RSB – ROUNDTABLE ON SUSTAINABLE BIOMATERIALS
RSB Standard for EU market access

Version 3.2
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Management of Change

Date	New Version	Section	Change	Reason for change
4 Jan 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 fertilizers resp. pesticides used in the facility.	Clarification: The eliminated sentence adds confusion. The emission factors (e.g., for fertilizers, 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 fertilizer 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 fertilizers 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 December 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 recognized 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.
		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 recognized EU package.
25 Feb 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). 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)
25 March 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)
28 April 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 3	Clarification that cropland and perennial cropland are regarded as one land uses was added	Revision of EU RED
12/2015	3.0	Annex 3	Requirements for emission savings esca, eccr and eccs were added	Revised EC assessment protocol
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

Introduction

From 2010 on, 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 2009/28/EC on the promotion of the use of energy from renewable sources (RED), to access the EU market and in the Fuel Quality Directive (2009/30/EC).

The EU Commission can recognize 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. The EU Commission may also recognize national schemes for compliance with the requirements set out in Directive 2009/28/EC. As required by Directive (EU) 2015/1513, RSB will not refuse mutual recognition with a recognized Member State`s scheme as regards the verification of compliance with the mandatory sustainability criteria set out in the RED.

The objective of RSB-STD-11-001 RSB Standard for EU market access, 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 the EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources (RED) and in the Fuel Quality Directive (2009/30/EC). This version 3.2 of the standard takes into account all changes in this regulatory context as laid down in European Union's Directive 2015/1513.

The standard specifies the requirements for operations producing, converting, processing, trading and using biomass/biofuels/bioliquids 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 biofuels and bioliquids.

All participating operators producing, converting, processing, trading biomass/biofuels/bioliquids 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.

Products compliant with this 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 2009/28/EC on the promotion of the use of energy from renewable sources (RED) and in the Fuel Quality Directive (2009/30/EC).

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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 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 EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources (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 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 for use in the European Union.

It specifies the requirements for operations producing, converting, processing, trading and using biofuels and bioliquids 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 3.2 of this *RSB Standard for EU market access* shall be effective on 15 February 2018.

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-DOC-10-001 RSB List of documents and references 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 EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources (RED), and in the RSB-STD-01-002 RSB Glossary of Terms 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 participating operator using this standard shall comprehensively, consistently and transparently comply with the EU Renewable Energy Directive (2009/28/EC) and the EU Fuel Quality Directive (98/70/EC).

1. 2. All participating operators producing, converting, processing, trading biomass/biofuels /bioliquids 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. 2. 1. Participating operators involved in primary production of biomass/biofuels/bioliquids for use in the European Union shall include in their certification scope only operations involved in primary production of biomass/biofuels/bioliquids 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 2 of this standard and with regard to the specific requirements for greenhouse gas (GHG) calculation detailed under section 4 of this standard.

1. 2. 2. Participating operators involved in converting, processing, trading and/or otherwise handling biomass/biofuels/bioliquids 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 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. 3. In cases where this RSB standard for EU market access (RSB-STD-11-001) and the RSB EU RED Principles & Criteria and/or other RSB EU RED 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. 4. 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.

Guidance to 1.4: The RSB Secretariat communicates on a regular basis to the participating operators' additions and/or alterations to the EU sustainability criteria for biofuels and bioliquids 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. 5. In case EU sustainability criteria for biofuels and bioliquids are not fully covered by RSB EU RED standards and procedures, participating operators shall implement the EU sustainability criteria for biofuels and bioliquids in addition to the RSB EU RED standards and procedures.

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

1. 7. Primary producers of biomass in an EU Member State shall provide evidence that the primary production (cultivation) complies with the EU requirements for good agricultural and environmental condition, and with the EU statutory management requirements, which together form the EU agricultural cross compliance rules (see Council Regulation (EC) 73/2009, Art. 6, and Annex II, No. 1-5, 9, and Commission Regulation (EC) 796/2004).

This requirement (1.7.) does not apply to biofuels and bioliquids produced from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues.

1. 8. The lead auditor appointed shall identify any non-compliance with the mandatory requirements of the EU-RED as a major non-compliance.

1. 9. All participating operators producing, converting, processing, trading Biomass/Biofuels/Bioliquids product in compliance with this standard and other RSB EU RED standards and procedures shall clearly identify such Biomass/Biofuels/Bioliquids product as being compliant with the RSB EU RED Standard, and use the relevant RSB EU RED compliance claim, as defined in the Consolidated RSB EU RED Procedure on communication and claims (RSB-PRO-11-001-50-001)

1. 10. Acceptance of material certified under other voluntary or national schemes

RSB certified operators may accept material certified against other voluntary or national schemes as "EU RED compliant" material if the voluntary or national scheme has been recognized 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 recognized by the RSB.

Note: Please find a list of recognized voluntary schemes published at www.rsb.org.

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"**

or equivalent

2. Specific land use requirements for primary production

2. 1. Primary producers of biomass shall ensure and provide evidence that land with high biodiversity value is not used for primary production of biomass for biofuels/bioliquids.

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. unless evidence is provided that the primary production of raw material (biomass) did and/or does not interfere with those nature protection purposes areas designated:

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

2. 1. 2. 2. for the protection of rare, threatened or endangered ecosystems or species, recognized 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;

2. 1. 3. Natural highly bio-diverse grassland or non-natural highly bio-diverse grassland.

2. 1. 4. For the purpose of paragraph 2.1.3, the following definitions and criteria shall apply:

2. 1. 4. 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 17(4)(b) of Directive 2009/28/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;

2. 1. 4. 2. ‘human intervention’ means managed grazing, mowing, cutting, harvesting or burning;

2. 1. 4. 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. 4. 4. ‘non-natural highly biodiverse grassland’ means grassland that:

2. 1. 4. 4. a. would cease to be grassland in the absence of human intervention; and

2. 1. 4. 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. 4. 4. c. is species-rich, that is to say it is:

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.

2. 1. 4. 5. Without prejudice to Paragraph 2.1.4.6., grasslands in the following geographic ranges of the European Union shall always be regarded as highly biodiverse grassland:

2. 1. 4. 5. 1. habitats as listed in Annex I to Council Directive 92/43/EEC[1]

2. 1. 4. 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. 4. 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].

Highly biodiverse grassland in the European Union is not limited to the geographic ranges referred to under 2.1.4.5.1, 2.1.4.5.2 and 2.1.4.5.3. Other grassland might fulfil the criteria for highly biodiverse grassland set out in 2.1.4.4.

2. 1. 4. 6. 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.

Guidance

Guidance to requirement 2.1.4: The definition of highly bio-diverse grassland contained in 2.1.4.1 and 2.1.4.2 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 2.1.3 and 2.1.4.See also RSB-STD-11-001-70 series of documents.

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

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

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. Primary producers of biomass shall ensure and provide evidence that no land with high carbon stock was converted for production of raw material (biomass) for biofuels/bioliquids.

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. continuously forested areas 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 primary production of raw material (biomass) did and/or does not alter carbon stock of the area to the extent where GHG emissions saving for the final biofuels/bioliquids product are less than those listed under point 3.2.1, 3.2.2., 3.2.3. or 3.2.4.;

2. 2. 4. peatland, unless evidence is provided that the soil was already drained fully in January 2008 or that no further drainage of the soils occurred after January 2008, **or** that the primary production of raw material (biomass) did and/or does not involve drainage of previously un-drained soil.

2. 3. For the purpose of paragraph 2.2.2, the term ‘continuously forested area’ is defined in the Renewable Energy Directive (2009/28/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. 4. Requirements 2.1 to 2.2 do not apply to biofuels and bioliquids produced from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues.

3. Specific requirements for chain of custody tracking

[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.

3. 1. The participating operator shall implement the Consolidated RSB EU RED Standard for Traceability of RSB EU RED and EU RED Certified Material (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".

3. 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.

3. 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.

3. 2. The participating operator shall only merge 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:

3. 2. 1. Until 31 December 2017: 35 % for biofuels/bioliquids produced in installations which started operation before 5 October 2015, and

3. 2. 2. From 1 January 2018: 50% for biofuels/bioliquids produced in installations which started operation before 5 October 2015, and

3. 2. 3. 60% for biofuels/bioliquids produced in installations which started operation after 5 October 2015.

Note: An installation shall be considered to be in operation if the physical production of biofuels or bioliquids has taken place.

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

3. 3. 1. either assign to the entire resulting batch the GHG emissions savings of the batch with the lowest GHG emissions savings, or

3. 3. 2. 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.]

3. 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 Consolidated RSB EU RED Standard for Traceability of RSB EU RED and EU RED Certified Material (RSB-STD-11-001-20-001), as well as the following

information:

3. 4. 1. the type of feedstock (raw material);

3. 4. 2. the country of origin of the feedstock;

3. 4. 3. whether:

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

3. 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[5] areas), or

3. 4. 3. 3. the biofuels/bioliquids were produced from waste or residues other than residues from agriculture, aquaculture or fisheries, or

3. 4. 3. 4. biofuels/bioliquids were produced from other raw materials or from raw materials for which no default values or disaggregated default values are available;

3. 4. 4. the types of processes used for production, processing or conversion of biomass to biofuels/bioliquids;

3. 4. 5. whether biofuel or bioliquid has been produced in an installation that was in operation on or before 5 October 2015.

3. 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.

3. 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 1.10 and 1.11 of this standard above to a batch of RSB EU RED certified material or EU RED certified material in the associated product documentation if:

3. 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; **and**

3. 6. 2. the batch of RSB certified material or EU RED certified material was

[5] **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**

identified with an RSB EU RED compliance claim or EU RED compliance claim as defined in points 1.10 and 1.11 of this standard above before calculation of the GHG emissions savings of the final biofuels/bioliquids product; **and**

3. 6. 3. the batch of RSB EU RED certified material or EU RED certified material is accompanied by the documented information specified in section 3.4 of this standard above; **and**

3. 6. 4. the GHG emissions savings of the final biofuels/bioliquids product are at least:

3. 6. 4. 1. Until 31 December 2017: 35 % for biofuels/bioliquids produced in installations which started operation before 5 October 2015, and

3. 6. 4. 2. From 1 January 2018: 50% for biofuels/bioliquids produced in installations which started operation before 5 October 2015, and

3. 6. 4. 3. 60% for biofuels/bioliquids produced in installations which started operation after 5 October 2015.

3. 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 3.4. of this standard above and the GHG emissions savings calculated by the final processor and forward the product characteristics in accordance with points 3.4. of this standard above and the GHG emissions savings to the customer when forwarding RSB EU RED certified material or EU RED certified material.

Guidance

Guidance to requirement 3.6.4.1.; 3.6.4.2.: The dates 31 December 2017 / 1 January 2018 refer to the dates when the compliance claims in accordance with point 1.10 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 1 January 2018 **will have to meet the GHG emission savings threshold of 50%** in order to qualify for the RSB claim "EU RED compliant Biofuel", **regardless of whether the biomass/biofuels/bioliquids were produced before that date**.

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

4. 1. General Requirements

4. 1. 1. The calculation of GHG emission savings of biofuels/bioliquids against fossil fuels shall follow the methodology detailed in the RED (see Annex 3).

4. 1. 2. GHG emission savings of biofuels/bioliquids against fossil fuels shall be determined based on default values or calculated based on disaggregated default values and/or actual values.

4. 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 against fossil fuels, if

4. 2. 1. the biofuel/bioliquid is listed in annex 1 of this standard, and

4. 2. 2. no net emissions from carbon stock change (e_l) due to land-use change were caused in primary production (see annex 3, points 7-10 of this standard), and

4. 2. 3. biofuels/bioliquids were produced from raw materials which complied with the product characteristic listed under point 3.4.3.1. or point 3.4.3.2. or point 3.4.3.3. of this standard, and

4. 2. 4. biofuels/bioliquids were produced using the specified characteristics of the conversion process indicated in the listing in annex 1.

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

4. 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.

4. 2. 5. Disaggregated default values in combination with actual values or actual values may be used for the calculation of GHG emission savings of biofuels/bioliquids against fossil fuels.

4. 3. Specific requirements for the use of actual values

4. 3. 1. Actual values shall be used for the calculation of GHG emission savings of biofuels/bioliquids against fossil fuels where disaggregated default values are not available, and may be used instead of disaggregated default values where available.

4. 3. 2. Actual values of emissions from cultivation shall be determined at the origin of the chain of custody, i.e. biomass production or biomass processing.

4. 3. 3. In case of emissions from cultivation within the European Union, average values for a NUTS 2-region may be used as an alternative to actual values if the values had been approved by the EU Commission and available on the EU Commission’s website in the unit gCO_{2eq}/dry-ton feedstock.

4. 3. 4. In the case of emissions from cultivation outside the European Union, average GHG values for a certain region may be calculated, provided that this takes place on a more fine-grained than a NUTS2 or equivalent level. The

calculation shall follow the provisions in 4.6

4\. 3. 5. If operators use an actual value for transport, all relevant transport steps shall be taken into account. In the case that no data is available for all transport steps of the supply chain, the use of actual values for transport is not allowed.

4\. 3. 6. If operators use actual values for processing, all relevant processing steps shall be taken into account. 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

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

4\. 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 ep and/or etd

4\. 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 Annex 3.

4\. 4. 3. Actual values shall be used for the calculation of GHG emission savings of biofuels/bioliquids against fossil fuels, if biofuels/bioliquids were produced from raw materials which complied with the product characteristic listed under point 3.4.3.4. of this standard.

4\. 4. 4. Actual values shall be calculated in accordance with the applicable provisions of annex 3 and annex 4 to this standard. This shall include documenting all details of determining actual values (e.g. methodology and measurements used, etc.).

4\. 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.

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

4\. 4. 7. Emission factors (Standard calculation values) shall be taken from the European Commission website[6] or from the ecoinvent database[7]. In the case alternative values are chosen this must be duly justified.

4\. 4. 8. Participating operators shall document the use of default values,

[6] https://ec.europa.eu/energy/sites/ener/files/documents/Standard%20values%20v.1.0.xlsx
[7] http://www.ecoinvent.org/database/database.html

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).

4\. 4. 9. GHG emission savings of biofuels/bioliquids 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 recognized by the EU Commission for this purpose or by carrying out an individual calculation.[8]

4. 5. Specific requirements for transmitting information about GHG emissions

4\. 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.

4\. 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.

4\. 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 ep/et default value” for disaggregated values) on the delivery note.

4. 6. Requirements for calculating aggregate values

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

4\. 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

[8] https://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes

NUTS2 or equivalent level.

4. 6. 2. Operators shall calculate aggregate values for cultivation following the methodology for e_{ec} as defined in Annex 3.

4. 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.

4. 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.

4. 6. 5. For fertilizer use, the typical type and quantity of fertilizer used for the crop in the region concerned shall be used.

4. 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 fertilizer input and vice versa.

Annex 1

Information provided in the RED (source: RED Annex V).

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.

Typical and default values for biofuels if produced with no net carbon emissions from land-use change (source: RED Annex V, part A)

Biofuel production pathway	Typical greenhouse gas emission saving	Default greenhouse gas emission saving
sugar beet ethanol	61%	52%
wheat ethanol (process fuel not specified)	32%	16%
wheat ethanol (lignite as process fuel in CHP plant)	32%	16%
wheat ethanol (natural gas as process fuel in conventional boiler)	45%	34 %
wheat ethanol (natural gas as process fuel in CHP plant)	53%	47%
wheat ethanol (straw as process fuel in CHP plant)	69%	69%
corn (maize) ethanol, Community produced (natural gas as process fuel in CHP plant)	56%	49%
sugar cane ethanol	71%	71%
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	45%	38%
sunflower biodiesel	58%	51%
soybean biodiesel	40%	31%
palm oil biodiesel (process not specified)	36%	19%
palm oil biodiesel (process with methane capture at oil mill)	62%	56%
waste vegetable or animal [*] oil biodiesel	88%	83%
hydrotreated vegetable oil from rape seed	51%	47%

hydrotreated vegetable oil from sunflower	65%	62%
hydrotreated vegetable oil from palm oil (process not specified)	40%	26%
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	68%	65%
pure vegetable oil from rape seed	58%	57%
biogas from municipal organic waste as compressed natural gas	80%	73%
biogas from wet manure as compressed natural gas	84%	81%
biogas from dry manure as compressed natural gas	86%	82%

* Not including animal oil produced from animal by-products classified as category 3 material in accordance with Regulation (EC). No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules on animal by-products not intended for human consumption (OJ L 273, 10.10.2002, p. 1).

Estimated typical and default values for future biofuels that were not on the market or were on the market only in negligible quantities in January 2008, if produced with no net carbon emissions from land-use change (source: RED Annex V, part B)

Biofuel production pathway	Typical greenhouse gas emission saving	Default greenhouse gas emission saving
wheat straw ethanol	87%	85%
waste wood ethanol	80%	74%
farmed wood ethanol	76%	70%
waste wood Fischer-Tropsch diesel	95%	95%
farmed wood Fischer-Tropsch diesel	93%	93%
waste wood dimethylether (DME)	95%	95%
farmed wood DME	92%	92%
waste wood methanol	94%	94%
farmed wood methanol	91%	91%
the part from renewable sources of methyl-tertio-butyl-ether (MTBE)	Equal to that of the methanol production pathway used	

Annex 2

1. **Disaggregated *default values*** (source: *RED* 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 3 point 1 of this standard

Biofuel and bioliquids production pathway	Typical greenhouse gas emissions (gCO_2eq/MJ)	Default greenhouse gas emissions (gCO_2eq/MJ)
sugar beet ethanol	12	12
wheat ethanol	23	23
corn (maize) ethanol, Community produced	20	20
sugar cane ethanol	14	14
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	29	29
sunflower biodiesel	18	18
soybean biodiesel	19	19
palm oil biodiesel	14	14
waste vegetable or animal oil biodiesel	0	0
hydrotreated vegetable oil from rape seed	30	30
hydrotreated vegetable oil from sunflower	18	18
hydrotreated vegetable oil from palm oil	15	15
pure vegetable oil from rape seed	30	30
biogas from municipal organic waste as compressed natural gas	0	0
biogas from wet manure as compressed natural gas	0	0
biogas from dry manure as compressed natural gas	0	0

Disaggregated default values for **processing** (including excess electricity):

$e_p - e_{ee}$ as defined in annex 3 point 1 of this standard

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO_2eq/MJ)	Default greenhouse gas emissions (gCO_2eq/MJ)
sugar beet ethanol	19	26
wheat ethanol (process fuel not specified)	32	45
wheat ethanol (lignite as process fuel in CHP plant)	32	45
wheat ethanol (natural gas as process fuel in conventional boiler)	21	30
wheat ethanol (natural gas as process fuel in CHP plant)	14	19
wheat ethanol (straw as process fuel in CHP plant)	1	1
corn (maize) ethanol, Community produced (natural gas as process fuel in CHP plant)	15	21
sugar cane ethanol	1	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	16	22
sunflower biodiesel	16	22
soybean biodiesel	18	26
palm oil biodiesel (process not specified)	35	49
palm oil biodiesel (process with methane capture at oil mill)	13	18
waste vegetable or animal oil biodiesel	9	13
hydrotreated vegetable oil from rape seed	10	13
hydrotreated vegetable oil from sunflower	10	13
hydrotreated vegetable oil from palm oil (process not specified)	30	42

hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	7	9
pure vegetable oil from rape seed	4	5
biogas from municipal organic waste as compressed natural gas	14	20
biogas from wet manure as compressed natural gas	8	11
biogas from dry manure as compressed natural gas	8	11

Disaggregated default values for **transport and distribution**:

e_{td} as defined in annex 3 point 1 of this standard

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO_2eq/MJ)	Default greenhouse gas emissions (gCO_2eq/MJ)
sugar beet ethanol	2	2
wheat ethanol	2	2
corn (maize) ethanol, Community produced	2	2
sugar cane ethanol	9	9
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	1	1
sunflower biodiesel	1	1
soybean biodiesel	13	13
palm oil biodiesel	5	5
waste vegetable or animal oil biodiesel	1	1
hydrotreated vegetable oil from rape seed	1	1
hydrotreated vegetable oil from sunflower	1	1
hydrotreated vegetable oil from palm oil	5	5
pure vegetable oil from rape seed	1	1

biogas from municipal organic waste as compressed natural gas	3	3
biogas from wet manure as compressed natural gas	5	5
biogas from dry manure as compressed natural gas	4	4

Total

for cultivation, processing, transport and distribution

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO_2eq/MJ)	Default greenhouse gas emissions (gCO_2eq/MJ)
sugar beet ethanol	33	40
wheat ethanol (process fuel not specified)	57	70
wheat ethanol (lignite as process fuel in CHP plant)	57	70
wheat ethanol (natural gas as process fuel in conventional boiler)	46	55
wheat ethanol (natural gas as process fuel in CHP plant)	39	44
wheat ethanol (straw as process fuel in CHP plant)	26	26
corn (maize) ethanol, Community produced (natural gas as process fuel in CHP plant)	37	43
sugar cane ethanol	24	24
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	46	52
sunflower biodiesel	35	41
soybean biodiesel	50	58
palm oil biodiesel (process not specified)	54	68
palm oil biodiesel (process with methane capture at oil mill)	32	37

waste vegetable or animal oil biodiesel	10	14
hydrotreated vegetable oil from rape seed	41	44
hydrotreated vegetable oil from sunflower	29	32
hydrotreated vegetable oil from palm oil (process not specified)	50	62
hydrotreated vegetable oil from palm oil (process with meth-ane capture at oil mill)	27	29
pure vegetable oil from rape seed	35	36
biogas from municipal organic waste as compressed natural gas	17	23
biogas from wet manure as compressed natural gas	13	16
biogas from dry manure as compressed natural gas	12	15

2. **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 January 2008 (source: *RED* Annex V, part E)

Disaggregated default values for **cultivation**:

e_{ec} as defined in annex 3 point 1 of this standard

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO_2eq/MJ)	Default greenhouse gas emissions (gCO_2eq/MJ)
wheat straw ethanol	3	3
waste wood ethanol	1	1
farmed wood ethanol	6	6
waste wood Fischer-Tropsch diesel	1	1
farmed wood Fischer-Tropsch diesel	4	4
waste wood DME	1	1
farmed wood DME	5	5

waste wood methanol	1	1
farmed wood methanol	5	5
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Disaggregated default values for **processing** (including excess electricity):
$e_p - e_{ee}$ as defined in annex 3 point 1 of this standard

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO_2eq/MJ)	Default greenhouse gas emissions (gCO_2eq/MJ)
wheat straw ethanol	5	7
wood ethanol	12	17
wood Fischer-Tropsch diesel	0	0
wood DME	0	0
wood methanol	0	0
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Disaggregated default values for **transport** and **distribution**:
e_{td} as defined in annex 3 point 1 of this standard

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO_2eq/MJ)	Default greenhouse gas emissions (gCO_2eq/MJ)
wheat straw ethanol	2	2
waste wood ethanol	4	4
farmed wood ethanol	2	2
waste wood Fischer-Tropsch diesel	3	3
farmed wood Fischer-Tropsch diesel	2	2
waste wood DME	4	4
farmed wood DME	2	2
waste wood methanol	4	4
farmed wood methanol	2	2
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Total for cultivation, processing, transport and distribution

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO_2eq/MJ)	Default greenhouse gas emissions (gCO_2eq/MJ)
wheat straw ethanol	11	13
waste wood ethanol	17	22
farmed wood ethanol	20	25
waste wood Fischer-Tropsch diesel	4	4
farmed wood Fischer-Tropsch diesel	6	6
waste wood DME	5	5
farmed wood DME	7	7
waste wood methanol	5	5
farmed wood methanol	7	7
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Annex 3

Methodology for GHG calculation (source: RED Annex V part C)

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

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

   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
e_{ee}	=	emission saving from excess electricity from cogeneration

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

2. Greenhouse gas emissions from fuels, E, shall be expressed in terms of grams of CO_2 equivalent per MJ of fuel, gCO_{2eq}/MJ.

   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 an/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 of the products and co-products (*allocation factor*, see also point 18).

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

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

Where:

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

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

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

The following formula applies to emissions from cultivation:

$$e_{ec} biofuel_a \left[\frac{gCO_2eq}{MJ\ biofuel}\right] = \frac{e_{ec} feedstock_a \left[\frac{gCO_2eq}{kg_{dry}}\right]}{LHV_a \left[\frac{MJ\ feedstock}{kg\ dry\ feedstock}\right]} * feedstock\ factor_a * Allocation\ factor\ biofuel_a$$

Where:

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

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

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

Feedstock factors and allocation factors shall be based on plant data and the Lower Heating Values (LHV) for dry-ton feedstock shall be applied.

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

   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.

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 : 296

   CH_4 : 23

6. Emissions from the extraction or cultivation of raw materials, e_{ec}, shall include emissions from the extraction or cultivation process itself; from the collection of raw materials; from waste and leakages; and from the production of chemicals or products used in extraction or cultivation. Capture of CO_2 in the cultivation of raw materials shall be excluded. Certified reductions of greenhouse gas emissions from flaring at oil production sites anywhere in the world shall be deducted. Estimates of emissions from cultivation may be derived from the use of averages calculated for smaller geographical areas than those used in the calculation of the default values, as an alternative to using actual values.

   Operators may use either measured or aggregate values (please see 4.3.3. and 4.3.4) .

   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, fertilizer input, N2O 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:

$$\frac{emiss°_{fertilizer}\left[\frac{kgCO_2eq}{ha*yr}\right]+emiss°_{pesticides}\left[\frac{kgCO_2eq}{ha*yr}\right]+emiss°_{mechanical-work}\left[\frac{kgCO_2eq}{ha*yr}\right]+emiss°_{electricity}\left[\frac{kgCO_2eq}{ha*yr}\right]+emiss°_{N_2O}\left[\frac{kgCO_2eq}{ha*yr}\right]+emiss°_{production\_seed}\left[\frac{kgCO_2eq}{ha*yr}\right]}{productyield_{main\_product(crop)}\left[\frac{kg_{productyield}}{ha*yr}\right]}$$

in [kg CO_2eq / kg of product]

As a rule product yield shall be determined as:

1. the actual product realized 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 realized 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 fertilizers, pesticides and mechanical work is performed by multiplying the actual amount (provided by the operator) with the emission factor:

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

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

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

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

Emission $_{N2O}$: The N_2O emissions from soils are taken into account according to the IPCC methodology, including what are described there as both "direct" and "indirect" N_2O emissions, using following formula. All three IPCC tiers could be used by economic operators. Tier 3 relies on detailed measurement and/or modeling.

$$N_2O = 44/28 * (EF_1 * (N_{tot} + N_{cr}) + EF_4 * 14/17 * NH_3 + EF_5 * 14/62 * NO_{3-})$$

Where:

N_2O = emissions of N_2O [kg N_2O/ha]

EF_1 = 0.01 (IPCC 2006, S. 11.11)

N_{tot} = total nitrogen input [kg N/ha]

N_{cr} = nitrogen contained in the crop residues [kg N/ha]

EF_4 = 0.01 (IPCC 2006, S. 11.24)

NH_3 = losses of nitrogen in the form of ammonia [kg NH_3/ha]; calculated according to Annex 4, chapter 1.

EF_5 = 0.0075 (IPCC 2006, S. 11.24)

NO_{3-} = losses of nitrogen in the form of nitrate [kg NO_{3-}/ha]; calculated according to Annex 4, chapter 2.

[IPCC (2006). 2006 IPCC guidelines for national greenhouse gas inventories. Volume 4: Agriculture, forestry and other land use. L. B. Simon Eggleston, Kyoko Miwa, Todd Ngara and Kiyoto Tanabe. Kanagawa.]

N_2O emissions are transformed in kg CO_2-eq according to point 5.

The emissions from seed production are included in e_{ec}.

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

[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.]

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 energy); “Cropland”[9] and “perennial cropland”[10] shall be regarded as one

[9] Cropland as defined by IPCC.

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 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_2eq/kg product (crop).* When applying the bonus the the participating operator has to 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.

This bonus will not be recognized by the Commission until further guidance is provided by the Commission on the definition of degraded lands. **The bonus shall therefore not be included in the calculation until such guidance is provided by the Commission on the definition of degraded lands.**

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, fertilizer 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) plus a seventh category of perennial crops, i.e. multi annual crops whose stem is usually not annually harvested such as short rotation coppice and oil palm. 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.

[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.]

[10] 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.

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 falls into one of the following categories:

      i severely degraded land, including such land that was formerly in agricultural use;

      i heavily contaminated land.

   The bonus of 29 gCO_{2eq}/MJ shall apply for a period of up to 10 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 i. are ensured and that soil contamination for land falling under ii. is reduced.

   Note: This bonus will not be recognized by the Commission until further guidance is provided by the Commission on the definition of degraded lands. **The bonus shall therefore not be included in the calculation until such guidance is provided by the Commission on the definition of degraded lands**

9. The categories referred to in point 8.b are defined as follows:

   a "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;

   b "heavily contaminated land" means land that is unfit for the cultivation of food and feed due to soil contamination.

   Such land shall include land that has been the subject of a Commission decision in accordance with the fourth subparagraph of RED Article 18(4).

10. The Commission guidelines shall serve as the basis for the calculation of land carbon stocks for the purposes of *EU RED* (see Annex 4).

    The Commission guidelines are detailed in the *Commission Decision of 10 June 2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V of the Directive 2009/28/EC. 25 pages*, which is included in this standard in Annex 4 to this standard.

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. 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.

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:

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

in [kg CO_2eq / kg of product]

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

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

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

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

The emission factor of the effluent is taken from point 5 for CO2, CH4 and N2O. 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, semi-finished and finished materials (e_{tr}), from the storage of finished materials (e_{st}) as well as emissions from filling stations (e_{fl}). Transport may be divided into several locally separate transport steps. e_{td} subsumes all of the transport steps.

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

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:

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

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

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

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

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 eletricity 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. 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. 2. Emission savings from such improvements can be taken into account if evidence is provided that the soil has carbon 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.

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 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. 3. The emission savings in terms of g CO_{2eq}/MJ can be calculated by using a formula as indicated in point 7 of Directive 2009/28/EC Annex V, replacing the divisor "20" by the period (in years) of cultivation of the crops concerned.

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 ep, shall be limited to emissions avoided through the capture and sequestration 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 stored permanently. A temporary storage (e.g. construction material) is not eligible for e_{ccs}.

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. Emission saving from excess electricity from cogeneration, e_{ee}, shall be taken into account in relation to the excess electricity produced by fuel production systems that use cogeneration except where the fuel used for the cogeneration is a co-product other than an agricultural crop residue. In accounting for that excess electricity, the size of the cogeneration unit shall be assumed to be the minimum necessary for the cogeneration unit to supply the heat that is needed to produce the fuel. The greenhouse gas emission saving associated with that excess electricity shall be taken to be equal to the amount of greenhouse gas that would be emitted when an equal amount of electricity was generated in a power plant using the same fuel as the cogeneration unit.

The *participating operator* determines the GHG emissions savings resulting from excess electricity from cogeneration e_{ee}, by applying actual values in the following formula:

$$e_{ee} = \frac{surplus\_electricity\left[\frac{kWh}{yr}\right] * emissions\_factor_{fuel}\left[\frac{kgCO_2eq}{kWh}\right]}{product\_yield_{main\_produc(crop)}\left[\frac{kg_{producyield}}{yr}\right]}$$

in [kg CO_{2eq} / kg of product]

The general allocation rule in point 17 does not apply for electricity from Combined Heat & Power (CHP) when the CHP runs on 1) fossil fuels; 2) bioenergy, where this is not a co-product from the same process; or 3) agricultural crop residues, even if they are a co-product from the same process. Instead, the rule in point 16 applies as follows:

a. Where the CHP supplies heat not only to the biofuel/bioliquid process but also for other purposes, the size of the CHP should be notionally reduced - for the calculation - to the size that is necessary to supply only the heat necessary for the biofuel/bioliquid process. The primary electricity output of the CHP should be notionally reduced in proportion.

b. To the amount of electricity that remains - after this notional adjustment and after covering any actual internal electricity needs - a greenhouse gas credit should be assigned that should be subtracted from the processing emissions.

c. The amount of this benefit is equal to the life cycle emissions attributable to the production of an equal amount of electricity from the same type of fuel in a power plant.

[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.]

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:

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

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. In many cases, however, notably in relation to nearly-dry products, the latter could give a result that is an adequate approximation.

Since heat does not have a lower heating value no emissions can be allocated to it on that basis.

No emissions should 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.

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 + those fractions of e_p, e_{td} and e_{ee} that take place at the point 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 this purpose instead of

the total of those emissions.

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

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

no dimension

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

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, agricultural crop residues, including straw, bagasse, husks, cobs and nut shells, and residues from processing, including crude glycerine (glycerine that is not refined), shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection of those materials.

In the case of fuels produced in refineries, 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 the latest available actual average emissions from the fossil part of petrol and diesel consumed in the Community as reported under Directive 98/70/EC. If no such data are available, the value used shall be 83,8 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 91 gCO_{2eq}/MJ.

For bioliquids used for heat production, for the purposes of the calculation referred to in point 4, the fossil fuel comparator E_F shall be 77 gCO_{2eq}/MJ.

For bioliquids used for cogeneration, for the purposes of the calculation referred to in point 4, the fossil fuel comparator E_F shall be 85 gCO_{2eq}/MJ.

The fossil fuel comparator to be used at present for biofuels is 83.8 gCO_2eq/MJ. This value will be superseded by "the latest actual average emissions from the fossil part of petrol and diesel in the Community" when that information becomes available from the reports submitted under the Fuel Quality Directive.

That reporting has to be done yearly, starting with reporting for 2011. If it is possible to calculate it, the Commission will publish the new value for the fossil fuel comparator on its transparency platform accompanied by a date from which the figure can be considered "available" and has to be used. The Commission will take into account the latest such update in its next amendment of the typical and default values in the Directive.

[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.]

Annex 4: Calculations of NH_3 and NO_{3-}

1. Agriculture: modelling of ammonia emissions

NH_3 [kg NH_3/ha volatized]=(N_{min_fert}*0.1+N_{org_fert}*0.2)*17/14

With:

N_{min_fert}: kg N/ha in mineral fertilizer

N_{org_fert}: kg N/ha in organic fertilizer

0.1 is $Frac_{GASF}$ = fraction of synthetic (mineral) fertiliser N that volatilises as NH3 and NOx, kg N volatilised (kg of N applied) (Table 11.3, IPCC 2006[11])
0.2 is $Frac_{GASM}$ = fraction of applied organic N fertiliser materials that volatilises as NH3 and NOx, kg N volatilised / (kg of N applied) (Table 11.3, IPCC 2006)

The N-content of organic fertilizers is taken from following table

Table *1-1: N content of organic fertilizer for ammonia calculation*

Animal category	Manure type	Unit	N soluble
Cattle	liquid manure	kg/m³	2.3
	low-excrement liquid manure	kg/m³	3.2
	stackable manure	kg/t	0.8
	solid manure from loose housing	kg/t	1.3
Pigs	liquid manure	kg/m³	4.2
	solid manure	kg/t	2.3
Poultry	broiler manure	kg/t	10
	laying hen manure	kg/t	6.3
	laying hen litter	kg/t	7
	dried poultry litter	kg/t	9

[11] IPCC (2006): Guidelines for National Greenhouse Gas Inventories, Volume 4 Agriculture, Forestry and other Land Use

2. Agriculture: modeling of nitrate emissions

The nitrate calculation follows IPCC 2006.

NO_3[kg NO_3/ha leaching]=(N_{min_fert}+ N_{org_fert}+N_{cr})*0.3*62/14

With:

N_{min_fert}: kg N in mineral fertilizer

N_{org_fert}: kg N in organic fertilizer

N_{cr}: kg N in crop residues

0.3 is $Frac_{LEACH-(H)}$ = fraction of all N added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff, kg N/(kg of N additions)
The N content of organic fertilizer is given in Table 1-1.

Annex 5:

Commission guidelines for calculation of land carbon stocks

(source: Commission Decision of June 10.2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V of the Directive 2009/28/EC. European Commission (10 June 2010). 23 pages)

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COMMISSION DECISION

of 10 June 2010

on guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC

(notified under document C(2010) 3751)

(2010/335/EU)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC [1], and in particular Annex V, part C, point 10 thereof,

Whereas:

(1) Directive 2009/28/EC lays down rules for calculating the greenhouse gas impact of biofuels, bioliquids and their fossil fuel comparators, which take into account emissions from carbon stock changes caused by land use change. Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC [2] includes corresponding rules as far as biofuels are concerned.

(2) The Commission should draw its guidelines for the calculation of land carbon stocks on the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. Those Guidelines were intended for national greenhouse gas inventories and are not expressed in a form that is readily applicable by economic operators. It is therefore appropriate, where IPCC Guidelines for National Greenhouse Gas Inventories lack the necessary information for purposes of biofuel and bioliquid production or where such information is not accessible, to draw on other scientific sources of data.

(3) For the calculation of the carbon stocks in soil organic matter it is appropriate to take into account climate, soil type, land cover, land management and input. For mineral soils, the IPCC Tier 1 methodology for soil organic carbon is an appropriate method to use for this purpose as it covers the global level. For organic soils, the IPCC methodology addresses in particular carbon loss following soil drainage and does this only through annual losses. As soil drainage normally results in high carbon stock loss that cannot be compensated by the greenhouse gas saving of biofuels or bioliquids and as drainage of peatland soil is prohibited by the sustainability criteria laid down by Directive 2009/28/EC, it suffices to lay down general rules for determining soil organic carbon or carbon losses in organic soils.

(4) For the calculation of carbon stock in living biomass and dead organic matter a low complexity approach corresponding to IPCC Tier 1 methodology for vegetation should be an appropriate method. In accordance with that methodology it is reasonable to assume that all carbon stock in living biomass and dead organic matter is lost from the land upon conversion. Dead organic matter is usually of low significance in land conversion for the establishment of crops for the production of biofuels and bioliquids, but should be taken into account at least for closed forests.

(5) In calculating the greenhouse gas impact of land conversion, economic operators should be able to use actual values for the carbon stocks associated with the reference land use and the land use after conversion. They should also be able to use standard values and it is appropriate for these guidelines to provide them. It is not necessary, however, to provide standard values for improbable combinations of climate and soil type.

(6) Annex V to Directive 2009/28/EC sets out the method for calculating greenhouse gas impacts and contains rules for the calculation of annualised emissions of carbon stock changes from land use changes. The guidelines annexed to this Decision establish rules for the calculation of land carbon stocks, completing the rules laid down in the Annex V.

[1] OJ L 140, 5.6.2009, p. 16.
[2] OJ L 350, 28.12.1998, p. 58.

L 151/20 EN Official Journal of the European Union 17.6.2010

HAS ADOPTED THIS DECISION:

Article 1

The guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC are set out in the Annex to this Decision.

Article 2

This Decision is addressed to the Member States.

Done at Brussels, 10 June 2010.

For the Commission
Günther OETTINGER
Member of the Commission

ANNEX

Guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC

TABLE OF CONTENTS

1. INTRODUCTION

These guidelines establish the rules for the calculation of land carbon stocks, both for the reference land use (CS_R, as defined in point 7 of Annex V to Directive 2009/28/EC) and the actual land use (CS_A, as defined in point 7 of Annex V to Directive 2009/28/EC).

In point 2 rules are provided in order that land carbon stocks are consistently determined. Point 3 provides the general rule for the calculation of carbon stocks, which consist of two components soil organic carbon and carbon stock in the above and below ground vegetation.

Point 4 provides detailed rules for determining the soil organic carbon stock. For mineral soils it provides the option of following a method that allows the use of values provided for in the guidelines, while the option of using alternative methods is also provided for. For organic soils methods are described, but the guidelines do not contain values for determining soil organic carbon stock in organic soils.

Point 5 provides detailed rules for carbon stock in vegetation, but is only relevant in the case the choice is made not to use values for above and below ground vegetation carbon stock provided in point 8 of the guidelines (the use of the values provided in point 8 is not obligatory and for certain cases it may not contain the appropriate values).

Point 6 provides the rules to select the appropriate values in case the choice is made to use the guidelines' values related to soil organic carbon in mineral soils (these values are provided in points 6 and 7). In these rules reference is made to data layers on climate regions and soil type available through the online Transparency platform established by Directive 2009/28/EC. These data layers are detailed layers underlying figures 1 and 2 below.

Point 8 provides values for carbon stock in the above and below ground vegetation and related parameters. Points 7 and 8 provide values for four different land use categories: cropland, perennial crops, grassland and forest land.

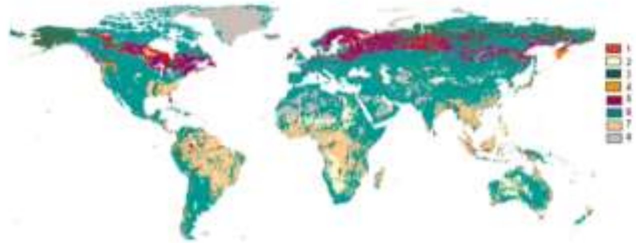
Figure 1

Climate regions

Legend: 1 = Tropical, montane; 2 = Tropical, wet; 3 = Tropical, moist; 4 = Tropical, dry; 5 = Warm temperate, moist; 6 = Warm temperate, dry; 7 = Cool temperate, moist; 8 = Cool temperate, dry; 9 = Boreal, moist; 10 = Boreal, dry; 11 = Polar, moist; 12 = Polar, dry.

Figure 2

Geographic distribution of soil types



Legend: 1 = Organic; 2 = Sandy Soils; 3 = Wetland Soils; 4 = Volcanic Soils; 5 = Spodic Soils; 6 = High Activity Clay Soils; 7 = Low Activity Clay Soils; 8 = Other Areas.

2. CONSISTENT REPRESENTATION OF LAND CARBON STOCKS

For determining the carbon stock per unit area associated with CS_R and CS_A the following rules shall apply:

(1) the area for which the land carbon stocks are calculated shall for the entire area have similar:

(a) biophysical conditions in terms of climate and soil type;

(b) management history in terms of tillage;

(c) input history in terms of carbon input to soil.

(2) the carbon stock of the actual land use, CS_A, shall be taken as:

— in the case of loss of carbon stock: the estimated equilibrium carbon stock that the land will reach in its new use,

— in the case of carbon stock accumulation: the estimated carbon stock after 20 years or when the crop reaches maturity, whichever the earlier.

3. CALCULATION OF CARBON STOCKS

For the calculation of CS_R and CS_A the following rule shall apply:

$$CS_i = (SOC + C_{VEG}) \times A$$

where:

CS_i = the carbon stock per unit area associated with the land use i (measured as mass of carbon per unit area, including both soil and vegetation);

SOC = soil organic carbon (measured as mass of carbon per hectare), calculated in accordance with point 4;

C_{VEG} = above and below ground vegetation carbon stock (measured as mass of carbon per hectare), calculated in accordance with point 5 or selected from the appropriate values in point 8;

A = factor scaling to the area concerned (measured as hectares per unit area).

4. SOIL ORGANIC CARBON STOCK

4.1. Mineral soils

For the calculation of SOC the following rule may be used:

$SOC = SOC_{ST} \times F_{LU} \times F_{MG} \times F_I$

where:

SOC = soil organic carbon (measured as mass of carbon per hectare);

SOC_{ST} = standard soil organic carbon in the 0-30 centimetre topsoil layer (measured as mass of carbon per hectare);

F_{LU} = land use factor reflecting the difference in soil organic carbon associated with the type of land use compared to the standard soil organic carbon;

F_{MG} = management factor reflecting the difference in soil organic carbon associated with the principle management practice compared to the standard soil organic carbon;

F_I = input factor reflecting the difference in soil organic carbon associated with different levels of carbon input to soil compared to the standard soil organic carbon.

For SOC_{ST} the appropriate values presented in point 6 shall apply.

For F_{LU}, F_{MG} and F_I the appropriate values presented in point 7 shall apply.

As an alternative to using the above rule, other appropriate methods, including measurements, may be used to determine SOC. As far as such methods are not based on measurements, they shall take into account climate, soil type, land cover, land management and inputs.

4.2. Organic soils (histosols)

For determining SOC, appropriate methods shall be used. Such methods shall take into account the entire depth of the organic soil layer as well as climate, land cover and land management and input. Such methods may include measurements.

Where carbon stock affected by soil drainage is concerned, losses of carbon following drainage shall be taken into account by appropriate methods. Such methods may be based on annual losses of carbon following drainage.

5. ABOVE AND BELOW GROUND VEGETATION CARBON STOCK

Except where a value for C_{VEG} set out in point 8 is used, for the calculation of C_{VEG} the following rule shall apply:

$C_{VEG} = C_{BM} + C_{DOM}$

where:

C_{VEG} = above and below ground vegetation carbon stock (measured as mass of carbon per hectare);

C_{BM} = above and below ground carbon stock in living biomass (measured as mass of carbon per hectare), calculated in accordance with point 5.1;

C_{DOM} = above and below ground carbon stock in dead organic matter (measured as mass of carbon per hectare), calculated in accordance with point 5.2.

For C_{DOM} the value of 0 may be used, except in the case of forest land — excluding forest plantations — having more than 30 % canopy cover.

5.1. Living biomass

For the calculation of C_{BM} the following rule shall apply:

$C_{BM} = C_{AGB} + C_{BGB}$

where:

C_{BM} = above and below ground carbon stock in living biomass (measured as mass of carbon per hectare);

C_{AGB} = above ground carbon stock in living biomass (measured as mass of carbon per hectare), calculated in accordance with point 5.1.1;

C_{BGB} = below ground carbon stock in living biomass (measured as mass of carbon per hectare), calculated in accordance with point 5.1.2.

5.1.1. *Above ground living biomass*

For the calculation of C_{AGB} the following rule shall apply:

$C_{AGB} = B_{AGB} \times CF_B$

where:

C_{AGB} = above ground carbon stock in living biomass (measured as mass of carbon per hectare);

B_{AGB} = weight of above ground living biomass (measured as mass of dry matter per hectare);

CF_B = carbon fraction of dry matter in living biomass (measured as mass of carbon per mass of dry matter).

For cropland, perennial crops and forest plantations the value for B_{AGB} shall be the average weight of the above ground living biomass during the production cycle.

For CF_B the value of 0,47 may be used.

5.1.2. *Below ground living biomass*

For the calculation of C_{BGB} one of the following two rules shall be used:

(1) $C_{BGB} = B_{BGB} \times CF_B$

where:

C_{BGB} = below ground carbon stock in living biomass (measured as mass of carbon per hectare);

B_{BGB} = weight of below ground living biomass (measured as mass of dry matter per hectare);

CF_B = carbon fraction of dry matter in living biomass (measured as mass of carbon per mass of dry matter).

For cropland, perennial crops and forest plantations the value for B_{BGB} shall be the average weight of the below ground living biomass during the production cycle.

For CF_B the value of 0,47 may be used.

(2) $C_{BGB} = C_{AGB} \times R$

where:

C_{BGB} = below ground carbon stock in living biomass (measured as mass of carbon per hectare);

C_{AGB} = above ground carbon stock in living biomass (measured as mass of carbon per hectare);

R = ratio of below ground carbon stock in living biomass to above ground carbon stock in living biomass.

Appropriate values for R set out in point 8 may be used.

5.2. Dead organic matter

For the calculation of C_{DOM} the following rule shall apply:

$C_{DOM} = C_{DW} + C_{LI}$

where:

C_{DOM} = above and below ground carbon stock in dead organic matter (measured as mass of carbon per hectare);

C_{DW} = carbon stock in dead wood pool (measured as mass of carbon per hectare), calculated in accordance with point 5.2.1;

C_{LI} = carbon stock in litter (measured as mass of carbon per hectare), calculated in accordance with point 5.2.2.

5.2.1. *Carbon stock in dead wood pool*

For the calculation of C_{DW} the following rule shall apply:

$$C_{DW} = DOM_{DW} \times CF_{DW}$$

where:

C_{DW} = carbon stock in dead wood pool (measured as mass of carbon per hectare);

DOM_{DW} = weight of dead wood pool (measured as mass of dry matter per hectare);

CF_{DW} = carbon fraction of dry matter in dead wood pool (measured as mass of carbon per mass of dry matter).

For CF_{DW} the value of 0,5 may be used.

5.2.2. *Carbon stock in litter*

For the calculation of C_{LI} the following rule shall apply:

$$C_{LI} = DOM_{LI} \times CF_{LI}$$

where:

C_{LI} = carbon stock in litter (measured as mass of carbon per hectare);

DOM_{LI} = weight of litter (measured as mass of dry matter per hectare);

CF_{LI} = carbon fraction of dry matter in litter (measured as mass of carbon per mass of dry matter).

For CF_{LI} the value of 0,4 may be used.

6. STANDARD SOIL CARBON STOCK IN MINERAL SOILS

A value for SOC_{ST} shall be selected from table 1, based on the appropriate climate region and soil type of the area concerned as set out in points 6.1 and 6.2.

Table 1

SOC_{ST}, standard soil organic carbon in the 0-30 centimetre topsoil layer

(tonnes of carbon per hectare)

Climate Region	Soil type					
	High activity clay soils	Low activity clay soils	Sandy soils	Spodic soils	Volcanic soils	Wetland soils
Boreal	68	—	10	117	20	146
Cold temperate, dry	50	33	34	—	20	87
Cold temperate, moist	95	85	71	115	130	87
Warm temperate, dry	38	24	19	—	70	88
Warm temperate, moist	88	63	34	—	80	88
Tropical, dry	38	35	31	—	50	86
Tropical, moist	65	47	39	—	70	86
Tropical, wet	44	60	66	—	130	86
Tropical, montane	88	63	34	—	80	86

6.1. **Climate region**

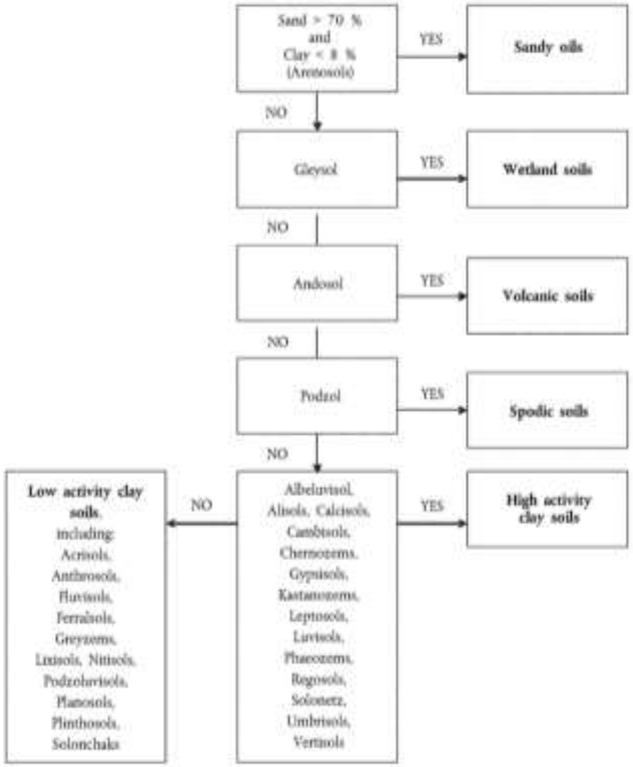
The appropriate climate region for the selection of the appropriate value for SOC_{ST} shall be determined from the climate region data layers available through the Transparency platform established by Article 24 of Directive 2009/28/EC.

6.2. **Soil type**

The appropriate soil type shall be determined according to figure 3. The soil type data layers available through the Transparency platform established by Article 24 of Directive 2009/28/EC may be used as guidance to determine the appropriate soil type.

Figure 3

Classification of soil types



7. FACTORS REFLECTING THE DIFFERENCE IN SOIL ORGANIC CARBON COMPARED TO THE STANDARD SOIL ORGANIC CARBON

Appropriate values for F_{LU}, F_{MG} and F_I shall be selected from tables in this point. For the calculation of CS_R the appropriate management and input factors are those that were applied in January 2008. For the calculation of CS_A the appropriate management and input factors are those that are being applied and will lead to the equilibrium carbon stock concerned.

7.3. **Cropland**

Table 2

Factors for cropland

Climate region	Land use (F_{LU})	Management (F_{MG})	Input (F_I)	F_{LU}	F_{MG}	F_I
Temperate/Boreal, dry	Cultivated	Full-tillage	Low	0,8	1	0,95
			Medium	0,8	1	1
			High with manure	0,8	1	1,37
			High without manure	0,8	1	1,04
		Reduced tillage	Low	0,8	1,02	0,95
			Medium	0,8	1,02	1
			High with manure	0,8	1,02	1,37
			High without manure	0,8	1,02	1,04
		No till	Low	0,8	1,1	0,95
			Medium	0,8	1,1	1
			High with manure	0,8	1,1	1,37
			High without manure	0,8	1,1	1,04
Temperate/Boreal, moist/wet	Cultivated	Full-tillage	Low	0,69	1	0,92
			Medium	0,69	1	1
			High with manure	0,69	1	1,44
			High without manure	0,69	1	1,11
		Reduced tillage	Low	0,69	1,08	0,92
			Medium	0,69	1,08	1
			High with manure	0,69	1,08	1,44
			High without manure	0,69	1,08	1,11
		No till	Low	0,69	1,15	0,92
			Medium	0,69	1,15	1
			High with manure	0,69	1,15	1,44
			High without manure	0,69	1,15	1,11
Tropical, dry	Cultivated	Full-tillage	Low	0,58	1	0,95
			Medium	0,58	1	1
			High with manure	0,58	1	1,37
			High without manure	0,58	1	1,04

Climate region	Land use (F_{LU})	Management (F_{MG})	Input (F_I)	F_{LU}	F_{MG}	F_I
		Reduced tillage	Low	0,58	1,09	0,95
			Medium	0,58	1,09	1
			High with manure	0,58	1,09	1,37
			High without manure	0,58	1,09	1,04
		No till	Low	0,58	1,17	0,95
			Medium	0,58	1,17	1
			High with manure	0,58	1,17	1,37
			High without manure	0,58	1,17	1,04
Tropical, moist/wet	Cultivated	Full-tillage	Low	0,48	1	0,92
			Medium	0,48	1	1
			High with manure	0,48	1	1,44
			High without manure	0,48	1	1,11
		Reduced tillage	Low	0,48	1,15	0,92
			Medium	0,48	1,15	1
			High with manure	0,48	1,15	1,44
			High without manure	0,48	1,15	1,11
		No till	Low	0,48	1,22	0,92
			Medium	0,48	1,22	1
			High with manure	0,48	1,22	1,44
			High without manure	0,48	1,22	1,11
Tropical Montane	Cultivated	Full-tillage	Low	0,64	1	0,94
			Medium	0,64	1	1
			High with manure	0,64	1	1,41
			High without manure	0,64	1	1,08
		Reduced tillage	Low	0,64	1,09	0,94
			Medium	0,64	1,09	1
			High with manure	0,64	1,09	1,41
			High without manure	0,64	1,09	1,08
		No till	Low	0,64	1,16	0,94
			Medium	0,64	1,16	1
			High with manure	0,64	1,16	1,41
			High without manure	0,64	1,16	1,08

Table 3 provides guidance for selecting appropriate values from Tables 2 and 4.

Table 3

Guidance on management and input for cropland and perennial crops

Management/Input	Guidance
Full-tillage	Substantial soil disturbance with full inversion and/or frequent (within year) tillage operations. At planting time, little (e.g. < 30 %) of the surface is covered by residues.
Reduced tillage	Primary and/or secondary tillage but with reduced soil disturbance (usually shallow and without full soil inversion) and normally leaves surface with > 30 % coverage by residues at planting.
No till	Direct seeding without primary tillage, with only minimal soil disturbance in the seeding zone. Herbicides are typically used for weed control.
Low	Low residue return occurs when there is due to removal of residues (via collection or burning), frequent bare-fallowing, production of crops yielding low residues (e.g. vegetables, tobacco, cotton), no mineral fertilisation or nitrogen-fixing crops.
Medium	Representative for annual cropping with cereals where all crop residues are returned to the field. If residues are removed then supplemental organic matter (e.g. manure) is added. Also requires mineral fertilisation or nitrogen-fixing crop in rotation.
High with manure	Represents significantly higher carbon input over medium carbon input cropping systems due to an additional practice of regular addition of animal manure.
High without manure	Represents significantly greater crop residue inputs over medium carbon input cropping systems due to additional practices, such as production of high residue yielding crops, use of green manures, cover crops, improved vegetated fallows, irrigation, frequent use of perennial grasses in annual crop rotations, but without manure applied (see row above).

7.1. **Perennial crops**

Table 4

Factors for perennial crops, namely multi-annual crops whose stem is usually not annually harvested such as short rotation coppice and oil palm

Climate region	Land use (F_{LU})	Management (F_{MG})	Input (F_I)	F_{LU}	F_{MG}	F_I
Temperate/Boreal, dry	Perennial crop	Full-tillage	Low	1	1	0,95
			Medium	1	1	1
			High with manure	1	1	1,37
			High without manure	1	1	1,04
		Reduced tillage	Low	1	1,02	0,95
			Medium	1	1,02	1
			High with manure	1	1,02	1,37
			High without manure	1	1,02	1,04
		No till	Low	1	1,1	0,95
			Medium	1	1,1	1
			High with manure	1	1,1	1,37
			High without manure	1	1,1	1,04

Climate region	Land use (F_{LU})	Management (F_{MG})	Input (F_I)	F_{LU}	F_{MG}	F_I
Temperate/Boreal, moist/wet	Perennial crop	Full-tillage	Low	1	1	0,92
			Medium	1	1	1
			High with manure	1	1	1,44
			High without manure	1	1	1,11
		Reduced tillage	Low	1	1,08	0,92
			Medium	1	1,08	1
			High with manure	1	1,08	1,44
			High without manure	1	1,08	1,11
		No till	Low	1	1,15	0,92
			Medium	1	1,15	1
			High with manure	1	1,15	1,44
			High without manure	1	1,15	1,11
Tropical, dry	Perennial crop	Full-tillage	Low	1	1	0,95
			Medium	1	1	1
			High with manure	1	1	1,37
			High without manure	1	1	1,04
		Reduced tillage	Low	1	1,09	0,95
			Medium	1	1,09	1
			High with manure	1	1,09	1,37
			High without manure	1	1,09	1,04
		No till	Low	1	1,17	0,95
			Medium	1	1,17	1
			High with manure	1	1,17	1,37
			High without manure	1	1,17	1,04
Tropical, moist/wet	Perennial crop	Full-tillage	Low	1	1	0,92
			Medium	1	1	1
			High with manure	1	1	1,44
			High without manure	1	1	1,11
		Reduced tillage	Low	1	1,15	0,92
			Medium	1	1,15	1
			High with manure	1	1,15	1,44
			High without manure	1	1,15	1,11
		No till	Low	1	1,22	0,92
			Medium	1	1,22	1
			High with manure	1	1,22	1,44
			High without manure	1	1,22	1,11
Tropical Montane	Perennial crop	Full-tillage	Low	1	1	0,94
			Medium	1	1	1
			High with manure	1	1	1,41
			High without manure	1	1	1,08

Climate region	Land use (F_{LU})	Management (F_{MG})	Input (F_I)	F_{LU}	F_{MG}	F_I
		Reduced tillage	Low	1	1,09	0,94
			Medium	1	1,09	1
			High with manure	1	1,09	1,41
			High without manure	1	1,09	1,08
		No till	Low	1	1,16	0,94
			Medium	1	1,16	1
			High with manure	1	1,16	1,41
			High without manure	1	1,16	1,08

Table 3 in point 7.1 provides guidance for selecting appropriate values from Table 4.

7.3. **Grassland**

Table 5

Factors for grassland, including savannahs

Climate region	Land Use (F_{LU})	Management (F_{MG})	Input (F_I)	F_{LU}	F_{MG}	F_I
Temperate/Boreal, dry	Grassland	Improved	Medium	1	1,14	1
			High	1	1,14	1,11
		Nominally managed	Medium	1	1	1
		Moderately degraded	Medium	1	0,95	1
		Severely degraded	Medium	1	0,7	1
Temperate/Boreal, moist/wet	Grassland	Improved	Medium	1	1,14	1
			High	1	1,14	1,11
		Nominally managed	Medium	1	1	1
		Moderately degraded	Medium	1	0,95	1
		Severely degraded	Medium	1	0,7	1
Tropical, dry	Grassland	Improved	Medium	1	1,17	1
			High	1	1,17	1,11
		Nominally managed	Medium	1	1	1
		Moderately degraded	Medium	1	0,97	1
		Severely degraded	Medium	1	0,7	1
Tropical, moist/wet	Savannah	Improved	Medium	1	1,17	1
			High	1	1,17	1,11
		Nominally managed	Medium	1	1	1
		Moderately degraded	Medium	1	0,97	1
		Severely degraded	Medium	1	0,7	1
Tropical Montane, dry	Grassland	Improved	Medium	1	1,16	1
			High	1	1,16	1,11

Climate region	Land Use (F_{LU})	Management (F_{MG})	Input (F_I)	F_{LU}	F_{MG}	F_I
		Nominally managed	Medium	1	1	1
		Moderately degraded	Medium	1	0,96	1
		Severely degraded	Medium	1	0,7	1

Table 6 provides guidance for selecting appropriate values from Table 5.

Table 6

Guidance on management and input for grassland

Management/Input	Guidance
Improved	Represents grassland which is sustainably managed with moderate grazing pressure and that receive at least one improvement (e.g. fertilisation, species improvement, irrigation).
Nominally managed	Represents non-degraded and sustainably managed grassland, but without significant management improvements.
Moderately degraded	Represents overgrazed or moderately degraded grassland, with somewhat reduced productivity (relative to the native or nominally managed grassland) and receiving no management inputs.
Severely degraded	Implies major long-term loss of productivity and vegetation cover, due to severe mechanical damage to the vegetation and/or severe soil erosion.
Medium	Applies where no additional management inputs have been used.
High	Applies to improved grassland where one or more additional management inputs/improvements have been used (beyond that is required to be classified as improved grassland).

7.4. **Forest land**

Table 7

Factors for forest land having at least 10 % canopy cover

Climate region	Land use (F_{LU})	Management (F_{MG})	Input (F_I)	F_{LU}	F_{MG}	F_I
All	Native forest (non-degraded)	n/a (*)	n/a	1		
All	Managed forest	All	All	1	1	1
Tropical, moist/dry	Shifting cultivation-shortened fallow	n/a	n/a	0,64		
	Shifting cultivation-mature fallow	n/a	n/a	0,8		
Temperate/Boreal, moist/dry	Shifting cultivation-shortened fallow	n/a	n/a	1		
	Shifting cultivation-mature fallow	n/a	n/a	1		

(*) n/a = not applicable; in these cases F_{MG} and F_I shall not apply and for the calculation of SOC the following rule may be used: $SOC = SOC_{ST} * F_{LU}$.

Table 8 provides guidance for selecting appropriate values from Table 7.

Table 8

Guidance on land use for forest land

Land use	Guidance
Native forest (non-degraded)	Represents native or long-term, non-degraded and sustainably managed forest.
Shifting cultivation	Permanent shifting cultivation, where tropical forest or woodland is cleared for planting of annual crops for a short time (e.g. 3-5 years) period and then abandoned to regrowth.
Mature fallow	Represents situations where the forest vegetation recovers to a mature or near mature state prior to being cleared again for cropland use.
Shortened fallow	Represents situations where the forest vegetation recovery is not attained prior to reclearing.

8. CARBON STOCK VALUES FOR ABOVE AND BELOW GROUND VEGETATION CARBON STOCK

For C_{VEG} or R the appropriate values laid down in this point may be used.

8.1. **Cropland**

Table 9

Vegetation values for cropland (general)

Climate region	C_{VEG} (tonnes carbon/hectare)
All	0

Table 10

Vegetation values for sugar cane (specific)

Domain	Climate region	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)
Tropical	Tropical dry	Tropical dry forest	Africa	4,2
			Asia (continental, insular)	4
		Tropical scrubland	Asia (continental, insular)	4
	Tropical moist	Tropical moist deciduous forest	Africa	4,2
			Central and South America	5
	Tropical wet	Tropical rain forest	Asia (continental, insular)	4
			Central and South America	5
Subtropical	Warm temperate dry	Subtropical steppe	North America	4,8
	Warm temperate moist	Subtropical humid forest	Central and South America	5
			North America	4,8

8.2. **Perennial crops, namely multi-annual crops whose stem is usually not annually harvested such as short rotation coppice and oil palm**

Table 11

Vegetation values for perennial crops (general)

Climate region	C_{VEG} (tonnes carbon per hectare)
Temperate (all moisture regimes)	43,2
Tropical, dry	6,2
Tropical, moist	14,4
Tropical, wet	34,3

Table 12

Vegetation values for specific perennial crops

Climate region	Crop type	C_{VEG} (tonnes carbon per hectare)
All	Coconuts	75
	Jatropha	17,5
	Jojoba	2,4
	Oil palm	60

8.3. **Grassland**

Table 13

Vegetation values for grassland — excluding scrubland (general)

Climate region	C_{VEG} (tonnes carbon per hectare)
Boreal — Dry & Wet	4,3
Cool Temperate — Dry	3,3
Cool Temperate — Wet	6,8
Warm Temperate — Dry	3,1
Warm Temperate — Wet	6,8
Tropical — Dry	4,4
Tropical — Moist & Wet	8,1

Table 14

Vegetation values for Miscanthus (specific)

Domain	Climate region	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)
Subtropical	Warm temperate dry	Subtropical dry forest	Europe	10
			North America	14,9
		Subtropical steppe	North America	14,9

Table 15

Vegetation values for scrubland, namely land with vegetation composed largely of woody plants lower than 5 meter not having clear physiognomic aspects of trees

Domain	Continent	C_{VEG} (tonnes carbon per hectare)
Tropical	Africa	46
	North and South America	53
	Asia (continental)	39
	Asia (insular)	46
	Australia	46
Subtropical	Africa	43
	North and South America	50
	Asia (continental)	37
	Europe	37
	Asia (insular)	41
Temperate	Global	7,4

8.4. **Forest land**

Table 16

Vegetation values for forest land — excluding forest plantations — having between 10 % and 30 % canopy cover

Domain	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)	R
Tropical	Tropical rain forest	Africa	40	0,37
		North and South America	59	0,37
		Asia (continental)	36	0,37
		Asia (insular)	45	0,37
	Tropical moist forest	Africa	30	0,24
		North and South America	26	0,24
		Asia (continental)	21	0,24
		Asia (insular)	34	0,24
	Tropical dry forest	Africa	14	0,28
		North and South America	25	0,28
		Asia (continental)	16	0,28
		Asia (insular)	19	0,28
	Tropical mountain systems	Africa	13	0,24
		North and South America	17	0,24
		Asia (continental)	16	0,24
		Asia (insular)	26	0,28

Domain	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)	R
Subtropical	Subtropical humid forest	North and South America	24	0,28
		Asia (continental)	22	0,28
		Asia (insular)	35	0,28
	Subtropical dry forest	Africa	17	0,28
		North and South America	24	0,32
		Asia (continental)	18	0,32
		Asia (insular)	20	0,32
	Subtropical steppe	Africa	9	0,32
		North and South America	10	0,32
		Asia (continental)	7	0,32
		Asia (insular)	9	0,32
Temperate	Temperate oceanic forest	Europe	14	0,27
		North America	79	0,27
		New Zealand	43	0,27
		South America	21	0,27
	Temperate continental forest	Asia, Europe (≤ 20 y)	7	0,27
		Asia, Europe (> 20 y)	14	0,27
		North and South America (≤ 20 y)	7	0,27
		North and South America (> 20 y)	16	0,27
	Temperate mountain systems	Asia, Europe (≤ 20 y)	12	0,27
		Asia, Europe (> 20 y)	16	0,27
		North and South America (≤ 20 y)	6	0,27
		North and South America (> 20 y)	6	0,27
Boreal	Boreal coniferous forest	Asia, Europe, North America	12	0,24
	Boreal tundra woodland	Asia, Europe, North America (≤ 20 y)	8	0,24
		Asia, Europe, North America (> 20 y)	2	0,24
	Boreal mountain systems	Asia, Europe, North America (≤ 20 y)	2	0,24
		Asia, Europe, North America (> 20 y)	6	0,24

Table 17

Vegetation values for forest land — excluding forest plantations — having more than 30 % canopy cover

Domain	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)
Tropical	Tropical rain forest	Africa	204
		North and South America	198
		Asia (continental)	185
		Asia (insular)	230
	Tropical moist deciduous forest	Africa	156
		North and South America	131
		Asia (continental)	119
		Asia (insular)	174
	Tropical dry forest	Africa	77
		North and South America	131
		Asia (continental)	83
		Asia (insular)	101
	Tropical mountain systems	Africa	77
		North and South America	94
		Asia (continental)	88
		Asia (insular)	130
Subtropical	Subtropical humid forest	North and South America	132
		Asia (continental)	109
		Asia (insular)	173
	Subtropical dry forest	Africa	88
		North and South America	130
		Asia (continental)	82
		Asia (insular)	109
	Subtropical steppe	Africa	46
		North and South America	53
		Asia (continental)	41
		Asia (insular)	47
Temperate	Temperate oceanic forest	Europe	84
		North America	406
		New Zealand	227
		South America	120
	Temperate continental forest	Asia, Europe (≤ 20 y)	27
		Asia, Europe (> 20 y)	87
		North and South America (≤ 20 y)	51
		North and South America (> 20 y)	93

Domain	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)
	Temperate mountain systems	Asia, Europe (≤ 20 y)	73
		Asia, Europe (> 20 y)	93
		North and South America (≤ 20 y)	43
		North and South America (> 20 y)	93
Boreal	Boreal coniferous forest	Asia, Europe, North America	53
	Boreal tundra woodland	Asia, Europe, North America (≤ 20 y)	26
		Asia, Europe, North America (> 20 y)	15
	Boreal mountain systems	Asia, Europe, North America (≤ 20 y)	12
		Asia, Europe, North America (> 20 y)	53

Table 18

Vegetation values for forest plantations

Domain	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)	R
Tropical	Tropical rain forest	Africa broadleaf > 20 y	87	0,24
		Africa broadleaf ≤ 20 y	29	0,24
		Africa *Pinus* sp. > 20 y	58	0,24
		Africa *Pinus* sp. ≤ 20 y	17	0,24
		Americas *Eucalyptus* sp.	58	0,24
		Americas *Pinus* sp.	87	0,24
		Americas *Tectona grandis*	70	0,24
		Americas other broadleaf	44	0,24
		Asia broadleaf	64	0,24
		Asia other	38	0,24
	Tropical moist deciduous forest	Africa broadleaf > 20 y	44	0,24
		Africa broadleaf ≤ 20 y	23	0,24
		Africa *Pinus* sp. > 20 y	35	0,24
		Africa *Pinus* sp. ≤ 20 y	12	0,24
		Americas *Eucalyptus* sp.	26	0,24
		Americas *Pinus* sp.	79	0,24
		Americas *Tectona grandis*	35	0,24
		Americas other broadleaf	39	0,24
		Asia broadleaf	52	0,24
		Asia other	29	0,24

Domain	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)	R
	Tropical dry forest	Africa broadleaf > 20 y	21	0,28
		Africa broadleaf ≤ 20 y	9	0,28
		Africa *Pinus* sp. > 20 y	18	0,28
		Africa *Pinus* sp. ≤ 20 y	6	0,28
		Americas *Eucalyptus* sp.	27	0,28
		Americas *Pinus* sp.	33	0,28
		Americas *Tectona grandis*	27	0,28
		Americas other broadleaf	18	0,28
		Asia broadleaf	27	0,28
		Asia other	18	0,28
	Tropical shrubland	Africa broadleaf	6	0,27
		Africa *Pinus* sp. > 20 y	6	0,27
		Africa *Pinus* sp. ≤ 20 y	4	0,27
		Americas *Eucalyptus* sp.	18	0,27
		Americas *Pinus* sp.	18	0,27
		Americas *Tectona grandis*	15	0,27
		Americas other broadleaf	9	0,27
		Asia broadleaf	12	0,27
		Asia other	9	0,27
	Tropical mountain systems	Africa broadleaf > 20 y	31	0,24
		Africa broadleaf ≤ 20 y	20	0,24
		Africa *Pinus* sp. > 20 y	19	0,24
		Africa *Pinus* sp. ≤ 20 y	7	0,24
		Americas *Eucalyptus* sp.	22	0,24
		Americas *Pinus* sp.	29	0,24
		Americas *Tectona grandis*	23	0,24
		Americas other broadleaf	16	0,24
		Asia broadleaf	28	0,24
		Asia other	15	0,24
Subtropical	Subtropical humid forest	Americas *Eucalyptus* sp.	42	0,28
		Americas *Pinus* sp.	81	0,28
		Americas *Tectona grandis*	36	0,28
		Americas other broadleaf	30	0,28
		Asia broadleaf	54	0,28
		Asia other	30	0,28

Domain	Ecological zone	Continent	C_{VEG} (tonnes carbon per hectare)	R
	Subtropical dry forest	Africa broadleaf > 20 y	21	0,32
		Africa broadleaf ≤ 20 y	4	0,32
		Africa *Pinus* sp. > 20 y	19	0,32
		Africa *Pinus* sp. ≤ 20 y	6	0,32
		Americas *Eucalyptus* sp.	34	0,32
		Americas *Pinus* sp.	34	0,32
		Americas *Tectona grandis*	28	0,32
		Americas other broadleaf	19	0,32
		Asia broadleaf	28	0,32
		Asia other	19	0,32
	Subtropical steppe	Africa broadleaf	6	0,32
		Africa *Pinus* sp. > 20 y	4	0,32
		Africa *Pinus* sp. ≤ 20 y	5	0,32
		Americas *Eucalyptus* sp.	19	0,32
		Americas *Pinus* sp.	19	0,32
		Americas *Tectona grandis*	14	0,32
		Americas other broadleaf	8	0,32
		Asia broadleaf > 20 y	25	0,32
		Asia broadleaf ≤ 20 y	4	0,32
		Asia coniferous > 20 y	8	0,32
		Asia coniferous ≤ 20 y	34	0,32
	Subtropical mountain systems	Africa broadleaf > 20 y	31	0,24
		Africa broadleaf ≤ 20 y	20	0,24
		Africa *Pinus* sp. > 20 y	19	0,24
		Africa *Pinus* sp. ≤ 20 y	7	0,24
		Americas *Eucalyptus* sp.	22	0,24
		Americas *Pinus* sp.	34	0,24
		Americas *Tectona grandis*	23	0,24
		Americas other broadleaf	16	0,24
		Asia broadleaf	28	0,24
		Asia other	15	0,24
Temperate	Temperate oceanic forest	Asia, Europe, broadleaf > 20 y	60	0,27
		Asia, Europe, broadleaf ≤ 20 y	9	0,27
		Asia, Europe, coniferous > 20 y	60	0,27
		Asia, Europe, coniferous ≤ 20 y	12	0,27
		North America	52	0,27
		New Zealand	75	0,27
		South America	31	0,27

Domain	Ecological zone	Continent	C_{VEG} tonnes carbon per hectare	R
	Temperate continental forest and mountain systems	Asia, Europe, broadleaf > 20 y	60	0,27
		Asia, Europe, broadleaf ≤ 20 y	4	0,27
		Asia, Europe, coniferous > 20 y	52	0,27
		Asia, Europe, coniferous ≤ 20 y	7	0,27
		North America	52	0,27
		South America	31	0,27
Boreal	Boreal coniferous forest and mountain systems	Asia, Europe > 20 y	12	0,24
		Asia, Europe ≤ 20 y	1	0,24
		North America	13	0,24
	Boreal tundra woodland	Asia, Europe > 20 y	7	0,24
		Asia, Europe ≤ 20 y	1	0,24
		North America	7	0,24