Standards Document

SBP Framework Instruction Document 6D: Methodology for the calculation and certification of GHG emissions savings for REDII

Sustainable Biomass Program
sbp-cert.org

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In the case of inconsistency between translations, the official English language version shall always take precedence.

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1 Introduction

Compliance with Instruction Document 6D is not mandatory to make SBP claims. Instruction Document 6D is optional within the SBP Framework but is mandatory to Certificate Holders that need to perform greenhouse gas (GHG) emissions savings calculations in accordance with the recast EU Renewable Energy Directive 2018/2001 of 11 December 2018 (REDII).

Instruction Document 6D is a normative document for the certification of the GHG savings calculation by an SBP-accredited Certification Body (CB). It describes the principles and methodology for the Certificate Holder to undertake the calculations and the requirements for the CB to audit it.

The general equations used for the calculation of GHG emissions savings in accordance with REDII are presented in section 5 of this document.

Normative references for the CB to provide certification of GHG savings requirements are presented in section 2 of this document.

DISCLAIMER: Certificate Holders certified against this document shall implement all applicable requirements of the recast EU Renewable Energy Directive 2018/2001 of 11 December 2018 (REDII). Where there is a conflict between the requirements in this document and REDII, REDII shall have precedence.

2 Normative references

1) Recast EU Renewable Energy Directive 2018/2001 of 11 December 2018 (REDII)
2) Instruction Document 5E: Collection and Communication of Energy and Carbon Data
3) SBP Framework Instruction Document REDII: Bridging requirements of the SBP scheme for meeting REDII
4) SBP Framework Standard 3: Certification Systems. Requirements for Certification Bodies
5) Draft Commission Implementing Regulation (EU) on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria

3 Verification of the calculation

Certificate Holders certified against this document shall provide the Certification Body with all relevant information on the calculation of the GHG emissions savings prior to the annual audit.

The Certificate Holder shall document and submit to the Certification Body for verification all data measured and recorded that are relevant for the calculation of the actual values.

GHG emissions data shall include accurate data on all relevant elements of the emissions calculation as collected within the SAR report during the reporting period (usually 12 consecutive months) as prescribed by SBP Standard 5.

4 General requirements

4.1 Options for the REDII GHG requirements

Supply chain operators shall use one of the following options for the greenhouse gas criterion for biomass fuels:

a. Use of a default value for greenhouse gas emissions savings if the production pathway is laid down in Part A of Annex VI of REDII. Default values can only be applied if the e_l value for those biomass fuels calculated in accordance with point 7 of Part B of Annex VI of REDII is equal or less than zero;
b. Use of actual greenhouse gas values to calculate total greenhouse gas emissions savings according to the REDII methodology and specified in Part B of Annex VI of REDII for biomass fuels. The methodology for measured values is documented in the SAR report of Standard 5 of SBP that is passed from the Biomass Producer to the End-user, while the Certificate Holder must document data sources for non-measured values for the verification by the certification body for the sake of Standard 6;
c. Use of a value calculated as the sum of the formulas referred to in point 1 of Part B of Annex VI of REDII, where disaggregated default values in Part C of Annex VI of REDII may be used for some factors, and actual values, calculated in accordance with the methodology laid down in Part B of Annex VI, are used for all other factors.

Detailed requirements and guidance on the use of default values and actual values have been elaborated below.

Use of default values

Default values listed in Annex VI of REDII can only be applied if the process technology and feedstock used for the production of the fuel match their description and scope, and the transport distance. In case specific technologies are set out, the default values can only be used if those technologies were actually applied.

Where biomethane is used as compressed biomethane as a transport fuel, a value of 4.6 g $CO_{2\text{-eq}}$/MJ biomethane needs to be added to the applicable default value.

Note: Some of the default values were subject to minor revisions and updates were published in the REDII corrigenda published on 25 September 2021. The default values in Annex VI of REDII may be subject to further revisions in future. Any updates by the European Commission will become valid under SBP requirements. It is the responsibility of the auditor to check that economic operators are using the most up to date default values.

Use of disaggregated default values

Disaggregated Default values listed in Annex VI of REDII can only be applied if the process technology and feedstock used for the production of the fuel match their description and scope, and the transport distance. In case specific technologies are set out, the disaggregated default values can only be used if those technologies were actually applied.

Annex VI of REDII also lists disaggregated default values. Disaggregated default values relate to GHG emissions in part of the supply chain/biomass fuel production pathway and can be used in combination with actual values to calculate overall GHG emissions and emission savings.

Producers and supply chain operators may use disaggregated default values for cultivation (e_{ec}) processing (e_p) and/or transport and distribution (e_{td}) specified in Annex VI of REDII.

These disaggregated default values can be combined with other disaggregated default values representing other parts of the supply chain, or with actual values for that part of the supply chain. Annex VI of REDII does not provide default emission values for land use change (e_l). This means that if a disaggregated default value is used for cultivation (e_{ec}), an actual GHG emission value for land use change will need to be added.

If supply chain operators use a combination of disaggregated default values and actual values and/or change from disaggregated default values to actual values this shall be done in accordance with the methodology presented in this document.

Producers and supply chain operators shall clearly communicate to the next economic operator that disaggregated default values or a combination of disaggregated default values and actual values is used for the REDII GHG criterion.

Note: Some of the disaggregated default values were subject to minor revisions and updates were published in the REDII corrigenda published on 25 September 2021. The disaggregated default values in Annex VI of REDII may be subject to further revisions in future. Any updates by the European Commission will become valid under SBP. It is the responsibility of the auditor to check that economic operators are using the most up to date disaggregated default values.

Use of actual values

Producers are only allowed to use actual GHG values after the capability to conduct GHG emission calculations has been verified by an auditor. Such a verification shall be performed during the audit of the producer prior to this issuance of the first SBP REDII certification

Information on actual GHG emissions has to be provided for all relevant elements of the GHG emission calculation formula. 'Relevant' refers in this context to elements for which reporting is obligatory (e.g. e_l in case of land use change), all elements for which actual values should be used instead of disaggregated default values and all elements related to emission savings (if applicable).
If at any point of the chain of custody emissions have occurred and are not recorded, so that the calculation of an actual value is no longer feasible for operators downstream in the chain of custody, this must be clearly indicated in the delivery notes.

When using actual values, at each step of the chain of custody, GHG emission estimates shall be added to the GHG value included in the documentation to the consignment purchased from the previous operator in the chain of custody.
The following GHG emissions shall be considered:

- Additional emissions from transport and/or processing have to be added to e_p and/or e_{td} respectively.
- Energy losses occurred during processing or if relevant transportation or storage have to be taken into account using a 'feedstock factor'. This applies to each processing step but can be also relevant for other steps in the chain of custody e.g. drying of feedstock.
- Whenever a processing step yields co-products, emissions need to be allocated using an 'allocation factor' following the rules set out in the GHG emission calculation methodology.
- The actual greenhouse gas data shall be communicated to the next economic operator. The greenhouse gas intensity shall be expressed as kg $CO_{2\text{-eq}}$/dry-tonne feedstock or intermediary product, or as g $CO_{2\text{-eq}}$/MJ biomass fuel. This means that at the last processing step the emission estimate needs to be converted into the unit g $CO_{2\text{-eq}}$/MJ of final biomass fuel.

Actual values can only be calculated when all relevant information is available and transmitted through the chain of custody:

a. Actual values of emissions from cultivation can only be determined at the origin of the chain of custody.
b. Actual values of emissions from transport can only be determined if emissions of all transport steps are recorded and transmitted through the chain of custody.

c. Actual values of emissions from processing can only be determined if emissions of all processing steps are recorded and transmitted through the chain of custody.

Whenever information which is relevant for the calculation of actual emissions is not available, default values must be used

Standard calculation values published in Annex IX of the Implementing Act shall be applied whenever available. Standard value means the value of a physical parameter for some resource (like fossil fuels) used within the biomass production process (e.g. density, low heating value). Alternative values may be used but must be appropriately and fully justified and noted in the calculation documentation to facilitate verification by auditors.

For the calculation of actual GHG emissions, all relevant input data shall be collected on site, documented and made available to the auditor. Chapter 5 specifies which data shall be collected at every step of the supply chain. It is not necessary to include in the calculation data which will have little or no effect on the result, such as chemicals used in low amounts in processing.

Input data used for actual GHG calculation shall cover a full year (12 months calculation period). This shall be as recent as possible, or alternatively cover the previous calendar year or financial year of the operations. The calculation period covered must be notified on the calculation sheet.

Records of greenhouse gas data and calculations shall be kept for 5 years.

4.2 Transfer of GHG data through the supply chain

Each consignment transacted shall contain information on GHG emissions, including accurate data on all relevant elements of the emission calculation formula.

In case actual values are not used, information on the amount of GHG emissions shall not be transmitted through the chain of custody before the last processing step. If at any point of the chain of custody emissions have occurred and are not recorded, so that the calculation of an actual value is no longer feasible for operators downstream in the chain of custody, this must be clearly indicated.

Averaging of GHG data

Where a combined consignment is supplied to a client, averaging GHG data is not allowed. The original GHG value of each component of the consignment can be allocated to a similar amount of outgoing material. Alternatively, a group consignment can use the worst GHG performance.

Each separate GHG value must be reported on the documents going to the client (buyer) or the highest (worst) GHG value can be used for the entire consignment. Other sustainability data such as country of origin and feedstock type can be grouped if identical.

Reporting GHG emissions

GHG emissions shall be reported using appropriate units.
These are:

1. g CO_2eq/dry-ton for raw materials and intermediary products
2. g CO_2eq/MJ of final energy commodity (electricity or heat) for electricity and heating produced from biomass products

When default values are used, information on GHG emissions should only be reported for final fuels and can be reported as an aggregate. If relevant, both, the process technology and the raw material used need to be specified.

In the context of biomass fuels (wood pellets), when using default values from Annex VI it is important to choose one of 3 cases*.

> * Case 1 refers to processes in which a natural gas boiler is used to provide the process heat to the pellet mill. Electricity for the pellet mill is supplied from the grid;
>
> Case 2a refers to processes in which a woodchips boiler, fed with pre-dried chips, is used to provide process heat. Electricity for the pellet mill is supplied from the grid;
>
> Case 3a refers to processes in which a CHP, fed with pre-dried woodchips, is used to provide electricity and heat to the pellet mill.

5 GHG calculation methodology

5.1 EQUATION 1 – Contributions to the GHG emissions

For the purposes of RED-II Article 29(10), the calculation of GHG emissions from solid biomass for electricity and heat production shall use the methodology as laid down in DIRECTIVE (EU) 2018/2001 (REDII) Annex VI, part B. This methodology is supplemented in this Instruction Document 6D.

GHG emissions from the production and use of the biomass products converted into electricity, heating and cooling shall be calculated on the basis of EQUATION 1.

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

Where

E = total emissions from the production of the fuel before energy conversion;

e_{ec} = emissions from the extraction or cultivation of raw materials;

e_l = annualised emissions from carbon stock changes caused by land-use change;

e_p = emissions from processing;

e_{td} = emissions from transport and distribution;

e_u = emissions from the fuel in use;

e_{sca} = emission savings from soil carbon accumulation via improved agricultural management;

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

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

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

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

GHG emissions shall be expressed on dry basis of the biomass product.

The GHG to be included in the GHG calculation are CO_2, N_2O and CH_4.

To calculate the CO_2 equivalenced, these gases are weighted as follows in accordance with the RED-II:

1 for CO_2, 25 for CH_4 and 298 for N_2O.

5.2 GHG emissions for wood extraction or cultivation e_{ec}

5.2.1 Use of disaggregated default values for wood extraction or cultivation

Disaggregated default values are to be taken from Annex VI of Directive (EU) 2018/2001. The list of (disaggregated) default values can be updated by the Commission. Any changes made by the European Commission to the (disaggregated) default values immediately enter into force in the SBP scheme.

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

The most useful disaggregated default values are shown in the Annex (Table 5 and Table 6). When different default values for cultivation are available, the more conservative one appearing in those tables should be used by Certificate Holder for their GHG calculations:

- in Table 5 (see Annex), default values for forestry and harvesting e_{ec}, include GHG emissions from the extraction or cultivation process itself; from the collection and storage of raw materials; from waste and leakages; and from the production of chemicals or products used in extraction or cultivation but capture of CO_2 in the cultivation of feedstock is not included;
- in Table 6 (see Annex), default values are given for wood chips that are used as fuel for the dryer/CHP inside the biomass plant: the default values cover, where appropriate: cultivation of wood fuel, processing of wood fuel, transport and distribution of wood fuel, and non CO_2 emissions generated by the combustion of wood fuel in the biomass plant.

5.2.2 Calculation of actual values

Actual values of GHG emissions from cultivation e_{ec} can only be determined at the beginning of the value chain.

The GHG emissions from the production of raw materials (e_{ec}) include the GHG emissions resulting from the cultivation and harvesting of the raw materials and the GHG emissions resulting from the production of the chemicals and other relevant substances used in cultivation. To calculate e_{ec}, the following data is collected on site at a minimum, i.e. the respective values are taken from, e.g. company documents:

- quantity of P_2O_5, K_2O, CaO, mineral and organic N fertilisers as well as crop residues in case of agricultural biomass [kg/(ha*year)] – total quantity used annually (in the year of cultivation
- quantity of chemicals (e.g. pesticides) [kg/(ha*year)] – total quantity used annually (in the year of cultivation)
- fuel consumption [l/(ha*year)] – total quantity of fuel used annually for, e.g., tractors, harvesters and water pumps per hectare in the year of cultivation – as a measured value or as an estimate based on documented, reliable data (distance, consumption, etc.)

- electricity consumption [kWh/(ha*year)] – total electricity consumption per hectare in the year of cultivation
- quantity and type of raw materials used [kg/(ha*year)] (e.g., seeds)
- harvest yield [kg harvest yield dry/(ha*year)] – quantity of the main/co-product in kg of dry matter per hectare in the year of cultivation. If drying took place, the dry matter content of the dried product must be included

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

It must be kept in mind that the requirements above for calculations and formulas are examples. If other emissions are incurred, they must be recorded and included in the calculation. The data has to be placed in the formula accordingly. The economic operator responsible calculates the GHG emissions for raw material production (e_{ec}) taking into account the GHG emissions from cultivation and harvest of the raw material as well as the GHG emissions from production of chemicals or products used in cultivation by applying actual values to the following formula (EM = emissions):

$$e_{ec}' = \frac{EM_{fertiliser}\left[\frac{kgCO_2eq}{ha \times year}\right] + EM_{pesticides}\left[\frac{kgCO_2eq}{ha \times year}\right] + EM_{fuel}\left[\frac{kgCO_2eq}{ha \times year}\right] + EM_{electricity}\left[\frac{kgCO_2eq}{ha \times year}\right] + EM_{N2O}\left[\frac{kgCO_2eq}{ha \times year}\right]}{yield_{main\ procuct}\left[\frac{kg_{yield}}{ha \times year}\right]}$$

specified in mass units in relation to the dry harvest yield or dry main product ($kgCO_2eq/kg$ dry). The harvest yield relates to the dry matter content. The formula below is to be used to specify the emissions of the dry matter in kg:

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

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

$$EM_{fertiliser}\left[\frac{kgCO_2eq}{ha \times year}\right] = fertiliser\left[\frac{kg}{ha\ x\ year}\right] \times \left(Ef_{production\ fertiliser}\left[\frac{kgCO_2eq}{kg_{fertiliser}}\right] + Ef_{field}\left[\frac{kgCO_2eq}{kg_{fertiliser}}\right]\right)$$

$$EM_{PSM}\left[\frac{kgCO_2eq}{ha \times year}\right] = PSM\left[\frac{kg}{ha \times year}\right] \times Ef_{production\ PSM}\left[\frac{kgCO_2eq}{kg}\right]$$

$$EM_{fuel}\left[\frac{kgCO_2eq}{ha\ x\ year}\right] = fuel\left[\frac{l}{ha\ x\ year}\right] \times Ef_{fuel}\left[\frac{kgCO_2eq}{l}\right]$$

$$EM_{electricity}\left[\frac{kgCO_2eq}{ha\ x\ year}\right] = electricity\left[\frac{kWh}{ha\ x\ year}\right] \times Ef_{electricity\ mix}\left[\frac{kgCO_2eq}{kWh}\right]$$

Formula components in detail (EM = emissions; Ef = emission factor):

$Ef_{production\ fertiliser}$ = emission factor fertiliser production [$kgCO_2eq$/kg fertiliser]

Ef_{field} = emission factor laughing gas (N_2O) [$kgCO_2eq$/kg N fertiliser]

$Ef_{pesticide\ production}$ = emission factor pesticide production [$kgCO_2eq$/kg pesticides]

Ef_{fuel} = emission factor fuel in agricultural or forestry machinery [$kgCO_2eq$/l fuel]

$Ef_{electricity\ mix}$ = emission factor EU electricity mix [$kgCO_2eq$/kWh]

The values (emission factors, calorific values, etc.) to calculate e_{ec} shall be taken from the REDII Implementing act on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria, Annex IX .

Alternatively, a scientific literature source or scientifically recognised database (e.g. BioGrace, ECOINVENT database) can be used.

An appropriate way to take into account N_2O emissions from soils is the IPCC methodology, including what are described there as both direct and indirect N_2O emissions. All three IPCC tiers can be used by economic operators. Tier 3 is based on detailed measurement and/or modelling. The BioGrace calculation tool provides details on the calculation of the N_2O emissions from the cultivation of the crop using IPCC Tier 1 (http://www.biograce.net/home). Another way to include these direct and indirect N_2O emissions is the Global Nitrous Oxide Calculator (GNOC) developed by the Joint Research Center for the biomass types not included in the BioGrace calculator (http://gnoc.jrc.ec.europa.eu/).

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

The life-cycle greenhouse gas emissions of agricultural and forestry waste, harvest residues and production residues including wood from thinning, crown material, non-merchantable wood, so-called forest residues, straw, and waste and residues from processing stages in the value chain, are taken to be “zero” until such time as these materials are collected. Materials can be classified as waste, residues or co-products using the Communication from the European Commission COM(2007) 59 and/or can be taken from the SBP scheme principles for the production of biomass fuels from waste and residues.

5.3 GHG emissions for land use change e_l

In the case of land-use changes (converted areas), which have taken place since 1 January 2008 and on which biomass production is permitted under Article 29 of Directive (EU) 2018/2001, the accumulated GHG emissions resulting from the land-use changes must be calculated and added to the other emissions.

Land-use changes refers to changes among the six land categories recognised by the IPCC (forest land, grassland, cropland, wetlands, settlements, and other land). Cropland and perennial cropland shall be regarded as one land use. Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice. This means, for example, that a change from forestland or grassland to cropland is a land-use change, while a change from one crop (such as SRC willow) to another (such as SRC poplar) 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.

Where applicable, annualised emissions e_l resulting from carbon stock changes caused by land-use change, like the conversion of forests into another type of land after 1 January 2008, shall be calculated in accordance with Directive (EU) 2018/2001 Annex VI B 7 (please see below).

Annualised GHG emissions from carbon stock changes caused by land-use change e_l are calculated by dividing total emissions equally over 20 years.

For the calculation of those emissions the following rule shall be applied:

$e_l = (CS_R – CS_A) \times 3{,}664 \times 1/20 \times 1/P – e_B$, ([2]) 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 biomass fuel energy). ‘Cropland’ (3) and ‘perennial cropland’ (4) shall be regarded as one land use;

CS_R =the carbon stock per unit area associated with the reference land use (measured as mass (tonnes) of carbon per unit area, including both soil and vegetation). The reference land use shall be the land use in January 2008 or 20 years before the raw material was obtained, whichever was the later;

CS_A =the carbon stock per unit area associated with the actual land use (measured as mass (tonnes) of carbon per unit area, including both soil and vegetation). In cases where the carbon stock accumulates over more than one year, the value attributed to CS_A shall be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier;

P =the productivity of the crop (measured as biomass fuel energy per unit area per year); and

e_B =bonus of 29 g CO_2eq/MJ biomass fuel if biomass is obtained from restored degraded land under the conditions laid down below.

The bonus of 29 g CO_2eq/MJ shall be attributed if evidence is provided that the land:

(a) was not in use for agriculture in January 2008 or any other activity; and

(b) is severely degraded land, including such land that was formerly in agricultural use.

The bonus of 29 g CO_2eq/MJ shall apply for a period of up to 20 years from the date of conversion of the land to agricultural use, provided that a steady increase in carbon stocks as well as a sizable reduction in erosion phenomena for land falling under (b) are ensured.

'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.

In accordance with point 10 of Part C of Annex V to the REDII Directive, Commission Decision 2010/335/EU (5), which provides for guidelines for the calculation of land carbon stocks in relation to this Directive, drawing on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories – volume 4, and in accordance with Regulations (EU) No 525/2013 and (EU) 2018/841, shall serve as the basis for the calculation of land carbon stocks.

If evidence is provided that the cropland was categorised as "cropland" on 1 January 2008, or the forestry as "forest" on the cut-off date 1 January 2008, and no change in land use took place after the cut-off date 1 January 2008, e_l equals "0".

5.4 GHG emissions for processing e_p

The emissions for processing the biomass product (e_p) includes the following emissions:

1. emissions from electricity use,
2. emissions from the use of fossil fuels,
3. emissions from the use of biomass fuels, usually essentially for drying,
4. emissions from binder/chemical integrated into the biomass product.

It is not mandatory to include contributions to the calculation which have negligible impact on the result, e.g. low quantities of chemical used in processing. Inputs with negligible impact are those with a calculated contribution of less than 0.5% of the total emissions of the biomass processing.

5.4.1 GHG emissions for the electricity use

The GHG emissions for the specific power consumption of the biomass producer in gCO_2/ton dry biomass shall be calculated as follows:

$$e_{p,e} = 3{,}6\,.\,CP.\,P$$

Where

CP is the GHG intensity of power in gCO_2eq/MJ in the country or region of origin,

P is the specific consumption of the BP in kWhe/ton biomass product, which is reported in the SAR report and verified by the certification body for SBP Standard 5.

<u>In case electricity use occurs within the European Union, then the GHG emission factor CP shall be assumed to be equal to the average emission intensity of the production and distribution of electricity in that country.</u>

In case of countries outside the European Union, a national or regional average as published by IEA can be used for CP.

In case of locally produced electricity, individual emission values may be used but the prerequisite is that the plant in question is not connected to the grid, otherwise the local grid reference must be used.

If electricity use is from renewable energy sources (e.g. wind turbine, PV) and if it is measured by an electricity meter on a permanent basis, the GHG emission factor CP can be set to zero if the renewable system is not connected to the grid.

5.4.2 Emission from use of primary energy from fossil fuels

The use of primary energy from fossil fuels for processing and drying is reported in the SAR.

The GHG emissions of each fossil fuels type are calculated as followed:

$$e_{p,f,i} = PV_i . C_i . L_i$$

where

$e_{p,f,i}$ is the GHG emissions from the use of fossil fuel #i in (gCO_2/ton dry biomass product)

PV_i is the amount of used fossil fuel #i in (mass or volume unit[1]/ton dry biomass product)

C_i is the GHG intensity of fossil fuel #i in (gCO_2/MJ) in Table 3 (see Annex)

L_i is the lower heating value per mass or volume unit of fossil fuel #i in (MJ/kg or MJ/other specified volume unit) as specified in Table 3 (see Annex).

The total emission from the use of fossil fuel for processing per ton of dry biomass $e_{p,f}$ is calculated as the sum of all $e_{p,f,i}$:

- the use of diesel oil and gasoline is generally reported in the SAR in volume (litres);
- the use of natural gas is generally reported in the SAR as primary energy (in kWhp or MJp) or by volume (in Nm^3 per ton biomass). Corresponding lower heating values shall be used;
- the use of propane is generally expressed in kg but if the use of propane is reported in volume of gaseous propane (Nm^3) or if the use is reported in the volume of liquid propane (m^3), the conversion in kg is performed based on the corresponding standard value for the density.

Some GHG intensities and lower heating values can be found in REDII Annex IX of the Implementing Act. GHG intensity and lower heating value of main fuels are reported in Table 3 (see Annex).

5.4.3 GHG emissions from the use of primary energy from biomass fuels used for drying

There are two methodologies for the calculation of the GHG emissions from the use of biomass fuels for drying.

<u>METHOD 1: amount of biomass fuels used for drying is monitored</u>

The CO_2 emissions and other GHG emissions (CH_4, N_2O) can be calculated from the amount of biomass fuels diverted from biomass feedstock groups or imported from external sources as reported in the SAR. The disaggregated values in Table 5 and Table 6 (see Annex) can be used resp. for biomass briquettes and wood chips.

This method necessitates that the amount of biomass fuels used be monitored, which is not often the case.

<u>METHOD 2: amount of biomass fuels used for drying is not monitored</u>

The amount of water to be evaporated during the drying process is evaluated on the basis of the weighted average of the moisture content of the total feedstock and the achieved moisture content of the dried feedstock, as reported in the SAR.

Where feedstock groups have significant differences in moisture content, it may be appropriate to allocate drying emissions to each feedstock group, in accordance with the energy required to remove water from each group.

To take into account the heat emission from drying the feedstock for each feedstock group, the relative amount of water removed by the drying process may be calculated for each feedstock group.

$$WR_i = M_{fresh,in} - \frac{M_{dry,in,i}}{1 - FM_{wet,out}}$$

Conversion from $M_{fresh,in}$ to $M_{dry,in}$ and from $M_{fresh,out}$ to $M_{dry,out}$ can be made through the following equations if all emissions in gCO_2/MJ are calculated on the basis of wet biomass fuel (not dry):

$$M_{dry,in,i} = M_{fresh,in,i}.\left(1 - IM_{wet,in,i}\right)$$

$$M_{dry,out} = M_{fresh,out,i}.\left(1 - FM_{wet,out}\right)$$

Where

WR_i	is the mass of water removed by drying for feedstock group #i (ton),
$M_{fresh,in,i}$	is the mass of the fresh matter of feedstock group #i as received onsite (ton),
$M_{dry,in,i}$	is the mass of the feedstock group #i at the dryer inlet, on a dry basis (ton),
$FM_{wet,out}$	is the final moisture content at the dryer outlet on a wet basis (%),
$IM_{wet,out,i}$	is the initial moisture content at the dryer inlet of the feedstock group #i, on a wet basis (%).

The amount of heat used for drying the feedstock group #i may be calculated as the ratio of the water removed for that feedstock group to the total water removed for all feedstock groups (sum of all individual water removed amount for each feedstock group). It is calculated as followed:

$$\% \; heat_i = \frac{WR_i}{\sum_{i=1}^{n} WR_i}$$

The sum of all WR_i can be reconverted into the amount of energy needed to evaporate it, through the enthalpy of vaporisation of water ∆Hvap (Latent heat of evaporation for water under standard temperature and pressure = 2.441 MJ/kg).

5.4.3.1 GHG emissions from the use of a burner/boiler

According to METHOD 2, to retrieve the amount of primary energy to produce the amount of energy needed for water evaporation, two efficiency parameters shall be taken into account :

- the efficiency of the dryer and
- the efficiency for the production of the energy carrier (steam, hot water or exhaust gases).

The energy carrier is the transfer medium circulated in pipes and used to transport the heat from the boiler/burner to the dryer, as reported in the SAR. When actual efficiency values are not available for the boiler, the following conservative default values should be used for the related efficiencies:

- dryer: 58%,
- production of hot water energy carrier: 86%,
- production of steam energy carrier: 81%,
- production of exhaust gases energy carrier: 78%.

Primary energy from biomass fuels for drying is calculated by subtracting the primary energy from fossil fuels used for drying as reported in the SAR from the primary energy needed for drying based on the evaporation of moisture.

The CO_2 emissions and other GHG emissions (CH_4, N_2O) can then be calculated from the amount of biomass fuels previously calculated. The disaggregated values in Table 5 and Table 6 (see Annex) can be used resp. for biomass briquettes and wood chips.

For boilers, e_{heat} (emissions from the heat produced by the fuel system) is equal to the sum of the emissions of each fuel types used as primary energy for this fuel system, taking into account the efficiencies detailed previously.

5.4.3.2 GHG emissions from the use of an onsite CHP plant

According to METHOD 2, to retrieve the amount of primary energy needed to produce the amount of energy needed for water evaporation, two efficiency parameters shall be taken into account : the efficiency of production of heat by the CHP and the efficiency of the energy carrier (whether it is steam, hot water or boiler exhaust gases).

The net heat efficiency of the CHP is calculated by considering all useful heat produced by the CHP, but on the basis of the restrictive amount of heat that is effectively used for the specific processing in the biomass plant.

In the SAR report, for the evaluation of the respective net electrical and heat efficiencies from an onsite CHP system, the exported useful heat and the electricity exported back to the grid or a third-party customer is not deduced from resp. the total electricity output and the total useful heat output.

When actual efficiency values are not available, the following conservative default values should be used:

- dryer: 58%,
- CHP net heat production efficiency: 55%,

The amount of other fuel types used for drying (such as fossil fuels), as reported in the SAR, shall be subtracted from the amount of primary energy needed for the CHP. The remaining amount of primary energy is assumed to be the amount of biomass fuels used in the CHP. The CO_2 emissions and other GHG emissions (CH4, N2O) can then be calculated from the amount of biomass fuels previously calculated. The disaggregated values in Table 5 and Table 6 (see Annex) can be used resp. for biomass briquettes and wood chips.

For each CHP system, the GHG emissions from the electricity used for processing is calculated by only considering the share of electricity produced by the CHP that is used for the sake of that specific biomass processing:

$$e_{p,CHP,e} = 3{,}6\,.\,CP.\,P_{CHP}$$

Where

CP is defined according to 5.4.1 in function of the connection of the CHP to the grid,

P_{CHP} is the share of the net power produced by the CHP that is used for the biomass processing.

The proportion of $e_{d,h}$ allocated to each feedstock group per ton of dry biomass ($e_{p,d,i}$ in $gCO_{2,eq}$/dry-ton of biomass) is calculated as followed :

$$e_{p,d,i} = \frac{e_{d,h}}{M_{dry,out,i}}.\%\,heat_i$$

Note that $e_{d,h}$ can be calculated back with a weighted average of all $e_{p,d,i}$ by the $M_{dry,out,i}$.
Finally, the emission from the heat used for drying for each feedstock group $e_{p,d,i}$ per MJ of biomass can be calculated by dividing the $e_{p,d,i}$ per ton of dry biomass by the lower heating value of the biomass.

5.4.4 GHG emissions from binder/chemical

When relevant, the amount of binders or chemicals used shall be reported in the SAR (in tons).

If the type of binders is unspecified, the emission factor of lubricants of 947 gCO_2/kg binder[2] shall be used as a proxy conservative emission factor to calculate the emission from binder/chemicals.

[2] Biograce-II, version 4a

The emission $e_{p,bc}$ in $gCO_{2,eq}$ per ton of dry biomass is calculated as followed ($M_{dry,out}$ being the total mass of biomass) :

$$e_{p,bc} = \frac{M_{binder/chemicals} . 947.1000}{M_{dry,out}}$$

Please note that the emission factor for binders may by subject to revision by the European Commission in future. Any update by the European Commission will become valid under SBP requirements. It is the responsibility of the auditor to check that the economic operators are using the most up to date emission factor.

5.4.5 Total GHG emissions for processing the biomass

All final emissions described in sections 5.4.1 to 5.4.4 shall be summed to calculate the total GHG emissions for processing the biomass in $gCO_{2,eq}$ per ton of dry biomass $e_{p,m}$: the GHG emissions from electricity use (from the grid and/or from a CHP), the GHG emissions from the use of fossil fuels and the GHG emissions from the use of biomass fuel.

When calculating the GHG emissions for processing, the calculation rules specified in Section 5.10 (allocation factor) shall be followed.

5.4.6 Calculation rules for producing excess electricity and/or excess useful heat

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

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

where

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

T_0 =Temperature of surroundings, set at 273,15 kelvin (equal to 0 °C). If the excess heat is exported for heating of buildings, at a temperature below 150 °C (423,15 kelvin),

C_h can alternatively be defined as follows: Ch =Carnot efficiency in heat at 150 °C (423,15 kelvin), which is: 0,3546 For the purposes of that calculation, the actual efficiencies shall be used, defined as the annual mechanical energy, electricity and heat produced respectively divided by the annual energy input.

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

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

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

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

5.5 Emissions from transport e_{td}

The emissions from transport are separated into three categories 1a, 1b, 2 of transportation:

1. Inland transport
    a. of the feedstock to the biomass production plant,
    b. of the biomass product.
2. Marine transport of the biomass product.

The GHG emission calculation is similar per vehicle type. But for inland transport of the feedstock this calculation is made for each feedstock group (per ton of wet feedstock) and converted per ton of dry product, while for inland transport of the biomass product it is calculated once for the whole product tonnage.

The GHG calculations per transport system are detailed in the following sections.

For each vehicle, the backhaul factor takes into account the fact that the vehicle does not return fully loaded. The backhaul factor b varies according to the situations:

- If the vehicle returns fully loaded then b = 1;
- If the vehicle returns empty then b =0.5, meaning the energy use of the vehicle is doubled,
- If the vehicle returns loaded at 50% of its capacity then b = 0.75.

For example, for marine transport, if the sea vessel is completely loaded for its first journey (one journey being 50% of the whole trip to consider) from USA to Europe, but then returns only loaded with 30% of its full loading capacity, the backhaul factor would then be 0.65 (obtained through 0.5 + 0.3*0.5).

5.5.1 Generalities for inland transport

For the transportation of the feedstock to the biomass plant, the vehicle types can be one of the following: diesel truck, bulk carriers, diesel train, electric train and river flatboat. The use of bulldozers for the handling on site must be included within the fuels used for processing.

The Certificate Holder can calculate the energy consumption (EnC in kWh/ton raw feedstock wet), from the reference values published by JRC.

$$EnC_i = \frac{d_i.L_i.G_i}{3{,}6.b_i.p_i}$$

with

d_i is the weighted average distance covered by the vehicle type #i (in km)

L_i is the lower heating value of the fuel used in vehicle type #i (in MJ/l) in Table 4,

G_i is the fuel consumption of the vehicle type #i (in l/km).

p_i is the actual payload of the vehicle type #i (in MJ/t.km), as documented in the SAR see Table 1.

b_i is the backhaul factor of the vehicle type #i (between 0.5 and 1).

Once the energy consumption is calculated, it can be converted into GHG emissions per ton of material transported (being raw wet feedstock or dry biomass product) as followed:

$$e_{td,i} = EnC.3{,}6.C_i$$

Where C_i is the GHG intensity of the fuel used in vehicle type #i (in gCO_2/MJ) in Table 4.

Because transport of feedstock is evaluated in [gCO_2/ton dry feedstock] a conversion rate, CR, needs to be applied to enable a value to be expressed in [gCO_2/ton dry biomass]. The reduction in weight between raw material and biomass is caused by the drying process. Hence, this conversion rate is given by following formula:

$$CR = \frac{1 - IM_{wet}}{1 - FM_{wet}}$$

with the following values as stated in "3.3. Moisture content and drying" of the SAR:

FM_{wet} Final moisture (wet basis)

IM_{wet} Initial moisture (wet basis)

For the initial moisture, the Certificate Holder has to specify the origin of the figure (it can be a rough estimation based on the typical moisture contents of the raw material, it can be based on a couple of punctual measurements, and, when available, it can be based on the weighted average of all moisture measurements performed of each entering batch of raw material during the reference period). The final moisture is based on specifications, and the values are as stated in "3.3. Moisture content and drying" of the SAR of Standard 5. Note: The typical range is 5-8%.

The GHG emissions from transportation of feedstock to the Biomass plant [gCO_2/ton feedstock] are then converted into [gCO_2/ton biomass] as follows:

$$e_{td,i/biomass} = \frac{e_{td,i/raw}}{CR}$$

5.5.2 Road transport by diesel truck

The REDII reference of energy use is 0,81 MJ/t.km. It considers a diesel truck with a payload (truck capacity) of 40 ton of raw feedstock. The default backhaul factor is 0.5 (the truck returns empty).

When the payload of the diesel truck communicated in the SAR or in the SREG is significantly different from 40 ton, the Certificate Holder can propose a method for estimating its fuel consumption based on actual values.

Fuel consumption *G* (l/100 km)	Fuel consumption per ton km estimation (l/t.km)	Fuel efficiency equivalent estimation (MJ/t.km)
-	-	*0.81*

Table 1– Fuel efficiencies of diesel trucks, from the standard value of REDII (reference payload of 40 ton)

When the Certificate Holder do not have access to the verifiable backhaul factor, the factor for trucks shall be 0.5. The Certificate Holder may use an actual backhaul factor based on measurements if they can provide adequate documentation to the certification body.

5.5.3 Transport by river flatboats

In the case that the transport is by river flatboats, the standard value of 0.32 MJ/t.km shall be applied (see values in Table 4 in Annex).

The default backhaul factor for river flatboats shall be 0.5.

The Certificate Holder can use other values if he can document it for the verification by the certification body.

5.5.4 Transport by diesel train

In the case that the transport is by diesel train, the reference energy use is 0.25 MJ/t.km.

The default backhaul factor for diesel trains shall be 0.5.

5.5.5 Transport by electric trains

In the case that transport is made by electric train, the reference energy use should be applied. The value for C_i is here the relevant CP, GHG intensity in gCO_2/MJ of electricity in the country of origin as described in section 5.4.1.

The default backhaul factor for electric trains shall be 0.5.

5.5.6 Marine transport of the biomass

To calculate the emissions of marine transport the Certificate Holder shall use the data reported in the SAR or the SREG in terms of:

- Distance of transport between port of departure and port of arrival.
- Deadweight tonnage and stowage factor resulting in effective tonnage of biomass product transported,
- Fuel consumption in metric ton of fuel for a single voyage,
- Applicable backhaul factor between 0.5 and 1.

SEA VESSELS	Speed mode	Ballast Speed (knots)	Fuel type	Fuel use[3] (t/day)	Dead weight tonnage (t)	Net pellets payload[4] (t)	%dwt according to stowage factor
Coaster	Speed	10.0	LMSGO	6.0	4000	3000	75%
Handysize 28k dwt vessel	Full Speed	14.0	VLSFO	22.0	28000	21000	75%
	Eco Speed	12.0	VLSFO	15.5			
Handysize 38k dwt vessel	Full Speed	14.0	VLSFO	24.0	38000	28500	75%
	Eco Speed	12.0	VLSFO	17.0			
Supramax 58k dwt vessel	Full Speed[5]	14.0	VLSFO	32.0	60000	45000	75%
	Eco Speed	12.5	VLSFO	23.0			
Panamax 82k dwt vessel	Full Speed	14.0	VLSFO	31.0	82000	61500	75%
	Eco Speed	12.5	VLSFO	23.0			

Table 2: Indicative heavy fuel oil daily use for various sea vessel types at different speed modes
(Source : Laborelec, data from transporters, can be used for the verification of data in SAR or SREG)

For checking the fuel consumption, the certification body shall verify

1. The order of magnitude of the sea vessel data in SAR or SREG against the references given in Table 2: by default the full speed mode is referenced, except if the Certificate Holder can prove that eco speed mode is used;
2. the route that the sea vessel uses in terms of distance and number of days of sea: the CB may use a tool like https://sea-distances.org/ specifying Port of Departure, Port of Arrival and the vessel speed (in knots) according to Table 2.

[3] Consumption of low sulphur fuel oil (VLSFO), in tons per day at sea.
[4] The net pellets payload (in tonne) is derived from the storage factor of pellets (inverse of their density), multiplied by the dead weight tonnage (dwt, in tonne). Note that JRC noticed that most of the SUPRAMAX carriers are designed with a stowage ration of about 0.75, which means that also the density of pellets (ca. 650 kg/m3) is not enough to guarantee a weight-limited cargo but it will be volume-limited. See https://op.europa.eu/en/publication-detail/-/publication/1893b3a1-3f61-11e7-a08e-01aa75ed71a1 for details.
[5] This option Supramax Full Speed corresponds to the default value E1 mentioned in Table 4 (taking into account the rounding of the values in this table).

If the Port is not in the list, the closest geographic Port in the list is used. Note: this sometimes results in several possible routes, such as via the Suez Canal or via Panama Canal. The route is selected according to the distance recorded in the SREG.

The conversion of the distance in nautical miles obtained through this kind of suitable tools to the distance in km (to be input into the energy and emission calculations) shall be made as followed:

$$d_{km,i} = d_{km,i} \cdot 1.852$$

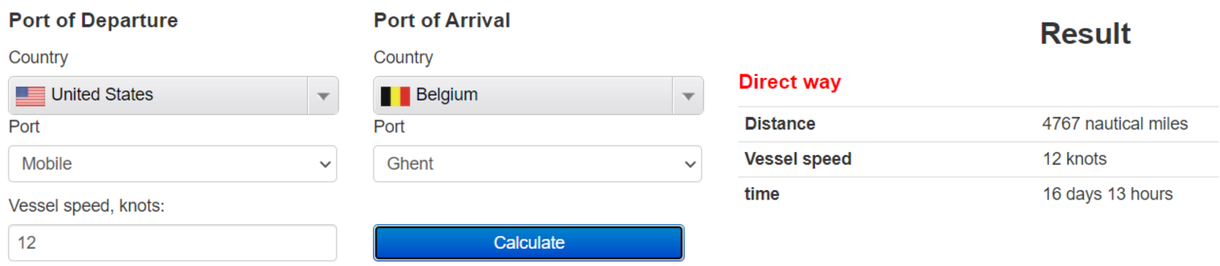

Figure 1 - Route between the port of Mobile, USA and Ghent, BE with Eco speed

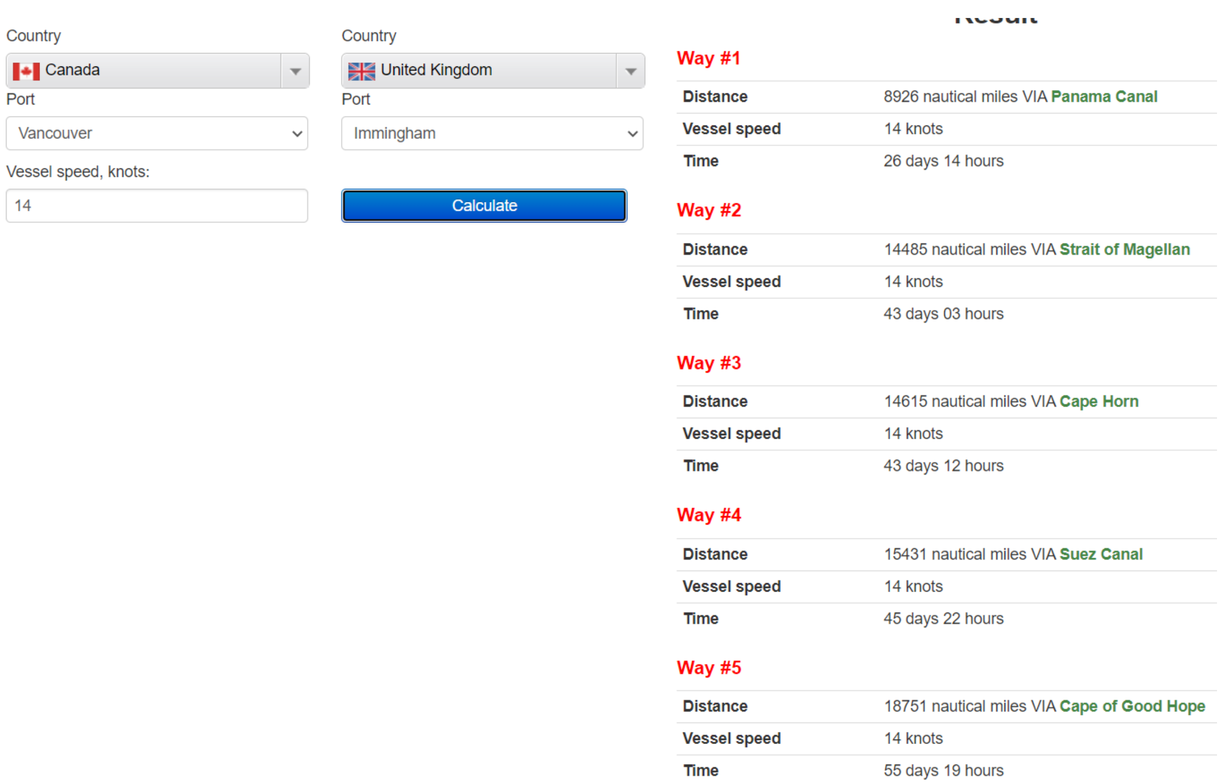

Figure 2 - Distance for the route between the port of Vancouver, BC, Canada and Immingham, UK via Panama Canal is 8926 nautical miles.

The conversion of the time in days-hours obtained through this kind of suitable tools to decimal time (used in the emission calculations) shall be made as followed:

$$time = \#days + \frac{\#hours}{24}$$

The reference energy use of the sea vessel is obtained by multiplying the decimal time ($time$) spent at sea with the appropriate LSFO consumption (in Table 2) and with the appropriate backhaul factor.

When the Certificate Holder does not have access to the actual backhaul value, it is not mentioned in the SREG or the SAR, and the default backhaul factor to be considered for marine transport shall be of **70%** as proposed by JRC[6]. The Certificate Holder can use a backhaul factor in the SREG or in the SAR calculated on the basis of actual data if he can document it for the sake of the verification by the certification body.

5.5.7 Total transport emissions

The total GHG emissions for transportation e_{td} (in $gCO_{2,eq}$/dry-ton of biomass) is calculated as the sum of all transportation emissions (per tons of dry biomass), divided by the lower heating value of biomass ($L_{dry,out}$) as followed:

$$e_{td} = \frac{\sum e_{td,i}}{L_{dry,out}}$$

When calculating the GHG emissions for transport, the calculation rules specified in Section 5.10 (allocation factor) shall be followed.

5.6 Emissions from the fuel in use e_u

GHG emissions from fuel in use, e_u, shall be taken to be zero for biomass product (pellets).

Emissions of non-CO_2 gases (CH_4 and N_2O) from the fuel in use shall be included in the e_u factor and taken equal to 0.3 gCO_{2eq}/MJ for pellets according to Table 5 (see Annex) and 0.5 gCO_{2eq}/MJ for wood chips according to Table 6 (see Annex).

The emissions from the fuel in use e_u (in gCO_{2eq}/MJ biomass) shall be selected from the disaggregated default value for non-CO_2 emissions in Table 5 and 6 (see Annex).

[6] JRC (2017 v2) Solid and gaseous bioenergy pathways: input values and GHG emissions p212. https://op.europa.eu/en/publication-detail/-/publication/1893b3a1-3f61-11e7-a08e-01aa75ed71a1
Note that JRC defines a capacity factor CF = (1 - backhaul factor), and decides to use CF=30% as default value based on several references.

5.7 Emission savings from soil carbon accumulation via improved management e_{sca}

By default, the emission savings from soil carbon accumulation via improved agricultural management e_{sca} is set to 0. This is a conservative approach. These emission savings could only apply to particular cases of plantations or of short rotation coppices.

For the purposes of the calculation referred to in point 4.3 above (EQUATION 1), emission savings from improved agriculture management, e_{sca}, such as shifting to reduced or zero-tillage, improved crop/rotation, the use of cover crops, including crop residue management, and the use of organic soil improver (e.g. compost, manure fermentation digestate), shall be taken into account only if solid and verifiable evidence is provided that the soil carbon has increased or that it is reasonable to expect to have increased over the period in which the raw materials concerned were cultivated while taking into account the emissions where such practices lead to increased fertiliser and herbicide use ([7]).

Economic operators seeking to claim emission savings from soil carbon accumulation via improved agricultural management (esca) in terms of g CO_2eq/MJ biomass fuel should use the following formula to calculate their actual values:

$$e_{sca} = (CS_R - CS_A) \times 3.664 \times 1n \times 1P - e_B$$

Where:

CS_R is the mass of soil carbon stock per unit area associated with the reference crop management practice.

CS_A is the mass of soil estimated carbon stock per unit area associated with the actual crop management practices after at least 10 years of application.

3.664 is the quotient obtained by dividing the molecular weight of CO2 (44.010g/mol) by the molecular weight of carbon (12.011g/mol).

n is the period (in years) of the cultivation of the crop considered.

P is the productivity of the crop (measured as biomass fuel per unit area per year).

e_B is a bonus of 29g CO_2eq/MJ biomass fuel if biomass is obtained from restored degraded land.

The entire area for which the soil carbon stocks are calculated shall have a similar climate and soil type as well as similar management history in terms of tillage and carbon input to soil.

To claim emissions savings from soil carbon accumulation via agricultural management (e_{sca}), measurements of soil carbon stocks should be performed by certified laboratories and samples should be retained for a period of at least 5 years for auditing purposes.

[7] Measurements of soil carbon can constitute such evidence, e.g. by a first measurement in advance of the cultivation and subsequent ones at regular intervals several years apart. In such a case, before the second measurement is available, increase in soil carbon would be estimated on the basis of representative experiments or soil models. From the second measurement onwards, the measurements would constitute the basis for determining the existence of an increase in soil carbon and its magnitude.

Measurements should be carried out at farm level before the management practice changes in order to establish a baseline, and then at regular intervals no later than 3 years apart. To ensure reduced year-to-year fluctuations in the measured soil carbon stocks and to reduce associated errors, fields that have the same soil and climate characteristics may be grouped, including those fields belonging to different farmers.

The use of modelling is permitted only between the first and second soil field measurement. The models used shall take into account the different soil, climate and field management history. Economic operators are obliged to demonstrate that the use of the selected model is appropriate for their agro-ecological zone. If modelling is used, the time period between the first two soil measurements may be extended to 5 years. However, the related final actual values shall be established based on the soil measurement results.

A long-term commitment by the farmer or economic operator to continue applying the improved management practice for a minimum of 10 years shall be required by voluntary schemes in order for GHG emission savings to be taken into account. Failure to meet this criterion will lead to all esca values for the farmer or economic operator being added as emissions to the overall GHG emissions of the energy crop delivered, instead of being deducted as a GHG emission saving. In addition, a continuous minimum period of 3 years for the application of the improved management practice shall be required before a claim can be made.

The following rules shall be applied to sampling:

1. Representative sampling method:

    (a) sampling shall be made for each plot or field;

    (b) at least one grab sample of 15 well distributed sub-samples per hectare or per field, whichever is smaller (taking into account the heterogeneity of the plot's carbon content), shall be taken;

    (c) sampling shall be done either in spring before soil cultivation and fertilisation or in autumn, a minimum of 2 months after harvest;

    (d) direct measurements of soil carbon stock changes shall be taken for the first 30 cm of soil;

    (e) the points of the initial sampling to measure the baseline of soil carbon stocks shall be used under identical field conditions (especially soil moisture);

    (f) The sampling protocol shall be well documented.

2. Measurement of the soil carbon content:

    (a) soil samples shall be dried, sieved, and if necessary grounded;

    (b) if the combustion method is used, inorganic carbon shall be excluded.

3. Determination of dry bulk density:

    (a) changes in bulk density over time shall be taken into account;

    (b) bulk density should be measured using the tapping method, that is to say by mechanically tapping a cylinder into the soil, which greatly reduces any errors associated with bulk density measurement;

    (c) if the tapping method is not possible, especially with sandy soils, a reliable method shall be used instead;

(d) samples should be oven-dried prior to weighing.

5.8 Emission savings from CO_2 capture and geological storage e_{ccs}

By default, the emission savings from CO_2 capture and geological storage e_{CCS} is set to 0. This is a conservative approach. The Certificate Holder can also calculate the emission saving from carbon capture and geological storage e_{ccs}.

Emission savings from CO_2 capture and geological storage, e_{ccs}, that have not already been accounted for in e_p, shall be limited to emissions avoided through the capture and storage of emitted CO_2 directly related to the extraction, transport, processing and distribution of biomass fuel if stored in compliance with Directive 2009/31/EC.

Emission savings from CO_2 capture and geological storage (e_{ccs}) may only be taken into account where there is valid evidence that CO_2 was effectively captured and safely stored. Where the CO_2 is directly stored, voluntary schemes shall verify whether the storage facility is in good condition and without leakages. In case of leakages, the storage facility shall ensure that any leakage does not exceed the current state of technology. Where the CO_2 is sold for storage, proof of storage may be provided through the relevant contracts and invoices from a professional recognised storage company.

The following formula shall be used to calculate e_{ccs} (in g CO_2eq per MJ fuel):

$$e_{ccs} = \frac{\text{quantitiy produced } CO_2\,[t] - \text{energy consumed } [MWh] \times EF\left[t\frac{CO_2eq}{MWh}\right] - \text{auxiliary materials consumed } [t] \times EF\left[t\frac{CO_2eq}{t}\right]}{\text{produced quantity of biomass fuel } [t] \times \text{lower calorific value biomass fuel } \left[\frac{GJ}{t}\right]} \times 1000$$

5.9 Emission savings from CO_2 capture and replacement e_{ccr}

By default, the emission savings from CO2 capture and replacement e_{ccr} is set to 0. This is a conservative approach. The Certificate Holder can also calculate the emission saving from carbon capture and replacement e_{ccr}.

Auditors shall verify that the estimate of emissions saving from capture and replacement of CO_2 is 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. That verification requires access to the following information:

(a) the purpose for which the captured CO_2 is used;

(b) the origin of the CO_2 that is replaced;

(c) the origin of the CO_2 that is captured;

(d) information on emissions due to capturing and processing of CO_2.

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

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

The emission savings e_{ccr} [g CO_2eq/MJ biomass fuel] are calculated as follows:

$$e_{ccr} = \frac{\text{quantity produced } CO_2\ [\text{t}] - \text{energy consumed } [\text{MWh}] \times \text{EF}\left[\text{t}\,\frac{CO_2\text{eq}}{\text{MWh}}\right] - \text{auxiliary materials consumed } [\text{t}] \times \text{EF}\left[\text{t}\,\frac{CO_2\text{eq}}{\text{t}}\right]}{\text{produced quantity of biomass fuels } [\text{t}] \times \text{lower calorific value biomass fuel}\left[\frac{\text{GJ}}{\text{t}}\right]} \times 1000$$

5.10 Allocation of the GHG emissions

5.10.1 Feedstock factors

All information that is relevant for establishing compliance with the EU sustainability criteria for biomass fuels must be transmitted through the chain of custody. This includes information on GHG emissions. The following describes what kind of information must be submitted and which units have to be used.

In order to establish whether the minimum GHG emissions savings have been achieved, GHG emissions from biomass fuels production are compared to the relevant fossil fuel comparator. GHG emissions are measured in this context in the unit CO_2eq/MJ of biomass fuel. Hence, for final biomass fuel GHG emissions have always to be reported in this unit. The situation is different for raw materials and interim products though. In case actual values are calculated for raw materials and interim products, farmers for example, cannot report cultivation GHG emissions in the unit CO_2eq/MJ of biomass fuel because this would require knowing how efficiently these are converted into final biomass fuels. <u>Instead, for raw materials and interim products, information on GHG emissions has to be provided in the unit g CO_2eq/dry-ton feedstock or g CO_2eq/dry-ton intermediary product, respectively.</u> To receive information on emissions per dry-ton feedstock the following formula has to be applied:

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

The moisture content should be the value measured after delivery, or, if this is not known, the maximum value allowed by the delivery contract.

Information on GHG emissions must include accurate data on all relevant elements of the emission calculation formula. As explained above, when default values are used, information on GHG emissions should be only reported for final biomass fuel and can be reported as an aggregate. When actual values are calculated, it is necessary to split the total amount of emissions into all elements of the GHG emission calculation formula that are relevant. This measure is required to ensure transparency and robustness of the calculation of actual GHG emissions, particularly, having in mind that certified material can be exchanged between schemes. If only aggregated values were used, it would not be sufficiently transparent which elements of the GHG emission calculation formula are comprised in the transmitted value. This would be in particular problematic at later stages of the chain of custody when it still could be decided to use disaggregated default values of individual elements of GHG emissions calculation formula.

In case actual values are not used, information on the amount of GHG emissions should not be transmitted through the chain of custody (before the last processing step) as it would be difficult to know at later stages of the chain of custody whether these emissions represent actual values or are derived from (disaggregated) default values. Furthermore, it would unnecessarily increase the administrative burden. Therefore, it is the responsibility of downstream operators to include information concerning the (disaggregated) default GHG emission values for the final biomass fuels when reporting to the Member States.

Adjusting GHG emissions estimates throughout the chain of custody

Whenever actual values are calculated at each step of the chain of custody, the additional emissions from transport and/or processing need to be added to e_p and/or e_{td}, respectively. Whenever a processing step yields co-products, emissions need to be allocated as set out in the GHG emission calculation methodology. Put more formally, the following formula should be applied 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

$$Allocation\ factor\ intermediate\ product\ _a = \left[\frac{Energy\ in\ intermediate\ product_a}{Energy\ in\ intermediate\ \ product\ and\ co-products}\right]$$

$$Feedstock\ factor_a = [Ratio\ of\ kg\ dry\ feedstock\ required\ to\ make\ 1\ kg\ dry\ intermediate\ product]$$

Where the greenhouse gas emissions from the extraction or cultivation of raw materials e_{ec} are expressed in unit g CO_2eq/dry-ton of feedstock, the conversion to grams of CO2 equivalent per MJ of fuel, g CO_2eq /MJ, shall be calculated as follows:

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

Where

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

$$Fuel\ feedstock\ factor_a = [Ratio\ of\ MJ\ feedstock\ required\ to\ make\ 1\ MJ\ fuel]$$

Fuel feedstock factors define how many MJ of feedstock is required per MJ of dry biomass product.

For the calculation of the feedstock factor, the low heating value, which relates to the dry matter, must be used. This approach is also used to calculate default values. The low heating value in relation to the dry matter does not take into account the energy needed to cause the water in the wet material to evaporate, as this is separately accounted in 5.4.3.

The GHG emission contribution for each module of the supply chain is calculated by multiplying the total emissions for each module, calculated in accordance with sections 5.2 to 5.5 of this document, by all downstream feedstock factors.

5.10.2 Allocation factor

If there are co-products generated besides the biomass product, GHG emissions need to be allocated between the biomass product and the associated co-products. The allocation factor fuel AF should multiply the corresponding GHG emissions:

$$AF = \frac{Energy\ in\ biomass\ product}{Energy\ in\ biomass\ product + Energy\ in\ co\ products}$$

For the calculation of the allocation factor, the lower heating value for the whole biomass product and the co-products must be used.

Allocation of GHG emissions shall take place at every processing step in the supply chain where a co-product(s) is produced. The GHG emissions up to this processing step shall be distributed to the main product and the co-product proportional to their energy content and weight. GHG emissions downstream of the processing step (e.g. further downstream processing or transport & distribution) shall not be included in the allocation, as these emissions are not related to the co-product.

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

5.10.3 GHG emissions for the end-use of the biomass product

In the general case of a cogeneration plant, the GHG emissions must be separately allocated resp. to electricity and heat according to plant resp. electrical efficiency (η_{el}) and heat efficiency (η_h) on the basis of exergy. This leads to EQUATION 2 expressing those respective allocated GHG emissions for electricity EC_{el} and heat EC_h.

The electrical efficiency (η_{el}) of the energy plant is calculated as the net electricity produced during the period of the past 12 months divided by the total energy input (fuel consumption during that same period, based on its energy content), where all quantities are taken from official production reporting towards the authorities of the relevant Member State.

The heat efficiency (η_h) of the energy plant is calculated as the net useful heat output during the period of the past 12 months divided by the total energy input (fuel consumption during that same period, based on its energy content) where all quantities are taken from official production reporting towards the authorities of the relevant Member State.

For energy installations delivering useful heat together with electricity and/or mechanical energy, two other terms are needed. The first one, C_{el}, is the fraction of exergy in the electricity, and/or mechanical energy (set to 100% = 1) of the energy installation. The second one, C_h, is the Carnot efficiency of the energy installation, which is

- calculated as followed if T_h (in K, kelvin) is above 150°C (with T_0 being set at 273.15 K),

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

- set to 0.3546 if T_h is below 150°C.

GHG emissions from the use of biomass product for electricity, heating and cooling, including the energy conversion to electricity and/or heat or cooling produced, shall be calculated as follows:

a) For energy installations delivering only heat:

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

b) For energy installations delivering only electricity:

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

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

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

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

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

5.11 EQUATION 2 – GHG savings from the Fossil Fuel Comparator

GHG savings for final energy (electricity, heating or cooling) production can be calculated as follows[8] :

$$SAVING = (EC_F - EC_B)/EC_F,$$

where

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

EC_F = total emissions from the fossil fuel comparator for useful heat or electricity

REDII Annex VI, part B, point 19 must be used to evaluated EC_F , as follows:

- for a biomass product used for the production of electricity, the fossil fuel comparator EC_F shall be 183 $gCO_{2,eq}$/MJ electricity or 212 $gCO_{2,eq}$/MJ electricity for the outermost regions.
- for a biomass product used for the production of useful heat, as well as for the production of heating and/or cooling, the fossil fuel comparator EC_F shall be 80 $gCO_{2,eq}$/MJ heat .
- for biomass product used for the production of useful heat, in which a direct physical substitution of coal can be demonstrated, the fossil fuel comparator EC_F shall be 124 $gCO_{2,eq}$/MJ heat.
- for a biomass product used as transport fuels, the fossil fuel comparator EC_F shall be 94 $gCO_{2,eq}$/MJ.

The greenhouse gas emission savings from the use of biomass product taken into account for the purposes referred to in paragraph 1 of the RED-II shall be:

- at least 70% for electricity, heating and cooling production in installations starting operation from 1 January 2021 until 31 December 2025, and
- 80% for installations starting operation from 1 January 2026.

[8] RED-II Annex VI-B-3

6 Certification and auditing of actual GHG emission calculations

6.1 SBP shall provide to the European Commission timely access to GHG calculations certified under their scheme, upon request.

6.2 The Certificate Holder can only make GHG values claims after the capability to conduct GHG emissions values calculations has been verified by an accredited certification body during an audit.

6.3 SBP shall require that the Certificate Holder makes available to the certification body all relevant information concerning the calculation of GHG emissions in advance of the planned audit. This includes input data and any relevant evidence, information on the emission factors and standard values applied and their reference sources, GHG emission calculations and evidence relating to the application of GHG emission saving credits (e.g. e_{csa}).

6.4 The auditor shall record the calculated GHG emissions in the audit report. For the processing of final fuels, the auditor shall record the GHG emissions after allocation and the achieved savings. Should the emissions deviate significantly from typical values the report shall include information that explains the deviation.

6.5 Calculations are carried out by Certificate Holders, saving can only be calculated by End-users. Other actors in the supply chain (Biomass Producers and traders) must follow requirements of SBP Instruction Document 5E and provide actual energy and transportation data (actual values) using the SBP SAR and SREG reports.

6.6 The Certification Body shall follow relevant requirements of Standard 3 and related normative interpretations when auditing the Certificate Holder against this document.

6.7 For the certification of the Certificate Holder against this document, the CB shall ensure that the audit team undertaking an audit has the combined necessary knowledge and experience to:

- understand, analyse and check the inventory of energy consumptions involved in a biomass supply chain,
- understand, analyse and check the inventory of GHG emissions involved in the biomass supply chain,
- understand, analyse and check the legal sustainability requirements applicable to the CH in the relevant region.

6.8 The CB must prepare an evaluation report, which covers all relevant SBP requirements.

6.9 The auditor shall have the appropriate specific skills necessary for conducting the audit related to REDII GHG criteria (GHG emission calculation at the End-User level):

- a minimum of two years' experience in biomass fuels life-cycle assessment, and specific experience in auditing GHG emission calculations following the RED/REDII calculation methodology. Relevant experience depending on the type of audits to be conducted by the individual auditor.

7 Annex

7.1 Standard values for fossil fuels, wood chips and wood pellets

Table 3 gives the reference low heating values and GHG intensities of main fuels. Full list of values is available in Annex IX of the Commission Implementing Regulation (EU) on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria.

Fuel type	Units	Energy	gCO_2/MJ
HFO	MJ/kg	40,5	94,2
diesel	MJ/kg	43,1	95,1
gasoline	MJ/kg	43,2	93,3
natural gas (EU mix)	MJ/kg	49,2	66,0
LPG	MJ/kg	46,0	66,3
wood chips	MJ/kg	19	-
wood pellets	MJ/kg	19	-

Table 3. Lower heating values and GHG values per type of fuel from REDII

7.2 Standard values for transport

Table 4 gives the energy intensities of the main transport types as provided by REDII. Full list of values is available in Annex IX of the Commission Implementing Regulation (EU) on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria.

Transport type	Fuel type	Energy MJ/t.km
'Supramax' bulk carrier (fuel oil) - pellets with bulk density 650 kg/m3	HFO	E1 = 0,07
Inland bulk carrier, 8.8 kt (diesel)	diesel	E2 = 0,32
Freight train USA (diesel)	diesel	E3 = 0,25
Electric train	electricity	E4 = 0,21
Truck (40 tonne) for dry product (Diesel)	diesel	E5 = 0,811

Table 4. Standard energy and GHG values per type of transport from REDII

7.3 Disaggregated default values for biomass production system

Biomass production system	Cultivation	Non CO_2	Total emission factor
	gCO_{2eq}/MJ	gCO_{2eq}/MJ	gCO_{2eq}/MJ
Wood briquettes or pellets from forest residues	0,0	0,3	**0.3**
Wood briquettes or pellets from stemwood	1,4	0,3	**1.7**
Wood briquettes or pellets from wood industry residues	0,0	0,3	**0.3**

Table 5: GHG emissions resulting from the cultivation and non CO_2 emissions for briquettes and pellets made out of forest residues, stemwood and industry residues from RED-II Annex VI C

Biomass production system	Cultivation	Processing	Transport on less than 500 km	Non CO_2	Total emission factor
	gCO_{2eq}/MJ	gCO_{2eq}/MJ	gCO_{2eq}/MJ	gCO_{2eq}/MJ	gCO_{2eq}/MJ
Wood chips from forest residues	0,0	1,9	3,6	0,5	**6.0**
Wood chips from stemwood	1,1	0,4	3,6	0,5	**5.6**
Wood chips from wood industry residues	0,0	0,4	3,6	0,5	**4.5**
Wood chips from SRC (eucalyptus)[9]	4,4	0,0	13,2	0,5	**18.1**
Wood chips from SRC (poplar, fertilised)	3,9	0,0	4,2	0,5	**8.6**
Wood chips from SRC (poplar, non-fertilised)	2,2	0,0	4,2	0,5	**6.9**

Table 6: GHG emissions resulting from the cultivation, processing, transport and non-CO2 emissions for the wood chips used for drying the feedstock for the biomass from RED-II Annex VI C

REDII Annex VI C shall be used to provide disaggregated default values for biomass fuels.

The most common disaggregated default values for biomass fuels are shown in Table 5 and Table 6 above. When different values are available (for default values for cultivation), the more conservative one is shown in those tables.

The transport values in Table 6 shall only be used when the average weighted transport distance is shown to be less than 500 km. Otherwise the corresponding value from REDII Annex VI C shall be used.

[9] Transport distance for wood chips from SRC of Eucalyptus is considered to be between 2 500 and 10 000km.