluding maize ethanol (natural gas as process fuel in CHP plant (*)) | 44,3 | 50,3 |
| other cereals excluding maize ethanol (lignite as process fuel in CHP plant (*)) | 59,5 | 71,7 |
| other cereals excluding maize ethanol (forest residues as process fuel in CHP plant (*)) | 30,7 | 31,4 |
| sugar cane ethanol | 28,1 | 28,6 |
| the part from renewable sources of ETBE | Equal to that of the ethanol production pathway used | |
| the part from renewable sources of TAEE | Equal to that of the ethanol production pathway used | |

## Annex III, Part A continued: Disaggregated *default values for biofuels and bioliquids*

**Total default values for cultivation, processing, transport and distribution**

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$) | Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$) |
|---|---|---|
| rape seed biodiesel | 45,5 | 50,1 |
| sunflower biodiesel | 40,0 | 44,7 |
| soybean biodiesel | 42,2 | 47,0 |
| palm oil biodiesel (open effluent pond) | 63,3 | 75,5 |
| palm oil biodiesel (process with methane capture at oil mill) | 46,1 | 51,4 |
| waste cooking oil biodiesel | 11,2 | 14,9 |
| animals fats from rendering biodiesel (**) | 15,2 | 20,7 |
| hydrotreated vegetable oil from rape seed | 45,8 | 50,1 |
| hydrotreated vegetable oil from sunflower | 39,4 | 43,6 |
| hydrotreated vegetable oil from soybean | 42,2 | 46,5 |
| hydrotreated vegetable oil from palm oil (open effluent pond) | 62,1 | 73,2 |
| hydrotreated vegetable oil from palm oil (process with methane capture at oil mill) | 44,0 | 47,9 |
| hydrotreated oil from waste cooking oil | 11,9 | 16,0 |
| hydrotreated oil from animal fats from rendering (**) | 16,0 | 21,8 |
| pure vegetable oil from rape seed | 38,5 | 40,0 |
| pure vegetable oil from sunflower | 32,7 | 34,3 |
| pure vegetable oil from soybean | 35,2 | 36,9 |
| pure vegetable oil from palm oil (open effluent pond) | 56,4 | 65,5 |
| pure vegetable oil from palm oil (process with methane capture at oil mill) | 38,5 | 40,3 |
| pure oil from waste cooking oil | 2,0 | 2,2 |

(*) Default values for processes using CHP are valid only if all the process heat is supplied by CHP.
(**) Note: applies only to biofuels produced from animal by-products classified as category 1 and 2 material in accordance with Regulation (EC) No 1069/2009, for which emissions related to hygenisation as part of the rendering are not considered.

## Annex III, Part B: Estimated disaggregated default values for future biofuels and bioliquids that were not on the market or were only on the market in negligible quantities in 2016 (source: Directive (EU) 2018/2001 Annex V, part E)

***NOTE:* Whenever the European Commission update the RED default/disaggregate default values, these will be applicable in the RSB EU RED Certification process with immediate effect.**

### Disaggregated default values for cultivation: $e_{ec}$ as defined in Annex I, Part A of this standard

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| wheat straw ethanol | 1,8 | 1,8 |
| waste wood Fischer-Tropsch diesel in free-standing plant | 3,3 | 3,3 |
| farmed wood Fischer-Tropsch diesel in free-standing plant | 8,2 | 8,2 |
| waste wood Fischer-Tropsch petrol in free-standing plant | 3,3 | 3,3 |
| farmed wood Fischer-Tropsch petrol in free-standing plant | 8,2 | 8,2 |
| waste wood dimethylether (DME) in free-standing plant | 3,1 | 3,1 |
| farmed wood dimethylether (DME) in free-standing plant | 7,6 | 7,6 |
| waste wood methanol in free-standing plant | 3,1 | 3,1 |
| farmed wood methanol in free-standing plant | 7,6 | 7,6 |
| Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill | 2,5 | 2,5 |
| Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill | 2,5 | 2,5 |
| dimethylether (DME) from black-liquor gasification integrated with pulp mill | 2,5 | 2,5 |
| Methanol from black-liquor gasification integrated with pulp mill | 2,5 | 2,5 |
| the part from renewable sources of MTBE | Equal to that of the methanol production pathway used | |

**Annex III, Part B continued:** Estimated disaggregated default values for future biofuels and bioliquids that were not on the market or were only on the market in negligible quantities in 2016
Disaggregated default values for **processing** (including excess electricity):
$e_p$ as defined in Annex I, Part A of this standard

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| wheat straw ethanol | 4,8 | 6,8 |
| waste wood Fischer-Tropsch diesel in free-standing plant | 0,1 | 0,1 |
| farmed wood Fischer-Tropsch diesel in free-standing plant | 0,1 | 0,1 |
| waste wood Fischer-Tropsch petrol in free-standing plant | 0,1 | 0,1 |
| farmed wood Fischer-Tropsch petrol in free-standing plant | 0,1 | 0,1 |
| waste wood dimethylether (DME) in free-standing plant | 0 | 0 |

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| farmed wood dimethylether (DME) in free-standing plant | 0 | 0 |
| waste wood methanol in free-standing plant | 0 | 0 |
| farmed wood methanol in free-standing plant | 0 | 0 |
| Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill | 0 | 0 |
| Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill | 0 | 0 |
| dimethylether (DME) from black-liquor gasification integrated with pulp mill | 0 | 0 |
| methanol from black-liquor gasification integrated with pulp mill | 0 | 0 |
| the part from renewable sources of MTBE | Equal to that of the methanol production pathway used | |

**Annex III, Part B continued:** Estimated disaggregated default values for future biofuels and bioliquids that were not on the market or were only on the market in negligible quantities in 2016

Disaggregated default values for transport and distribution:

$e_{td}$ as defined in Annex I, Part A of this standard

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| wheat straw ethanol | 7,1 | 7,1 |
| waste wood Fischer-Tropsch diesel in free-standing plant | 12,2 | 12,2 |
| farmed wood Fischer-Tropsch diesel in free-standing plant | 8,4 | 8,4 |
| waste wood Fischer-Tropsch petrol in free-standing plant | 12,2 | 12,2 |
| farmed wood Fischer-Tropsch petrol in free-standing plant | 8,4 | 8,4 |
| waste wood dimethylether (DME) in free-standing plant | 12,1 | 12,1 |
| farmed wood dimethylether (DME) in free-standing plant | 8,6 | 8,6 |
| waste wood methanol in free-standing plant | 12,1 | 12,1 |
| farmed wood methanol in free-standing plant | 8,6 | 8,6 |
| Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill | 7,7 | 7,7 |
| Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill | 7,9 | 7,9 |
| dimethylether (DME) from black-liquor gasification integrated with pulp mill | 7,7 | 7,7 |

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|
| methanol from black-liquor gasification integrated with pulp mill | 7,9 | 7,9 |
| the part from renewable sources of MTBE | Equal to that of the methanol production pathway used | |

**Annex III, Part B continued:** Estimated disaggregated default values for future biofuels and bioliquids that were not on the market or were only on the market in negligible quantities in 2016

Disaggregated default values

**Total** for cultivation, processing, transport and distribution

| Biofuel and bioliquid production pathway | Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$) | Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$) |
|---|---|---|
| wheat straw ethanol | 13,7 | 15,7 |
| waste wood Fischer-Tropsch diesel in free-standing plant | 15,6 | 15,6 |
| farmed wood Fischer-Tropsch diesel in free-standing plant | 16,7 | 16,7 |
| waste wood Fischer-Tropsch petrol in free-standing plant | 15,6 | 15,6 |
| farmed wood Fischer-Tropsch petrol in free-standing plant | 16,7 | 16,7 |
| waste wood dimethylether (DME) in free-standing plant | 15,2 | 15,2 |
| farmed wood dimethylether (DME) in free-standing plant | 16,2 | 16,2 |
| waste wood methanol in free-standing plant | 15,2 | 15,2 |
| farmed wood methanol in free-standing plant | 16,2 | 16,2 |
| Fischer-Tropsch diesel from black-liquor gasification integrated with pulp mill | 10,2 | 10,2 |
| Fischer-Tropsch petrol from black-liquor gasification integrated with pulp mill | 10,4 | 10,4 |
| dimethylether (DME) from black-liquor gasification integrated with pulp mill | 10,2 | 10,2 |
| methanol from black-liquor gasification integrated with pulp mill | 10,4 | 10,4 |
| the part from renewable sources of MTBE | Equal to that of the methanol production pathway used | |

## **Annex III, Part C:** Disaggregated *default values for biomass fuels*

**(Source: Directive (EU) 2018/2001 Annex VI, part C)**

***NOTE:* Whenever the European Commission update the RED default/disaggregate default values, these will be applicable in the RSB EU RED Certification process with immediate effect.**

C. DISAGGREGATED DEFAULT VALUES FOR BIOMASS FUELS

Wood briquettes or pellets

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | | | | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cultivation | Processing | Transport | Non-$CO_2$ emissions from the fuel in use | Cultivation | Processing | Transport | Non-$CO_2$ emissions from the fuel in use |
| Wood chips from forest residues | 1 to 500 km | 0,0 | 1,6 | 3,0 | 0,4 | 0,0 | 1,9 | 3,6 | 0,5 |
| | 500 to 2 500 km | 0,0 | 1,6 | 5,2 | 0,4 | 0,0 | 1,9 | 6,2 | 0,5 |
| | 2 500 to 10 000 km | 0,0 | 1,6 | 10,5 | 0,4 | 0,0 | 1,9 | 12,6 | 0,5 |
| | Above 10 000 km | 0,0 | 1,6 | 20,5 | 0,4 | 0,0 | 1,9 | 24,6 | 0,5 |
| Wood chips from SRC (Eucalyptus) | 2 500 to 10 000 km | 4,4 | 0,0 | 11,0 | 0,4 | 4,4 | 0,0 | 13,2 | 0,5 |
| Wood chips from SRC (Poplar – fertilised) | 1 to 500 km | 3,9 | 0,0 | 3,5 | 0,4 | 3,9 | 0,0 | 4,2 | 0,5 |
| | 500 to 2 500 km | 3,9 | 0,0 | 5,6 | 0,4 | 3,9 | 0,0 | 6,8 | 0,5 |
| | 2 500 to 10 000 km | 3,9 | 0,0 | 11,0 | 0,4 | 3,9 | 0,0 | 13,2 | 0,5 |
| | Above 10 000 km | 3,9 | 0,0 | 21,0 | 0,4 | 3,9 | 0,0 | 25,2 | 0,5 |
| Wood chips from SRC (Poplar – Not fertilised) | 1 to 500 km | 2,2 | 0,0 | 3,5 | 0,4 | 2,2 | 0,0 | 4,2 | 0,5 |
| | 500 to 2 500 km | 2,2 | 0,0 | 5,6 | 0,4 | 2,2 | 0,0 | 6,8 | 0,5 |
| | 2 500 to 10 000 km | 2,2 | 0,0 | 11,0 | 0,4 | 2,2 | 0,0 | 13,2 | 0,5 |
| | Above 10 000 km | 2,2 | 0,0 | 21,0 | 0,4 | 2,2 | 0,0 | 25,2 | 0,5 |
| Wood chips from stemwood | 1 to 500 km | 1,1 | 0,3 | 3,0 | 0,4 | 1,1 | 0,4 | 3,6 | 0,5 |
| | 500 to 2 500 km | 1,1 | 0,3 | 5,2 | 0,4 | 1,1 | 0,4 | 6,2 | 0,5 |
| | 2 500 to 10 000 km | 1,1 | 0,3 | 10,5 | 0,4 | 1,1 | 0,4 | 12,6 | 0,5 |
| | Above 10 000 km | 1,1 | 0,3 | 20,5 | 0,4 | 1,1 | 0,4 | 24,6 | 0,5 |

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

**(Source: Directive (EU) 2018/2001 Annex VI, part C)**

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | | | | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cultivation | Processing | Transport | Non-$CO_2$ emissions from the fuel in use | Cultivation | Processing | Transport | Non-$CO_2$ emissions from the fuel in use |
| Wood chips from wood industry residues | 1 to 500 km | 0,0 | 0,3 | 3,0 | 0,4 | 0,0 | 0,4 | 3,6 | 0,5 |
| | 500 to 2 500 km | 0,0 | 0,3 | 5,2 | 0,4 | 0,0 | 0,4 | 6,2 | 0,5 |
| | 2 500 to 10 000 km | 0,0 | 0,3 | 10,5 | 0,4 | 0,0 | 0,4 | 12,6 | 0,5 |
| | Above 10 000 km | 0,0 | 0,3 | 20,5 | 0,4 | 0,0 | 0,4 | 24,6 | 0,5 |

Wood briquettes or pellets

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | | | | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use |
| Wood briquettes or pellets from forest residues (case 1) | 1 to 500 km | 0,0 | 25,8 | 2,9 | 0,3 | 0,0 | 30,9 | 3,5 | 0,3 |
| | 500 to 2 500 km | 0,0 | 25,8 | 2,8 | 0,3 | 0,0 | 30,9 | 3,3 | 0,3 |
| | 2 500 to 10 000 km | 0,0 | 25,8 | 4,3 | 0,3 | 0,0 | 30,9 | 5,2 | 0,3 |
| | Above 10 000 km | 0,0 | 25,8 | 7,9 | 0,3 | 0,0 | 30,9 | 9,5 | 0,3 |
| Wood briquettes or pellets from forest residues (case 2a) | 1 to 500 km | 0,0 | 12,5 | 3,0 | 0,3 | 0,0 | 15,0 | 3,6 | 0,3 |
| | 500 to 2 500 km | 0,0 | 12,5 | 2,9 | 0,3 | 0,0 | 15,0 | 3,5 | 0,3 |
| | 2 500 to 10 000 km | 0,0 | 12,5 | 4,4 | 0,3 | 0,0 | 15,0 | 5,3 | 0,3 |
| | Above 10 000 km | 0,0 | 12,5 | 8,1 | 0,3 | 0,0 | 15,0 | 9,8 | 0,3 |
| Wood briquettes or pellets from forest residues (case 3a) | 1 to 500 km | 0,0 | 2,4 | 3,0 | 0,3 | 0,0 | 2,8 | 3,6 | 0,3 |
| | 500 to 2 500 km | 0,0 | 2,4 | 2,9 | 0,3 | 0,0 | 2,8 | 3,5 | 0,3 |
| | 2 500 to 10 000 km | 0,0 | 2,4 | 4,4 | 0,3 | 0,0 | 2,8 | 5,3 | 0,3 |
| | Above 10 000 km | 0,0 | 2,4 | 8,2 | 0,3 | 0,0 | 2,8 | 9,8 | 0,3 |

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*
**(Source: Directive (EU) 2018/2001 Annex VI, part C)**

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | | | | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use |
| Wood briquettes from short rotation coppice (Eucalyptus – case 1) | 2 500 to 10 000 km | 3,9 | 24,5 | 4,3 | 0,3 | 3,9 | 29,4 | 5,2 | 0,3 |
| Wood briquettes from short rotation coppice (Eucalyptus – case 2a) | 2 500 to 10 000 km | 5,0 | 10,6 | 4,4 | 0,3 | 5,0 | 12,7 | 5,3 | 0,3 |
| Wood briquettes from short rotation coppice (Eucalyptus – case 3a) | 2 500 to 10 000 km | 5,3 | 0,3 | 4,4 | 0,3 | 5,3 | 0,4 | 5,3 | 0,3 |
| Wood briquettes from short rotation coppice (Poplar – Fertilised – case 1) | 1 to 500 km | 3,4 | 24,5 | 2,9 | 0,3 | 3,4 | 29,4 | 3,5 | 0,3 |
| | 500 to 10 000 km | 3,4 | 24,5 | 4,3 | 0,3 | 3,4 | 29,4 | 5,2 | 0,3 |
| | Above 10 000 km | 3,4 | 24,5 | 7,9 | 0,3 | 3,4 | 29,4 | 9,5 | 0,3 |
| Wood briquettes from short rotation coppice (Poplar – Fertilised – case 2a) | 1 to 500 km | 4,4 | 10,6 | 3,0 | 0,3 | 4,4 | 12,7 | 3,6 | 0,3 |
| | 500 to 10 000 km | 4,4 | 10,6 | 4,4 | 0,3 | 4,4 | 12,7 | 5,3 | 0,3 |
| | Above 10 000 km | 4,4 | 10,6 | 8,1 | 0,3 | 4,4 | 12,7 | 9,8 | 0,3 |
| Wood briquettes from short rotation coppice (Poplar – Fertilised – case 3a) | 1 to 500 km | 4,6 | 0,3 | 3,0 | 0,3 | 4,6 | 0,4 | 3,6 | 0,3 |
| | 500 to 10 000 km | 4,6 | 0,3 | 4,4 | 0,3 | 4,6 | 0,4 | 5,3 | 0,3 |
| | Above 10 000 km | 4,6 | 0,3 | 8,2 | 0,3 | 4,6 | 0,4 | 9,8 | 0,3 |
| Wood briquettes from short rotation coppice (Poplar – no fertilisation – case 1) | 1 to 500 km | 2,0 | 24,5 | 2,9 | 0,3 | 2,0 | 29,4 | 3,5 | 0,3 |
| | 500 to 2 500 km | 2,0 | 24,5 | 4,3 | 0,3 | 2,0 | 29,4 | 5,2 | 0,3 |
| | 2 500 to 10 000 km | 2,0 | 24,5 | 7,9 | 0,3 | 2,0 | 29,4 | 9,5 | 0,3 |

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*
**(Source: Directive (EU) 2018/2001 Annex VI, part C)**

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | | | | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use |
| Wood briquettes from short rotation coppice (Poplar – no fertilisation – case 2a) | 1 to 500 km | 2,5 | 10,6 | 3,0 | 0,3 | 2,5 | 12,7 | 3,6 | 0,3 |
| | 500 to 10 000 km | 2,5 | 10,6 | 4,4 | 0,3 | 2,5 | 12,7 | 5,3 | 0,3 |
| | Above 10 000 km | 2,5 | 10,6 | 8,1 | 0,3 | 2,5 | 12,7 | 9,8 | 0,3 |
| Wood briquettes from short rotation coppice (Poplar – no fertilisation– case 3a) | 1 to 500 km | 2,6 | 0,3 | 3,0 | 0,3 | 2,6 | 0,4 | 3,6 | 0,3 |
| | 500 to 10 000 km | 2,6 | 0,3 | 4,4 | 0,3 | 2,6 | 0,4 | 5,3 | 0,3 |
| | Above 10 000 km | 2,6 | 0,3 | 8,2 | 0,3 | 2,6 | 0,4 | 9,8 | 0,3 |
| Wood briquettes or pellets from stemwood (case 1) | 1 to 500 km | 1,1 | 24,8 | 2,9 | 0,3 | 1,1 | 29,8 | 3,5 | 0,3 |
| | 500 to 2 500 km | 1,1 | 24,8 | 2,8 | 0,3 | 1,1 | 29,8 | 3,3 | 0,3 |
| | 2 500 to 10 000 km | 1,1 | 24,8 | 4,3 | 0,3 | 1,1 | 29,8 | 5,2 | 0,3 |
| | Above 10 000 km | 1,1 | 24,8 | 7,9 | 0,3 | 1,1 | 29,8 | 9,5 | 0,3 |
| Wood briquettes or pellets from stemwood (case 2a) | 1 to 500 km | 1,4 | 11,0 | 3,0 | 0,3 | 1,4 | 13,2 | 3,6 | 0,3 |
| | 500 to 2 500 km | 1,4 | 11,0 | 2,9 | 0,3 | 1,4 | 13,2 | 3,5 | 0,3 |
| | 2 500 to 10 000 km | 1,4 | 11,0 | 4,4 | 0,3 | 1,4 | 13,2 | 5,3 | 0,3 |
| | Above 10 000 km | 1,4 | 11,0 | 8,1 | 0,3 | 1,4 | 13,2 | 9,8 | 0,3 |
| Wood briquettes or pellets from stemwood (case 3a) | 1 to 500 km | 1,4 | 0,8 | 3,0 | 0,3 | 1,4 | 0,9 | 3,6 | 0,3 |
| | 500 to 2 500 km | 1,4 | 0,8 | 2,9 | 0,3 | 1,4 | 0,9 | 3,5 | 0,3 |
| | 2 500 to 10 000 km | 1,4 | 0,8 | 4,4 | 0,3 | 1,4 | 0,9 | 5,3 | 0,3 |
| | Above 10 000 km | 1,4 | 0,8 | 8,2 | 0,3 | 1,4 | 0,9 | 9,8 | 0,3 |
| Wood briquettes or pellets from wood industry residues (case 1) | 1 to 500 km | 0,0 | 14,3 | 2,8 | 0,3 | 0,0 | 17,2 | 3,3 | 0,3 |
| | 500 to 2 500 km | 0,0 | 14,3 | 2,7 | 0,3 | 0,0 | 17,2 | 3,2 | 0,3 |
| | 2 500 to 10 000 km | 0,0 | 14,3 | 4,2 | 0,3 | 0,0 | 17,2 | 5,0 | 0,3 |
| | Above 10 000 km | 0,0 | 14,3 | 7,7 | 0,3 | 0,0 | 17,2 | 9,2 | 0,3 |

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

### (Source: Directive (EU) 2018/2001 Annex VI, part C)

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | | | | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use |
| Wood briquettes or pellets from wood industry residues (case 2a) | 1 to 500 km | 0,0 | 6,0 | 2,8 | 0,3 | 0,0 | 7,2 | 3,4 | 0,3 |
| | 500 to 2 500 km | 0,0 | 6,0 | 2,7 | 0,3 | 0,0 | 7,2 | 3,3 | 0,3 |
| | 2 500 to 10 000 km | 0,0 | 6,0 | 4,2 | 0,3 | 0,0 | 7,2 | 5,1 | 0,3 |
| | Above 10 000 km | 0,0 | 6,0 | 7,8 | 0,3 | 0,0 | 7,2 | 9,3 | 0,3 |
| Wood briquettes or pellets from wood industry residues (case 3a) | 1 to 500 km | 0,0 | 0,2 | 2,8 | 0,3 | 0,0 | 0,3 | 3,4 | 0,3 |
| | 500 to 2 500 km | 0,0 | 0,2 | 2,7 | 0,3 | 0,0 | 0,3 | 3,3 | 0,3 |
| | 2 500 to 10 000 km | 0,0 | 0,2 | 4,2 | 0,3 | 0,0 | 0,3 | 5,1 | 0,3 |
| | Above 10 000 km | 0,0 | 0,2 | 7,8 | 0,3 | 0,0 | 0,3 | 9,3 | 0,3 |

Agriculture pathways

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | | | | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use |
| Agricultural Residues with density < 0,2 t/$m^3$ | 1 to 500 km | 0,0 | 0,9 | 2,6 | 0,2 | 0,0 | 1,1 | 3,1 | 0,3 |
| | 500 to 2 500 km | 0,0 | 0,9 | 6,5 | 0,2 | 0,0 | 1,1 | 7,8 | 0,3 |
| | 2 500 to 10 000 km | 0,0 | 0,9 | 14,2 | 0,2 | 0,0 | 1,1 | 17,0 | 0,3 |
| | Above 10 000 km | 0,0 | 0,9 | 28,3 | 0,2 | 0,0 | 1,1 | 34,0 | 0,3 |
| Agricultural Residues with density > 0,2 t/$m^3$ | 1 to 500 km | 0,0 | 0,9 | 2,6 | 0,2 | 0,0 | 1,1 | 3,1 | 0,3 |
| | 500 to 2 500 km | 0,0 | 0,9 | 3,6 | 0,2 | 0,0 | 1,1 | 4,4 | 0,3 |
| | 2 500 to 10 000 km | 0,0 | 0,9 | 7,1 | 0,2 | 0,0 | 1,1 | 8,5 | 0,3 |
| | Above 10 000 km | 0,0 | 0,9 | 13,6 | 0,2 | 0,0 | 1,1 | 16,3 | 0,3 |

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*
**(Source: Directive (EU) 2018/2001 Annex VI, part C)**

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | | | | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use | Cultivation | Processing | Transport & distribution | Non-$CO_2$ emissions from the fuel in use |
| Straw pellets | 1 to 500 km | 0,0 | 5,0 | 3,0 | 0,2 | 0,0 | 6,0 | 3,6 | 0,3 |
| | 500 to 10 000 km | 0,0 | 5,0 | 4,6 | 0,2 | 0,0 | 6,0 | 5,5 | 0,3 |
| | Above 10 000 km | 0,0 | 5,0 | 8,3 | 0,2 | 0,0 | 6,0 | 10,0 | 0,3 |
| Bagasse briquettes | 500 to 10 000 km | 0,0 | 0,3 | 4,3 | 0,4 | 0,0 | 0,4 | 5,2 | 0,5 |
| | Above 10 000 km | 0,0 | 0,3 | 8,0 | 0,4 | 0,0 | 0,4 | 9,5 | 0,5 |
| Palm Kernel Meal | Above 10 000 km | 21,6 | 21,1 | 11,2 | 0,2 | 21,6 | 25,4 | 13,5 | 0,3 |
| Palm Kernel Meal (no $CH_4$ emissions from oil mill) | Above 10 000 km | 21,6 | 3,5 | 11,2 | 0,2 | 21,6 | 4,2 | 13,5 | 0,3 |

Disaggregated default values for biogas for the production of electricity

| Biomass fuel production system | | Technology | TYPICAL VALUE [g $CO_2$eq/MJ] | | | | | DEFAULT VALUE [g $CO_2$eq/MJ] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cultivation | Processing | Non-$CO_2$ emissions from the fuel in use | Transport | Manure credits | Cultivation | Processing | Non-$CO_2$ emissions from the fuel in use | Transport | Manure credits |
| Wet manure (¹) | case 1 | Open digestate | 0,0 | 69,6 | 8,9 | 0,8 | − 107,3 | 0,0 | 97,4 | 12,5 | 0,8 | − 107,3 |
| | | Close digestate | 0,0 | 0,0 | 8,9 | 0,8 | − 97,6 | 0,0 | 0,0 | 12,5 | 0,8 | − 97,6 |
| | case 2 | Open digestate | 0,0 | 74,1 | 8,9 | 0,8 | − 107,3 | 0,0 | 103,7 | 12,5 | 0,8 | − 107,3 |
| | | Close digestate | 0,0 | 4,2 | 8,9 | 0,8 | − 97,6 | 0,0 | 5,9 | 12,5 | 0,8 | − 97,6 |
| | case 3 | Open digestate | 0,0 | 83,2 | 8,9 | 0,9 | − 120,7 | 0,0 | 116,4 | 12,5 | 0,9 | − 120,7 |
| | | Close digestate | 0,0 | 4,6 | 8,9 | 0,8 | − 108,5 | 0,0 | 6,4 | 12,5 | 0,8 | − 108,5 |

(¹) The values for biogas production from manure include negative emissions for emissions saved from raw manure management. The value of $e_{sca}$ considered is equal to − 45 g $CO_2$eq/MJ manure used in anaerobic digestion.

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

**(Source: Directive (EU) 2018/2001 Annex VI, part C)**

| Biomass fuel production system | | Technology | TYPICAL VALUE [g $CO_2$eq/MJ] | | | | | DEFAULT VALUE [g $CO_2$eq/MJ] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cultiva-tion | Processing | Non-$CO_2$ emissions from the fuel in use | Transport | Manure credits | Cultiva-tion | Processing | Non-$CO_2$ emissions from the fuel in use | Transport | Manure credits |
| Maize whole plant (1) | case 1 | Open digestate | 15,6 | 13,5 | 8,9 | 0,0 (2) | — | 15,6 | 18,9 | 12,5 | 0,0 | — |
| | | Close digestate | 15,2 | 0,0 | 8,9 | 0,0 | — | 15,2 | 0,0 | 12,5 | 0,0 | — |
| | case 2 | Open digestate | 15,6 | 18,8 | 8,9 | 0,0 | — | 15,6 | 26,3 | 12,5 | 0,0 | — |
| | | Close digestate | 15,2 | 5,2 | 8,9 | 0,0 | — | 15,2 | 7,2 | 12,5 | 0,0 | — |
| | case 3 | Open digestate | 17,5 | 21,0 | 8,9 | 0,0 | — | 17,5 | 29,3 | 12,5 | 0,0 | — |
| | | Close digestate | 17,1 | 5,7 | 8,9 | 0,0 | — | 17,1 | 7,9 | 12,5 | 0,0 | — |
| Biowaste | case 1 | Open digestate | 0,0 | 21,8 | 8,9 | 0,5 | — | 0,0 | 30,6 | 12,5 | 0,5 | — |
| | | Close digestate | 0,0 | 0,0 | 8,9 | 0,5 | — | 0,0 | 0,0 | 12,5 | 0,5 | — |
| | case 2 | Open digestate | 0,0 | 27,9 | 8,9 | 0,5 | — | 0,0 | 39,0 | 12,5 | 0,5 | — |
| | | Close digestate | 0,0 | 5,9 | 8,9 | 0,5 | — | 0,0 | 8,3 | 12,5 | 0,5 | — |
| | case 3 | Open digestate | 0,0 | 31,2 | 8,9 | 0,5 | — | 0,0 | 43,7 | 12,5 | 0,5 | — |
| | | Close digestate | 0,0 | 6,5 | 8,9 | 0,5 | — | 0,0 | 9,1 | 12,5 | 0,5 | — |

(1) Maize whole plant means maize harvested as fodder and ensiled for preservation.

(2) Transport of agricultural raw materials to the transformation plant is, according to the methodology provided in the Commission's report of 25 February 2010 on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling, included in the 'cultivation' value. The value for transport of maize silage accounts for 0,4 g $CO_2$eq/MJ biogas.

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

**(Source: Directive (EU) 2018/2001 Annex VI, part C)**

Disaggregated default values for biomethane

| Biomethane production system | Technological option | | TYPICAL VALUE [g $CO_2$eq/MJ] | | | | | | DEFAULT VALUE [g $CO_2$eq/MJ] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cultivation | Processing | Upgrading | Transport | Compression at filling station | Manure credits | Cultivation | Processing | Upgrading | Transport | Compression at filling station | Manure credits |
| Wet manure | Open digestate | no off-gas combustion | 0,0 | 84,2 | 19,5 | 1,0 | 3,3 | – 124,4 | 0,0 | 117,9 | 27,3 | 1,0 | 4,6 | – 124,4 |
| | | off-gas combustion | 0,0 | 84,2 | 4,5 | 1,0 | 3,3 | – 124,4 | 0,0 | 117,9 | 6,3 | 1,0 | 4,6 | – 124,4 |
| | Close digestate | no off-gas combustion | 0,0 | 3,2 | 19,5 | 0,9 | 3,3 | – 111,9 | 0,0 | 4,4 | 27,3 | 0,9 | 4,6 | – 111,9 |
| | | off-gas combustion | 0,0 | 3,2 | 4,5 | 0,9 | 3,3 | – 111,9 | 0,0 | 4,4 | 6,3 | 0,9 | 4,6 | – 111,9 |
| Maize whole plant | Open digestate | no off-gas combustion | 18,1 | 20,1 | 19,5 | 0,0 | 3,3 | — | 18,1 | 28,1 | 27,3 | 0,0 | 4,6 | — |
| | | off-gas combustion | 18,1 | 20,1 | 4,5 | 0,0 | 3,3 | — | 18,1 | 28,1 | 6,3 | 0,0 | 4,6 | — |
| | Close digestate | no off-gas combustion | 17,6 | 4,3 | 19,5 | 0,0 | 3,3 | — | 17,6 | 6,0 | 27,3 | 0,0 | 4,6 | — |
| | | off-gas combustion | 17,6 | 4,3 | 4,5 | 0,0 | 3,3 | — | 17,6 | 6,0 | 6,3 | 0,0 | 4,6 | — |
| Biowaste | Open digestate | no off-gas combustion | 0,0 | 30,6 | 19,5 | 0,6 | 3,3 | — | 0,0 | 42,8 | 27,3 | 0,6 | 4,6 | — |
| | | off-gas combustion | 0,0 | 30,6 | 4,5 | 0,6 | 3,3 | — | 0,0 | 42,8 | 6,3 | 0,6 | 4,6 | — |
| | Close digestate | no off-gas combustion | 0,0 | 5,1 | 19,5 | 0,5 | 3,3 | — | 0,0 | 7,2 | 27,3 | 0,5 | 4,6 | — |
| | | off-gas combustion | 0,0 | 5,1 | 4,5 | 0,5 | 3,3 | — | 0,0 | 7,2 | 6,3 | 0,5 | 4,6 | — |

# **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

## Total typical and *default values for biomass fuels*

D. TOTAL TYPICAL AND DEFAULT VALUES FOR BIOMASS FUEL PATHWAYS

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|---|
| Woodchips from forest residues | 1 to 500 km | 5 | 6 |
| | 500 to 2 500 km | 7 | 9 |
| | 2 500 to 10 000 km | 12 | 15 |
| | Above 10 000 km | 22 | 27 |
| Woodchips from short rotation coppice (Eucalyptus) | 2 500 to 10 000 km | 16 | 18 |
| Woodchips from short rotation coppice (Poplar – Fertilised) | 1 to 500 km | 8 | 9 |
| | 500 to 2 500 km | 10 | 11 |
| | 2 500 to 10 000 km | 15 | 18 |
| | Above 10 000 km | 25 | 30 |
| Woodchips from short rotation coppice (Poplar – No fertilisation) | 1 to 500 km | 6 | 7 |
| | 500 to 2 500 km | 8 | 10 |
| | 2 500 to 10 000 km | 14 | 16 |
| | Above 10 000 km | 24 | 28 |
| Woodchips from stemwood | 1 to 500 km | 5 | 6 |
| | 500 to 2 500 km | 7 | 8 |
| | 2 500 to 10 000 km | 12 | 15 |
| | Above 10 000 km | 22 | 27 |
| Woodchips from industry residues | 1 to 500 km | 4 | 5 |
| | 500 to 2 500 km | 6 | 7 |
| | 2 500 to 10 000 km | 11 | 13 |
| | Above 10 000 km | 21 | 25 |
| Wood briquettes or pellets from forest residues (case 1) | 1 to 500 km | 29 | 35 |
| | 500 to 2 500 km | 29 | 35 |
| | 2 500 to 10 000 km | 30 | 36 |
| | Above 10 000 km | 34 | 41 |
| Wood briquettes or pellets from forest residues (case 2a) | 1 to 500 km | 16 | 19 |
| | 500 to 2 500 km | 16 | 19 |
| | 2 500 to 10 000 km | 17 | 21 |
| | Above 10 000 km | 21 | 25 |

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

### Total typical and *default values for biomass fuels*

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|---|
| Wood briquettes or pellets from forest residues (case 3a) | 1 to 500 km | 6 | 7 |
| | 500 to 2 500 km | 6 | 7 |
| | 2 500 to 10 000 km | 7 | 8 |
| | Above 10 000 km | 11 | 13 |
| Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 1) | 2 500 to 10 000 km | 33 | 39 |
| Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 2a) | 2 500 to 10 000 km | 20 | 23 |
| Wood briquettes or pellets from short rotation coppice (Eucalyptus – case 3a) | 2 500 to 10 000 km | 10 | 11 |
| Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 1) | 1 to 500 km | 31 | 37 |
| | 500 to 10 000 km | 32 | 38 |
| | Above 10 000 km | 36 | 43 |
| Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 2a) | 1 to 500 km | 18 | 21 |
| | 500 to 10 000 km | 20 | 23 |
| | Above 10 000 km | 23 | 27 |
| Wood briquettes or pellets from short rotation coppice (Poplar – Fertilised – case 3a) | 1 to 500 km | 8 | 9 |
| | 500 to 10 000 km | 10 | 11 |
| | Above 10 000 km | 13 | 15 |
| Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 1) | 1 to 500 km | 30 | 35 |
| | 500 to 10 000 km | 31 | 37 |
| | Above 10 000 km | 35 | 41 |
| Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 2a) | 1 to 500 km | 16 | 19 |
| | 500 to 10 000 km | 18 | 21 |
| | Above 10 000 km | 21 | 25 |
| Wood briquettes or pellets from short rotation coppice (Poplar – no fertilisation – case 3a) | 1 to 500 km | 6 | 7 |
| | 500 to 10 000 km | 8 | 9 |
| | Above 10 000 km | 11 | 13 |

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

### Total typical and *default values for biomass fuels*

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|---|
| Wood briquettes or pellets from stemwood (case 1) | 1 to 500 km | 29 | 35 |
| | 500 to 2 500 km | 29 | 34 |
| | 2 500 to 10 000 km | 30 | 36 |
| | Above 10 000 km | 34 | 41 |
| Wood briquettes or pellets from stemwood (case 2a) | 1 to 500 km | 16 | 18 |
| | 500 to 2 500 km | 15 | 18 |
| | 2 500 to 10 000 km | 17 | 20 |
| | Above 10 000 km | 21 | 25 |
| Wood briquettes or pellets from stemwood (case 3a) | 1 to 500 km | 5 | 6 |
| | 500 to 2 500 km | 5 | 6 |
| | 2 500 to 10 000 km | 7 | 8 |
| | Above 10 000 km | 11 | 12 |
| Wood briquettes or pellets from wood industry residues (case 1) | 1 to 500 km | 17 | 21 |
| | 500 to 2 500 km | 17 | 21 |
| | 2 500 to 10 000 km | 19 | 23 |
| | Above 10 000 km | 22 | 27 |
| Wood briquettes or pellets from wood industry residues (case 2a) | 1 to 500 km | 9 | 11 |
| | 500 to 2 500 km | 9 | 11 |
| | 2 500 to 10 000 km | 10 | 13 |
| | Above 10 000 km | 14 | 17 |
| Wood briquettes or pellets from wood industry residues (case 3a) | 1 to 500 km | 3 | 4 |
| | 500 to 2 500 km | 3 | 4 |
| | 2 500 to 10 000 | 5 | 6 |
| | Above 10 000 km | 8 | 10 |

Case 1 refers to processes in which a Natural Gas boiler is used to provide the process heat to the pellet mill. Process electricity is purchased from the grid.

Case 2a refers to processes in which a boiler fuelled with wood chips is used to provide the process heat to the pellet mill. Process electricity is purchased from the grid.

Case 3a refers to processes in which a CHP, fuelled with wood chips, is used to provide heat and electricity to the pellet mill.

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

### Total typical and *default values for biomass fuels*

| Biomass fuel production system | Transport distance | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|---|
| Agricultural Residues with density < 0,2 t/m³ (1) | 1 to 500 km | 4 | 4 |
| | 500 to 2 500 km | 8 | 9 |
| | 2 500 to 10 000 km | 15 | 18 |
| | Above 10 000 km | 29 | 35 |
| Agricultural Residues with density > 0,2 t/m³ (2) | 1 to 500 km | 4 | 4 |
| | 500 to 2 500 km | 5 | 6 |
| | 2 500 to 10 000 km | 8 | 10 |
| | Above 10 000 km | 15 | 18 |
| Straw pellets | 1 to 500 km | 8 | 10 |
| | 500 to 10 000 km | 10 | 12 |
| | Above 10 000 km | 14 | 16 |
| Bagasse briquettes | 500 to 10 000 km | 5 | 6 |
| | Above 10 000 km | 9 | 10 |
| Palm Kernel Meal | Above 10 000 km | 54 | 61 |
| Palm Kernel Meal (no $CH_4$ emissions from oil mill) | Above 10 000 km | 37 | 40 |

Typical and default values – biogas for electricity

| Biogas production system | Technological option | | Typical value | Default value |
|---|---|---|---|---|
| | | | Greenhouse gas emissions (g $CO_2$eq/MJ) | Greenhouse gas emissions (g $CO_2$eq/MJ) |
| Biogas for electricity from wet manure | Case 1 | Open digestate (3) | – 28 | 3 |
| | | Close digestate (4) | – 88 | – 84 |
| | Case 2 | Open digestate | – 23 | 10 |
| | | Close digestate | – 84 | – 78 |
| | Case 3 | Open digestate | – 28 | 9 |
| | | Close digestate | – 94 | – 89 |

(1) This group of materials includes agricultural residues with a low bulk density and it comprises materials such as straw bales, oat hulls, rice husks and sugar cane bagasse bales (not exhaustive list).

(2) The group of agricultural residues with higher bulk density includes materials such as corn cobs, nut shells, soybean hulls, palm kernel shells (not exhaustive list).

(3) Open storage of digestate accounts for additional emissions of methane which change with the weather, the substrate and the digestion efficiency. In these calculations the amounts are taken to be equal to 0,05 MJ $CH_4$/MJ biogas for manure, 0,035 MJ $CH_4$/MJ biogas for maize and 0,01 MJ $CH_4$/MJ biogas for biowaste.

(4) Close storage means that the digestate resulting from the digestion process is stored in a gas tight tank and the additional biogas released during storage is considered to be recovered for production of additional electricity or biomethane.

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

### **Total typical and *default values for biomass fuels***

| Biogas production system | Technological option | | Typical value<br>Greenhouse gas emissions ($g\ CO_2eq/MJ$) | Default value<br>Greenhouse gas emissions ($g\ CO_2eq/MJ$) |
|---|---|---|---|---|
| Biogas for electricity from maize whole plant | Case 1 | Open digestate | 38 | 47 |
| | | Close digestate | 24 | 28 |
| | Case 2 | Open digestate | 43 | 54 |
| | | Close digestate | 29 | 35 |
| | Case 3 | Open digestate | 47 | 59 |
| | | Close digestate | 32 | 38 |
| Biogas for electricity from biowaste | Case 1 | Open digestate | 31 | 44 |
| | | Close digestate | 9 | 13 |
| | Case 2 | Open digestate | 37 | 52 |
| | | Close digestate | 15 | 21 |
| | Case 3 | Open digestate | 41 | 57 |
| | | Close digestate | 16 | 22 |

Typical and default values for biomethane

| Biomethane production system | Technological option | Greenhouse gas emissions – typical value ($g\ CO_2eq/MJ$) | Greenhouse gas emissions – default value ($g\ CO_2eq/MJ$) |
|---|---|---|---|
| Biomethane from wet manure | Open digestate, no off-gas combustion ([1]) | − 20 | 22 |
| | Open digestate, off-gas combustion ([2]) | − 35 | 1 |
| | Close digestate, no off-gas combustion | − 88 | − 79 |
| | Close digestate, off-gas combustion | − 103 | − 100 |
| Biomethane from maize whole plant | Open digestate, no off-gas combustion | 58 | 73 |
| | Open digestate, off-gas combustion | 43 | 52 |
| | Close digestate, no off-gas combustion | 41 | 51 |
| | Close digestate, off-gas combustion | 26 | 30 |

([1]) This category includes the following categories of technologies for biogas upgrade to biomethane: Pressure Swing Adsorption (PSA), Pressure Water Scrubbing (PWS), Membranes, Cryogenic, and Organic Physical Scrubbing (OPS). It includes an emission of 0,03 MJ $CH_4$/MJ biomethane for the emission of methane in the off-gases.

([2]) This category includes the following categories of technologies for biogas upgrade to biomethane: Pressure Water Scrubbing (PWS) when water is recycled, Pressure Swing Adsorption (PSA), Chemical Scrubbing, Organic Physical Scrubbing (OPS), Membranes and Cryogenic upgrading. No methane emissions are considered for this category (the methane in the off-gas is combusted, if any).

## **Annex III, Part C continued:** Disaggregated *default values for biomass fuels*

### Total typical and *default values for biomass fuels*

| Biomethane production system | Technological option | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|---|
| Biomethane from biowaste | Open digestate, no off-gas combustion | 51 | 71 |
| | Open digestate, off-gas combustion | 36 | 50 |
| | Close digestate, no off-gas combustion | 25 | 35 |
| | Close digestate, off-gas combustion | 10 | 14 |

Typical and default values – biogas for electricity – mixtures of manure and maize: greenhouse gas emissions with shares given on a fresh mass basis

| Biogas production system | | Technological options | Greenhouse gas emissions – typical value (g $CO_2$eq/MJ) | Greenhouse gas emissions – default value (g $CO_2$eq/MJ) |
|---|---|---|---|---|
| Manure – Maize 80 % - 20 % | Case 1 | Open digestate | 17 | 33 |
| | | Close digestate | – 12 | – 9 |
| | Case 2 | Open digestate | 22 | 40 |
| | | Close digestate | – 7 | – 2 |
| | Case 3 | Open digestate | 23 | 43 |
| | | Close digestate | – 9 | – 4 |
| Manure – Maize 70 % - 30 % | Case 1 | Open digestate | 24 | 37 |
| | | Close digestate | 0 | 3 |
| | Case 2 | Open digestate | 29 | 45 |
| | | Close digestate | 4 | 10 |
| | Case 3 | Open digestate | 31 | 48 |
| | | Close digestate | 4 | 10 |
| Manure – Maize 60 % - 40 % | Case 1 | Open digestate | 28 | 40 |
| | | Close digestate | 7 | 11 |
| | Case 2 | Open digestate | 33 | 47 |
| | | Close digestate | 12 | 18 |
| | Case 3 | Open digestate | 36 | 52 |
| | | Close digestate | 12 | 18 |

Comments

Case 1 refers to pathways in which electricity and heat required in the process are supplied by the CHP engine itself.

Case 2 refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by the CHP engine itself. In some Member States, operators are not allowed to claim the gross production for subsidies and case 1 is the more likely configuration.

Case 3 refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by a biogas boiler. This case applies to some installations in which the CHP engine is not on-site and biogas is sold (but not upgraded to biomethane).

Typical and default values – biomethane - mixtures of manure and maize: greenhouse gas emissions with shares given on a fresh mass basis

| Biomethane production system | Technological options | Typical value | Default value |
|---|---|---|---|
| | | (g $CO_2$eq/MJ) | (g $CO_2$eq/MJ) |
| Manure – Maize 80 % - 20 % | Open digestate, no off-gas combustion | 32 | 57 |
| | Open digestate, off-gas combustion | 17 | 36 |
| | Close digestate, no off-gas combustion | – 1 | 9 |
| | Close digestate, off-gas combustion | – 16 | – 12 |
| Manure – Maize 70 % - 30 % | Open digestate, no off-gas combustion | 41 | 62 |
| | Open digestate, off-gas combustion | 26 | 41 |
| | Close digestate, no off-gas combustion | 13 | 22 |
| | Close digestate, off-gas combustion | – 2 | 1 |
| Manure – Maize 60 % - 40 % | Open digestate, no off-gas combustion | 46 | 66 |
| | Open digestate, off-gas combustion | 31 | 45 |
| | Close digestate, no off-gas combustion | 22 | 31 |
| | Close digestate, off-gas combustion | 7 | 10 |

Where biomethane is used as Compressed Biomethane as a transport fuel, a value of 3,3 g $CO_2$eq/MJ biomethane needs to be added to the typical values and a value of 4,6 g $CO_2$eq/MJ biomethane to the default values.

# Annex IV: Criteria for determining the high indirect land-use change-risk feedstock for which a significant expansion of the production area into land with high carbon stock is observed

**(Source: Delegated Act C(2019) 2055 final).**

***NOTE:* Whenever the European Commission updates the Delegated Act and/or Annex, these will be applicable in the RSB EU RED Certification process with immediate effect.**

For the purpose of determining the high indirect land-use change-risk feedstock for which a significant expansion of the production area into land with high-carbon stock is observed, the following cumulative criteria shall apply:

a) the average annual expansion of the global production area of the feedstock since 2008 is higher than 1% and affects more than 100,000 hectares;

b) the share of such expansion into land with high-carbon stock is higher than 10%, in accordance with the following formula:

$$x_{hcs} = \frac{x_f + 2{,}6 x_p}{PF}$$

where

$x_{hcs}$ = share of expansion into land with high-carbon stock;

$x_f$ = share of expansion into land referred to in Article 29(4)(b) and (c) of Directive (EU) 2018/2001;

$x_p$ = share of expansion into land referred to in Article 29(4)(a) of Directive (EU) 2018/2001 including peatland;

$PF$ = productivity factor.

PF shall be 1,7 for maize, 2,5 for palm oil, 3,2 for sugar beet, 2,2 for sugar cane and 1 for all other crops.

The application of the criteria in points (a) and (b) above shall be based on the information included in the Annex to C(2019) 2055, as revised in accordance with Article 7 of Directive 2018/2001/EU. Operators should therefore refer to the latest version of the Annex.

**Annex to C(2019) 2055. Operators should refer to the latest version of the Annex.**

| | Average annual expansion of production area since 2008 (kha) | Average annual expansion of production area since 2008 (%) | Share of expansion into land referred to in Article 29(4)(b) and (c) of Directive (EU) 2018/2001 | Share of expansion into land referred to in Article 29(4)(a) of Directive (EU) 2018/2001 |
|---|---|---|---|---|
| Cererals | | | | |
| Wheat | -263,4 | -0,1% | 1% | - |
| Maize | 4027,5 | 2,3% | 4% | - |
| Sugar crops | | | | |
| Sugar cane | 299,8 | 1,2% | 5% | - |
| Sugar beet | 39,1 | 0,9% | 0,1% | - |
| Oil crops | | | | |
| Rapeseed | 301,9 | 1,0% | 1% | - |
| Palm oil | 702,5 | 4,0% | 45% | 23% |
| Soybean | 3183,5 | 3,0% | 8% | - |
| Sunflower | 127,3 | 0,5% | 1% | - |

# Annex V: Emission from cultivation ($e_{ec}$)

**METHODOLOGY FOR DETERMINING THE EMISSIONS FROM THE EXTRACTION OR CULTIVATION OF RAW MATERIALS**

To calculate the emissions from the extraction or cultivation of raw materials Part C, point 5 of Annex V and Part B, point 5 of Annex VI to Directive 2018/2001 (EU) state that the calculation shall 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.

The capture of $CO_2$ in the cultivation of raw materials shall be excluded.

Estimates of emissions from agriculture biomass cultivation may be derived from the use of regional averages for cultivation emissions included in the reports referred to in Article 31(4) of Directive 2018/2001 (EU) or the information on the disaggregated default values for cultivation emissions included in the Annex of the EU Commission Implementing Regulation on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria (henceforth referred to as “IR”), as an alternative to using actual values. In the absence of relevant information in those reports, averages can be calculated based on local farming practices, for instance on data of a group of farms, as an alternative to using actual values.

**EMISSIONS FROM THE EXTRACTION OR CULTIVATION PROCESS ITSELF**

The emissions from the extraction or cultivation process itself shall include all emissions from (i) the provision of the fuels for farm machinery used; (ii) the production of seeding material for crop cultivation; (iii) the production of fertilisers and pesticides; (iv) fertiliser acidification and liming application; and (v) soil emissions from crop cultivation.

**1.1. Fuel use (diesel oil, gasoline, heavy fuel oil, biofuels or other fuels) for farm machinery**

The GHG emissions from crop cultivation (field preparation, seeding, fertiliser and pesticide application, harvesting, collection) shall include all emissions from the use of fuels (such as diesel oil, gasoline, heavy fuel oil, biofuels or other fuels) in farm machinery. The amount of fuel use in farm machinery shall be duly documented. Appropriate emission factors of the fuels must be used in accordance with Annex IX of the IR. Where biofuels are used, the default GHG emissions set out in Directive 2018/2001 must be used.

**1.2. Chemical fertilisers and pesticides**

The emissions from the use of chemical fertilisers and pesticides[45] for the cultivation of raw materials shall include all related emissions from the manufacture of chemical fertilisers and pesticides. The amount of the chemical fertilisers and pesticides, depending on the crop, local conditions and farming practices, shall be duly documented. 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 the IR. If the economic operator knows the factory producing the fertiliser and it falls under the EU Emissions Trading System (ETS), then the economic operator can use the production emissions declared under ETS, adding the upstream emissions for natural gas etc. Transport of the fertilisers shall also be included, using the emissions from transport modes listed in Annex IX of the IR. If the economic

[45] ‘Pesticides’ means all plant protection products, including herbicides, insecticides, fungicides, etc.

operator does not know the factory supplying the fertiliser, it should use the standard values provided for in Annex IX of the IR.

### 1.3. Seeding material

The calculation of cultivation emissions from the production of seeding material for crop cultivation shall be 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. The standard values for emission factors set out in Annex IX of the IR must be used. For other seeds, literature values from the following hierarchy must be used.

(a) version 5 of JEC-WTW report
(b) ECOINVENT database;
(c) 'official' sources, such as Intergovernmental Panel on Climate Change (IPCC), International Energy Agency (IEA) or governments;
(d) other reviewed sources of data, such as E3 database, GEMIS database;
(e) peer-reviewed publications;
(f) duly documented own estimates.

### 1.4. Emissions from fertiliser acidification and liming application

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

1.4.1. Emissions from neutralisation of fertiliser acidification

The emissions resulting from acidification caused by nitrogen fertiliser use in the field shall be 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 shall be 0.783 kg $CO_2$/kg N; for urea fertilisers, the neutralisation emissions shall be 0.806 kg $CO_2$/kg N.

1.4.2. Soil emissions from liming (aglime)

The real amount of aglime used shall be duly documented. Emissions shall be calculated as follows:

1. 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 (0.44 kg $CO_2$/kg $CaCO_3$ equivalent aglime).
2. If soil pH is greater or equal to 6.4, an emission factor of 0.98/12.44 = 0.079 kg $CO_2$/ (kg $CaCO_3$-equivalent) aglime applied shall be taken into account in the calculation, in addition to the emissions due to the neutralisation of acidification caused by the fertiliser.
3. The liming emissions calculated from actual lime use, calculated in points 1 and 2 above, may be greater than the fertilizer neutralization emissions calculated in 1.4.1 if the fertilizer acidification was neutralized by the applied lime. In such a case, the fertilizer neutralization emissions (in 1.4.1) may be subtracted from the calculated liming emissions to avoid that its emissions are counted twice.

   The emissions from fertilizer acidification may exceed those attributed to liming. In such a case, the subtraction would result in apparently negative net liming emissions because not all of the fertilizer-acidity is neutralized by aglime but also partly by naturally-occurring carbonates. In this case, the net liming emissions shall be counted zero, but the fertilizer- acidification emissions that occur anyway shall be maintained in line with section 1.4.1.

If data on actual aglime use is not available, the aglime use recommended by the Agricultural Lime Association shall be assumed. This shall be a function of the type of crop, measured soil pH, soil type and type of liming material. The accompanying CO2 emissions shall be calculated using points 1 and 2 of the procedure above. However, the subtraction specified in point 3 shall not be applied in this case, since the recommended use of aglime does not include aglime used to neutralize fertilizer applied in the same year, so there is no possible double counting of fertilizer neutralization emissions.

### 1.5. Soil (nitrous oxide/$N_2O$) emissions from crop cultivation

The calculation of $N_2O$ emissions from managed soils shall follow the IPCC methodology. The use of disaggregated crop-specific emission factors for different environmental conditions (corresponding to Tier 2 of the IPCC methodology) shall be used to calculate the $N_2O$ emissions resulting from crop cultivation. Specific emission factors for different environmental conditions, soil conditions and different crops should be taken into account. Economic operators could use validated models to calculate those emission factors provided that the models take these aspects into account. In line with the IPCC guidelines[46], both direct and indirect $N_2O$ emissions shall be taken into account.

To calculate soil N2O emissions, the GNOC tool shall be used when available, which is based on the formulas below, following the naming conventions in the IPCC (2006) guidelines:

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

Where:
For mineral soils: $N_2O_{Direct} - N =$
(i) at least 12% (by weight) organic carbon (about 20% organic matter) if it has no clay; or

carbon when
For organic soils: $N_2O_{Direct} - N =$ 2 If the soil is

For both mineral and organic soils: $N_2O_{Direct} - N = [((F_{SN} \cdot Frac_{GASF}) + (F_{ON} \cdot Erac_{GASM}) \cdot EF_4] + [(F_{SN} + F_{ON} + F_{CR}) \cdot Frac_{Leach-(H)} \cdot EF_5]$

### 1.5.1 Crop residue N input

It must be calculated for:
(a) **sugar beet, sugar cane** according to IPCC (2006) Vol. 4 Chapter 11 Eq. 11.6, not considering below-ground residues and with the addition of N input from vignasse and filter cake in the case of sugar cane;

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

(b) **coconut and oil palm plantations applying a fixed N input** based on literature as IPCC (2006) provides no default calculation method for standard emission factors, pursuant to Annex IX of the IR;

(c) **for all other crops** according to IPCC (2006) Vol. 4 Chapter 11 Eq. 11.7a 11, 12, as

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

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[46] IPCC (2006), Vol. 4, Chapter 11: N2O emissions from managed soils, and CO2 emissions from lime and urea application.

Where:

$N_2O_{total}$ - N = direct and indirect annual $N_2O$–N emissions produced from managed soils; kg $N_2O$– N $ha^{-1}$ $a^{-1}$

$N_2O_{direct}$ - N = annual direct $N_2O$–N emissions produced from managed soils; kg $N_2O$–N $ha^{-1}$ $a^{-1}$

$N_2O_{indirect}$ - N = 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 $ha^{-1}$ $a^{-1}$

$F_{SN}$ = annual synthetic nitrogen fertiliser input; kg N $ha^{-1}$ $a^{-1}$

$F_{ON}$ = annual animal manure N applied as fertiliser; kg N $ha^{-1}$ $a^{-1}$

$F_{CR}$ = annual amount of N in crop residues (above ground and below ground); kg N $ha^{-1}$ $a^{-1}$

$F_{OS,CG,Temp}$ = annual area of managed/drained organic soils under cropland in temperate climate; $ha^{-1}$ $a^{-1}$

$F_{OS,CG,Trop}$ = annual area of managed/drained organic soils under cropland in tropical climate; $ha^{-1}$
$Frac_{GASF}$ = 0.10 (kg N $NH_3$–N + NOx–N) (kg N applied)$^{-1}$. Volatilisation from synthetic fertiliser

$Frac_{GASM}$ = 0.20 (kg N $NH_3$–N + NOx–N) (kg N applied)$^{-1}$. Volatilisation from all organic nitrogen fertilisers applied

$Frac_{Leach-(H)}$ = 0.30 kg N (kg N additions) -1. N losses by leaching/run-off for regions where leaching/run-off occurs

$EF_{1ij}$ = Crop and site-specific emission factors for $N_2O$ emissions from synthetic fertiliser and organic N application to mineral soils (kg $N_2O$–N (kg N input)$^{-1}$);

$EF_1$ = 0.01 [kg $N_2O$–N (kg N input) $^{-1}$]

$EF_{2CG,Temp}$ = 8 kg N2O-N $ha^{-1}$ $a^{-1}$ for temperate organic crop and grassland soils

$EF_{2CG,Trop}$ = 16 kg N2O-N $ha^{-1}$ $a^{-1}$ for tropical organic crop and grassland soils

$EF_4$ = 0.01 [kg $N_2O$–N (kg N NH3–N + NOx–N volatilised) $^{-1}$]

$EF_5$ = 0.0075 [kg $N_2O$–N (kg N leaching/run-off) $^{-1}$]

Yield = annual fresh yield of the crop (kg $ha^{-1}$)

DRY = dry matter fraction of harvested product [kg d.m. (kg fresh weight)$^{-1}$] (see Table 1)

$Frac_{Burnt}$ = Fraction of crop area burnt annually [ha (ha)-1]

$C_f$ = Combustion factor [dimensionless] (see Table VI.1)

$R_{AG}$ = Ratio of above-ground residues, dry matter to harvested dry matter yield, for the crop [kg d.m. (kg d.m.)$^{-1}$] (see Table 3)

$N_{AG}$ = N content of above-ground residues [kg N (kg d.m.)-1] (see Table 1)
$Frac_{Remove}$ = Fraction of above-ground residues removed from field [kg d.m. (kg AGDM)$^{-1}$]

$F_{VF}$ = Annual amount of N in sugar cane vignasse and filter cake returned to the field [kg N ha$^{-1}$], calculated as Yield * 0.000508.

AG = Above-ground residue dry matter [kg d.m. ha$^{-1}$]

### 1.5.2 Crop and site-specific emission factors for $N_2O$ emissions from synthetic fertiliser and organic N application

$N_2O$ 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 (hereinafter referred to as 'the S&B model'):

$$E = exp(-1.516 + \sum ev)$$

Where:
E = $N_2O$ emissions (in kg $N_2O$-N ha$^{-1}$ a$^{-1}$)

*ev* = effect value for different drivers (see Table VI.2)

The $EF_{1ij}$ for the biofuel crop i at location j is calculated (S&B model) as:

$$EF_{1ij} = (E_{fert,ij} – E_{unfert,ij}) / N_{appl,ij}$$

The IPCC (2006) factor (EF1) for direct $N_2O$ emissions from fertiliser input based on a global mean shall be replaced by the crop- and site-specific EF1ij for direct emissions from mineral fertiliser and manure N input, based on the crop- and site-specific EF1ij, applying the S&B model.

Where:

$E_{fert,ij}$ = $N_2O$ emission (in kg $N_2O$-N $ha_{-1}$ a$^{-1}$) based on S&B, where the fertiliser input is the actual N application rate (mineral fertiliser and manure) to the crop i at location j

$E_{unfert,ij}$ = $N_2O$ emission of the crop i at location j (in kg $N_2O$-N $ha_{-1}$ a$^{-1}$) based on S&B. The N application rate is set to 0, all the other parameters are kept the same.

$N_{appl,ij}$ = N input from mineral fertiliser and manure (in kg N ha$^{-1}$ a$^{-1}$) to the crop i at location j

## Table VI.1 Crop-specific parameters to calculate N input from crop residues[47]

| Crop | Calculation method | DRY | LHV | $N_{AG}$ | slope | intercept | $R_{BG\_BIO}$ | $N_{BG}$ | Cf | $R_{AG}$ | Fixed amount of N in crop residues (kg N ha$^{-1}$) | 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 |

## Table VI.2 Constant and effect values for calculating $N_2O$ emissions from agricultural fields based on the S&B model

| Constant value | -1.516 | |
|---|---|---|
| **Parameter** | **Parameter class or unit** | **Effect value (ev)** |
| Fertilizer input | | 0.0038 * N application rate in kg N ha$^{-1}$ a$^{-1}$ |
| Soil organic C content | <1 % | 0 |
| | 1-3 % | 0.0526 |
| | >3 % | 0.6334 |
| pH | <5.5 | 0 |
| | 5.5-7.3 | -0.0693 |
| | >7.3 | -0.4836 |
| Soil texture | Coarse | 0 |
| | Medium | -0.1528 |
| | Fine | 0.4312 |
| Climate | Subtropical climate | 0.6117 |
| | Temperate continental climate | 0 |
| | Temperate oceanic climate | 0.0226 |
| | Tropical climate | -0.3022 |
| Vegetation | Cereals | 0 |
| | Grass | -0.3502 |
| | Legume | 0.3783 |
| | None | 0.5870 |
| | Other | 0.4420 |
| | Wetland rice | -0.8850 |
| Length of experiment | 1 yr | 1.9910 |

[47] Data source: JRC report "Definition of input data to assess GHG default emissions from biofuels in EU legislation" JRC 2019 (EUR 28349 EN). https://op.europa.eu/en/publication-detail/-/publication/7d6dd4ba-720a-11e9-9f05- 01aa75ed71a1

## 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.

### 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).

### Biomass drying

The cultivation emissions shall include emissions from drying before storage as well as from storage and handling of biomass feedstock. Data on energy use for drying before storage shall include 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, including upstream emissions, shall 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 and does not include drying of materials during processing.

## ACCOUNTING FOR EMISSIONS FOR ELECTRICITY USED IN FARMING OPERATIONS

When accounting for the consumption of electricity not produced within the fuel production plant, the GHG emissions intensity of the produced and distributed electricity shall be assumed to be equal to the average emission intensity of the produced and distributed electricity in a defined region, which can be at a NUTS2[4] region or a national level. In case national electric emission coefficients are used, the values from Annex IX of the IR shall 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.

For electricity used in farming operations the emission intensity shall be that of a defined region, which can be at a NUTS2 region (if available and recognized by the European Commission) or a national level. In case national electricity emission coefficients are used, the values from Annex IX of the IR shall be used.

# Annex VI: Emission savings from soil carbon accumulation ($e_{sca}$)

## 1 Methodology for determining the emission savings from soil carbon accumulation via improved agricultural management

1.1 Improved agriculture management practices, accepted for the purpose of achieving emission savings from soil carbon accumulation ($e_{sca}$), include shifting to reduced or zero-tillage, improved crop/rotation, the use of cover crops, including crop residue management, and the use of organic soil improver (e.g. compost, manure fermentation, digestate, biochar etc.,).

1.2 In determining the $e_{sca}$ value, the methodology set out in this Annex, according to Annex V of the EU Commission Implementing Regulation (IR) on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria, shall be applied.

1.3 Participating operators seeking to claim emission savings from soil carbon accumulation via improved agricultural management in terms of g $CO_2$eq/MJ shall use the following formula to calculate their actual values:

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

Where:

$CS_R$ is the mass of soil carbon stock per unit area associated with the reference crop management practice in Mg of C per ha.

$CS_A$ is the mass of soil estimated carbon stock per unit area associated with the actual crop management practices after at least 10 years of application in Mg of C per ha.

3.664 is the quotient obtained by dividing the molecular weight of $CO_2$ (44.010g/mol) by the molecular weight of carbon (12.011g/mol) in g $CO_2$eq/g C.

$n$ is the period (in years) of the cultivation of the crop considered.

$P$ is the productivity of the crop (measured as MJ biofuel or bioliquid energy per ha per year).

$e_f$ is emissions from the increased fertilisers and/ or herbicide use

1.4 The calculation of the actual values of $CS_R$ and $CS_A$ shall be based on measurements of soil carbon stocks. The measurement of $CS_R$ shall be carried out at farm level before the management practice changes in order to establish a baseline, and then the $CS_A$ shall be measured at regular intervals no later than 5 years apart[48].

[48] Operators who are already engaged in eligible $e_{sca}$ practices and have made respective $e_{sca}$ claims before the entry into force of the EU RED IR (i.e. December 2023), may use a model of neighbouring fields if history of farming practices is available. Models for baseline values for the time without the improved practices can be established on the basis that soil types are known.

1.5 The entire area for which the soil carbon stocks are calculated shall have a similar climate and soil type as well as similar management history in terms of tillage and carbon input to soil.

1.6 If the improved management practices are only applied to part of the farm, the GHG emissions savings can only be claimed for the area covered by them. If different improved management practices are applied on separate areas within a single farm, a claim of GHG emission savings shall be calculated and claimed individually for each area with different $e_{sca}$ practices.

1.7 To ensure reduced year-to-year fluctuations in the measured soil carbon stocks and to reduce associated errors, 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 for the purposes of testing, baselining and modeling verification, including those fields belonging to different farmers.

1.8 After the first measurement of the baseline, the increase in soil carbon can be estimated based on representative experiments or soil models, before a second measurement of the increase in carbon stock is made. From the second measurement onwards, the measurements shall constitute the ultimate basis for determining the actual values of the increase in soil carbon stock.

1.8.1 Participating Operators shall only use the following soil models, together with guidance provided in Annex IX:

- RothC
- CENTURY
- DayCent
- IPCC Tier 2

Please note: RSB maintains a list of accepted soil models[49]. Participating Operators may request for new soil models to be added to the list. RSB holds responsibility for validating models and approving on a case-by-case basis.

1.9 After the second measurement, modelling to estimate the annual increase in soil carbon stocks may only be permitted until the next measurement if the models used have been calibrated, based on the real values measured.

1.10 The related final actual values that are established based on the soil measurement results, shall be used to adjust the annual claims of emissions savings from soil carbon accumulation via agricultural management, made on the basis of modelling.

1.11 To claim the $e_{sca}$ credit, measurements of soil carbon stocks shall be performed by certified laboratories and samples shall be retained for a period of at least 5 years for auditing purposes.

1.12 Participating operators shall commit to continue applying the improved management practice for a minimum of 10 years in order for GHG emission savings to be taken into account. This commitment may be implemented as a 5-yearly renewable commitment.

Failure to meet 1.12 will lead to all $e_{sca}$ values of the current year for the farmer or PO being added as emissions to the overall GHG emissions of the energy crop delivered, instead of being deducted as a GHG emission savings, and a prohibition to include an $e_{sca}$ value in the GHG calculations for 5 years.

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[49] Models shall take into account the different soil, climate and field management history to simulate carbon dynamics in soil.

Please note: If a commitment has been signed in the name of a PO on behalf of several farmers and one of these farmers withdraws early, the above-mentioned penalties shall apply only to the farmer concerned and not to all the commitments of the PO.

1.13 If a commitment has been signed in the name of a Participating Operator on behalf of several farmers and one of these farmers withdraws early, the above-mentioned penalty shall apply only to the farmer concerned and not to all the commitments of the Participating Operator.

1.14 Participating Operators shall apply the improved management practice for a continuous minimum period of 3 years before an $e_{sca}$ claim can be made.

This applies to both old and new POs registered under the RSB certification scheme. To evidence the implementation of the improved management practises, POs may use for example farm records.

1.15 The maximum possible total value of the annual $e_{sca}$ claim shall be capped at:

- 45 g CO2eq/MJ biofuel or bioliquid for the entire period of application of the $e_{sca}$ practices, if biochar[50] is used as organic soil improver alone or in combination with other eligible $e_{sca}$ practices, or
- 25 g CO2eq/MJ biofuel or bioliquid for the entire period of application of the $e_{sca}$ practices, in all other cases.
- Please see 1.16 for the exception to this cap.
- In all cases, the cap must be applied by the biofuel processor.
- Information on which cap should be applied by the biofuel processor, shall be provided by the biomass producer on the PoS, and checked by the auditor.

1.16 Participating Operators who engaged in eligible $e_{sca}$ practices and made respective $e_{sca}$ claims <u>before the entry into force of the IR (i.e. prior to December 2023)</u>, may apply a cap of 45 g $CO_2$eq/MJ biofuel or bioliquid in a transition period until the first measurement of the carbon stock increase is made at the 5$^{th}$ year.

In such a case, the measured carbon stock increase at the 5$^{th}$ year will become a cap for the annual claims to be made in the following period of 5 years.

- If the first measurement of the carbon stock increase at the 5$^{th}$ year shows **higher** total annual carbon stock increase, compared to the annual claims made, the annual difference can be claimed by the Participating Operator in subsequent years to compensate for lower carbon stock increases.
- If the first measurement of the carbon stock increase at the 5$^{th}$ year shows **lower** total annual soil carbon stock increase, compared to the annual claims made, the annual difference shall be deducted accordingly by the Participating Operator from their claims in the subsequent five years.
- In all cases, the cap must be applied by the biofuel processor.

[50] IPCC 2019 ap4.5 definition: "biochar is defined as a solid material generated by heating biomass to a temperature in excess of 350°C under conditions of controlled and limited oxidant concentrations to prevent combustion.

- Information on which cap should be applied by the biofuel processor, shall be provided by the biomass producer on the PoS, and checked by the auditor.

1.17 If the application of eligible $e_{sca}$ practices started in the past but no previous $e_{sca}$ claims were made, annual retroactive $e_{sca}$ claims can be made if the following provisions are met:

- The retroactive $e_{sca}$ claims shall be no longer than 3 years prior to the moment of the first $e_{sca}$ certification;

- Participating Operators shall provide evidence to demonstrate the start of the application of the improved farming practices, demonstrated with for example farm records.

- The estimate of the $CS_R$ value may 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 are no available data from such a field, the $CS_R$ estimated value shall be based on modelling, and a first soil measurement shall be done at the moment of commitment (i.e. prior to the first certification audit). The next measurement of carbon stock increase shall be made 5 years later.

1.18 Increased emissions resulting from the increased fertilisers or herbicide use due to the application of improved agricultural practices ($e_f$), shall be calculated with the following provisions:

- Adequate evidence shall be provided on the historic use of fertilisers or herbicide that shall 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.

2 Requirements related to soil sampling

The following rules shall be applied to soil sampling:

2.1 Representative sampling method:

(a) sampling shall be made for each plot or field;

(b) at least one grab sample of 15 well distributed sub-samples per every 5 hectares or per field, whichever is smaller (taking into account the heterogeneity of the plot's carbon content), shall be taken;

(c) smaller fields with same climatic conditions, soil type, reference farming practice, and $e_{sca}$ practice can be grouped as per point 1.7 of this Annex and when the soil management practices are applied by all farmers covered by the group audit, with one combined sample per each segment of 5ha;

(d) sampling shall be done either in spring before soil cultivation and fertilisation or in autumn, a minimum of 2 months after harvest;

(e) direct measurements of soil carbon stock changes shall be taken for the first 30cm of soil;

(f) the points of the initial sampling to measure the baseline of soil carbon stocks shall be used under identical field conditions (especially soil moisture);

(g) The sampling protocol shall be well documented.

2.2 Measurement of the soil carbon content:

(a) soil samples shall be dried, sieved, and if necessary ground;

(b) if the combustion method is used, inorganic carbon shall be excluded.

2.3 Determination of dry bulk density:

(a) changes in bulk density over time shall be taken into account;

(b) bulk density should be measured using the tapping method, that is to say by mechanically tapping a cylinder into the soil, which greatly reduces any errors associated with bulk density measurement;

(c) if the tapping method is not possible, especially with sandy soils, a reliable method shall be used instead. The PO shall provide evidence to the CB on the reliability of the alternative method, which shall be reviewed by the CB;

(d) samples should be oven-dried to constant weight, prior to weighing.

## Annex VII: Feedstocks which may be considered twice their energy content

(Source: Directive (EU) 2018/2001, Annex IX)

a. Algae if cultivated on land in ponds or photobioreactors

b. Biomass fraction of mixed municipal waste, but not separated household waste subject to recycling targets under point (a) of Article 11(2) of Directive 2008/98/EC

c. Bio-waste as defined in Article 3(4) of Directive 2008/98/EC from private households subject to separate collection as defined in Article 3(11) of that Directive

d. Biomass fraction of industrial waste not fit for use in the food or feed chain, including material from retail and wholesale and the agro-food and fish and aquaculture industry, and excluding feedstocks listed in r. (used cooking oil) and s. (cat. 1. and 2. animal fats)

e. Straw

f. Animal manure and sewage sludge

g. Palm oil mill effluent and empty palm fruit bunches

h. Tall oil pitch

i. Crude glycerine

j. Bagasse

k. Grape marcs and wine lees

l. Nut shells

m. Husks

n. Cobs cleaned of kernels of corn

o. Biomass fraction of wastes and residues from forestry and forest-based industries, namely, bark, branches, pre- commercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil.

   *Please note: All materials within this category must also comply with the requirements set out in RSB Standard Amendment Requirements for woody materials [RSB-SA-01]. If there are any contradictions between the RSB-SA-01 and this Standard, this Standard shall prevail.*

p. Other non-food cellulosic material

q. Other lignocellulosic material except saw logs and veneer logs

r. Used cooking oil

s. Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009 of the European Parliament and of the Council

# Annex VIII: Minimum information regarding low ILUC risk certification

**MINIMUM REQUIREMENTS ON THE PROCESS AND METHOD FOR CERTIFYING LOW INDIRECT LAND-USE CHANGE (ILUC) RISK BIOMASS (Source: Annex VIII to Implementing Regulation on Voluntary Schemes)**

**A. Process of low ILUC risk certification**

The low ILUC risk certification application shall contain at least the following information:

a) the name and contact details of the applicant or applicants, including where relevant the members of a group for group certification[5];

b) a description of the low ILUC risk additionality measures envisaged, including:

(i) details on the delineated plot where the additionality measure will be implemented, including current land use, current management practices, current plot yield data, and if applicable a statement on whether the land is unused, abandoned or severely degraded;

(ii) description of the additionality measures and an estimate of the additional biomass that will be produced following its application (either through a yield increase or production on unused, abandoned or severely degraded land);

c) information on any existing Commission-recognised voluntary scheme certification (name of the voluntary scheme, certificate number, status and validity period).

If the application is made after the additionality measures have been implemented, only the additional biomass produced after the date of low ILUC risk certification may be claimed as low ILUC risk.

1. Content of the management plan

Once the low ILUC risk application is accepted, the economic operator shall develop a management plan and submit it to the certification body. The management plan shall build on the information in the certification application, and include:

(a) a definition of the delineated plot of land;

(b) a description of additionality measures;

(c) check on sustainability of the additionality measure against the requirements of Directive (EU) 2018/2001;

(d) where relevant, demonstration of additionality assessment (either financial attractiveness or non-financial barrier test);

(e) determination of the dynamic yield baseline, including:

(i) for yield increase measures: at least 3 years of historical crop yield data related to the delineated plot of land;

(ii) for cultivation on unused, abandoned or severely degraded land: proof of land status (the baseline yield for cultivation on unused, abandoned or severely degraded land is considered to be zero)

(f) estimate of the additional biomass yield per year, with reference to the dynamic yield baseline for the delineated plot.

The management plan must allow a comparison to be made between the use of the delineated plot before and after implementation of the additionality measure.

2. Non-exhaustive list of additionality measures

Table VIII.1. Non-exhaustive list of yield increase additionality measures.

| Additionality category | Additionality measure | Example |
|---|---|---|
| Mechanisation | Machinery | Adoption of machinery that reduces/complements existing workforce input to boost output or reduce losses. This could include sowing, precision farming, harvesting machinery or machinery to reduce post-harvest losses. |
| Multi-cropping | Sequential cropping | Introduction of second crop on same land in the same year. |
| Management | Soil management | Mulching instead of ploughing, low tillage. |
| | Fertilisation | Optimisation of fertilisation regime, use of precision agriculture. |
| | Crop protection | Change in weed, pest and disease control. |
| | Pollination | Improved pollination practices. |
| | Other | Leaves room for innovation, combinations of measures and unforeseen developments. |
| Replanting (for perennial crops)[6] | Choice of crop varieties | Higher yield variety, better adaptation to eco-physiological or climatic conditions. |

[6] Replanting at the end of the crop lifetime is always necessary for a perennial crop. For replanting to count as an additionality measure, the economic operator must prove that their replanting goes beyond ‘business as usual’.

Additionality measures are measures that go beyond common agricultural practices. Table IX.1 contains a non-exhaustive list of the types of yield increase additionality measures that economic operators can apply. Measures, or combinations of measures, shall boost output without compromising sustainability. The additionality measure shall not compromise future growing potential by creating a trade-off between short-term output gains and mid/long-term deterioration of soil, water and air quality and pollinator populations. The additionality measures shall not result in homogenisation of the agricultural landscape through removal of landscape elements and habitats such as solitary trees, hedgerows, shrubs, field edges or flower strips.

Only additional yield above the dynamic yield baseline may be claimed as low ILUC risk. Furthermore, an additionality measure may only be certified if it aims to achieve additional yields as a result of an improvement in agricultural practice. If a measure is applied that only aims to improve the sustainability of the plot, without improving yields, it is not deemed an additionality measure. This is not the case with cultivation on unused, abandoned or severely degraded land, in which case the cultivation itself is the additionality measure.

The economic operator will have to demonstrate that the management plan sets reasonable expectations on the yield increase by referring to, for example, scientific literature, experience from field trials, information from agronomy companies, seed/fertiliser developers or simple calculations. Satisfactory evidence supporting the expected yield increase of the additionality measure applied is needed for the project to be certified.

In the case of agricultural improvements, the agricultural practices applied, machinery and means before and after the additionality measure has been applied shall be documented in detail as part of the management plan. This shall allow a comparison in order to (i) determine whether an additionality measure has been implemented; (ii) evaluate if that additionality measure may be considered to be additional compared to a ‘business as usual’ development.

**B. Additionality assessment: Financial attractiveness or barrier analysis tests**

<u>1. Financial attractiveness test</u>

The financial attractiveness test shall demonstrate that the investment required for the additionality measure becomes financially attractive only if the resulting additional yield is certified as low ILUC risk. The analysis shall consist of a simple financial analysis of the envisaged low ILUC risk additionality measure investment.

The test shall include only those costs and yields that are directly related to the additionality measure investment. Normal operating costs of the entire farm shall therefore not be included in the analysis. The costs and revenues included in the test shall be related to the preparation, implementation, maintenance and decommissioning of the additionality measure that would not have been otherwise incurred.

Financial attractiveness arises from a business case in which the net present value (‘NPV’)[51] of the investment is positive, which means that the investment may be conducted by the economic operator itself. As a result, only measures for which the business case analysis is negative (without the inclusion of a premium) shall pass the financial additionality test and become eligible to be certified as low ILUC risk. Outcomes above zero (a positive NPV) may still be eligible only if they pass the non-financial barrier test.

Formula to calculate the NPV of an investment:

$$NPV = \sum {}^{P-L} (1+i)^t$$

[51] NPV is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyse the profitability of a future investment or project https://www.investopedia.com/terms/n/npv.asp

**Where:**

P = expected income from additional biomass (estimate of additional biomass x feedstock sales price without low ILUC premium)

L = cost of additionality measure (CAPEX and OPEX)
i = discount rate
t = time period

The parameters used in the NPV calculation shall be in line with the data included in the management plan.

The following parameters shall be included in the NPV calculation:

(a) estimate of additional biomass volume;

(b) feedstock sales price [currency/tonne]:

(i) the feedstock sales price may be a single number extrapolated over the lifetime of the additional yield investment;

(ii) this single number may be based on an average of actual historical feedstock sales values achieved by the economic operator. The average value shall be based on data for the same 3 years that the historical yield data used to set the dynamic yield baseline;

(iii) in the event of introducing a new crop for which the economic operator does not have actual price data, this value may be based on price data from FAOSTAT[52]

(c) discount rate to be used: 3.5% for high income countries[53] and 5.5% for all other countries;

(d) lifetime of the investment:

(i) a lifetime of up to 10 years shall be used in conformity with the lifetime of the low ILUC risk certification (baseline validity);

(ii) in some cases, the maximum lifetime of the investment may be set at 25 years based on the typical lifetime of perennial crops (that is to say, oil palm tree, in the case of oil palm replanting);

(e) investment cost related to the additionality measure [CAPEX + OPEX].

2. Non-financial barrier test

The non-financial barrier analysis shall only cover non-financial project barriers that prevent the implementation of the additionality measures in case of no low ILUC risk certification. Any barrier whose cost can be estimated shall be included in the financial attractiveness analysis rather than in the non-financial barrier analysis.

The economic operator that plans the additionality measure is responsible for justifying the existence of non-financial barriers. The justification shall consist of a clear, verifiable description of the situation that prevents the uptake of the additionality measure. The economic operator shall provide all the necessary verifiable evidence to support the claim and demonstrate how low ILUC risk certification would ensure that the non-financial barrier is overcome.

The validity of the PO's claim shall be assessed and validated by the baseline audit before RSB will issue a RSB EU RED low ILUC risk certificate.

[52] FAOSTAT producer prices. Source: http://www.fao.org/faostat/en/#data/PP
[53] OECD countries

**C. Setting the dynamic yield baseline and calculation of the actual volume of low ILUC risk biomass**

The dynamic yield baseline shall be set individually for each delineated plot based on the crop and the type or combination of additionality measures applied. Plot-specific historical crop yield data from at least the 3 years preceding the application of an additionality measure shall be used to calculate the starting point of the dynamic yield baseline. This shall be combined with a global crop-specific trend line for expected yields based on historical data of actual yields over the past decade, or longer if data is available. For perennial crops, the dynamic yield baseline also takes into account the yield curve over the lifetime of the crop.

<u>1. Setting the dynamic yield baseline for annual crops</u>

Where a farm rotates crops between fields and the crop whose yield will be increased ('target crop') has been planted in different fields on the same farm in previous years, two options are envisaged for gathering the historical yield data in order to calculate the dynamic yield baseline:

**Option 1:** The PO calculates an average of the yields for the 3 most recent years that the target crop was grown on the specific delineated plot prior to implementation of the additionality measure. As crops are grown in rotation, this may mean using data that is more than 5 years old.

**Option 2:** The PO calculates a weighted average of the yields of the 3 most recent years that the target crop was grown on the farm prior to implementation of the additionality measure, even if those yields were obtained from different plots of different sizes on the same farm.

If historical data for the 3 most recent years of crop yields is not available, whether inaccessible or not representative as per the auditor's judgement, or if crop yield data is of insufficient quality, additional data may be obtained for earlier years or data from a neighbouring field growing the same crop under the same management plan. If 1 of the 3 years of historical data represents an exceptionally good or bad harvest (for example, discrepancy of 30% or more compared to the other reference years), the outlier crop yield shall not be included in the calculation to avoid skewing the three-year average10.

The auditor is responsible for determining a yield outlier, based on their expert judgement, experience on the ground and knowledge of the economic operator's practices over the long term. The auditor is also obliged to evaluate whether the crop yield data is of insufficient quality to be included as part of the baseline and annual audits, and to then decide whether a crop yield needs to be excluded or not.

The slope of the dynamic yield baseline shall be taken as the slope of a straight trend line fitted for yield developments of the target crop over the previous 10 years or longer if data is available. It is based on global data and shall be derived from the FAOSTAT World+ data for the relevant crop. This shall be done at the start of the certification period, and the slope shall be valid for the 10-year baseline validity period of the low ILUC certification.

Table IX.2 shows the slope of the dynamic yield baseline for the most common biofuel feedstock crops. These values are obtained by fitting a trend line over 20 years of global crop data obtained from FAOSTAT.

**Table VIII.2:** Slope of the trend line obtained for FAOSTAT World+ crop yield data. Average improvement in yield (tonne/ha/year) per year.

| Crop | Barley | Maize | Oil palm fruit | Rapeseed | Soybean | Sugar beet | Sugar cane | Sunflower seed | Wheat |
|---|---|---|---|---|---|---|---|---|---|
| Slope-20 | 0.035 | 0.074 | 0.200 | 0.036 | 0.028 | 1.276 | 0.379 | 0.035 | 0.04 |

Slope-20 is based on 2008-2017.

For any crop in the table, the dynamic yield baseline is determined by taking the starting point (three-year average of historical yields prior to application of the additionality measure) and adding the global trend line (slope) from Table IX.2. The following formula shall be used, starting at the year the additionality measure is implemented:

$$DYBx = (starting\ point\ DYB) + (slope_{20})x$$

Where:

$DYB_x$ = dynamic yield baseline in year x after implementation of the additionality measure

x = year(s) after implementation of additionality measure

If the additionality measure is to replace the existing crop with a different (higher yielding) crop on a delineated plot, the counterfactual situation is the cultivation of the existing crop. The dynamic yield baseline shall be determined based on historical yield and trend line data for the existing crop.

The starting point of the baseline shall be the 3-year average of the crop yield obtained for the lower performing existing crop. The trend line is based on the global FAOSTAT trend line data for the existing crop (see Table IX.2). This approach shall only be used if it can be demonstrated that the better performing crop could be introduced due to changes in the biofuel market, as demonstrated in the additionality assessment.

<u>2. Setting the dynamic yield baseline for perennial crops</u>

Depending on the yield variation observed over the lifetime of different types of perennial crop, different methodological approaches shall be possible.

For palm trees, the following data may be used by economic operators of oil palm plantations when determining their dynamic yield baseline:

a) the historical crop yields obtained prior to implementation of an additionality measure;
b) the planting year of palm trees on the delineated plot of land and/or their age profile;
c) the cultivars of palm trees on the delineated plot, if applicable;
d) the area of land replanted each year on a plantation, if applicable.

That data is combined with a growth curve to determine the dynamic yield baseline. The key characteristic from the growth curve shall be the shape, not the magnitude of the yield.

The growth curve gives the shape and it needs to be combined with the historical yield data and age of the trees, as set out in points (a) and (b), to adjust the magnitude of the dynamic yield baseline curve to the specific plot.

The following three options are available for determining the dynamic yield baseline for palm trees.

For each option, the data required to set the dynamic yield baselines must include:

a) **<u>Option 1a: Standard growth curve</u>**

   i. three most recent years of historical crop yields for palm trees grown on the delineated plot;

   ii. age of trees on the delineated plot / planting year;

b) **Option 1b: Economic operator provides growth curve**

   i. three most recent years of historical crop yield for palm trees grown on the delineated plot;

   ii. age of trees on the delineated plot/planting year;

   iii. the cultivars of palm trees on the delineated plot;

   iv. economic operator's own reference growth curve.

c) **Option 2: Group certification approach**

   i. for the three most recent years, the total hectares and total yield in fresh fruit bunches (FFB) for palm trees grown on the delineated plot/plantation(s), producing palm as part of the group.

Options 1a and 1b apply where an additionality measure is taken on a stand of trees that are the same age, or if the age profile of the trees on the delineated plot(s) is known and does not remain constant year after year.

Option 2 may be applied when the age profile of the trees on the delineated plots is mixed and remains relatively constant year after year, that is to say in a group certification approach or if a consistent percentage of a plantation area is replanted each year, resulting in a constant age profile for the trees.

Option 2 shall not be used if more than 20% of the volume in the group comes from the same plantation, or if more than 5% of the total area in the group is being replanted in the same year. In that case, option 1a or b shall be used to determine the baseline.

**<u>Option 1a: Standard growth curve</u>**

The first option uses the shape of a pre-established "standard" growth curve (based on existing scientific evidence) to determine the dynamic yield baseline for a delineated plot. The standard curve has been normalised and is shown in Figure IX.1 and Table IX.3 below.

The dynamic yield baseline is determined by using the 3 most recent years of historical crop yield data for the specific plot and the age of the palm trees when that yield was observed, and using the annual percentage yield change from the standard curve to form a "business-as-usual" yield curve relevant to the specific plot.

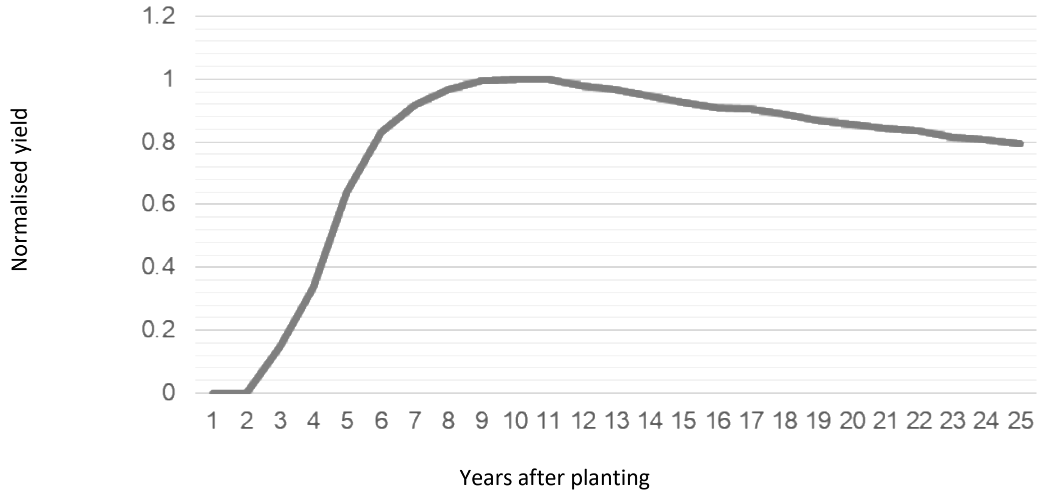


Figure VI. 1: Normalised standard growth curve palm yield

Table VI.3: Normalised standard growth curve palm yield data

| **Years after planting** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Normalised yield | 0 | 0 | 0.147 | 0.336 | 0.641 | 0.833 | 0.916 | 0.968 | 0.996 | 1 | 0.999 | 0.980 | 0.965 |
| **Years after planting** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | [illegible] |
| Normalised yield | 0.945 | 0.926 | 0.910 | 0.906 | 0.888 | 0.870 | 0.858 | 0.842 | 0.836 | 0.815 | 0.806 | 0.793 | 0.793 |

* After 25 years, the yield would be expected to continue to decline. However, as the typical lifetime of an oil palm tree is around 25 years, there is a lack of data to support the magnitude of the decline after 25 years. Therefore, a conservative approach is taken to assume that the yield curve would remain at the 25-year level.

Option 1a involves the following methodological steps:

1. To determine the average historical crop yield, collect the three most recent historical crop yields observed on the delineated plot prior to implementation of the additionality measure, as well as the corresponding age of the trees when those yields were observed;
2. Calculate an average (mean) of the three historical crop yields;
3. Based on the age of the trees when the historical yield data is from, determine where this average historical crop yield shall be on the standard growth curve (e.g. if the yield data is from trees aged 7, 8 and 9 years, the average historical yield should be considered to be year 8);
4. To determine the next point of the dynamic yield baseline, multiply the average historical crop yield from step 2 by the corresponding calculated annual percentage change, derived from the standard growth curve (Table IX.4 below). Repeat this for each subsequent point to plot the dynamic yield baseline;

Table VI.4: Annual percentage change in yield derived from standard growth curve

| **Years after planting** | **1 to 3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual percentage change | - | 128.0% | 90.6% | 30.0% | 10.0% | 5.6% | 2.9% | 0.4% | -0.1% | -1.9% | -1.6% | -2.0% |
| **Years after planting** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | [illegible] |
| Annual percentage change | -2.1% | -1.7% | -0.5% | -1.9% | -2.0% | -1.4% | -1.8% | -0.8% | -2.5% | -1.1% | -1.6% | 0% |

* After 25 years, the yield would be expected to continue to decline. However, as the typical lifetime of an oil palm tree is around 25 years, there is a lack of data to support the magnitude of the decline after 25 years. Therefore, a conservative approach is taken to assume that the yield curve would remain at the 25-year level.

5. To incorporate the global yield trend in the dynamic yield baseline, apply the compound annual growth rate (CAGR) calculated from FAOSTAT World+ yield data (Table IX.5 below), to each point of the dynamic yield baseline to obtain the CAGR corrected dynamic yield baseline.

Table VI.5: Compound annual growth rate palm (20-year)

| | |
|---|---|
| **Annual performance increase palm - business as usual** | **1.37%** |

Based on FAOSTAT World+ 2008-2017

**Option 1b: Economic operator provides the growth curve**

This option may be used in exceptional cases, if the PO can demonstrate that option 1a is not appropriate for their specific case. In such a case, if the PO has an expected growth curve determined based on the available data of palm seedlings (that relates to their 'business-as-usual' scenario), that curve may be used as the basis for the dynamic yield baseline instead of using the standard growth curve. All steps described in Option 1a shall be followed, replacing the standard growth curve with the PO's own curve. The PO shall therefore calculate the annual percentage change.
The plot-specific growth curve shall still be corrected for global yield development using the CAGR calculated FAOSTAT World+ yield data (Table IX.5).

**Option 2: Group certification approach**

In the case of group certification, or when a first gathering point or mill acts as the unit of certification, the dynamic yield baseline may be set using a similar "straight line" dynamic yield baseline approach as used for annual crops. This approach may be used if a group manager, first gathering point or mill is seeking to certify a group that is taking the same additionality measure, and when the plantation or area supplying the mill contains a mix of ages of trees meaning that the annual yield supplying the mill has remained relatively constant.

To determine the dynamic yield baseline, the group manager needs to record the total plantation area (ha) supplying the mill and the total yield (fresh fruit bunches) that corresponds to that area in each of the last 3 years. This is used to determine the yearly yield per hectare for each of the last 3 years (in tonnes/ha). These data points are then averaged and used as the starting point for the dynamic yield baseline. The starting point is combined with the global trendline slope for oil palm from FAOSTAT World+ data (Table 2) to determine the dynamic yield baseline.

Sugar cane shall be treated as an annual crop when setting the dynamic yield baseline.

3. Setting the dynamic yield baseline for sequential cropping

If multi-cropping practices such as sequential cropping are used, the economic operators have three options to calculate the additional biomass:

1. Demonstrate that the second crop does not lower the yield of the main crop.
2. If the second crop lowers the yield of the main crop:
    a. Determine a dynamic yield baseline for a system in which the main crop is the same each year;
    b. Determine a compensation factor for a system in which the main crop is different each year;

**Option 1. Demonstrate that the second crop does not lower the yield of the main crop**

If an PO can demonstrate that the introduction of the second crop does not lower the yield of the main crop, the whole yield of the second crop can be claimed as additional biomass.

This may be demonstrated, for example, by comparison of the observed yield of the main crop before (3-year historical average) and after introduction of the second crop.

**Option 2a. Determine a dynamic yield baseline for a system in which the main crop is the same each year**

The dynamic yield baseline shall be based on the 'business as usual' situation for the delineated plot of land. When the main crop is the same each year, the baseline shall be determined based on at least the 3-year average historical yield of the main crop on that plot, combined with the global trend line for the main crop, as is done for annual crops.

This approach may also be used when the crop rotation follows a clearly defined rotation pattern that can be observed from historical data, which enables the business-as-usual situation to be clearly determined. In this case, it may be necessary to use data older than 3 years to determine the average historical yield of the main crop.

After implementation of sequential cropping, the net additional biomass shall be calculated as the difference between the total annual yield from the delineated plot of land (that is to say, the yield of the main crop plus the yield of the second crop) and the main crop dynamic yield baseline.

If the main and second crops are different feedstocks that produce a different combination of crop components (for example, oil, protein meal, starch, fibre), when the main crop and second crop yields are added together, the calculation shall be based on appropriate units of measurement to allow for the calculation of a single representative figure for the net additional biomass produced. Respectively, the methodology shall allow for an effective compensation of the biomass loss of the main crop. For example, the calculation can be done on a simple weight (tonnes) basis or an energy content basis (e.g. if the full second crop is used for energy, such as for biogas). The choice of methodology shall be justified by the PO and validated by the auditor.

**Option 2b. Determine a compensation factor for a system in which the main crop is different each year**

When the main crop differs each year in the crop rotation and does not follow a regular pattern, the PO needs to assess any loss in yield of the main crop due to the second crop and to take it into account in the volume of additional biomass claimed.

The PO needs to compare the observed yield of the main crop after introduction of the second crop with the historical yield of the same (main) crop. That comparison may be done based on observed yields in neighbouring fields (e.g. if the same farm grows the same crops on rotation but in different fields), or on the basis of justified scientific literature that describes the impact of sequential cropping on those crops in that region.

The impact on yield of the main crop shall be translated into a compensation factor that shall be deducted from the volume of the second crop to calculate the additional biomass. As for Option 2a, the factor can be based on weight or energy content and shall allow for an effective compensation of the biomass loss of the main crop. The choice of methodology shall be justified by the PO and validated by the auditor.

4. Calculating additional biomass volume

After implementation of the additionality measure, the PO shall determine the volume of low ILUC risk biomass that can be claimed by comparing the actual crop yield achieved on the delineated plot with the dynamic yield baseline. The auditor must verify in the annual audit that the volume of additional biomass achieved is in line with the projections in the management plan, and seek justification if there are discrepancies of more than 20% compared to the estimates in the management plan.

If certification is sought for an additionality measure applied in the past, the additional biomass yield may be calculated and recorded in the management plan. While this allows the actual volume of low ILUC risk biomass to be precisely calculated, low ILUC risk biomass may only be claimed after low ILUC risk certification has been awarded. Retrospective claims cannot be made for biomass supplied in the past.

To calculate the additional biomass volume, the PO must record the full crop yield from the delineated plot for each year, from the start of the implementation of the additionality measure. The economic operator must prove the link between the specific delineated plot and the crop yield achieved (tonne/ha).

If the harvested volume is only measured (weighed) at a first gathering point where products from multiple farms or plots arrive, then the documentation from the first gathering point may be used as proof of the harvested volume (yield) for the farms and plots involved.

A record of the business transaction between the PO and the first gathering point may be used as evidence, as long as the link back to the specific delineated plot can be proven. In this case, the first gathering point is responsible for collecting and recording the crop yield data. It shall record yields of biomass collected per farm (and if necessary, for a specified delineated plot on a farm) based on a template to be issued by the voluntary scheme.

In the case of group auditing and if the first gathering point acts as the group lead, it shall be responsible for recording yield data for all delineated plots.

To calculate the additional biomass volume, the crop yield data obtained for a given year shall be compared to the dynamic yield baseline. The additional biomass yield is equal to the difference between the crop yield observed and the yield projected by the dynamic yield baseline for the same year, multiplied by the surface area A (ha) of the delineated plot in question. This additional volume can then be claimed as low ILUC risk biomass.

$$\text{Additional biomass} = (Y_x - DYB_x) \times A$$

Where:

$Y_x$ = Observed yield in year x (in tonne/ha/yr)

$DYB_x$ = Dynamic yield baseline in year x (in tonne/ha/yr)

A = Surface area of delineated plot (ha)

## **D. Minimum content of the low ILUC risk certificate**

Low ILUC-risk certificates must contain all the following information:

a) contact details of main certified entity (company name and address, details of the designated point of contact);
b) scope of certification (type of additionality measure and additionality test applied as well as type of economic operator (if they are small holders));
c) longitude and latitude coordinates (for farms and plantations certified as single entities);
d) list of sites under the scope of certification (name and address);
e) total volume of biomass certified as low ILUC risk;
f) contact details of the certification body (name and address) and logo;
g) (unique) certificate number or code;
h) place and date of issuance;

i) certificate valid from/to dates (and date certified, if applicable);

j) stamp and/or signature of issuing party.

# Annex IX: Guidance on the use of Soil Organic Carbon Models

RSB specifies the models which may be used by POs for soil organic carbon (SOC) modelling under $e_{sca}$. Only those models listed in this Annex may be used. Further models may be added following validation and approval by the RSB Secretariat.

## Model 1a and 1b: The CENTURY and DayCent Models

### The CENTURY Model

CENTURY is a process-based model that simulates carbon and nutrient dynamics in the plant/soil/atmosphere interface, and is comprised of modules for organic matter decomposition, water budget, and grassland/crop/forest production (Parton et al., 1987). The CENTURY model has been used to assess the impact of changes in land use and agricultural management practices on soil carbon, nitrogen, phosphorus and sulphur dynamics at multiple scales. CENTURY was initially developed to model organic matter in North American prairies, but has been used in simulation studies of forests, pastures, annual and perennial crops - including bioenergy crops - in several regions of the world (Galdos et al., 2009).

### The DayCent Model

DayCent, or Daily Century, is the daily time step version of the CENTURY model (Del Grosso et al., 2005, Parton et al., 1998). The main difference between DayCent and CENTURY is that DayCent explicitly represents nitrification and denitrification, processes that lead to $N_2O$, $NO_x$, and $N_2$ emissions, whilst CENTURY assumes that a constant proportion of available N in a time step is lost as N gas, without distinguishing between different N gas species.

### How it works

The CENTURY model includes three soil organic matter pools (active, slow, and passive) with different potential decomposition rates, above and belowground litter pools and a surface microbial pool which is associated with decomposing surface litter (Metherell et al., 1993). Above and belowground plant residues are divided into structural and metabolic pools as a function of the lignin/ N ratio in the residue. Figure IX.1a illustrates the flows of carbon between the plant, crop residue, and soil compartments. The organic matter submodel in CENTURY divides the soil organic matter in the 0- to 20-cm depth into three pools: active, slow, and passive. The active fraction includes the soil microbes and microbial products, and has a turnover time of months to a few years. The slow pool includes resistant plant material derived from the structural pool and soil-stabilized microbial products derived from the active and surface microbe pools, with a turnover time of decades. The passive pool includes organic matter physically and chemically stabilized, with a turnover time of centuries.

The soil organic matter and plant growth submodels are similar between CENTURY and DayCent, but the different time steps – monthly for CENTURY and daily for DayCent – dictate that the equations representing the controls are different (Figure IX.1b). The soil water and temperature submodels are more finely resolved both spatially and temporally in DayCent. Model outputs in DayCent include daily N-gas flux ($N_2O$, $NO_x$, $N_2$), $CO_2$ flux from heterotrophic soil respiration, soil organic C and N, NPP, H2O and $NO_3$ leaching, and other ecosystem parameters.

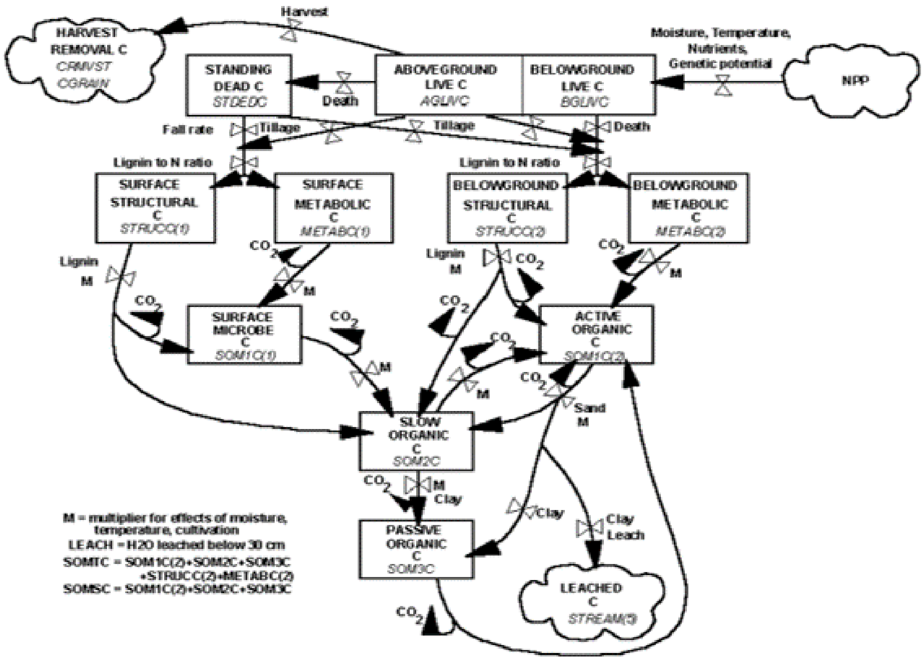


**Figure IX.1a.** The pools and flows of carbon in the CENTURY model.

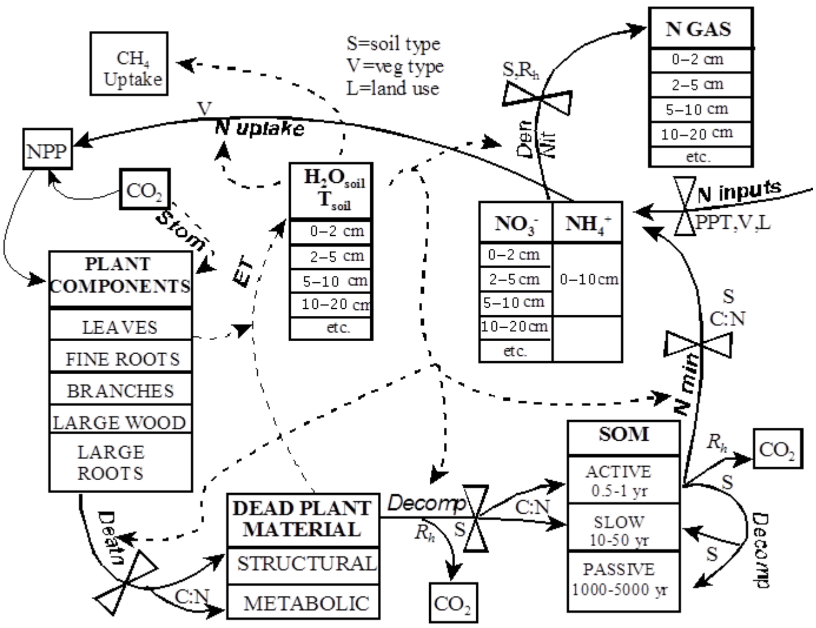


**Figure IX.1b.** The pools and flows of carbon and nitrogen in the DayCent model.

## How to use it

The models and relevant supporting documents can be downloaded by contacting the CENTURY/DayCent developers at the Natural Resource Ecology Laboratory (NREL) of Colorado State University (CSU) using the following email address: SCSC_Consortium@colostate.edu. Further information on the CENTURY model can be found at https://www.nrel.colostate.edu/projects/century/, and information about DayCent can be found at https://www.nrel.colostate.edu/projects/daycent.

As CENTURY and DayCent simulate plant growth and development besides soil organic matter dynamics, they require detailed information on crop physiology and phenology, ideally at the cultivar level. Additional data required for parameterization, calibration and evaluation include soil chemical and physical properties, historical and current land management, and long-term weather data at the daily time-step. Climate, soil and land use minimum data requirements are described in Table IX.1. A full list of crop parameters can be found in the CENTURY model and DayCent model technical manuals.

**Table IX.1.** CENTURY/DayCent model minimum data requirements.

| Climate Data | | Soil Data | Land Use Management Data |
|---|---|---|---|
| CENTURY | DayCent | | |
| Monthly rainfall (cm) | Daily rainfall (cm) | Total initial 0-20cm SOC stocks (t C $ha^{-1}$) | Historical land use |
| Averages for each calendar month of daily maximum air temperature (ºC) | Daily maximum air temperature (ºC) | Soil clay, silt and sand content (%) | Crop yields (t $ha^{-1}$) |
| Averages for each calendar month of daily minimum air temperature (ºC) | Daily minimum air temperature (ºC) | Bulk density (g $dm^{3}$) | Above- and belowground biomass for each crop (t $ha^{-1}$) |
| | | Soil drainage class | Timing of agricultural operations |
| | | Soil hydrological parameters | Details about tillage, weeding, sowing, harvesting and irrigation systems. |
| | | | Type, amount and nutrient content of fertilizers and organic amendments. |

## References


Galdos, M.V., Cerri, C.C., Cerri, C.E.P., Paustian, K., Van Antwerpen, R. (2009). "Simulation of Soil Carbon Dynamics under Sugarcane with the CENTURY Model." Soil Science Society of America Journal 73(3): 802-811.

Del Grosso, S. J., Mosier, A. R., Parton, W. J., & Ojima, D. S. (2005). DAYCENT model analysis of past and contemporary soil N2O and net greenhouse gas flux for major crops in the USA. Soil & Tillage Research, 83, 9–24.

Metherell, A.K., Harding, L.A., Cole, C.V., Parton, W.J. (1993). CENTURY: Soil organic matter model environment. Technical documentation agroecosystem version 4.0. GPSR Tech. Rep. 4. USDA-ARS, Fort Collins, CO.

Parton, W.J., Schimel, D.S., Cole, C.V., Ojima, D.S (1987). Analysis of factors controlling soil organic levels of grasslands in the Great Plains. Soil Science Society of America Journal. 51:1173-1179.

Parton, W. J., Hartman, M. D., Ojima, D. S., & Schimel, D. S. (1998). DAYCENT and its land surface sub-model: Description and testing. Global Plant Change, 19, 35–48.

## Model 2: The Rothamsted Carbon Model

The Rothamsted Carbon Model (RothC) is one of the most widely used soil organic matter models in the world, having been successfully used to investigate soil carbon changes due to land use, management and climate from plot and field scale through to national and global simulations (Coleman and Jenkinson, 1996). The model uses monthly climate and land management variables to estimate the effects of soil type, temperature, moisture content and plant cover on soil carbon turnover in non-waterlogged topsoil (0-30cm depth) over years to centuries timescales. The model was originally parameterized with data from arable systems from the Rothamsted Long Term Field experiments at Rothamsted Research, and was later extended to model carbon turnover in grassland and woodland and to operate in different soils and under different climates. The model has been used by thousands of users from 125 countries, and has been recommended by the Food and Agriculture Organization (FAO) of the United Nations as it requires less and more easily obtainable data inputs than other process-based models; it has been applied using data from long-term experiments across several ecosystems, climate conditions, soils and land use classes; and it has been used to estimate carbon dioxide emissions and removals in different national GHG inventories as a Tier 3 approach.

### How it works

RothC represents soil organic carbon turnover through five pools of carbon: decomposable plant material (DPM), resistant plant material (RPM), microbial biomass (BIO), humified organic matter (HUM), and an inert pool (IOM) which is not involved in the decomposition cycle (Figure 1). Each pool has a rate constant which determines how much carbon is incorporated into the BIO or HUM pool, or exits the model as carbon dioxide. Organic inputs (on a monthly timestep) enter the model as a ratio of DPM and RPM (and a small amount of HUM in the case of farmyard manure). Temperature, rainfall, evaporation, and whether the soil is "covered" (has plants or is bare) inform rate modifying factors which apply to each pool (except IOM) and clay concentration contributes to the moisture rate modifying factor and the allocation to carbon dioxide.

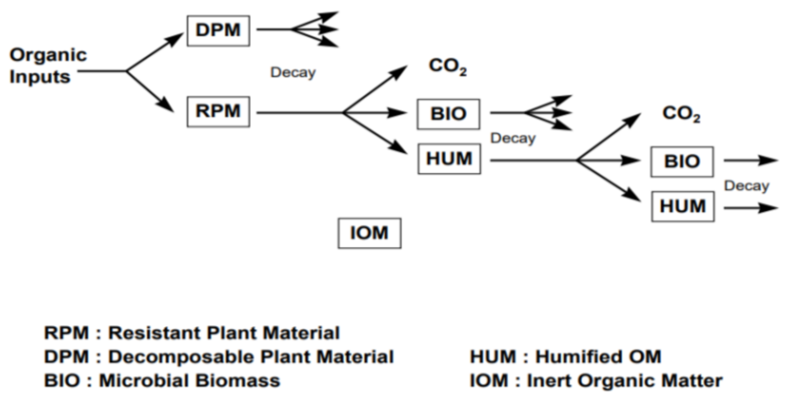


**Figure IX.2.** Structure of the RothC model

Soil carbon sequestration in RothC is based solely on soil processes, and is not linked to a plant production model. Therefore, the user is required to define carbon inputs to the soil. The model is designed to run in two modes: 'forward' in which known inputs are used to calculate changes in soil organic matter and 'inverse' when inputs are calculated from known changes in soil organic matter. RothC is a point-scale model and can be extrapolated to large spatial extents using remote sensing and GIS approaches (Falloon et al., 1998).

### How to use it

The model can be downloaded at:
[https://www.rothamsted.ac.uk/rothamsted-carbon-model-rothc](https://www.rothamsted.ac.uk/rothamsted-carbon-model-rothc)
Data required are soil texture (clay concentration), initial soil carbon content (to inform the inert organic matter pool), mean monthly air temperature, accumulated monthly rainfall, accumulated monthly evaporation, and biomass data to estimate C inputs. Model minimum data requirements are described in Table IX.2.

**Table IX.2.** Roth-C model minimum data requirements.

| Climate Data | Soil Data | Land Use Management Data |
|---|---|---|
| Monthly rainfall(mm) | Total initial 0-30cm SOC stocks (t C $ha^{-1}$) | Monthly Soil cover (binary: bare vs. vegetated) |
| Average monthly mean air temperature (ºC) | Initial C stocks of the different pools (t C ha-1): DPM, RPM, BIO, HUM, IOM | Irrigation (to be added to rainfall amounts) |
| Monthly open pan evaporation (mm)/evapotranspiration (mm) | Clay content (%) at simulation depth. | Monthly Carbon inputs from plant residue (aboveground + roots + rhizodeposition), (t C $ha^{-1}$) |
| | | Monthly Carbon inputs from organic fertilizers and grazing animals' excretion (t C $ha^{-1}$) |
| | | DPM/RPM ratio, an estimate of the decomposability of the incoming plant material |

## References


Coleman, K., Jenkinson, D.S., 1996. RothC-26.3 - A model for the turnover of carbon in soil. In: Powlson, D.S., Smith, P., Smith, J.U. (Eds.), Evaluation of Soil Organic Matter Models Using Existing Long-Term Datasets. Springer-Verlag, Heidelberg, pp. 237-246.

Falloon, P. D., Smith, P., Smith, J. U., Szabo, J., Coleman, K. and Marshall, S., 1998. Regional estimates of carbon sequestration potential: linking the Rothamsted Carbon Model to GIS databases. *Biology And Fertility Of Soils*. 27 (3), pp. 236-241. https://doi.org/10.1007/s003740050426

## Model 3: **The IPCC Tier 2 Method**

The Intergovernmental Panel on Climate Change (IPCC) provides a framework for estimating the effect of changes in land use and agricultural management on soil organic carbon (SOC) stocks. Their approach makes it possible to estimate change in SOC storage by assigning a reference soil carbon stock in native vegetation, which varies depending on climate, soil type and other factors, and then multiplying that value by factors representing the quantitative effect of changing land use, management practices and cropping intensity on SOC storage. In order to develop such factors, the IPCC analysed data from a large number of studies that isolated the management effect, discriminating study sites by climate regions and deriving coefficients for estimating changes in SOC stocks over a finite period following changes in management that impact SOC storage. The IPCC stock change factors were designed to be applied in the context of national greenhouse gas inventories but have been adapted to assess potential SOC changes at multiple scales. The framework has been used in a range of Greenhouse Gas balance calculators. Stock change factors were developed under the assumption that after land use or management change, a new steady state or equilibrium carbon stock would be reached after 20 years. The standard soil depth for this method is 30cm.

IPCC soil carbon stock change factors are derived following different levels of complexity, or Tiers. Tier 1 methods are designed to be the simplest to use, and are mostly global in scale, using default factors for broad climate and land use categories. Tier 2 stock change factors are developed using country- or region-specific data, for the most important land-use categories and climatic regions. Tier 2 factors are based on more refined empirical estimation methodologies. Tier 3 factors use dynamic bio-geophysical simulation models using multi-year time series and inventory measurement systems repeated over time. Generally, Tiers 2 and 3 are considered more accurate and have less uncertainty than Tier 1.

### Guidelines for IPCC stock change factors

The IPCC soil carbon stock change approach is described in detail in a comprehensive set of methodologies - the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). The methods have been revised and updated in the 2019 Refinement to the 2006 IPCC Guidelines for National greenhouse Gas Inventories (IPCC, 2019). The 2019 Refinement has updated soil carbon stock change Tier 1 factors for tillage management, grassland management and land use. Reference soil carbon stocks have also been updated based on an analysis of a global dataset. The Tier 2 and Tier 3 methods have also been refined to estimate the impact of biochar amendments on soil carbon stocks in mineral soils for cropland and grassland. The document also provides an alternative Tier 2 approach, the steady-state method.

### SOC stock calculation

SOC stocks are calculated in the IPCC stock change factor method using the following formula:

$$SOC = SOC_{REF} * F_{LU} * F_{MG} * F_{I}$$

Where:

$SOC_{REF}$ = the reference carbon stock, tonnes C $ha^{-1}$

$F_{LU}$ = stock change factor for land use or land-use change type, dimensionless

$F_{MG}$ = stock change factor for management regime, dimensionless

$F_{I}$ = stock change factor for input of organic matter, dimensionless

For example, consider an area that has been converted from native conditions and managed for annual crops under full tillage and nominal carbon input levels for over 50 years. The area is in a cool temperate moist climate, under high activity clay, and was converted from full tillage to no-till, with high level of intensification but without manure application input. Soil carbon stocks to 30cm depth after 20 years of the change in management would be calculated as follows, based on Tier 1 factors provided for reference carbon stocks and stock change factors in IPCC (2019):

SOC = 81 * 0.70 * 1.09 * 1.11

SOC = 68.6 tonnes C $ha^{-1}$

**Tier 2 Steady State Method**

The Tier 2 steady-state method addresses more complexity in soil carbon dynamics than Tier 1 or Tier 2 using default equations, by subdividing soil organic carbon into three separate sub-pools with fast (Active sub-pool), intermediate (Slow sub-pool), and long turnover times (Passive sub-pool). The turnover time of carbon within each sub-pool determines the length of time that carbon remains in the soil. The approach is based on a steady state solution to the three soil organic C sub-pools in the Century ecosystem model (Ogle et al. 2012; Parton et al. 1987; Paustian et al. 1997). The Tier 2 steady-state method incorporates spatial and temporal variation in climate, organic carbon inputs to soils, soil properties and management practices.

**References**

IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

IPCC (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize, S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds). Published: IPCC, Switzerland.

Ogle, S. M., Swan, A. & Paustian, K. (2012) No-till management impacts on crop productivity, carbon input and soil carbon sequestration. Agriculture, Ecosystems and Environment 149: 37-49.

Parton, W. J., Schimel, D. S., Cole, C. V. & Ojima, D. S. (1987) Analysis of factors controlling soil organic matter levels in Great Plains grasslands. Soil Science Society of America Journal 51(5): 1173-1179.

Paustian, K, Andren, O., Janzen, H.H., Lal, R., Smith, P., Tian, G., Tiessen, H., van, Noordwijk, M. and Woomer, P.L. (1997). Agricultural soils as a sink to mitigate $CO_2$ emissions. Soil Use

# Annex X: History of Changes

| Date | New Version | Section | Change | Reason for change |
|---|---|---|---|---|
| 01/2012 | 2.1 | Annex 3, point 6, P.33 | The emission factors are taken from the ecoinvent database (without infrastructure). The operator chooses the specific emission factor for the fertilisers resp. pesticides used in the facility. | Clarification: The eliminated sentence adds confusion. The emission factors (e.g., for fertilisers, etc.) are taken from the ecoinvent database. The operator does not have to select the emission factor, as it is in the ecoinvent database. The operator merely must indicate the actual values (e.g., of fertiliser use, etc.), as stated earlier in the same section. |
| | | Annex 3, point 6, P.34 | Added emissions associated with seed production (minor emission source) to the feedstock production eec emissions. | |
| | | Annex 4 | Ammonia Emissions calculation | The new ammonia calculation for organic fertilisers was simplified by introducing a new methodology which relies on standard parameters for the proportion of ammonia volatilizing. |
| | | Annex 4 | Nitrate emissions calculation. | The nitrate calculation was corrected in the matter of a term having only a small importance on the overall calculation. It concerns the organic carbon content, which was changed into nitrogen carbon content so as to fit better to the original equation. |
| 12/2014 | 2.3 | Entire document | coverage of bioliquids by RSB Standards is made more explicit throughout the document. | Consistency with scope of RED and FQD. |
| | | Entire document | Use of "certified material" instead of "compliant product" | Consistent with updated terminology in revised EU RED Standard (Version 3.0) on traceability of RSB EU RED and EU RED certified material. |
| | | Entire document | RSB certified operators are now allowed to acquire and process material certified by another EU-recognised certification scheme and attach an "EU RED" compliance claim to any product derived from this material (but not an "RSB EU RED" compliance claim). This is reflected throughout the document by the use of the term "EU RED certified material" | Consistent with revised EU RED Standard (Version 3.0) on traceability of RSB EU RED and EU RED certified material and revised RSB EU RED Procedure (Version 3.0) on Communication and Claims (RSB-PRO-11-001-50-001) |
| | | Entire document | Language improvement | Clarification, simplification, consistence |
| | | G.1.11 | Update of the section on claim. "EU RED Compliance" claim is expanded to certified materials certified by another voluntary scheme recognised by the European Commission under certain conditions. | Consistent with revised RSB EU RED Procedure (Version 3.0) on Communication and Claims (RSB-PRO-11-001-50-001) |
| | | G.2.1.4 | Additional definition and criteria for highly biodiverse grassland. Removal of the guidance mentioning that certification of biomass from grassland was not possible. | Alignment with EU Commission Regulation (EU) No 1307/2014 |
| | | G.3.8 | Update of the section on chain-of-custody allow the possibility for an RSB-certified operator to acquire and process EU RED certified material (i.e. certified by another EU-recognised scheme) | Consistent with revised EU RED Standard (Version 3.0) on traceability of RSB EU RED and EU RED certified material. |

| Date | New Version | Section | Change | Reason for change |
|---|---|---|---|---|
| | | G.4.3 | Reference to the GHG Calculator | The GHG calculator is based on the methodology described in annex of this document and should be part of the recognised EU package. |
| 02/2015 | 2.4 | Annex I & II | A note was added, stating that updates in default/aggregate default values by the EC will be applicable in the RSB certification process with immediate effects. | Required by the EC (23 Feb 2015) |
| | | 2.1.4 | Cross Reference in Guidance paragraph was updated (2.1.4 instead of 2.1.3).<br>A note to auditors was added to require an independent expert to evaluate the status of grasslands. | Required by the EC (23 Feb 2015) |
| | | 2.3 | The definition of “continuously forested area” was added, as per Commission Communication 2010/C/160/02. | Required by the EC (23 Feb 2015) |
| 03/2015 | 2.5 | 2.1.4.6 | Additional details to the note to auditors regarding the evaluation Highly Biodiverse Grasslands | Required by the EC (25 March 2015) |
| 04/2015 | 2.6 | C. | Clarification that version 2.6 prevails over other versions. | Required by the EC (22 April 2015) |
| | 2.6 | 2.1.4.6 | Modifications of the note to auditors regarding the evaluation Highly Biodiverse Grasslands | Required by the EC (22 April 2015) |
| 12/2015 | 3.0 | 3 | GHG emission saving thresholds and timelines were updated | Revision of EU RED |
| 12/2015 | 3.0 | 3 | Clarification that separate tracking of different GHG intensities is allowed | Clarification for improved practicality |
| 12/2015 | 3.0 | 4.2 | Details for the use of default values were added | Revised EC assessment protocol |
| 12/2015 | 3.0 | 4.3/4.4 | Details for the use of actual values were added | Revised EC assessment protocol |
| 12/2015 | 3.0 | 4.4 | Clarification that operators are entitled to carry out an individual GHG calculation | improved practicality |
| 12/2015 | 3.0 | 4.4 | Details for transmitting information about GHG emissions were added | Revised EC assessment protocol |
| 12/2015 | 3.0 | Annex III | Clarification that cropland and perennial cropland are regarded as one land uses was added | Revision of EU RED |
| 12/2015 | 3.0 | Annex III | Requirements for emission savings esca, eccr and eccs were added | Revised EC assessment protocol |

| Date | New Version | Section | Change | Reason for change |
|---|---|---|---|---|
| 01/2017 | 3.1 | D | This standard prevails in the event of any inconsistency | RSB Principles & Criteria (Global Version) are now applicable for RSB EU RED |
| 02/2018 | 3.2 | 1.10 | Acceptance of other standards for waste and residual materials based on a benchmark | Consistency with other standards |
| 08/2020 | 4.0 | Multiple | Multiple revisions | Full revision in-line with EU RED II |
| 12/2023 | 5.0 | 1 | Concept of Critical non-conformity introduced | Revisions in-line with Implementing Regulation (EU) 2022/996 |
| | | 3 | Requirements for certification of low iLUC risk biomass specified and detailed in Annex VIII | Revisions in-line with Implementing Regulation (EU) 2022/996 |
| | | 8 | Requirements for conducting & verifying GHG savings – multiple updates on the use of average values, | Revisions in-line with Implementing Regulation (EU) 2022/996 |
| | | Annex I | 14.1 eSCA methodology has been elaborated and set out in detail in Annex VI<br><br>15.4 eCCS The operator shall demonstrate to the auditor that the storage facility is in good condition and without leakages | Revisions in-line with Implementing Regulation (EU) 2022/996 |
| | | Annex V | Emissions from cultivation (eEC) – new chapter with detailed specifications | Revisions in-line with Implementing Regulation (EU) 2022/996 |
| | | Annex VI | Emission savings from soil carbon accumulation (eSCA)– new chapter with detailed specifications | Revisions in-line with Implementing Regulation (EU) 2022/996 |
| 03/2024 | 5.1 | Annex VI | Addition of DayCent soil carbon model. | Expansion of available soil carbon models for eSCA system users |