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ANNEX

ANNEX

to the

Commission Delegated Regulation

supplementing Regulation (EU) 2024/3012 of the European Parliament and of the Council by establishing the certification methodologies for permanent carbon removals activities

ANNEX

Contents

DEFINITIONS

For the purposes of this Annex, the following definitions shall apply:

(1) 'associated GHG emissions' means the increase in direct and indirect greenhouse gas emissions over the entire lifecycle of the activity which are attributable to its implementation;

(2) 'capital emissions' means the emissions associated with the construction of facilities and equipment associated with an activity;

(3) 'captured CO_2' means CO_2 captured and concentrated from a point source of CO_2 or from the atmosphere;

(4) 'capture facility' means a facility that captures CO_2 from the atmosphere or from a biogenic-CO_2 containing stream and conditions it to a form that is ready to be transported or stored, including in terms of CO_2 purity and pressure;

(5) 'certification period' means the period between a re-certification audit of an activity and the most recent preceding certification audit or re-certification audit of that activity;

(6) 'CO_2 fugitives' means any irregular or unintended CO_2 emissions from sources that are not localised, or are too diverse or not substantial enough to be monitored individually;

(7) 'CO_2 venting' means an intentional release of CO_2 occurring for operational or safety reasons;

(8) 'exit point' means a point at which CO_2 is transferred out of the capture facility for the purpose of either transport or storage , which excludes any smokestack, flue or other outlet at the capture facility from which CO_2 is released into the atmosphere;

(9) 'permanent geological storage' means storage of CO_2 in a geological storage site permitted under Directive 2009/31/EC;

(10) 'point source of CO_2' means a natural or anthropogenic source of gases that has a CO_2 concentration higher than that in the free atmosphere due to the generation of CO_2 by an oxidation process or other chemical process or the release of CO_2 from some form of storage or containment;

(11) 'storage facility' means a facility that receives captured CO_2 and injects it into a storage site;

(12) ‘useful heat’ means heat generated to satisfy an economically justifiable demand for heat, for heating or cooling purposes.

1. DESCRIPTION OF THE CARBON REMOVAL ACTIVITY

1.1. Eligibility

1.1.1. Carbon removal activities with CO2 capture and geological storage

Operators of DACCS or BioCCS activities shall be the capture facilities.

DACCS and BioCCS activities may transfer all or part of the captured CO_2 to storage sites for permanent storage to generate permanent carbon removal units. If part of the captured CO_2 is transferred for utilisation or is transferred for storage but recognised under an alternative framework, no permanent carbon removal units will be generated in respect of that fraction of the CO_2.

1.1.2. Biochar carbon removal activity

A BCR activity shall consist of biochar production at one or more biochar production facilities that are owned by the same legal entity and that apply the same biochar production technology as each other. Biochar produced at different locations may never be assigned to the same production batch (see Section 2.2.5.1) even if the feedstock and production conditions are similar)y. Biochar from a single activity may be applied in soils or incorporated in products at several sites.

1.1.2.1. Eligibility criteria for the production

The biochar production process shall:

(a) involve heating biomass to temperatures of at least 350 °C. ;

(b) be designed with the intention of fully capturing or destroying any methane produced with the biochar;

(c) utilise the co-produced heat for biomass drying or to satisfy another economically justifiable demand for heat, for heating or cooling purposes.

1.1.2.2. Eligible forms of biochar applications

a) Biochar applied in soils

Biochar application shall be eligible for certification if it has been, either directly without first intermixing it with any other product, or after intermixing with a matrix consisting of soil or one or more additional soil amendment products in compliance with Article 5 of Regulation (EU) 2019/1009 of the European Parliament and of the Council[1], or after feeding to animals and recovery as manure:

(i) applied to agricultural soils;

(ii) applied to forest soils;

[1] Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003 (OJ L 170 25.6.2019, p. 1, ELI: http://data.europa.eu/eli/reg/2019/1009/oj).

(iii) used in landscaping, for daily cover at landfill sites or for filling holes, including disused mines and oil wells;

(iv) applied to urban soils, including planting media used in flowerbeds or for urban tree planting and in public parks and public or private gardens, or in soil in greenhouses.

Operators of activities that produce biochar that is used for landscaping, landfill or hole filling shall intermix the biochar with at least one other material prior to application and shall ensure that the intermixture cannot self-sustain combustion.

Operators of activities where biochar is applied to soils shall ensure that there is no significant risk that the net climate benefit of the BCR is offset by heat absorption due to albedo decreases.

Total application of biochar to soil shall be limited to 50 tonnes per hectare [t/ha].

b) Biochar incorporated in products

Only BCR activities that incorporate biochar in cement, concrete or asphalt shall be eligible for certification.

1.2. Activity period, monitoring period and certification period

1.2.1. DACCS and BioCCS activities

1.2.1.1. Activity period

The duration of any activity period for DACCS and BioCCS activities shall not exceed 10 years. At the end of the every activity period operators may start a new activity period by submitting a new activity plan.

1.2.1.2. Monitoring period

The monitoring period for DACCS and BioCCS activities shall be the period up until the point at which responsibility for all geological storage sites utilised by the activity has been transferred to the relevant competent national authorities in accordance with Article 18 of Directive 2009/31/EC of the European Parliament and of the Council[2].

1.2.1.3. Certification period

The duration of the certification period for DACCS and BioCCS activities shall not exceed 1 year.

Where it is not possible to precisely identify the period in time during which CO_2 captured during a given certification period physically enters permanent storage, operators may estimate emissions associated with transport and storage based on data recorded during the certification period without including in the calculation a temporal delay between the time at which the CO_2 was captured and the time at which it is injected, by assessing the average associated emissions, including fugitive emissions, leakage or venting, during transport and storage of CO_2, per tonne of CO_2 handled during the certification period.

[2] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006 (OJ L 140 5.6.2009, p. 114, ELI: http://data.europa.eu/eli/dir/2009/31/oj).

1.2.2. BCR Activity

1.2.2.1. Activity period

The duration of any activity period for a BCR activity shall not exceed 10 years. At the end of every activity period operators may start a new activity period by submitting a new activity plan.

1.2.2.2. Monitoring period

The monitoring period for BCR activities shall be:

(a) for activities that use biochar by application to the land, the period up until one year after the end of the certification period during which it is demonstrated that the biochar has been applied to the land;

(b) for activities that use biochar by incorporation in products, the period up until the point at which it is demonstrated that the biochar has been incorporated.

1.2.2.3. Certification period

The certification period for a BCR activity shall not exceed one year. Carbon removals and associated emissions shall be recorded in the certification period in which the CO_2 is permanently stored.

1.3. Planning and reporting

1.3.1. Activity plan

Before the certification audit, the operator shall submit to the certification body an activity plan that includes the information necessary to assess compliance with the requirements of this methodology, as referred to in the second paragraph . Where an operator wishes to change the activity plan during the activity period, that operator shall submit a rationale behind the changes to the certification bodies without delay and shall include any adjustment to the initial plan, in particular the recalculation of the expected greenhouse gas ('GHG') emissions and removals and impacts on sustainability requirements.

The activity plan shall include:

(a) a general description of the project, the technologies and the infrastructure to be utilised;

(b) details of all entities of the carbon removal value chain involved in delivery of the activity;

(c) identification and demonstration of compliance of the activity with any relevant local, regional and national laws, statutes and regulatory frameworks;

(d) a list of emission sources and sinks that are relevant to the activity, in accordance with Sections 2.1.1 and 2.2.1;

(e) estimates of total carbon removals and GHG associated emissions of the activity for the activity period, in accordance with points (k), (l) and (m) of Annex II to Regulation (EU) 2024/3012 of the European Parliament and of the Council[3];

(f) a description of any materiality test undertaken in accordance with Section 2.3.1;

(g) a description of the assessment of uncertainty, in accordance with Section 2.3.6;

(h) proof of compliance with the minimum sustainability requirements, in accordance with Section 4.1;

(i) funding sources received or applied for with regard to the activity, in accordance with Sections 2.1.2 and 2.2.2;

(j) any other information necessary for the certification body to conduct the certification audit in accordance with Article 9 of Regulation (EU) 2024/3012.

1.3.2. Monitoring plan

Before the certification audit, operators shall submit a monitoring plan to the certification body. That monitoring plan shall comply with the following criteria:

(a) it shall include a description of the activity to be monitored;

(b) it shall include a description of the procedure for managing the assignment of responsibilities for monitoring and reporting, and for managing the competences of responsible personnel;

(c) it shall include, where applicable, the default values used for calculation factors indicating the source of the factor, or the relevant source, from which the default factor will be retrieved periodically;

(d) it shall include, where applicable, a list of laboratories engaged in carrying out relevant analytical procedures;

(e) it shall include, where measurements are taken, a description of the measurement method including descriptions of all written procedures relevant for the measurement;

(f) it shall include, where applicable, a detailed description of the monitoring methodology where transfer of CO2 is carried out, including a description of continuous measurement systems used and of procedures for preventing, detecting and quantification of leakage events from CO2 transport infrastructure;

(g) it shall apply, where applicable, the minimum frequencies for analysis listed in Annex VII to Commission Implementing Regulation (EU) 2018/2066[4] ;

(h) it shall apply the standard for quality assurance laid down in Article 60 of Implementing Regulation (EU) 2018/2066;

[3] Regulation (EU) 2024/3012 of the European Parliament and of the Council of 27 November 2024 establishing a Union certification framework for permanent carbon removals, carbon farming and carbon storage in products (OJ L 6.12.2024, ELI: http://data.europa.eu/eli/reg/2024/3012/oj)

[4] Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012 (OJ L 334 31.12.2018, p. 1, ELI: http://data.europa.eu/eli/reg_impl/2018/2066/oj).

(i) it shall include a record keeping requirement for all relevant data and information consistent with the record keeping requirements laid down in Article 67(1) of Implementing Regulation (EU) 2018/2066.

Certification schemes may provide additional guidance on the elements to be included for each type of activity, minimum measurement frequencies for measurements not listed in Annex VII to Implementing Regulation (EU) 2018/2066, and/or best practice requirements for quality assurance.

Operators shall obtain, record, compile, analyse and document monitoring data, including assumptions, references, activity data and calculation factors in a transparent manner that enables the checking of performance achieved during at the various activity stages, and, when requested, report this information to the certification bodies or certification schemes .

Each parameter monitored shall be accompanied with the following information:

(a) entity responsible for collection and archiving;

(b) data source;

(c) equipment, measurement methods and procedures used for monitoring, including details on accuracy and calibration;

(d) monitoring frequency;

(e) quality assessment and quality check procedures.

All measurements shall be conducted with calibrated measurement equipment according to industry standards, following the requirements in Articles 42 of Implementing Regulation (EU) 2018/2066, and any necessary data aggregation shall be undertaken following the requirements in Article 44 of that Implementing Regulation (EU) 2018/2066.

1.3.3. Monitoring report

Before each re-certification audit, the operator shall submit to the certification body a monitoring report including the necessary information relating to the quantification of the net carbon removal benefit and any relevant information on the compliance of the activity with storage, liability and sustainability requirements. In particular, the monitoring report shall include the following:

(a) all the parameters specified in Sections 2.1.5.3, 2.1.6.4, 2.1.7.3, 2.1.8.5, 2.2.5.6 or 2.2.7.3 measured and calculated for the quantification of carbon removals and GHG emissions associated with the activity. All removals and emissions of CO_2 and emissions of other GHGs shall be assessed over the certification period that is to be audited and reported in the monitoring report. Emissions of GHGs other than CO_2 shall be converted to tonnes of CO_2e by use of the 100-year Global Warming Potentials set out in Annex I to Commission Delegated Regulation (EU) 2020/1044[5];

(b) the biomass feedstock or feedstock mix consumed as required under Sections 4.3.1 and 4.3.2;

[5] Commission Delegated Regulation (EU) 2020/1044 of 8 May 2020 supplementing Regulation (EU) 2018/1999 of the European Parliament and of the Council with regard to values for global warming potentials and the inventory guidelines and with regard to the Union inventory system and repealing Commission Delegated Regulation (OJ L 230 17.07.2020, p.1, ELI: http://data.europa.eu/eli/reg_del/2020/1044/oj).

(c) the fraction of the biomass feedstock consumed for which carbon farming sequestration units have been cancelled in accordance with Section 4.3.3;

(d) financing received or applied for with regard to the activity, in accordance with Sections 2.1.2 and 2.2.2.

2. QUANTIFICATION OF BASELINE, TOTAL CARBON REMOVAL AND ASSOCIATED GHG EMISSIONS

2.1. DACCS and BioCCS activities

2.1.1. GHG sources and sinks

DACCS or BioCCS activities shall consider the GHG sources and sinks included in Table 1.

Table 1: Sinks and sources that shall be included for DACCS and BioCCS activities.

Phase of the operation	Emission sources and sinks	Gases included
CO_2 capture	Capture facility: Operation of equipment used to capture CO_2 from the ambient air or from biogenic emissions, including equipment used to generate airflow, and equipment associated with regeneration processes to recover the fluids or other media used in the carbon capture process.	Greenhouse gases
	Capture facility: Any CO_2 conditioning equipment used to further process the CO_2 stream before transfer to transport or storage infrastructure.	Greenhouse gases
	Capture facility: Any associated energy generation equipment powering the capture process that is under the control of the operator.	Greenhouse gases
	Capture facility: Any treatment equipment for processing wastes or byproducts of the carbon capture process.	Greenhouse gases
	Capture facility: Fuel combustion, electricity consumption, heat consumption.	Greenhouse gases
	Biomass supply: Emissions associated with additional biomass consumed for the operation of the capture facility (e.g. emissions for the harvest or transport of biomass).	Greenhouse gases
	Input emissions: Production and supply of inputs used by the capture facility.	Greenhouse gases
	Waste treatment: Processing and treatment of any wastes (including wastewater and exhaust gases) generated by the capture facility.	Greenhouse gases
	Capital emissions: Emissions associated with the construction and installation of the capture facility.	Greenhouse gases

Phase of the operation	Emission sources and sinks	Gases included
Transport of CO_2	Transportation: Fuel consumption and electricity consumption of road and rail transportation, maritime transportation and other vehicles.	Greenhouse gases
	Infrastructure: Fuel consumption, electricity consumption and heat consumption in infrastructure and buildings functionally connected to the pipeline transport network (e.g. booster stations, heaters).	Greenhouse gases
	Losses: CO_2 fugitive, vented, and leakage emissions from the transport network.	CO_2 only
Injection at the geological storage site	Storage facility: Removal by CO_2 injection.	CO_2 only
	Storage facility: Fuel consumption, electricity consumption, heat consumption.	Greenhouse gases
	Losses: CO_2 fugitive and vented emissions from injection and from the storage facility prior to entering permanent geological storage.	CO_2 only
	Input emissions: Production and supply of any inputs used by the storage facility.	Greenhouse gases
	Waste treatment: Processing and treatment of any wastes (including wastewater and exhaust gases) generated by the storage facility.	Greenhouse gases
	Capital emissions: Emissions associated with the construction and installation of the storage facility.	Greenhouse gases

2.1.2. Baseline

A standardised baseline set to 0 tonnes of CO_2 per year [tCO_2/year] shall apply for DACCS and BioCCS activities.

Where the activity is financed through a combination of public and private funding, in order to ensure that there is no overcompensation of costs, when submitting the activity plan to the certification scheme operators shall indicate any form of financing received or applied for with regard to the activity. This information shall be included in the certificate of compliance.

2.1.3. Quantification of the total removals of the activity

Operators may use two approaches for the calculation of the total carbon removal (CR_{total}), either the approach specified in Section 2.1.3.3 or that in Section 2.1.3.4, depending on whether the CO_2 captured by the activity would share transport infrastructure or storage site with CO_2 from other sources.

2.1.3.1. Designation of captured CO_2 streams

A capture facility may capture CO_2 that is:

(a) solely atmospheric or biogenic CO_2;
(b) a combination of biogenic CO_2 and fossil CO_2 from a mixed CO_2 stream;
(c) fossil CO_2 captured from a process associated with the capture process.

The fractions of CO_2 captured by the activity shall be given the following designations.

The total amount of CO_2 captured at the capture facility and transferred for transport or storage shall be designated $CO_{2_{captured,total}}$ and calculated in accordance with equation [1]:

$$CO_{2_{captured,total}} = \sum_{i} CO_{2_{OUT,activity,i}} \quad [1]$$

where:

$CO_{2_{OUT,activity,i}}$ = minus the amount of CO_2 from the capture activity leaving the capture facility at each exit point i, which shall be measured;

Any leakage of CO_2 occurring between the point of capture and the point of leaving the capture facility is implicitly excluded from the term $CO_{2_{captured,total}}$.

The amount of fossil CO_2 that is captured from processes at the capture facility that are specifically associated with the activity and that is intermixed with captured atmospheric or biogenic CO_2 before being transferred for transport and storage shall be designated $CO_{2_{captured,fossil}}$, This does not include the fossil CO_2 fraction of CO_2 captured from mixed streams. It shall be calculated in accordance with equation [2]:

$$CO_{2_{captured,fossil}} = \sum_{sources} CO_{2_{captured,fossil,source}} \quad [2]$$

where:

$CO_{2_{captured,fossil,source}}$ = minus the amount of CO_2 captured from each fossil CO_2 source associated with the activity and then to be intermixed with the captured atmospheric biogenic CO_2 before being transferred for transport and storage, which shall be measured prior to being mixed with captured CO_2 of atmospheric or biogenic origin;

sources = an index of the point sources from which fossil CO_2 from processes associated with the activity is captured.

Any CO_2 that is captured from a fossil source associated with the activity but which is segregated from the atmospheric or biogenic CO_2 at the point that it is transferred for transport or storage shall be excluded from the calculation of $CO_{2_{captured,fossil}}$.

The amount of CO_2 of atmospheric or biological origin that is captured at the capture facility and is transferred for transport or storage shall be designated $CO_{2_{captured}}$ and shall be calculated in accordance with equation [3]:

$$CO_{2_{captured}} = F_B * \left(CO_{2_{captured,total}} - CO_{2_{captured,fossil}}\right) \quad [3]$$

where:

F_B = fraction of captured CO_2 from a mixed stream that is of atmospheric or biogenic origin. This shall be set as 1 for DACCS activities or if the material from which the CO_2 is generated is demonstrably wholly biogenic, or else shall be calculated in accordance with Article 39 of Implementing Regulation (EU) 2018/2066. See section 2.1.6

The amount of captured CO_2 for which transport and storage emissions shall be counted towards the term $GHG_{associated}$ shall be designated $CO_{2\ activity}$ and shall be calculated in accordance with equation [4] as the sum of the atmospheric or biogenic CO_2 captured by the activity and transferred for permanent storage to be counted towards total carbon removals and the associated share of the amount of fossil CO_2 captured at the capture facility from processes that are specifically associated with the activity:

$$CO_{2\ activity} = F_{CRCF} * \left(CO_{2_{captured}} + CO_{2_{captured,fossil}}\right)$$	[4]

where:

F_{CRCF} = is defined in section 2.1.3.2.

The amount of captured CO_2 that is captured at the capture facility and is transferred for transport or storage but is not of atmospheric or biogenic origin shall be designated $CO_{2_{captured,other}}$ and shall be calculated in accordance with equation [5]:

$$CO_{2_{captured,other}} = CO_{2_{captured,total}} - CO_{2_{captured}}$$	[5]

2.1.3.2. Fraction of captured CO_2 to be counted towards the total carbon removal

An operator may choose to dispatch some fraction of the captured CO_2 of atmospheric or biogenic origin for purposes other than storage at an eligible site, or may choose to count part of the CO_2 that is permanently stored under a scheme other than the Regulation (EU) 2024/3012. The operator shall designate the fraction of the captured CO_2 of atmospheric or biogenic origin that shall be counted towards the total carbon removal as F_{CRCF}, which shall be 1 in the case that all of the captured CO_2 of atmospheric or biogenic origin shall be transferred to permanent storage and generate permanent carbon removal units.

2.1.3.3. Segregated CO_2 stream

If the CO_2 captured by the activity is at all times segregated from CO_2 from other sources during transit in the transport infrastructure and during storage and injection at the storage facilities , CR_{total} shall be measured as the quantity of CO_2 entering storage, adjusted where necessary to exclude any CO_2 captured by the activity that is not atmospheric or biogenic in accordance with equation [6].

$$CR_{total} = F_C * F_{CRCF} * \left(\sum_S \left(CO_{2_{injected,S}} \right) - CO_{2_{captured,other}} * (1 - F_{lost}) \right)$$ [6]

where:

$CO_{2_{injected,S}}$ = minus the amount of CO_2 (of all origins) from the activity that is injected at each storage facility S, which shall be measured during injection;

$CO_{2_{captured,other}}$ = is defined in equation [5];

S = an index of utilised storage facilities, at which CO_2 from the activity is fully segregated from any CO_2 from other sources up to and including the point of injection;

F_C = the conservatism factor calculated based on the uncertainty in the measurement of the activity calculated in accordance with Section 2.3.6;

F_{CRCF} = is defined in Section 2.1.3.2;

F_{lost} = the fraction of the transferred CO_2 that is lost between the point at which the mixed CO_2 stream left the capture facility at one or more exit points, and the point at which it is injected for storage. This may be assumed as 0 or be calculated in accordance with equation [7].

$$F_{lost} = 1 - \frac{\sum_S \left(CO_{2_{injected,S}} \right)}{CO_{2_{captured,total}}}$$ [7]

2.1.3.4. Non-segregated CO_2 stream

As an alternative to Section 2.1.3.3, the operator may or, where the CO_2 captured by the activity is not fully segregated from other CO_2 in the transport infrastructure or at the storage facility, shall, calculate CR_{total} in accordance with equation [8].

$$CR_{total} = F_C * \left(F_{CRCF} * CO_{2_{captured}} + CO_{2_{transport\ losses}} + CO_{2_{storage\ losses}} \right)$$ [8]

where:

$CO_{2_{captured}}$ = is defined in equation [3];

$CO_{2_{transport\ losses}}$ = amount of atmospheric or biogenic CO_2 lost during transport from the capture facility to the storage facilities, calculated following the rules in Section 2.1.7.1;

$CO_{2_{storage\ losses}}$ = amount of atmospheric or biogenic CO_2 lost at the storage facilities prior to entering permanent geological storage, calculated following the rules in section 2.1.8.3;

F_{CRCF} = the fraction of the captured CO_2 that is designated as being transferred for storage to generate carbon removal units. This is equal to 1, if no captured CO_2 is to be transferred for another purpose;

F_C = the conservatism factor calculated based on the uncertainty in the measurement of the activity calculated in accordance with Section 2.3.6.

2.1.4. Quantification of the greenhouse gases associated with the activity

The greenhouse gases associated shall be calculated according to equation [9].

$GHG_{associated} = F_{CRCF} * GHG_{capture} + GHG_{transport} + GHG_{storage}$	[9]

where:

$GHG_{capture}$ = GHG emissions associated with the capture facility, calculated following the rules in Section 2.1.5.2 in the case of atmospheric CO_2 capture and following the rules in Section 2.1.6.3 in the case of biogenic CO_2 capture;

$GHG_{transport}$ = GHG emissions associated with CO_2 transport from the capture facility to the storage facilities, calculated following the rules in Section 2.1.7.2;

$GHG_{storage}$ = GHG emissions associated with the storage facilities, calculated following the rules in Section 2.1.8.4;

F_{CRCF} = the fraction of the captured CO_2 that is designated as being transferred for storage to generate carbon removal units. This is equal to 1 if no captured CO_2 is to be transferred for another purpose.

2.1.5. Capture of CO_2 Directly from the Air

2.1.5.1. Quantification of total CO_2 captured

The total amount of CO_2 captured at the capture facility, $CO_{2_{captured,total}}$, shall be calculated in accordance with equation [1] and the quantity of CO_2 of atmospheric origin captured, $CO_{2_{captured}}$, shall be calculated in accordance with equation [3].

2.1.5.2. Quantification of GHG associated emissions

The GHG associated emissions with the capture shall correspond to the sum of emissions associated with the capture facility itself and relevant processes to produce inputs to the capture facility and shall be calculated in accordance with equation [10]:

$$GHG_{capture} = GHG_{facility} + GHG_{inputs}$$	[10]

where:

$GHG_{facility}$ = total GHG emissions from all relevant activities within the boundaries of the capture facility, in tonnes of CO_2e [tCO_2e], including emissions associated with conditioning CO_2 prior to transfer to transport infrastructure or a storage facility;

GHG_{inputs} = total emissions associated with inputs to the capture facility, in tCO_2e.

2.1.5.2.1. Emissions from the capture facility

The emissions $GHG_{facility}$ associated with the capture facility shall be calculated in accordance with equation [11]:

$$GHG_{facility} = GHG_{combustion} + GHG_{elec} + GHG_{heat} + GHG_{capital} + GHG_{disposal}$$	[11]

whereby:

$GHG_{combustion}$ refers to emissions due to fuel consumption at the capture facility, calculated in accordance with equation [12]:

$$GHG_{combustion} = \sum_{fuels} (Q_{fuel} * EF_{fuel}) + CO_{2\ stored,fossil}$$	[12]

where:

Q_{fuel} = quantity of the fuel consumed in the certification period, expressed in an appropriate unit;

EF_{fuel} = lifecycle emissions value, expressed in tCO_2e per unit [tCO_2e/unit] , selected in accordance with the rules in Section 2.3.4.4;

$CO_{2\ stored,fossil}$ = minus the quantity of fossil CO_2 from fuel combustion at the capture facility captured and permanently stored, in tonnes CO_2. It shall be calculated as minus the measured quantity of CO_2 captured from fossil sources at the capture facility, for CO_2 that is not mixed with the captured atmospheric CO_2 before being transferred for transport or storage plus any CO_2 losses occurring prior to storage (losses from any CO_2 mixed with the atmospheric CO_2 stream are accounted for under the rules in Sections 2.1.7 and 2.1.8).

GHG_{elec} refers to emissions due to net electricity consumption at the capture facility, calculated in accordance with equation [13]:

$$GHG_{elec} = \sum_{\text{electricity source}} Q_{elec} * EF_{elec}$$	[13]

where:

Q_{elec} = net quantity of electricity consumed in the certification period, selected in accordance with Section 2.3.2, expressed in an appropriate unit;

EF_{elec} = lifecycle emission factor for the consumed electricity, expressed in tCO_2e/unit, selected in accordance with Section 2.3.4.1.

GHG_{heat} refers to emissions due to net consumption of useful heat at the capture facility, calculated in accordance with equation [14]:

$$GHG_{heat} = \sum_{\text{heat source}} Q_{heat} * EF_{heat}$$	[14]

where:

Q_{heat} = net quantity of useful heat consumed in the certification period, selected in accordance with Section 2.3.2, expressed in an appropriate unit;

EF_{heat} = lifecycle emission factor for the consumed heat, expressed in tCO_2e/unit, selected in accordance with Section 0.

$GHG_{capital}$ refers to capital emissions from construction and installation of the carbon capture facility and shall be calculated in accordance with the principles detailed in Section 2.3.5.

$GHG_{disposal}$ refers to emissions from the treatment or disposal of any wastes generated by the direct air capture facility. This shall include emissions associated with the supply of any energy and inputs consumed in the course of waste disposal and any other GHG emissions associated with the disposal process.

2.1.5.2.2. Emissions from inputs

Where there are inputs including chemicals consumed by the capture facility the emissions associated with the consumption of these inputs during the certification period shall be calculated in accordance with equation [15]:

$$GHG_{inputs} = \sum_{\text{inputs}} Q_{input} * EF_{input}$$	[15]

where:

Q_{input} = quantity of the input consumed in the certification period, expressed in an appropriate unit;

EF_{input} = lifecycle emission factor for the input consumed, expressed in tonnes of

CO_2e per unit, selected in accordance with the rules in Section 2.3.4.4.

Operators may group any number of inputs whose collective emissions are considered non-material on the basis of a materiality assessment and substitute for them an emission term equal to $2\% * CR_{total}$, i.e. a group of inputs for which when taking a high-end estimate of expected associated emissions in accordance with equation [16]:

$$\sum_{inputs} Q_{input} * EF_{input} < 2\% * CR_{total}$$	[16]

2.1.5.3. Monitoring and reporting

In accordance with Section 1.3.3, operators shall include in the monitoring report before each re-certification audit the measured or calculated parameters listed in Table 2. Where a parameter is noted as to be monitored, it shall be included in the monitoring plan in accordance with Section 1.3.2.

Table 2: Parameters for inclusion in the monitoring report.

Equation	Parameter	Unit	Definition	Notes
[8]	$CO_{2_{captured}}$	tCO_2	Amount of CO_2 of atmospheric or biogenic origin captured at the capture facility and transferred for transport or storage	Calculated using equation [3]
[6]	$CO_{2_{captured,other}}$	tCO_2	Amount of CO_2 that is captured at the capture facility and is transferred for transport or storage but is not of atmospheric or biogenic origin	Calculated using equation [5]
[1]	$CO_{2_{OUT,activity,i}}$	tCO_2	Amount of CO_2 from the capture activity leaving the capture facility at each exit point i	To be monitored
[4]	$CO_{2\ activity}$	tCO_2	The amount of CO_2 for which transport and storage emissions shall be counted towards the term $GHG_{associated}$	
	F_{CRCF}	ratio	The fraction of the captured CO_2 of atmospheric or biogenic origin that shall be counted towards the total carbon removal	
[10]	$GHG_{capture}$	tCO_2e	Total GHG emissions associated with the capture of CO_2 from	

			ambient air	
	$GHG_{facility}$	tCO_2e	Total GHG emissions from all relevant activities within the boundaries of the capture facility	Calculated using eq. [11]
	GHG_{input}	tCO_2e	Total GHG emissions associated with inputs to the capture facility	Calculated using eq. [15]
[11]	$GHG_{combustion}$	tCO_2e	Emissions due to fuel consumption at the capture facility	Calculated using eq. [12]
	GHG_{elec}	tCO_2e	Emissions due to net electricity consumption at the capture facility	Calculated using eq. [13]
	GHG_{heat}	tCO_2e	Emissions due to net consumption of useful heat at the capture facility	Calculated using eq. [14]
	$GHG_{capital}$	tCO_2e	Capital emissions	Calculated using eq. [68]
	$GHG_{disposal}$	tCO_2e	Emissions from waste disposal	To be monitored
[12]	Q_{fuel}	[appropriate unit]	Quantity of the fuel consumed in the certification period	To be monitored
	EF_{fuel}	tCO_2e/unit	Lifecycle emission factor for consumed fuel	
	$CO_{2\ stored,fossil}$	tCO_2	Quantity of fossil CO_2 from fuel combustion at the capture facility captured and permanently stored	To be monitored
[13]	Q_{elec}	[appropriate unit]	Net quantity of electricity consumed in the certification period	To be monitored
	EF_{elec}	tCO_2e/unit	Lifecycle emission factor for consumed electricity	
[14]	Q_{heat}	[appropriate unit]	Net quantity of useful heat consumed in the certification period	
	EF_{heat}	tCO_2e/unit	Lifecycle emission factor for consumed heat	

[15]	Q_{input}	[appropriate unit]	Quantity of the input consumed in the certification period	To be monitored
	EF_{input}	tCO_2e/unit	Lifecycle emission factor for input consumed	
[68]	$GHG_{materials}$	tCO_2e	Emissions from the materials utilised in the construction of the facility	Calculated using eq. [69]
[69]	$Q_{materials}$	t	Quantity of materials utilised in the construction of the facility	
	$EF_{materials}$	tCO_2e/t of material	Lifecycle emission factor for the utilised materials	

2.1.6. Capture of CO2 from Biogenic Emissions

2.1.6.1. Quantification of total CO_2 captured

The total amount of CO_2 captured at the capture facility, $CO_{2_{captured,total}}$, shall be calculated in accordance with equation [1] and the quantity of CO_2 of atmospheric origin captured, $CO_{2_{captured}}$, shall be calculated in accordance with equation [3].

2.1.6.2. Capture of CO_2 from partially biogenic streams

Activities that capture biogenic CO_2 as part of a mixed stream that also contains CO_2 of fossil or other origin may be certified for the biogenic part. Such activities include, among others, activities capturing CO_2 from co-fired bioenergy facilities or from waste-to-energy facilities processing partially biogenic waste, as well as from energy-intensive industries, including but not restricted to cement, lime, metal and silicon producers that use partially biogenic fuel or feedstock. Only the biogenic part of the captured CO_2 may be counted towards CR_{total}. Emissions associated with the carbon capture facility shall be allocated proportionately between the biogenic fraction that shall be included in $GHG_{associated}$ and the non-biogenic fraction that shall not be included in the quantification. After transfer of the CO_2 from the point of capture into transportation infrastructure or a storage facility, either a segregated system or mass balance accounting shall be used to identify a quantity of biogenic CO_2 entering permanent storage that is consistent with the amount of biogenic CO_2 capture (minus any losses).

2.1.6.3. Quantification of associated GHG emissions

The calculation of the $GHG_{capture}$ term shall consider only the emissions specifically associated with operating the capture process and the transfer of the CO_2 for storage or transport. The calculation shall include emissions associated with any static and mobile machinery utilised to enable the capture process. Emissions associated with the normal operation of the facility generating the biogenic CO_2 source, that do not result from the operation of the capture process, shall not be included in the quantification. In the case that an emission source (e.g. on-site mobile machinery) serves both the capture process and one or

more other processes at the facility, then a pro-rata fraction of the emissions from that source shall be attributed to the capture process.

$GHG_{capture}$ shall be calculated in accordance with equation [17]:

$$GHG_{capture} = F_B * (GHG_{facility} + GHG_{inputs})$$	[17]

where:

$GHG_{facility}$ = total GHG emissions from all relevant activities required for CO_2 capture at the capture facility, in tCO_2e, including emissions associated with conditioning CO_2 prior to transfer to transport infrastructure or a storage facility;

GHG_{inputs} = total emissions associated with inputs to the capture facility, in tCO_2e.

F_B fraction of captured CO_2 that is of biogenic origin. This shall be set as 1 if the material from which CO_2 is generated is demonstrably wholly biogenic, or else shall be calculated in accordance with Article 39 of Implementing Regulation (EU) 2018/2066. See also Section 2.1.6.2.

2.1.6.3.1. Emissions from the capture facility

The emissions $\mathbf{GHG_{facility}}$ associated with the capture facility shall be calculated in accordance with equation [18]:

$$GHG_{facility} = GHG_{bio} + GHG_{bio\text{-}storage} + GHG_{combustion} + GHG_{elec} + GHG_{heat} + GHG_{capital} + GHG_{disposal}$$	[18]

whereby:

$\mathbf{GHG_{bio}}$ refers to emissions due to the supply of additional biomass that is used to generate energy consumed by the capture process, calculated in accordance with the following equation [19]:

$$GHG_{bio} = \sum_{biomass\ types} Q_{biomass} * EF_{biomass}$$	[19]

where:

$Q_{biomass}$ = quantity of additional biomass that is consumed in the certification period to supply any on-site heat and/or electricity used for the capture process and the transfer of the CO_2 for storage or transport specifically, calculated in accordance with the rules in Section 2.3.3, expressed in an appropriate unit;

$EF_{biomass}$ = lifecycle emissions value, expressed in tCO_2e/unit, selected in accordance with the rules in Section 2.3.4.3.

$\mathbf{GHG_{bio\text{-}storage}}$ refers to CH_4 emissions due to biomass storage prior to processing at the facility where CO_2 is captured. It shall be calculated for each feedstock batch, where a feedstock batch consists of a quantity of feedstock of a given type that is harvested or collected at the same time and stored in the same way. $GHG_{bio\text{-}storage}$ shall be set to zero if one or more of the following practices are followed for all biomass utilised:

(a) biomass stored consists of coarse woody material that naturally remains well aerated;
(b) biomass that is stored in a form that does not necessarily remain naturally aerated shall either:
    (i) be stored for no more than four weeks prior to processing; or
    (ii) be stored with a maximum of 30 % residual moisture.
(c) biomass is pelleted for storage;
(d) operators otherwise demonstrate that biomass is stored in a way that avoids anaerobic decomposition given the nature of the feedstock and the local conditions.

Otherwise, $\mathbf{GHG_{bio\text{-}storage}}$ shall be calculated in accordance with equation [20]:

$$GHG_{bio\text{-}storage} = \frac{Q_{biomass}}{Q_{biomass,total}} * \sum_{feedstock\ batches} \left(\frac{16}{12} * 0.0013 * Q_{feedstock} * C_{feedstock} * (T_{storage} - 1) \right) * GWP_{CH_4} \quad [20]$$

where:

$Q_{biomass}$		quantity of additional biomass that is consumed in the certification period to supply any on-site heat and/or electricity used for the capture process and the transfer of the CO_2 for storage or transport specifically, calculated in accordance with the rules in Section 2.3.3, expressed in an appropriate unit;
$Q_{biomass,total}$	=	total quantity of biomass consumed by the capture facility in the certification period for both the main process generating the captured CO_2 stream and for the capture process, expressed in an appropriate unit;
$Q_{feedstock}$	=	quantity of the feedstock in each batch, expressed in an appropriate unit;
$C_{feedstock}$	=	carbon content of the feedstock, expressed as a mass %;
$T_{storage}$	=	time in months for which the feedstock batch is stored (rounded up);
Feedstock batches	=	an index of the feedstock batches consumed;
0.0013	=	assumed monthly fractional loss of biomass carbon from storage.

$\mathbf{GHG_{combustion}}$ refers to emissions due to fuel consumption at the capture facility for the capture process specifically, including any CH_4 and N_2O emissions from additional biomass combustion as defined in Section 2.3.3 but treating the CO_2 emissions factors for biomass combustion as zero. In the case that a facility requires the use of fossil fuels to start up the combustion cycle the emissions from those fuels shall not be included as they are not

considered associated with the capture process specifically. In the case that fuel is consumed for biomass handling or pre-treatment, then a fraction of that fuel calculated as $Q_{biomass}/Q_{biomass,total}$ (see equation [20]) shall be treated as associated with the capture process specifically. $\mathbf{GHG_{combustion}}$ shall be calculated in accordance with equation [21]:

$$GHG_{combustion} = \sum_{fuels} (Q_{fuel} * EF_{fuel}) + CO_{2\ stored,fossil} \quad [21]$$

where:

Q_{fuel} = quantity of the fuel consumed in the certification period, expressed in an appropriate unit;

EF_{fuel} = lifecycle emissions value, expressed in tCO_2e/unit, selected in accordance with the rules in Section 2.3.4.4;

$CO_{2\ stored,fossil}$ = minus the quantity of fossil CO_2 from fuel combustion at the capture facility captured and permanently stored. If this captured CO_2 is intermixed with the atmospheric or biogenic CO_2 captured by the activity prior to transfer to the transport infrastructure or storage facility, it shall be included in the term $CO_{2\,captured,other}$ in equation [6].

$\mathbf{GHG_{elec}}$ refers to emissions due to net consumption of electricity at the capture facility for the capture process specifically, excluding own electricity consumption, calculated in accordance with equation [22]:

$$GHG_{elec} = \sum_{electricity\ sources} Q_{elec} * EF_{elec} \quad [22]$$

where:

Q_{elec} = net quantity of electricity from each source consumed in the certification period for the capture process and the transfer of the CO_2 for storage or transport specifically, selected in accordance with Section 2.3.2, expressed in an appropriate unit;

EF_{elec} = lifecycle emission factor for the consumed electricity, expressed in tCO_2e/unit, selected in accordance with Section 2.3.4.1.

$\mathbf{GHG_{heat}}$ refers to emissions due to net consumption of useful heat at the capture facility for the capture process specifically, excluding own heat consumption, calculated in accordance with equation [23]:

$$GHG_{heat} = \sum_{heat\ source} Q_{heat} * EF_{heat} \quad [23]$$

where:

Q_{heat} = net quantity of useful heat consumed in the certification period for the capture process specifically, selected in accordance with Section 2.3.2, expressed in an appropriate unit;

EF_{heat} = lifecycle emission factor for the consumed heat, expressed in tCO_2e/unit, selected in accordance with Section 0.

$\mathbf{GHG_{capital}}$ refers to capital emissions from construction and installation of the carbon capture facility and shall be calculated in accordance with the principles detailed in Section 2.3.5.

$\mathbf{GHG_{disposal}}$ refers to emissions from the treatment or disposal of any wastes generated specifically due to the capture activity, including waste from any biomass used for energy consumed by the capture process. This shall include emissions associated with the supply of any energy and inputs consumed in the course of waste disposal and any other GHG emissions associated with the disposal process including emissions of N_2O and/or CH_4 due to aerobic or anaerobic degradation of the fraction of biomass wastes associated with additional biomass use.

2.1.6.3.2. Emissions from inputs

Where there are inputs including chemicals consumed by the capture facility the emissions associated with the consumption of these inputs during the certification period shall be calculated in accordance with equation [24]:

$$GHG_{inputs} = \sum_{inputs} Q_{input} * EF_{input}$$	[24]

where:

Q_{input} = quantity of the input consumed in the certification period for the capture process specifically, expressed in an appropriate unit;

EF_{input} = lifecycle emission factor for the input consumed, expressed in tCO_2e/unit, selected in accordance with Section 2.3.4.4.

The operator may group any number of inputs whose collective emissions are considered non-material on the basis of a materiality assessment and substitute for them an emission term equal to $1\% * CR_{total}$, i.e. a group of inputs for which when taking a high-end estimate of expected associated emissions:

$$\sum_{inputs} Q_{input} * EF_{input} < 2\% * CR_{total}$$	[25]

2.1.6.4. Monitoring and reporting

In accordance with Section 1.3.3, operators shall include in the monitoring report before each re-certification audit the measured or calculated parameters listed in Table 3. Where a parameter is noted as to be monitored, it shall be included in the monitoring plan in accordance with Section 1.3.2.

Table 3: Parameters for inclusion in the monitoring report.

Equation	Parameter	Unit	Definition	Notes
[8]	$CO_{2_{captured}}$	tCO_2	Amount of CO_2 of atmospheric or biogenic origin captured at the capture facility and transferred for transport or storage	Calculated using equation [3]
[6]	$CO_{2_{captured,other}}$	tCO_2	Amount of CO_2 that is captured at the capture facility and is transferred for transport or storage but is not of atmospheric or biogenic origin	Calculated using equation [5]
[1]	$CO_{2_{OUT,activity,i}}$	tCO_2	Amount of CO_2 from the capture activity leaving the capture facility at each exit point i	To be monitored
[3], [17]	F_B	%	Fraction of captured CO_2 that is of biogenic origin	To be monitored
[17]	$GHG_{capture}$	tCO_2e	Total GHG emissions associated with the capture of CO_2	
	$GHG_{facility}$	tCO_2e	Total GHG emissions from all relevant activities required for CO_2 capture at the capture facility	Calculated using eq. [18]
	GHG_{inputs}	tCO_2e	Total GHG emissions associated with inputs to the capture facility	Calculated using eq. [24]
[18]	GHG_{bio}	tCO_2e	Emissions due to additional biomass use for energy consumed by the capture process	Calculated using eq. [19]
	$GHG_{bio-storage}$	tCO_2e	CH_4 emissions due to biomass storage prior to processing at the facility where CO_2 is captured.	Calculated using eq. [20]
	$GHG_{combustion}$	tCO_2e	Emissions due to fuel consumption at the capture facility for the capture process specifically, including CH_4 and N_2O emissions from additional biomass combustion but treating the CO_2 emissions from biomass combustion as zero	Calculated using eq. [21]

	GHG_{elec}	tCO_2e	Emissions due to net consumption of electricity at the capture facility	Calculated using eq. [22]
	GHG_{heat}	tCO_2e	Emissions due to net consumption of useful heat at the capture facility	Calculated using eq. [23]
	$GHG_{capital}$	tCO_2e	Capital emissions	Calculated using eq. [68]
	$GHG_{disposal}$	tCO_2e	Emissions from waste disposal	To be monitored
[19]	$Q_{biomass}$	[appropriate unit]	Quantity of the biomass that is consumed in the certification period to supply any on-site heat and/or electricity used for the capture process specifically	To be monitored. Relevant data may be available in verified reporting in Directive (EU) 2018/2001.
	$EF_{biomass}$	tCO_2e/unit	Lifecycle emissions value for biomass consumed	Relevant data may be available in verified reporting in Directive (EU) 2018/2001.
[20]	$Q_{feedstock}$	[appropriate unit]	Quantity of the feedstock in each batch	To be monitored where relevant
	$C_{feedstock}$	%	Carbon content of the feedstock	To be monitored where relevant
	$T_{storage}$	months	Time in months for which the feedstock batch is stored	To be monitored where relevant
[21]	Q_{fuel}	[appropriate unit]	Quantity of the fuel consumed in the certification period	To be monitored

	EF_{fuel}	tCO_2e	Lifecycle emission factor for the consumed fuel	
	$CO_{2\ stored,fossil}$	tCO_2	Quantity of fossil CO_2 from fuel combustion at the capture facility captured and permanently stored	To be monitored
[22]	Q_{elec}	[appropriate unit]	Net quantity of electricity from each source consumed in the certification period for the capture process	To be monitored
	EF_{elec}	tCO_2e	Lifecycle emission factor for the consumed electricity	
[23]	Q_{heat}	[appropriate unit]	Net quantity of useful heat consumed in the certification period for the capture process	To be monitored
	EF_{heat}	tCO_2e	Lifecycle emission factor for the consumed heat	
[24]	Q_{input}	[appropriate unit]	Net quantity of the input consumed in the certification period for the capture process	To be monitored
	EF_{input}	tCO_2e	Lifecycle emission factor for input consumed	
[68]	$GHG_{materials}$	tCO_2e	Emissions from the materials utilised in the construction of the facility	Calculated using eq. [69]
[69]	$Q_{materials}$	t	Quantity of materials utilised in the construction of the facility	
	$EF_{materials}$	tCO_2/t of material	lifecycle emission factor for the utilised materials	

2.1.7. Transport of CO_2

This section provides rules for the quantification of GHG emissions associated with CO_2 transportation activities via pipelines, road, rail or water transportation, and their infrastructure, as well as losses of CO_2 occurring during this process.

These rules apply to activities that transport captured CO_2 as a concentrated CO_2 stream from a capture facility to one or more storage facilities using one or more modes of CO_2

transportation. The transport pathway from the capture facility to the storage facilities consists of one or more segments of transport infrastructure as defined in Article 3, point (29), of Regulation (EU) 2024/1735 of the European Parliament and of the Council[6], which may be parts of one or more transport networks as defined in Article 3, point (22), of Directive 2009/31/EC. Where relevant data is available from reporting under Implementing Regulation (EU) 2018/2066, that data shall be considered reliable for the purpose of calculating transport emissions for the activity.

Transport infrastructure segments shall be designated in order to allow the allocation of transport-related emissions in the case that CO_2 from more than one source passes through parts of the same transport network. If CO_2 captured by a single removal activity is the only CO_2 passing through the relevant transport infrastructure, the whole transport pathway may be designated as a single transport infrastructure segment. Otherwise, the transport pathway shall be divided into a series of transport infrastructure segments. A new transport infrastructure segment shall be designated at least every time two or more CO_2 streams are merged, or two or more CO_2 streams are separated. Additional transport infrastructure segments may be specified at the discretion of the operator or certification body for organisational reasons.

An allocation fraction F_S shall be specified for each transport infrastructure segment S as the fraction of the CO_2 passing through the segment in a certification period that comes from the activity and is being sent for storage (i.e. not including any CO_2 coming from the activity that is being transferred for utilisation) in accordance with equation [26]:

$$F_S = CO_{2\ activity,S} / CO_{2\ total,S}$$	[26]

where:

$CO_{2\ total,S}$ = total amount of CO_2 from all sources passing through the CO_2 infrastructure segment S in the certification period, in tCO_2;

$CO_{2\ activity,S}$ = amount of CO_2 from the activity that is being transferred for permanent storage to generate carbon removal units (including an associated fraction of $CO_{2captures,total}$, see equation [1],i.e.CO_2 captured as part of the activity and transferred for permanent storage that is not of atmospheric or biogenic origin) passing through the CO_2 infrastructure segment S in the certification period, in tCO_2. For the first infrastructure segment in the transport pathway, this is equal to the part of the activity CO_2 ($CO_{2\ activity}$) measured as transferred from the capture facility to the infrastructure segment. This excludes any CO_2 that is not biogenic that was captured from a mixed CO_2 stream. For subsequent infrastructure segments, this is the quantity of activity CO_2 entering the previous infrastructure segment minus any CO_2 losses in that infrastructure segment, and where the CO_2 stream is split at a node to be sent to multiple storage facilities the activity CO_2 shall be

[6] Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724 (OJ L 1735 28.6.2024, p. 1, ELI: http://data.europa.eu/eli/reg/2024/1735/oj).

allocated across the infrastructure segments leaving that node.

S = index of the transport infrastructure segment.

2.1.7.1. Quantification of fugitive, vented and leaked emissions of captured CO_2

In the event of intentional or accidental losses of transported CO_2 throughout the transport network, if the quantity CR_{total} is calculated based on equation [8], these losses shall be explicitly quantified. Quantification rules are based on Implementing Regulation (EU) 2018/2066, which sets out the following two methods for the quantification of GHG emissions due to the operation of pipeline transport network: Method A, based on the overall mass balance of all input and output streams[7]; and Method B, relying on the monitoring of emission sources individually, as included below.

Operators shall choose the method that leads to lower uncertainty of the overall emissions without incurring disproportionate costs.

2.1.7.1.1. CO_2 losses: Method A

Operators shall quantify the intentional and accidental escapes of CO_2 throughout the transport network in accordance with equation [27].

$$CO_{2\,transport,losses} = \sum_{S} \left(F_S * \left(CO_{2\,in,S} - CO_{2\,out,S} \right) \right) \quad [27]$$

where:

F_S = defined in equation [26];

$CO_{2\,in,S}$ = amount of CO_2 entering transport infrastructure segment S, determined in accordance with Articles 40 to 46 and Article 49 of Implementing Regulation (EU) 2018/2066, in tCO_2;

$CO_{2\,out,S}$ = amount of CO_2 leaving transport infrastructure segment S, determined in accordance with Articles 40 to 46 and Article 49 of Implementing Regulation (EU) 2018/2066, in tCO_2;

S = index of the transport infrastructure segments.

2.1.7.1.2. CO_2 losses: Method B

Operators shall quantify $CO_{2transport,losses}$ based on the measured losses throughout the transport network, in accordance with equation [28].

$$CO_{2\,transport,losses} = \sum_{S} \left(F_S * \left(CO_{2\,fugitive,S} + CO_{2\,vented,S} + CO_{2\,leakage,S} \right) \right) \quad [28]$$

[7] Each transport network shall have a minimum of one start point and one end point, each connected to other installations carrying out one or more of the activities: capture, transport or geological storage of CO_2. This includes bifurcations of the network and cross-national borders.

where:

F_S = defined in equation [26];

$CO_{2\ fugitive,S}$ = sum of fugitive emissions from CO_2 transported in the transportation infrastructure, such as from seals, valves, intermediate compressor stations in pipeline structures and intermediate storage facilities, in tCO_2;

$CO_{2\ vented,S}$ = sum of vented emissions from CO_2 transported in the transportation infrastructure, in tCO_2;

$CO_{2\ leakage,S}$ = sum of CO_2 transported in the transportation infrastructure, which is emitted as the result of the failure of one or more components of the network, in tCO_2;

S = index of the transport infrastructure segments.

2.1.7.1.2.1. Fugitive emissions

Fugitive emissions during CO_2 transportation in any of the following components: (a) seals; (b) measurement devices; (c) valves; (d) intermediate compressor stations; (e) intermediate storage facilities shall be calculated in accordance with on equation [29].

$$CO_{2\ fugitive} = \sum_{S}\left(\sum_{c}\left(EF_{occur,c,S} * N_{occur,c,S}\right)\right) \quad [29]$$

where:

F_S = defined in equation [26];

$EF_{occur,c,S}$ = average emission factors per piece of component per time period, expressed in tCO_2/unit time. $EF_{occur,c}$ shall be determined by the operator for each type of component. These factors shall be reviewed at least every 5 years based on newly available techniques and knowledge;

$N_{occur,c,S}$ = number of components type c in the transportation system, multiplied by the number of time periods;

c = type of equipment: seals*;* measurement devices*;* valves*;* intermediate compressor stations*;* and intermediate storage facilities;

S = index of the transport infrastructure segments.

Certification schemes may provide lists of default fugitive emissions factors for relevant equipment.

2.1.7.1.2.2. Vented emissions

Activity operators shall calculate $CO_{2\ vented}$ for each transport infrastructure segment S as the expected venting identified for that transport infrastructure segment by the transport network operator's monitoring plan. If the transport network operator's monitoring plan does not identify venting emissions at the disaggregated level of the transport infrastructure segment,

venting emissions shall be allocated by segment on a reasonable basis to be agreed by the activity operator and certification body. Certification schemes may provide guidance further specifying the basis to estimate vented emissions.

2.1.7.1.2.3. Leakage events

Implementing Regulation (EU) 2018/2066 requires that each transport network operator shall monitor the transport network and calculate the amount of CO_2 leaked from the transport with a suitable methodology documented in the monitoring plan, based on industry best practice guidelines.

Activity operators shall calculate $CO_{2\ leakage}$ for each transport infrastructure segment S as the amount of leakage identified for that transport infrastructure segment by the transport network operator during the certification period. If the transport network operator does not report leakage emissions at the disaggregated level of the transport infrastructure segment, leakage emissions shall be allocated for each segment on a reasonable basis to be agreed by the activity operator and certification body.

2.1.7.2. Quantification of associated GHG emissions for transport

GHG emissions associated with the transportation of CO_2 (for vehicles and/or in the supporting infrastructure) shall be calculated in accordance with equation [30]:

$$GHG_{transport} = \sum_{S}^{\square} \left(F_S * \left(\sum_{T} GHG_{T,S} + GHG_{infra,S} \right) \right) \quad [30]$$

where:

F_S = defined in equation [24];

$GHG_{T,S}$ = GHG emissions due to energy use for CO_2 transportation in mode of transportation type T in infrastructure segment S, in tCO_2e;

GHG_{infra} = GHG emissions due to energy use at the supporting infrastructure connected to the CO_2 transport network (including pipeline operation infrastructure), in tCO_2e;

T = transport type for the infrastructure segment, road, rail or maritime;

S = index of the transport infrastructure segments.

2.1.7.2.1. Emissions from non-pipeline transportation of CO_2

Following the principles in Section 2.3.4.5, GHG emissions associated with the non-pipeline transport of CO_2 by transportation mode T in each transport infrastructure segment, $GHG_{T,S}$, shall either be calculated based on actual data on fuel consumption in accordance with equation [31] or based on vehicle efficiencies and actual data about vehicle distance travelled in accordance with equation [32]. Operators are permitted to use different approaches for different transport modes and infrastructure segments.

$$GHG_{T,S} = \sum_{trips} \left(Q_{fuel,S} * EF_{fuel} \right) \quad [31]$$

where:

$Q_{fuel,S}$ = quantity of fuel consumed for each trip in infrastructure segment S, including empty return trips, expressed in an appropriate unit;

EF_{fuel} = lifecycle emissions value for the consumed fuel, expressed in tCO_2e/unit, selected in accordance with the rules in Section 2.3.4.4;

trips = an index of the trips taken.

$$GHG_{T,S} = \left(\sum_{L=1}^{O}\left(K_{L,S} * EF_{vehicle,loaded}\right) + \sum_{L=1}^{R}\left(K_{L,S} * EF_{vehicle,unloaded}\right)\right) \quad [32]$$

where:

$K_{L,S}$ = distance of each trip in infrastructure segment S in kilometres [km];

$EF_{vehicle,loaded}$ = the CO_2 emissions per kilometre of the vehicle when loaded, in tCO_2/km travelled. This may be based on an appropriate conservative default emission factor if it has been provided by the certification scheme;

$EF_{vehicle,unloaded}$ = the CO_2 emissions per kilometre of the vehicle when unloaded, in tCO_2/km travelled. This may be based on an appropriate conservative default emission factor if it has been provided by the certification scheme. If no data/default is available for the unloaded vehicle but a value is available for $EF_{vehicle,loaded}$, then the operator may set $EF_{vehicle,unloaded} = EF_{vehicle,loaded}$;

O = total number of outbound trips taken;

R = total number of empty return trips taken;

L = an index of the trips.

2.1.7.2.2. Emissions from transportation infrastructure

GHG emissions due to fuel and electricity consumption across all processes at installations required to operate the transport network shall be calculated according to equation [33].

$$GHG_{infra} = \sum_{S}\left(F_S * \sum_{f}\left(GHG_{stat,f} + GHG_{mob,f}\right) + GHG_{elec}\right)$$

$$= \sum_{S}\left(F_S * \sum_{f}\left(Q_{stat,f} * EF_f + Q_{mob,f} * EF_f\right) + Q_{elec} * EF_{elec}\right) \quad [33]$$

where:

$GHG_{stat,f}$ = GHG emissions from the combustion of fuels type f in stationary machinery at the installed infrastructure, in tCO_2e. This shall include fuel consumed for generation of electric power and heat, and from auxiliary loads, where such emissions occur;

$GHG_{mob,f}$ = GHG emissions from the combustion of fuel type f in on-site vehicles and other transportation at the installed infrastructure, in tCO_2e. This includes vehicles used for regular maintenance;

GHG_{elec} = GHG emissions due to the electricity imported from the grid and consumed at the installed infrastructure, in tCO_2e;

$Q_{stat,f}$ = quantity of fuel type f combusted in stationary sources at the site, in giga joule [GJ]. Should any unit conversions be necessary, the density and NCV parameters adopted shall be included in Table 4;

$Q_{mob,f}$ = quantity of fuel type f combusted in mobile sources at the installed infrastructure, in GJ;

EF_f = emission factor due to the combustion of the fuel type f, in tCO_2e/GJ, chosen following Section 2.3.4.4;

Q_{elec} = net amount of electricity imported from the grid and consumed at the installed infrastructure, selected in accordance with Section 2.3.2, in MWh;

EF_{elec} = emissions factor for the generation of electricity, in tCO_2e/MWh, chosen following Section 2.3.4.1;

f = fuel type, including those from fossil and biogenic origin.

2.1.7.3. Monitoring and reporting

In accordance with Section 1.3.3, operators shall include in the monitoring report before each re-certification audit the measured or calculated parameters listed in Table 4. Where a parameter is noted as to be monitored, it shall be included in the monitoring plan in accordance with Section 1.3.2.

Table 4: Parameters for inclusion in the monitoring report.

Equation	Parameter	Unit	Definition	Notes
[26]	F_S	%	Allocation fraction defined for each transport segment S as the fraction of the CO_2 from the activity passing through the segment in a certification period and is being sent for storage	Calculated using equation [26].
	$CO_{2\ activity,S}$	tCO_2	Amount of CO_2 from the activity passing through the CO_2 infrastructure segment S in the certification period	To be monitored
	$CO_{2\ total,S}$	tCO_2	Total amount of CO_2 from all sources passing through the CO_2 infrastructure segment S in the certification period	To be monitored
[27]	$CO_{2transport,loss}$ (Method A)	tCO_2	Amount of intentional and accidental escapes of CO_2 throughout the transport network	
	$CO_{2_{in,S}}$	tCO_2	Amount of CO_2 transferred to the transport infrastructure segment S, determined in accordance with Articles 40 to 46 and Article 49 of Commission Implementing Regulation (EU) 2018/2066	To be monitored
	$CO_{2_{out,S}}$	tCO_2	Amount of CO_2 transferred out of the transport infrastructure segment, determined in accordance with Articles 40 to 46 and Article 49 of Commission Implementing Regulation (EU) 2018/2066	To be monitored
[28]	$CO_{2transport,loss}$ (Method B)	tCO_2	Amount of measured losses of CO_2 throughout the transport network	
	$CO_{2\ fugitive,S}$	tCO_2	Sum of fugitive emissions from CO_2 transported in the transportation infrastructure	Calculated using eq. [29]
	$CO_{2\ vented,S}$	tCO_2	Sum of vented emissions from CO_2 transported in the transportation	To be informed by

			infrastructure,	the transport infrastructure operator.
	$CO_{2\ leakage,S}$	tCO_2	Sum of CO_2 transported in the transportation infrastructure, which is emitted as the result of the failure of one or more components of the network	To be informed by the transport infrastructure operator.
[29]	$EF_{occur,c,S}$	tCO_2e/unit time	Average emission factors per piece of component per occurrence,	To be monitored.
	$N_{occur,c,S}$	number of time units/year	Number of components in the transportation system type of equipment	To be monitored.
[30]	$GHG_{transport}$	tCO_2e	Total amount of GHG emissions from the combustion of fuels during the transportation of CO_2	Calculated using eq. [30]
	$GHG_{T,S}$	tCO_2e	Emissions due to energy use for CO_2 transportation in mode of transportation type T in infrastructure segment S	Calculated using eq. [31], [32]
	$GHG_{infra,S}$	tCO_2e	Emissions due to energy use at the supporting infrastructure connected to the CO_2 transport network	Calculated using eq. [33]
[31]	Q_{fuel}	[appropriate unit]	Quantity of the fuel consumed in the certification period	To be monitored
	EF_{fuel}	tCO_2e	Lifecycle emission factor for consumed fuel	
[32]	$K_{L,S}$	km	Distances of trips in infrastructure segments S	To be monitored
	$EF_{vehicle,loaded}$	tCO_2e/km	CO_2 emission per kilometre of the loaded transport vehicles	
	$EF_{vehicle,unload}$	tCO_2e/km	CO_2 emission per kilometre of the unloaded transport vehicles	
[33]	$Q_{stat,f}$	GJ	Quantity of fuel type f combusted	To be

			in stationary sources at the installed infrastructure	monitored
	$Q_{mob,f}$	GJ	Quantity of fuel type f combusted in mobile sources at the installed infrastructure	To be monitored
	Q_{elec}	MWh	Amount of electricity imported from the grid and consumed at the installed infrastructure	To be monitored
	EF_f	tCO_2e/GJ	emission factor due to the combustion of the fuel type f	
	EF_{elec}	tCO_2e/MWh	emissions factor for the generation of electricity	

2.1.8. Injection of CO2 into storage sites

A CO_2 capture activity may transfer CO_2 via a transport pathway to one or more storage facilities for injection into geological storage.

If CO_2 from sources other than the activity is stored at the same facility, an allocation fraction shall be defined for each storage site S as the fraction of the CO_2 stored at that facility in a certification period that comes from the activity in accordance with equation [34]:

$F_S = CO_{2\,activity.injected,S} / CO_{2\,injected,S}$	[34]

where:

$CO_{2\,activity.injected,S}$ = the part of $CO_{2\,activity}$ (see equation [4]) that is stored at facility S. In the case of a non-segregated CO_2 stream this amount shall be specified on a mass balance basis;

$CO_{2\,injected,S}$ = total amount of CO_2 from all sources stored at site S in the certification period;

S = index of the storage facilities.

2.1.8.1. Quantification of CO_2 entering the storage facility

The amount of CO_2 entering the storage facility shall be determined at the entry point or points using a measurement-based approach in accordance with Articles 40 to 45 and Article 49 of Implementing Regulation (EU) 2018/2066.

2.1.8.2. Application of mass balance rules

Other than in the case that the CO_2 stream is fully segregated and the rules in section 2.1.3.3 are used to determine CR_{total}, a mass balance system based on the following principles shall be

used to trace CO_2 through the transport infrastructure from the capture facility to the storage facility:

(a) each quantity of CO_2 entering the transport and storage system may be treated as having been stored or otherwise discharged from the system (by losses or by supply for a non-storage application) only once;

(b) the sum of the quantities of CO_2 entering, or released from storage at, any transport infrastructure segment or storage facility in a given period shall be equal to the sum of the quantities of CO_2 identified as leaving or being stored at that infrastructure segment or storage facility in the same period (allowing for any discrepancy associated with the quantity of CO_2 actively in transit or undergoing storage related processes at the end of the period and for measurement uncertainty);

(c) where a quantity of CO_2 from an activity is mixed with a quantity of CO_2 from other sources, and that mixed stream of CO_2 is then transferred to more than one subsequent transport infrastructure segments or storage facilities, then the activity operator may agree with other interested parties which of the transferred quantities of CO_2 is (or are) to be treated as originating or partially originating from that activity;

(d) where a quantity of CO_2 is transferred into an interconnected transport network and thereby mixed with a quantity of CO_2 from other sources, the operator is not required to model the transit time of the CO_2 from the activity through the transport network – any corresponding quantity of CO_2 transferred out of the transport network after the time at which the CO_2 from the activity enters the transport network may be treated as the CO_2 from the activity, with the constraint that it is not permissible to assume that CO_2 has travelled against the flow direction in a transport infrastructure segment.

(e) subject to these principles detailed in points a) to d), contractual arrangements may be used to identify a quantity of CO_2 being injected into a storage site with an equivalent quantity of CO_2 from a capture installation (accounting for losses en route using the rules in this methodology) that was transferred into a system of shared infrastructure, even though the actual physical location of the CO_2 molecules captured by the activity may be unknown. No other quantity of CO_2 stored by or leaving that system of shared infrastructure may be identified with the quantity of CO_2 captured by the carbon removal activity;

(f) activity operators shall provide adequate evidence or arrange for the operators of the transport and/or storage infrastructure to provide adequate evidence that the abovementioned mass balance requirements and any additional requirements imposed by the certification scheme have been complied with.

2.1.8.3. Quantification of fugitive and vented emissions of captured CO_2

In the event of any intentional or accidental losses of CO_2 prior to entering permanent storage, if the quantity CR_{total} is calculated based on Equation [8], these losses shall be explicitly quantified.

Fugitive and vented emissions during injection into the storage site shall be calculated in accordance with Section 23, subsection B.1., of Annex IV to Implementing Regulation (EU) 2018/2066. In the case of geological storage sites, data regarding fugitive and vented emissions shall be based on data recorded by the relevant site operator under Implementing Regulation (EU) 2018/2066. The total loss of CO_2 from the activity during storage shall be calculated in accordance with equation [35]:

$$CO_{2_{storage,losses}} = \sum_{S} \left(F_S * \left(CO_{2_{fugitive,S}} + CO_{2_{vented,S}} \right) \right)$$	[35]

where:

F_S = fraction of the CO_2 stored at site S that originates from the activity, in %;

$CO_{2_{fugitive,S}}$ = fugitive CO_2 emissions from the facility S, in tonnes CO_2;

$CO_{2_{vented,S}}$ = vented CO_2 emissions from the facility S, in tonnes CO_2;

At each facility S, the sum of the fugitive and vented emissions shall be equal to the difference between the measured amount of CO_2 entering the site and the measured amount of CO_2 entering the storage reservoir, in accordance with equation [36]:

$$CO_{2_{fugitive,S}} + CO_{2_{vented,S}} = CO_{2_{IN,S}} - CO_{2_{injected,S}}$$	[36]

where:

$CO_{2_{IN,S}}$ = measured total amount of CO_2 entering the facility S, in tonnes CO_2;

$CO_{2_{total,S}}$ = measured total amount of CO_2 entering permanent storage at the facility S, in tonnes CO_2.

2.1.8.4. Quantification of associated GHG emissions

The GHG emissions associated with the injection into a geological storage site shall be calculated in accordance with equation [37]:

$$GHG_{storage} = \sum_{S} \left(F_S * \left(GHG_{on-site} + GHG_{inputs} \right) \right)$$	[37]

where:

$GHG_{on-site}$ = GHG emissions associated with energy use and operation at the storage facility, in tonnes CO_2e;

GHG_{inputs} = GHG emissions associated with the production and use of other inputs used at the storage facility, in tonnes CO_2e.

2.1.8.4.1. Emissions from the storage facility

The on-site GHG emissions at each site shall be calculated in accordance with equation [38]:

$$GHG_{on-site} = GHG_{combustion} + GHG_{elec} + GHG_{heat} + GHG_{capital}$$	[38]

where:

$GHG_{combustion}$ = GHG emissions due to fuel consumption at the storage facility, in tonnes CO_2e, calculated in accordance with equation [39] below;

GHG_{elec} = GHG emissions due to net electricity consumption at the storage facility in tonnes CO_2e, calculated in accordance with equation [40] below;

GHG_{heat} = GHG emissions due to net useful heat consumption at the storage facility, in tonnes CO_2e, calculated in accordance with equation [41] below;

$GHG_{capital}$ = capital emissions from construction and installation of the storage facility, in tonnes CO_2e, calculated in accordance with the principles detailed in Section 2.3.5.

$$GHG_{combustion} = \sum_{fuels} Q_{fuel} * EF_{fuel} + CO_{2\ stored,fossil}$$	[39]
$$GHG_{elec} = \sum_{electricity\ source} Q_{elec} * EF_{elec}$$	[40]
$$GHG_{heat} = \sum_{heat\ source} Q_{heat} * EF_{heat}$$	[41]

where:

Q_{fuel} = quantity of the fuel consumed in the certification period, expressed in an appropriate unit;

EF_{fuel} = lifecycle emission factor for the fuel consumed, expressed in tonnes of CO_2e per unit, selected in accordance with Section 2.3.4.4;

$CO_{2\ stored,fossil}$ = minus the quantity of fossil CO_2 from fuel combustion at the storage facility captured and permanently stored, in tonnes CO_2. It shall be calculated as the minus the measured quantity of CO_2 captured from fossil sources at the capture facility plus any CO_2 losses prior to storage;

Q_{elec} = net quantity of electricity consumed in the certification period, selected in accordance with Section 2.3.2, expressed in an appropriate functional unit;

EF_{elec} = lifecycle emission factor for the consumed electricity, expressed in tonnes of CO_2 per functional unit, selected in accordance with Section 2.3.4.1;

Q_{heat} = net quantity of useful heat consumed in the certification period, selected in accordance with Section 2.3.2, expressed in an appropriate

unit;

EF_{heat} = lifecycle emission factor for the consumed heat, expressed in tonnes of CO_2e per unit, selected in accordance with Section 0.

2.1.8.4.2. Emissions from inputs

Where there are inputs consumed by the storage facility the emissions associated with the consumption of these inputs during the certification period shall be calculated in accordance with equation [42]:

$$GHG_{inputs} = \sum_{inputs} Q_{input} * EF_{input} \quad [42]$$

where:

Q_{input} = quantity of the input consumed in the certification period, expressed in an appropriate unit;

EF_{input} = lifecycle emission factor for the input consumed, expressed in tonnes of CO_2e per unit, selected in accordance with the rules in Section 2.3.4.4.

The operator may group any number of inputs whose collective emissions are considered non-material on the basis of a materiality assessment and substitute for them an emission term equal to $1\% * CR_{total}$, i.e. a group of inputs for which, when taking a high-end estimate of possible associated emissions:

$$\sum_{inputs} Q_{input} * EF_{input} < 2\% * CR_{total} \quad [43]$$

2.1.8.5. Monitoring and reporting

In accordance with Section 1.3.3, operators shall include in the monitoring report before each re-certification audit the measured or calculated parameters for the certification period being audited listed in Table 5. Where a parameter is noted as 'to be monitored', it shall be included in the monitoring plan in accordance with Section 1.3.2.

Table 5: Parameters for inclusion in the monitoring report.

Equation	Parameter	Unit	Definition	Notes
[34]	F_S	%	Allocation fraction of the CO_2 stored at facility S that originates from the activity and shall be used to generate carbon removal units	

	$CO_{2_{activity,injected}}$	tonnes CO_2	The part of $CO_{2_{injected,S}}$ stored at facility S	To be identified following mass balance rules in the case of non-segregated CO_2 streams
	$CO_{2_{injected,S}}$	tonnes CO_2	Total amount of CO_2 injected for permanent storage at each relevant storage facility	To be monitored
[35]	$CO_{2_{storage,losses}}$	tonnes CO_2	Total loss of CO_2 during storage activity	
	$CO_{2_{vented,S}}$	tonnes CO_2	Amount of CO_2 vented at each relevant storage facility	To be monitored
	$CO_{2_{fugitive,S}}$	tonnes CO_2	Amount of CO_2 fugitives at each relevant storage facility	To be monitored
[36]	$CO_{2_{IN,S}}$	tonnes CO_2	Amount of CO_2 entering the facility S	To be monitored
[37]	$GHG_{storage}$	tonnes CO_2e	GHG emissions associated with the injection into a geological storage site	
	$GHG_{on-site}$	tonnes CO_2e	GHG emissions associated with energy use and operation in the storage facility	Calculated using eq. [38]
	GHG_{inputs}	tonnes CO_2e	GHG emissions associated with the production and use of other inputs used at the storage facility	Calculated using eq. [42]
[38]	$GHG_{combustion}$	tonnes CO_2e	GHG emissions due to fuel consumption at the storage facility	Calculated using eq. [39]
	GHG_{elec}	tonnes CO_2e	GHG emissions due to net electricity consumption at the storage facility	Calculated using eq. [40]
	GHG_{heat}	tonnes CO_2e	GHG emissions due to net useful heat consumption at the storage	Calculated using eq. [41]

			facility	
	$GHG_{capital}$	tonnes CO_2e	Capital emissions	To be informed by the operator. Calculated using eq. [68]
[39]	Q_{fuel}	[appropriate unit]	Amount of fuels used for combustion at each storage facility, for all relevant storage facilities	To be monitored
	EF_{fuel}	tonnes CO_2e/unit	lifecycle emission factor for the fuel consumed	
[40]	Q_{elec}	MWh	Net amount of electricity consumed at each storage facility, for all relevant storage facilities	To be monitored
	EF_{elec}	tonnes CO2e/unit	lifecycle emission factor for the consumed electricity	
[41]	Q_{heat}	MWh	Net amount of useful heat consumed at storage facility, for all relevant storage facilities	To be monitored
	EF_{heat}	tonnes CO_2e/unit	Lifecycle emission factor for the consumed heat	
[42]	Q_{input}	[appropriate unit]	Amount of input consumed	To be monitored
	EF_{input}	tonnes CO_2e/unit	Lifecycle emission factor for the input consumed	
[68]	$GHG_{materials}$	tonnes CO_2e	Emissions from the materials utilised in the construction of the facility	Calculated using eq. [69]
[69]	$Q_{materials}$	tonnes	Quantity of materials utilised in the construction of the facility	
	$EF_{materials}$	tonnes CO_2e/tonne material	lifecycle emission factor for the utilised materials	

2.2. BCR activity

2.2.1. GHG sources and sinks

BCR activities shall consider GHG sources and sinks included in Table 6.

Table 6: Sinks and sources that shall be included for a BCR activity

Phase of the operation	Emission sources/sinks	Gases included
Biochar production	Biochar production facility: Equipment used to produce biochar.	Greenhouse gases
	Biochar production facility: Any biochar processing equipment that is used to treat the biochar prior to its shipping for application or incorporation.	Greenhouse gases
	Biochar production facility: Any associated energy generation equipment that is geographically contiguous with the facility.	Greenhouse gases
	Biochar production facility: Any treatment equipment for processing wastes or byproducts of the biochar production process.	Greenhouse gases
	Biomass supply emissions: Production/collection of biomass used by the biochar production facility.	Greenhouse gases
	Input emissions: Production and supply of inputs used by the biochar production facility.	Greenhouse gases
	Waste treatment: Processing and treatment of any wastes (including wastewater and exhaust gases) generated by the biochar production facility.	Greenhouse gases
	Capital emissions: Emissions associated with the construction and installation of the biochar production facility.	Greenhouse gases
Transport of biochar	Transportation: Fuel combustion and electricity consumption at road transportation (e.g. tank trucks, rails), maritime transportation (e.g. sea tanker) and other vehicles.	Greenhouse gases
Application to soils or incorporation in materials	Quantity of CO_2 permanently stored in the form of biochar	CO_2 only
	Application/incorporation site: Any energy consumption and/or generation associated with the process of application or incorporation.	Greenhouse gases

2.2.2. Baseline

A standardised baseline set to 0 tCO_2/year shall apply for BCR activities.

Where the activity is financed through a combination of public and private funding, in order to ensure that there is no overcompensation of costs, when submitting the activity plan to the

certification scheme operators shall indicate any form of financing received or applied for with regard to the activity. This information shall be included in the certificate of compliance.

2.2.3. Quantification of the total removals of the activity

The operator shall calculate the total carbon removals (CR_{total}) in accordance with equation [44]:

$$CR_{total} = -3.664 * F_{perm} * C_{org} * Q_{biochar}$$	[44]

where:

F_{perm} = permanence fraction of the biochar calculated following the rules in Section 2.2.7.1, as a percentage;

C_{org} = the organic carbon content of the biochar, C_{org}, shall be established by laboratory analysis as the ratio of the mass of organic carbon in the biochar to the total mass of the biochar;

$Q_{biochar}$ = the mass of biochar applied or incorporated during the certification period, in tonnes on a dry matter basis. The mass of biochar shall exclude any non-biogenic material also processed in the biochar production process. If the biochar feedstock may be expected to contain a fraction of non-biogenic carbon greater than 2 % of the total carbon feedstock by mass, the biogenic fraction in the product shall be identified by carbon 14 (C^{14}) testing. If non-biogenic material is co-processed in the biochar production process, the char produced shall not be applied to soils, and carbon removal units may only be issued if the mixed char produced conforms to all threshold requirements for biochar incorporated in materials (see Section 4.4.3).

2.2.4. Quantification of the greenhouse gases associated to the activity

The greenhouse gases associated shall be calculated according to the equation [45].

$$GHG_{associated} = GHG_{biochar} + GHG_{transport} + GHG_{use}$$	[45]

where:

$GHG_{biochar}$ = GHG emissions associated with the production of biochar, calculated following the rules in Section 2.2.5.1;

$GHG_{transport}$ = GHG emissions associated with biochar transport from the production facility to the point of application or incorporation, calculated following the rules in Section 2.2.6.1;

GHG_{use} = GHG emissions associated with the application or incorporation of

biochar, calculated following the rules in Section 2.2.7.2.

2.2.5. Production of Biochar

2.2.5.1. Production batches

The amount of biochar produced shall be measured and assigned to production batches that share feedstock mix and common processing conditions, i.e. the same underlying process is used and target biochar production temperature, the biochar residence time and any techniques used to manage the oxygen concentration are consistent across the batch. Common feedstock mix requires shares of feedstock types in the mix to be approximately the same across the batch.

A production batch may be interrupted and restarted at a later time. If biochar produced from the same feedstock under the same conditions is split into more than one batch for sale to different end uses, this may still be treated as a single production batch for the purpose of quantification.

Certification schemes may establish additional requirements on the definition of a production batch to limit the permissible variation of the biochar in the batch.

2.2.5.2. Biochar properties

Operators shall undertake laboratory testing on each production batch of biochar. Certification schemes may provide guidance on the list of properties to be reported to certification bodies during recertification audits, which shall at least include the properties required in order to follow this methodology:

(a) the organic carbon content of the biochar, C_{org}, as required in equation [44].

(b) the molar ratio of elemental hydrogen to organic carbon in the biochar (H/C_{org} ratio), as required in Section 3.2 and when the decay function is used to assess the permanence fraction of the biochar (Section 2.2.7.1.2).

(c) the energy density of the biochar on a lower heating value basis .

(d) where the inertinite assessment is used to assess the permanence fraction of the biochar (Section 2.2.7.1.1), the fraction of the biochar that is identified as having a R_o reflectance value of 2 % or greater.

(e) content of the limited substances detailed in Section 4.4.1 or 4.4.3.

2.2.5.3. Biochar sampling

All production batches of biochar shall be sampled. Samples shall be representative of the average properties of the production batch being sampled. Operators shall include a description of the sampling protocol in the monitoring plan for review by the certification body at the certification audit, and shall follow this protocol during the activity period. The sampling protocol may be amended during the activity period where operators demonstrate that the sample data is at least equally representative of the batches. Sampling protocols shall be consistent with Article 33 of Implementing Regulation (EU) 2018/2066, with the exception of the last sentence of paragraph 1 of that Article.

The biochar to be sampled shall be well-mixed, and operators shall take an appropriate number of samples to ensure that the data from the samples is representative of the production batch. When a production batch is produced over a period of time (in one or more production runs) sampling shall be undertaken either after mixing of the biochar produced over the full production period, or on subsets of the batch and a sufficient number of samples shall be

taken to robustly establish the average properties of the biochar across the full production batch. A certification body or certification scheme may require analysis of retention samples if this is deemed necessary to establish a representative characterisation of a production batch, or to confirm that measurements taken are representative.

Sampling protocols may allow for a reduction in the frequency of sampling over time if it is demonstrated that a process reliably produces biochar with consistent characteristics from a given feedstock. Certification schemes may provide additional guidance, which may differentiate the level of sampling required for different production contexts and between different types of biochar where that is technically justified.

The biochar producer shall take retention samples of the biochar produced which shall be made available on request to the certification body, certification scheme or relevant representatives of competent national authorities. One litre retention samples shall be taken for each production batch every day that biochar is produced and may be aggregated across the calendar month for storage, keeping samples of each production batch separate. Retention samples shall be stored for at least two years.

2.2.5.4. Quantification of associated GHG emissions

The emissions associated with the operation of the biochar facility shall be calculated in accordance with equation [46]:

$$GHG_{biochar} = F_{alloc} * \left(GHG_{facility} + GHG_{inputs}\right) \quad [46]$$

where:

F_{alloc} = allocation fraction for biochar, calculated in accordance with equation [47]. The biochar shall be treated as a residue of another process if the chemical energy in the biochar produced (LHV) is less than 10 % of the total energy of the produced output, and in that case F_{alloc} = 0 and it is not necessary for the terms $GHG_{facility}$ and GHG_{inputs} to be calculated;

$GHG_{facility}$ = total GHG emissions from operation and construction of the biochar production facility, calculated in accordance with Section 2.2.5.4.1;

GHG_{inputs} = total emissions associated with inputs to the biochar production facility, calculated using equation [54].

$$F_{alloc} = \begin{cases} 0 \text{ if the biochar is treated as a residue} \\ E_{biochar} \Big/ \left(E_{biochar} + \sum_{co-products} E_{co-products}\right) \text{ otherwise} \end{cases} \quad [47]$$

where:

$E_{biochar}$ = chemical energy in the biochar in mega joule per kg [MJ/kg] of biochar produced, assessed by laboratory testing on a lower heating value basis;

$co - products$ = an index of the energy-containing co-products of the biochar production process. Outputs from the process that are exported from the facility to be used elsewhere and that contain at least 10 % of the total energy in all the outputs of the process are co-products. Electricity, useful heat and materials containing chemical energy (assessed on a lower heating-value basis) exported from the facility shall be treated as co-products if they meet these conditions. Co-products that are subject to further processing before export from the facility shall be included based on their energy content prior to this additional processing. Outputs with no heating value (e.g. ash) shall not be considered in the allocation calculation;

$E_{co-products}$ = In the case of material co-products, the chemical energy in each co-product in MJ/kg of biochar produced, assessed by laboratory testing on a lower heating value basis. In the case of electricity and heat as co-products, the amount of electricity or useful heat supplied to a grid, network or user outside the activity, where useful heat is defined as heat generated to satisfy an economical justifiable demand for heat, for heating and cooling purposes (cf. Paragraph 1 of Part C of Annex V to Directive (EU) 2018/2001).

2.2.5.4.1. Emissions from the biochar facility

The emissions $GHG_{biochar}$ associated with the biochar production facility shall be calculated in accordance with equation [48]:

$$GHG_{facility} = GHG_{bio} + GHG_{bio\text{-}storage} + GHG_{combustion} + CH_{4_{release}} + GHG_{elecy} + GHG_{heat} + GHG_{capital} + GHG_{disposal} \quad [48]$$

whereby:

GHG_{bio} refers to emissions associated with the production and supply of biomass used at the biochar-producing facility, calculated in accordance equation [49]:

$$GHG_{bio} = \sum_{fuels} Q_{biomass} * EF_{biomass} \quad [49]$$

where:

$Q_{biomass}$ = quantity of the biomass that is consumed in the certification period, calculated in accordance with the rules in Section 2.3.3, expressed in an appropriate unit, excluding any non-biomass contamination (e.g. soil, rocks);

$EF_{biomass}$ = lifecycle emissions value, expressed in tCO_2e/unit, selected in accordance with the rules in Section 2.3.4.3.

$GHG_{bio\text{-}storage}$ refers to CH_4 emissions due to biomass storage prior to processing at the biochar production facility. $GHG_{bio\text{-}storage}$ shall be set to zero if one or more of the following practices are followed for all biomass utilised:

(a) biomass stored for use in the biochar production process consists of coarse woody material that naturally remains well aerated;
(b) biomass that is stored in a form that does not necessarily remain naturally aerated shall either:
    (i) be stored for no more than four weeks prior to processing; or
    (ii) be stored with a maximum of 30 % residual moisture.
(c) biomass is pelleted for storage;
(d) operators otherwise demonstrate that biomass is stored in a way that avoids anaerobic decomposition given the nature of the feedstock and the local conditions.

Otherwise, $GHG_{bio\text{-}storage}$ shall be calculated in accordance with equation [50]:

$$GHG_{bio\text{-}storage} = \sum_{feedstocks} \begin{pmatrix} 1.335 * 0.0013 * Q_{feedstock} * C_{feedstock} * \\ (T_{storage} - 1) \end{pmatrix} * GWP_{CH_4} \quad [50]$$

where:

$Q_{feedstock}$ = quantity of the fuel consumed in the certification period, expressed in an appropriate unit;

$C_{feedstock}$ = carbon content of the feedstock, expressed as a mass %;

$T_{storage}$ = time in months for which the feedstock batch is stored (rounded up);

feedstocks = an index of the batches of feedstocks consumed;

0.0013 = assumed monthly fractional loss of biomass carbon from storage;

GWP_{CH_4} = global warming potential of methane.

$GHG_{combustion}$ refers to emissions due to fuel consumption at the biochar production facility, including CH_4 and N_2O emissions from biomass combustion for energy, calculated in accordance with equation [51]:

$$GHG_{combustion} = \sum_{fuels} (Q_{fuel} * EF_{fuel}) + CO_{2\ stored,fossil} \quad [51]$$

where:

Q_{fuel} = quantity of the fuel consumed in the certification period, expressed in an appropriate unit, including in the case of mixed biogenic and non-biogenic feedstocks any fossil-carbon-based material in the input that is combusted to CO_2;

EF_{fuel} = lifecycle emissions value, expressed in tCO_2e/unit, selected in accordance with the rules in Section 2.3.4.4;

$CO_{2\ stored,fossil}$ = minus the quantity of fossil CO_2 from fuel combustion at the biochar production facility captured and permanently stored at a site permitted under Directive 2009/31/EC;

fuels = an index of the fuels consumed.

$CH_{4_{release}}$ refers to any emission into the atmosphere of methane generated by the biochar production process. CH_4 emissions shall be sampled at least twice per pyrolysis unit during the first certification period with an interval of at least a third of the certification period, and measured in units of grams of methane emission per kilogram of biochar production.

If these measurements are consistent, the average of the measurements may be taken as characteristic of the pyrolysis unit. CH_4 emissions measurements shall be considered consistent if either:

(a) both measurements demonstrate that CH_4 is only emitted at trace levels, defined as a level of CH_4 emissions that would amount to less than 1% of CR_{total} if continued for the entire certification period and expressed in tCO_2e on a GWP 100 basis; or
(b) the measured level is similar for the two measurements, defined as the higher of the two measurements being not more than 40 % above the lower measurement.

If the measurements are not consistent, additional measurements shall be taken until a reliable estimate of average CH_4 emissions is established. In the case that non-zero CH_4 emissions above a trace level are identified, the operator shall produce and implement a CH_4 reduction plan to eliminate these emissions that shall be measured again in the subsequent certification period. If CH_4 emissions are found to be emitted at only trace levels, such measured level may be taken as representative for that pyrolysis unit for the following five years, after which CH_4 emissions shall be measured again.

$GHG_{electricity}$ refers to emissions due to electricity consumption at the biochar production facility, calculated in accordance with equation [52]:

$$GHG_{elec} = \sum_{electricity\ source} Q_{elec} * EF_{elec} \quad [52]$$

where:

Q_{elec} = net quantity of electricity consumed in the certification period, selected in accordance with Section 2.3.2, expressed in an appropriate unit;

EF_{elec} = lifecycle emission factor for the consumed electricity, expressed in tCO_2e/unit, selected in accordance with Section 2.3.4.1;

electricity source = an index across electricity sources.

GHG_{heat} refers to emissions due to net consumption of useful heat at the biochar producing facility, calculated in accordance with equation [53]:

$$GHG_{heat} = \sum_{heat\ source} Q_{heat} * EF_{heat} \quad [53]$$

where:

Q_{heat} = net quantity of useful heat consumed in the certification period for the biochar production process, selected in accordance with Section 2.3.2, expressed in an appropriate unit;

EF_{heat} = lifecycle emission factor for the consumed heat, expressed in tCO_2e/unit, selected in accordance with Section 0;

heat source = index of all utilised external heat sources.

$GHG_{capital}$ refers to capital emissions from construction and installation of the biochar production facility and shall be calculated in accordance with the principles detailed in Section 2.3.5.

$GHG_{disposal}$ refers to emissions from the treatment or disposal of any wastes generated by the biochar production facility. This shall include emissions associated with the supply of any energy and inputs consumed in the course of waste disposal and any other GHG emissions associated with the disposal process including emissions of N_2O and/or CH_4 due to aerobic or anaerobic degradation of biomass wastes.

2.2.5.5. Emissions from inputs

Where there are inputs including chemicals, but excluding anything within the scope of capital emissions, consumed by the biochar production facility, other than fuels that are considered in the $GHG_{combustion}$ term, the lifecycle emissions associated with the consumption of these inputs during the certification period shall be calculated in accordance with equation [54]:

$$GHG_{inputs} = \sum_{inputs} Q_{input} * EF_{input} \quad [54]$$

where:

Q_{input} = quantity of the input consumed in the certification period, expressed in an appropriate unit;

EF_{input} = lifecycle emission factor for the input consumed, expressed in tCO_2e/unit, selected in accordance with Section 2.3.4.4.

The operator may group any number of inputs whose collective emissions are considered non-material on the basis of a materiality assessment and substitute for them an emission term equal to $1\% * CR_{total}$, i.e. a group of inputs for which when taking a high end estimate of expected associated emissions, in accordance with equation [55]:

$$\sum_{inputs} Q_{input} * EF_{input} < 2\% * CR_{total} \quad [55]$$

2.2.5.5.1. CO_2 capture at the biochar production facility

Where CO_2 capture of biogenic CO_2 is implemented at the biochar production facility, this shall not be counted as a negative emission in $GHG_{associated}$ but may be eligible for certification as a BioCCS carbon removal activity.

2.2.5.6. Monitoring and reporting

In accordance with Section 1.3.3, operators shall include in the monitoring report before each re-certification audit the measured or calculated parameters listed in Table 7. Where a parameter is noted as to be monitored, it shall be included in the monitoring plan in accordance with Section 1.3.2.

If a quantity of biochar is produced during one certification period but applied or incorporated in a later certification period, the emissions and removals associated with that quantity of biochar shall be recorded in the later certification period.

Table 7: Parameters for inclusion in the monitoring report.

Equation	Parameter	Unit	Definition	Notes
[46]	$GHG_{biochar}$	tCO_2e	Emissions associated with the operation of the biochar facility	
	F_{alloc}	%	Allocation fraction of biochar	Calculated using eq. [47]
	$GHG_{facility}$	tCO_2e	Total GHG emissions from operation and construction of the biochar production facility	Calculated using eq.[48]
	GHG_{inputs}	tCO_2e	Total GHG emissions associated with inputs to the biochar production facility	Calculated using eq. [54]
[47]	$E_{biochar}$	MJ/kg biochar produced	Chemical energy in the biochar	To be monitored
	$E_{co-products}$	MJ/kg biochar produced	Chemical energy in each co-product in case of material co-products	To be monitored
[48]	GHG_{bio}	tCO_2e	GHG emissions associated with the production and supply of biomass used at the biochar producing facility	Calculated using eq. [49]
	$GHG_{bio-storage}$	tCO_2e	CH_4 emissions due to biomass storage prior to processing at the biochar production facility	Calculated using eq. [50]

	$GHG_{combustion}$	tCO_2e	Emissions due to fuel consumption at the biochar production facility, including CH_4 and N_2O emissions from biomass combustion for energy	Calculated using eq.[51]
	$CH_{4release}$	tCO_2e	Quantity of methane emitted from the biochar producing process	To be monitored
	GHG_{elec}	tCO_2e	Emissions due to net electricity consumption at the biochar production facility	Calculated using eq. [52]
	GHG_{heat}	tCO_2e	Emission due to net consumption of useful heat at the biochar producing facility	Calculated using eq. [53]
	$GHG_{capital}$	tCO_2e	Capital emissions	To be informed by the operator. Calculated using eq. [68]
	$GHG_{disposal}$	tCO_2e	Emissions from treatment or disposal of any waste generated by the biochar producing facility	To be monitored
[49]	$Q_{biomass}$	[appropriate unit]	Quantity of biomass consumed for biochar producing process	To be monitored
	$EF_{biomass}$	tCO_2e/unit	Emission factor for that biomass	
[50]	$Q_{feedstock}$	[appropriate unit]	Quantity of feedstock in each batch stored for more than four weeks in potentially anaerobic conditions	To be monitored where relevant
	$C_{feedstock}$	%	Carbon fraction in that feedstock	To be monitored where relevant
	$T_{storage}$	months	Period for which feedstock batch is stored in potentially anaerobic conditions	To be monitored where relevant
[51]	Q_{fuel}	[appropriate unit]	Quantity of the fuel consumed in the certification period	To be monitored

	EF_{fuel}	tCO_2e/unit	Lifecycle emission factor for the consumed fuel	
	$CO_{2\ stored,fossil}$	tCO_2	Quantity of fossil CO_2 from fuel combustion at the biochar production facility captured and permanently stored at a site	To be monitored
[52]	Q_{elec}	[appropriate unit]	Net quantity of electricity consumed in the certification period	To be monitored
	EF_{elec}	tCO_2e/unit	Lifecycle emission factor for the consumed electricity	
[53]	Q_{heat}	[appropriate unit]	Net quantity of useful heat consumed in the certification period	To be monitored
	EF_{heat}	tCO_2e/unit	Lifecycle emission factor for the consumed heat	
[54]	Q_{input}	[appropriate unit]	Quantity of the input consumed in the certification period	To be monitored
	EF_{input}	tCO_2e/unit	Lifecycle emission factor for the input consumed	
[68]	$GHG_{materials}$	tCO_2e	Emissions from the materials utilised in the construction of the facility	Calculated using eq. [69]
[69]	$Q_{materials}$	t	Quantity of materials utilised in the construction of the facility	To be monitored
	$EF_{materials}$	tCO_2e/t of material	lifecycle emission factor for the utilised materials	

2.2.6. Transport of Biochar

This section provides rules for the quantification of GHG emissions associated with biochar transportation. Any emissions associated with biomass transportation from the point of harvest/collection to the biochar production facility do not fall under this section, but shall be included in the term GHG_{bio} in equation [49].

2.2.6.1. Quantification of associated greenhouse gas emissions for transport

Following the principles in Section 2.3.4.5, GHG emissions associated with the transport of biochar, $GHG_{transport}$, shall either be calculated based on actual data on fuel consumption in

accordance with equation [56] or based on vehicle efficiencies and actual data about vehicle distance travelled in accordance with equation [57]. Operators are permitted to use different approaches for different transport modes, in which case $GHG_{transport}$ shall be calculated as the sum of the emissions calculated with each approach.

$$GHG_{transport} = \sum_{trips} (Q_{fuel} * EF_{fuel}) \quad [56]$$

where:

Q_{fuel} = quantity of fuel consumed for each trip, including empty return trips, expressed in an appropriate unit;

EF_{fuel} = lifecycle emissions value for the consumed fuel, expressed in tCO_2e/unit, selected in accordance with the rules in Section 2.3.4.4;

trips = an index of the trips taken.

$$GHG_{transport} = \left(\sum_{L=1}^{O} (K_L * EF_{vehicle,loaded}) + \sum_{L=1}^{R} (K_L * EF_{vehicle,unloaded}) \right) \quad [57]$$

where:

K_L = distance of each trip in kilometres;

$EF_{vehicle,loaded}$ = the CO_2 emissions per kilometre of the vehicle when loaded, in tCO_2e/km travelled. This may be based on an appropriate conservative default emission factor if it has been provided by the certification scheme;

$EF_{vehicle,unloaded}$ = the CO_2 emissions per kilometre of the vehicle when unloaded, in grams of CO_2e/km travelled. This may be based on an appropriate conservative default emission factor if it has been provided by the certification scheme. If no data/default is available for the unloaded vehicle but a value is available for $EF_{vehicle,loaded}$, then the operator may set $EF_{vehicle,unloaded} = EF_{vehicle,loaded}$;

O = total number of outbound trips taken;

R = Total number of empty return trips taken;

L = an index of the trips.

2.2.6.2. Monitoring and reporting

In accordance with Section 1.3.3, operators shall include in the monitoring report before each re-certification audit the measured or calculated parameters listed in Table 8. Where a parameter is noted as to be monitored, it shall be included in the monitoring plan in accordance with Section 1.3.2.

Table 8: Parameters for inclusion in the monitoring report.

Equation	Parameter	Unit	Definition	Notes
[56], [57]	$GHG_{transport}$	tCO_2e	GHG emissions due to energy use for biochar transportation	Calculated using eq. [56], [57]
[56]	Q_{fuel}	[appropriate unit]	Quantity of the fuel consumed in the certification period	To be monitored
	EF_{fuel}	tCO_2e	Lifecycle emission factor for consumed fuel	
[57]	K_L	km	Distances of trips	To be monitored
	$EF_{vehicle,loaded}$	tCO_2e/km	CO_2 emission per kilometre of the loaded transport vehicles	
	$EF_{vehicle,unload}$	gCO_2e/km	CO_2 emission per kilometre of the unloaded transport vehicles	

2.2.7. Application of Biochar

This section provides rules for the quantification of the permanence fraction of the CO_2 removals generated by the BCR activity and GHG emissions associated with the application of biochar to soils or incorporation of biochar to materials.

2.2.7.1. Calculation of the permanence fraction

The permanence fraction of the biochar, F_{perm}, may be calculated using one of the approaches described below.

Operators may not combine elements of these two approaches.

2.2.7.1.1. Inertinite assessment

Operators using this option shall submit samples of each production batch of biochar for random reflectance testing at a qualified laboratory. The fraction of the biochar that is identified as having an R_o reflectance value of 2 % or greater shall be treated as delivering permanent carbon storage for that production batch.

2.2.7.1.2. Decay function

This approach consists in the application of a decay function parameterised by the H/C_{org} ratio of the biochar, which shall always be less than or equal to 0.7, and the annual average temperature at its location of application or incorporation, i.e. soil temperature for application to soils and air temperature for incorporation in materials.

Operators using this option for permanence assessment shall use the H/C_{org} ratio for the biochar and the expected average temperature for the location of biochar application/incorporation to calculate F_{perm} in accordance with equation [58] using the appropriate parameters m and c from Table 9, rounding temperature up to the next 5 °C interval. This estimates the remaining carbon after 200 years using the decay data documented by Woolf et al. (2021)[8].

$F_{perm} = m * H/C_{org} + c$	[58]

where:

H/C_{org} = ratio of hydrogen to organic carbon in the biochar production batch;

m = a parameter for the linear part of the modelled relationship between H/C_{org} ratio and permanence;

c = a parameter for the constant part of the modelled relationship between H/C_{org} ratio and permanence;

Table 9: Parameters for calculating F_{perm}.

Temperature (°C)	m	C
5	-0.5	1.108
10	-0.650	1.001
15	-0.653	0.896
20	-0.636	0.829
25	-0.621	0.789

[8] Woolf, D., Lehmann, J., Ogle, S., Kishimoto-Mo, A. W., McConkey, B., & Baldock, J. (2021). *Greenhouse gas inventory model for biochar additions to soil*. Environmental Science & Technology, 55(21), 14795–14805. https://doi.org/10.1021/acs.est.1c02425.

2.2.7.2. Quantification of associated GHG emissions

The GHG emissions associated with the application and/or incorporation of biochar into soils and materials across one or more application/incorporation sites shall be calculated in accordance with equation [59]. Only emissions that are directly related to the use of the biochar shall be included. In the case that biochar is intermixed with another material, such as fertiliser prior to application to soil or by incorporation into concrete, emissions associated with producing and handling those second materials shall not be included, and the emissions from application or incorporation shall be allocated on a mass basis.

Where provided by the certification scheme, the operator may use more detailed requirements on how the associated greenhouse gas emissions shall be assessed for particular types of activities.

$$GHG_{use} = \sum_{S} \left(F_S * GHG_{on-site,S}\right)$$	[59]

where:

F_S = mass fraction of the project biochar in the total quantity of soil amendment applied to soils or of material incorporated into products at each site. The total mass includes the biochar from the activity, any biochar sourced from other activities for use at the same site, and any other materials intermixed with the biochar.

2.2.7.2.1. Emissions from application or incorporation

The on-site GHG emissions at each site shall be calculated in accordance with equation [60]:

$$GHG_{on-site} = GHG_{combustion} + GHG_{elec} + GHG_{heat}$$	[60]

where:

$GHG_{combustion}$ = GHG emissions due to fuel consumption at the application or incorporation site, including by vehicles and mobile equipment, in tCO_2e, calculated in accordance with equation [61] ;

$GHG_{electricity}$ = GHG emissions due to electricity consumption at the application or incorporation site in tCO_2e., calculated in accordance with equation [62] ;

GHG_{heat} = GHG emissions due to heat consumption at the application or incorporation site, in tCO_2e., calculated in accordance with equation [63] .

$$GHG_{combustion} = \sum_{fuels} Q_{fuel} * EF_{fuel}$$	[61]
$$GHG_{electricity} = \sum_{electricity\ source} Q_{elec} * EF_{elec}$$	[62]
$$GHG_{heat} = \sum_{heat\ source} Q_{heat} * EF_{heat}$$	[63]

where:

Q_{fuel} = quantity of the fuel consumed in the certification period, expressed in appropriate unit;

EF_{fuel} = lifecycle emission factor for the fuel consumed, expressed in tCO_2e/unit, selected in accordance with Section 2.3.4.4;

Q_{elec} = net quantity of electricity consumed in the certification period, selected in accordance with Section 2.3.2, expressed in appropriate unit;

EF_{elec} = lifecycle emission factor for the consumed electricity, expressed in tCO_2e/unit, selected in accordance with Section 2.3.4.1;

Q_{heat} = net quantity of useful heat consumed in the certification period, selected in accordance with Section 2.3.2, expressed in appropriate unit;

EF_{heat} = lifecycle emission factor for the consumed heat, expressed in tCO_2e/unit, selected in accordance with Section 0.

2.2.7.3. Monitoring and reporting

In accordance with Section 1.3.3, operators shall include in the monitoring report before each re-certification audit the measured or calculated parameters listed in Table 10. Where a parameter is noted as to be monitored, it shall be included in the monitoring plan in accordance with Section 1.3.2.

Table 10: Parameters for inclusion in the monitoring report.

Equation	Parameter	Unit	Definition	Notes
[44]	$Q_{biochar}$	t	Quantity of biochar in the production batch	To be monitored
	C_{org}	%	Fractional content of organic carbon in the biochar production batch	To be monitored
-	F_{perm}	%	Permanence fraction of biochar	Operators

	(Inertinite assessment approach)		determined using the inertinite assessment approach	shall choose only one approach to determine F_{perm}
[58]	F_{perm} (Decay function approach)	%	Permanence fraction of biochar determined using the decay function approach	
	H/C_{org}	dimensionless	Ratio of hydrogen to organic carbon in biochar production batch. H/C_{org} ratio is to be measured for every production batch.	To be monitored
[59]	GHG_{use}	tCO_2e	GHG emissions associated with the application or incorporation of biochar into soils and materials across one or more application/incorporation sites	To be monitored
	F_S	%	Mass fraction of the project biochar in the total quantity of soil amendment applied to soils or of material incorporated into products at each site.	To be monitored
	$GHG_{on-site,S}$	tCO_2e	GHG emissions associated with energy use and operation to apply or incorporate the biochar or biochar-containing matrix	Calculated using eq. [60]
[60]	$GHG_{combustion}$	tCO_2e	GHG emissions due to fuel consumption at the application or incorporation site	Calculated using eq.[61]
	GHG_{elec}	tCO_2e	GHG emissions due to electricity consumption at the application or incorporation site	Calculated using eq. [62]
	GHG_{heat}	tCO_2e	GHG emissions due to heat consumption at the application or incorporation site	Calculated using eq. [63]
[61]	Q_{fuel}	[appropriate unit]	Quantity of the fuel consumed in the certification period	To be monitored

	EF_{fuel}	tCO_2e/unit	Lifecycle emission factor for the fuel consumed	
[62]	Q_{elec}	[appropriate unit]	Net quantity of electricity consumed in the certification period	To be monitored
	EF_{elec}	tCO_2e/unit	Lifecycle emission factor for the consumed electricity	
[63]	Q_{heat}	[appropriate unit]	Net quantity of useful heat consumed in the certification period	To be monitored
	EF_{heat}	tCO_2e/unit	Lifecycle emission factor for the consumed heat	

2.3. Common elements for quantification

2.3.1. Completeness and materiality

The quantification of associated GHG emissions shall be complete and shall cover all process and combustion emissions from all material emission sources and source streams belonging to the permanent carbon removal activities and all other relevant emissions.

Where an operator or a certification body identifies emissions from a source, or from a group of sources, associated with an activity that are material but are not covered by the present methodology, the operator shall ensure that such emissions are included in the calculation of the associated GHG emissions.

Unless otherwise stated, all emission sources identified in these rules must be assessed and must be included in the calculation of $GHG_{associated}$, even if they do not reach the level of materiality described here. There are two potential exceptions to this principle, contexts in which a materiality assessment may be undertaken and emissions assessed as being below the materiality threshold do not need to be directly assessed.

These contexts are capital emissions (Section 2.3.5), and input emissions (Sections 2.1.5.2.2, 2.1.6.3.2 and 2.1.8.4.2). A materiality assessment may also be required, as noted above, if the operator or certification body identified emissions from a source that is associated with the activity but is not explicitly identified in the present methodology. Where a materiality assessment is required on a specified emission source or group of emission sources, the operator must present to the certification body an estimate of the potential range of emissions across the activity period associated with that source. If the emissions at the high end of this range are equal to or greater than 2 % of the gross carbon removals delivered, or expected to be delivered, over the course of the activity period, then the emissions from that source are considered potentially material and must be directly assessed. At the certification audit operators shall carry out the materiality test based on expected emissions and removals over the activity period, and the basis for concluding that any emissions are immaterial shall be described in the activity plan. At re-certification audits the certification body shall assess

whether there has been a significant deviation from the operational conditions declared at the certification audit. If such a deviation is identified operators shall carry out the materiality test again.

2.3.2. Net consumption of useful heat and/or electricity

Any energy recovery resulting from process configurations may lead to a reduction in the additional net consumption of a specified type of energy or a shift in net demand from one energy type to another. Therefore, for the calculation of net electricity or net useful heat consumption, operators shall assess the overall change in demand after such recovery processes have been implemented. The calculation of net consumption shall exclude any electricity or heat both produced and consumed on-site at the capture facility or the storage facility or for the transport infrastructure. Emissions associated with electricity or heat generated on-site at a facility shall be accounted for separately by consideration of the fuel consumed. The overall change in demand corresponds to the difference between the quantity of electricity or heat imported from outside the facility for use directly by the activity and the quantity of electricity or heat that is exported for other uses that was recovered from processes directly required for the activity, including downstream processes such as CO_2 liquefaction. The calculation of net electricity or net useful heat consumption shall not include any heat or electricity that is produced specifically for export from the facility rather than recovered from a necessary process.

Where the net quantity of consumed heat or electricity is less than the gross quantity and this heat or electricity originates from more than one source, $Q_{heat/elec,net,source}$, the net consumption from each source shall be calculated proportionally so that:

$$Q_{heat/elec,net,source} = Q_{heat/elec,gross,source} * \frac{\sum_{sources} Q_{heat/elec,net,source}}{\sum_{sources} Q_{heat/elec,gross,source}} \quad [64]$$

where:

$Q_{heat/elec,gross,source}$ = gross quantity of electricity or useful heat from a given source consumed in the certification period;

Sources = Index of sources of heat or electricity.

In case of a net increase in availability of a type of energy as a result of energy recovery, the quantity (Q_{heat} or Q_{elec}) may be reported as a negative value. Operators shall ensure that any abovementioned negative quantity is substantiated through correct process assumptions. In the case that one or both of the terms Q_{heat} or Q_{elec} calculated for a process element is negative, then the accompanying emission factor (EF_{heat} or EF_{elec}) shall be set to zero (i.e. there shall never be a negative term for GHG_{heat} or GHG_{elec}).

2.3.3. Additional biomass consumption

Additional biomass consumption refers to the biomass that is consumed specifically to provide energy for a carbon capture process. In the case that heat is recovered from an existing biomass-based process whose primary aim is not the production of heat or electricity, and is used by the capture facility, this shall not be treated as a form of additional biomass consumption and shall instead by assessed using an emission factor for the consumed heat following Section 2.3.4.3.

2.3.3.1. Bioenergy facilities generating only electricity

In the case that carbon is captured at a bioenergy facility generating only electricity and some of this own electricity is consumed to power the carbon capture process, the additional biomass consumption $Q_{biomass}$ shall be calculated from the net amount of own electricity consumed in accordance with equation [65].

$$Q_{biomass} = \frac{Q_{elec}}{\eta_{elec}}$$	[65]

where:

Q_{elec} = the net consumption of own electricity;

η_{elec} = the electrical efficiency of the facility, defined as the annual electricity produced, including the electricity consumed for carbon capture, divided by the annual fuel input based on its energy content.

2.3.3.2. Bioenergy facilities generating only heat

In the case that carbon is captured at a bioenergy facility generating only heat and some of this own heat is consumed to power the carbon capture process, the additional biomass consumption $Q_{biomass}$ shall be calculated from the net amount of own heat consumed in accordance with equation [66].

$$Q_{biomass} = \frac{Q_{heat}}{\eta_{heat}}$$	[66]

where:

Q_{heat} = the net consumption of own heat;

η_{heat} = the heat efficiency of the facility, defined as the annual heat produced, including the heat consumed for carbon capture, divided by the annual fuel input based on its energy content.

2.3.3.3. Bioenergy facilities generating a mix of heat and electricity

In the case that carbon is captured at a bioenergy facility generating both electricity and heat, the additional biomass consumption $Q_{biomass}$ shall be calculated from the net amount of own electricity and own heat consumed in accordance with equation [67], whereby the value $Q_{biomass}$ shall be > 0).

$$Q_{biomass} = \frac{(C_{elec} * Q_{elec} + C_{heat} + Q_{heat})}{(C_{elec} * \eta_{elec} + C_{heat} * \eta_{heat})}$$	[67]

where:

Q_{elec} = the net consumption of own electricity;

η_{elec} = the electrical efficiency of the facility, defined as the annual electricity produced, including the electricity consumed for carbon capture, divided by the annual fuel input based on its energy content;

Q_{heat} = the net consumption of own heat;

η_{heat} = the heat efficiency of the facility, defined as the annual heat produced, including the heat consumed for carbon capture, divided by the annual fuel input based on its energy content;

C_{elec} = The fraction of exergy in the electricity, set to 1;

C_{heat} = Carnot efficiency (fraction of exergy in the useful heat), defined as $C_{heat} = \frac{(T_{heat} - T_0)}{T_{heat}}$ where T_{heat} is the average temperature of the consumed heat in °K (degrees Kelvin), and T_0 is 273.15 °K.

2.3.4. Emission factors

2.3.4.1. Electricity

The emission factor applied in the calculation of emissions associated with any net electricity consumption (EF_{elec}) shall be calculated in accordance with paragraphs 5 and 6 of Part A of the Annex to Commission Delegated Regulation (EU) 2023/1185[9].

By way of derogation from the first paragraph:

(a) the calculation period for the electricity emission factor may be less than a calendar year and may span across parts of two calendar years; the certification period includes only part of one or two calendar years:

(i) if the certification period falls entirely within a single calendar year, the electricity emission factor shall be calculated either based on data for the exact certification period or on data for the full calendar year.

(ii) if the certification period spans across two calendar years, an electricity emission factor shall be calculated for electricity consumed in each of those calendar years either based on data for the exact part of the certification period falling in each year or on data for the full calendar years.

(b) for the period until 31 December 2029, temporal correlation of renewable electricity generation with consumption may be assessed on an annual basis instead of on a monthly basis.

[9] Commission Delegated Regulation (EU) 2023/1185 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels (OJ L 157 of 20.6.2023, p.20, ELI: http://data.europa.eu/eli/reg_del/2023/1185/oj).

Operators may choose the reporting basis for each source of consumed electricity independently, i.e. they are not required to use the same basis for setting the emission factor for electricity consumed in different locations.

Certification schemes may provide lists of up to date electricity emissions intensity values at the bidding zone level. In the case of net electricity export (a negative value for Q_{elec}) the emission factor shall be zero.

2.3.4.2. Heat

The following emission factors shall be applied in the calculation of emissions associated with any net heat consumption:

(a) for heat that is recovered from a process that is part of the activity: there are no additional emissions;

(b) for heat that is generated by combustion of fossil fuels: lifecycle emission factors for fossil fuel supply and combustion set out in the latest version of the Joint Research Centre document *Definition of input data to assess GHG default emissions from biofuels in EU legislation*[10] divided by the thermal efficiency of the heat generation process;

(c) for heat that is generated from biomass resources other than the case of own-heat consumption by a facility capturing CO_2 from biomass consumption for energy generation: emission factors for the supply and combustion (excluding CO_2 from combustion) of the biomass used, calculated in accordance with Annex VI to Directive (EU) 2018/2001 divided by the thermal efficiency of the heat generation process;

(d) for heat that is generated from non-biomass renewable sources: the emission factor is equal to zero;

(e) for heat from nuclear energy production: the emission factor is equal to zero;

(f) for heat that is recovered from a process from which heat was not previously recovered until a maximum of three months prior to the start of the activity): emission factor is equal to zero;

(g) for heat that is recovered from a process from which heat was already recovered or from a new process, i.e. a process coming into operation less than 6 months prior to the start of the activity, and that process is not directly related to the activity: the emission factor shall be set to the EU ETS benchmark emission factor for heat;

(h) for heat that is supplied from a heat network: the emission factor shall be set to the EU ETS benchmark emission factor for heat.

In the case of net heat export (a negative value for Q_{heat}) the emission factor shall be zero.

2.3.4.3. Biomass

When biomass or biomass-derived fuel meeting the sustainability requirements set out in Article 29 of Directive (EU) 2018/2001 is consumed for an activity, any CO_2 produced by chemical processes from the carbon atoms contained in the biomass shall be accounted for with a CO_2 emission factor equal to zero, but the supply chain emissions for provision of the

[10] Padella, M., O'Connell, A., Giuntoli, J., Bulgheroni, C., Edwards, R. et al., *Definition of input data to assess GHG default emissions from biofuels in EU legislation – Version 1d - 2019*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/69179.

biomass shall be accounted for, and any non-CO_2 emissions associated with biomass combustion (primarily CH_4 and N_2O) shall be accounted for.

The emission factor applied in the calculation of supply chain emissions associated with any consumption of biomass for the activity shall be calculated in accordance with the rules for calculating the GHG emissions associated with biomass supply set out in Annex V and Annex VI to Directive (EU) 2018/2001, considering the emissions up to the point of consumption associated with the terms e_{ec}, e_l, and e_p as defined in those annexes plus emissions associated with biomass transport (see next paragraph), and converting where necessary from emissions per unit of energy produced by a bioenergy facility to emissions per unit of feedstock consumed. As in Directive (EU) 2018/2001, wastes and residues shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection of those materials. For municipal waste the 'process of collection' for the purposes of emissions calculation under Regulation (EU) 2024/3012 shall be understood to start only when the material is deposited at a centralised waste handling facility.

Emissions for transport of the biomass raw materials to the capture facility shall be calculated based on the actual distance travelled and mode of transport, whereby the disaggregated default emissions values listed for the e_{td} term shall not be used. With regard to indirect land-use change (ILUC) emissions, the requirements set in Section 4.3.1 prevent the increase in the consumption of food and feed crops or food and feed-crop based biofuels, bioliquids or biomass fuels to supply on-site heat or electricity used for the CO_2 capture process and ILUC emissions may therefore be [neglected][ignored?].

Certification schemes may provide guidance on the calculation for feedstocks that do not have disaggregated default values in the Annexes to Directive (EU) 2018/2001.

2.3.4.4. Inputs and fuels

Where the quantification rules require the calculation of emissions associated with the use of inputs to that activity, including fossil fuels and materials used in the construction of capital equipment, lifecycle emission factors for those inputs shall be taken either from lists of defaults provided by the certification schemes or from the following data hierarchy list, sourcing data from the first source in the list from which it is available and using, where available, the most recent version of the following sources:

(a) part B of the Annex to Delegated Regulation (EU) 2023/1185;

(b) the most recent version of the Environmental Footprint database;

(c) the Joint Research Centre document, *Definition of input data to assess GHG default emissions from biofuels in EU legislation*;

(d) the JEC Well-to-Wheels report[11];

(e) the ECOINVENT database, version 3.5 or a more recent version;

(f) official sources such as the Intergovernmental Panel on Climate Change (IPCC), International Energy Agency (IEA), or government;

(g) other reviewed sources or peer-reviewed publications.

[11] Prussi, M., Yugo, M., De Prada, L., Padella, M. and Edwards, R., *JEC well-to-tank report V5 – JEC well-to-wheels analysis – Well-to-wheels analysis of future automotive fuels and powertrains in the European context*, Publications Office, 2020, https://data.europa.eu/doi/10.2760/100379.

Where access to the ECOINVENT database is not possible, operators may rely on points (f) or (g) above.

The lifecycle emission factors shall reflect the emissions associated with supplying those inputs up to the point of use by the activity. If necessary, lifecycle emissions values taken from these sources shall be adjusted to exclude any carbon contained within the input material itself. If such carbon is oxidised and emitted as a result of processes associated with the activity this shall be counted as an emission source directly. The use of data from divergent sources may lead to slight inconsistencies in the scope of lifecycle accounting applied to different inputs. Operators are not required to recalculate data from these sources to achieve full consistency in lifecycle scope across the utilised input data.

Certification schemes may provide lists of conservative emission factors. This may include tabulating emission factors available in the data hierarchy above. If there is uncertainty in the best estimate of these values or if some degree of variability can be expected in these values, such default emission factors shall be set conservatively, i.e. must be set in such a way that the use of those default emission factors is likely to lead to a marginal underestimation of delivered net carbon removals. Where standard deviation is quoted for a value, the default shall be set to the mean value plus one standard deviation. Where a 95 % confidence interval is quoted for a value, the default value shall be set halfway between the mean value and the 95 % confidence limit. These adjustments shall always be made in the direction that reduces the estimated net carbon removal benefit for an activity.

2.3.4.5. Transport

Emissions from transport, whether of CO_2 or of bulk materials, may be calculated either based on assessment of the fuel consumption and consequent emissions associated with the specific vehicles/routes utilised or based on conservative default factors provided by the certification scheme. Certification schemes may provide additional conservative default emission factors for specific forms of CO_2 transport, under the condition that the basis for these values are clearly documented and the values are demonstrated to be conservative.

Where default values are not used, operators may either undertake the calculation by recording the actual fuel consumption of the vehicles or other infrastructure utilised or as the product of the average GHG emissions associated with operating the specific vehicle or infrastructure (in gCO_2e/km) and the distance travelled. GHG emission factors for fuels consumed shall be set on a lifecycle basis (i.e. including upstream emissions) in accordance with Section 2.3.4.4. GHG emission factors for vehicles transporting CO_2 shall account for the mass of the CO_2 containment equipment and for energy expenditures to compress/liquefy the CO_2 and maintain it in that state. Operators shall account for the emissions associated with the return trip of vehicles used to transport CO_2 or bulk materials considering them empty, unless they demonstrate that the return trip is used to provide another transport service. In that case the return emissions allocated to the activity may be set at zero for those trips.

2.3.5. Capital emissions

If the quantification rules require the consideration of capital emissions associated with one or more facilities, the following shall apply:

(a) if any facility first came into operation or has been expanded or refitted within 20 years of the certification date of the activity, or will be expanded or refitted within the activity period, the capital emissions associated with that construction/expansion/refit shall be considered;

(b) for any other facility, the capital emissions shall be considered to be zero;

(c) a materiality assessment shall be undertaken for the sum of all capital emissions across all relevant facilities. If the certification body concludes on the basis of this assessment that capital emissions may be material, the capital emissions shall be assessed;

(d) any capital emissions associated with non-biomass renewable energy generating equipment shall be excluded from the calculation;

(e) capital emissions shall only be assessed for the part of facilities or equipment that is directly required for the performance of the activity.

If capital emissions are to be assessed, the total capital emissions for each facility or facilities shall be calculated by taking an inventory of the construction materials utilised and fuel and energy consumed in the construction of the facility and summing the associated emissions. Emissions factors used in assessing capital emissions shall consider the full lifecycle of the materials and energy utilised. The calculated capital emissions for each facility shall be amortised by dividing them across twenty years, and in cases where not all of the CO_2 handled by the facility is associated with the activity certified under Regulation (EU) 2024/3012 (e.g. if some of the CO_2 is transferred for utilisation) a pro-rata fraction of the capital emissions shall be allocated to the activity. In the case that a facility has equal or lower material requirements for construction than a previously constructed facility of the same type, operators may use the capital emission for that previous facility as an estimate of capital emissions for the new facility.

Certification schemes may provide conservative capital emissions factors for specific activity types/activity stages/facility sizes as an alternative to undertaking a project-specific materiality assessment or full calculation. Such conservative values shall be set in such a way that they can be reasonably expected to be higher than the actual capital emissions for the relevant facility in at least 95 % of cases. If providing a default-based option, the certification scheme shall clearly document the basis for treating the provided values as conservative.

This amortised emission shall be added to the associated GHG emissions for the activity for each year until the twentieth year following the year in which the facility came into operation, was expanded or was refitted, as relevant, in accordance with equation [68]:

$$GHG_{capital} = \frac{(GHG_{combustion} + GHG_{elec} + GHG_{heat} + GHG_{materials})}{20} \quad [68]$$

Where, depending on the process step in the carbon removal activity, $GHG_{combustion}$ shall be calculated as in equation [12], [21], [39] or [51] , GHG_{elec} shall be calculated as in equation [13], [22], [40] or [52], GHG_{heat} shall be calculated as in equation [14], [23], [41] or [53] and $GHG_{materials}$ shall be calculated in accordance with equation [69]:

$$GHG_{materials} = \sum_{materials} Q_{materials} * EF_{materials} \quad [69]$$

where:

$Q_{materials}$ = quantity of materials utilised in the construction of the facility, expressed in t;

$EF_{materials}$ = lifecycle emission factor for the utilised materials, expressed in tCO_2/t of

material.

2.3.6. Measured data and uncertainties

Measurements, including measurements of CO_2 flows shall be undertaken in a way consistent with the requirements of Article 42 of Implementing Regulation (EU) 2018/2066. Certification schemes may provide additional guidelines for specific types of measurement.

2.3.6.1. Assessment of uncertainty

Where measured, estimated or default data are used as the basis for calculations of sources or sinks, the operator shall assess the uncertainty introduced into the calculation of net carbon removals. Operators may follow the principles for combining uncertainties set out in Section 3 of Chapter 6 ('Quantifying Uncertainties in Practice') of the IPCC document *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*[12]. Uncertainty shall be assessed based on the 95 % confidence interval.

If the total resulting uncertainty estimate is lower than ± 2.5 %, no adjustment shall be applied (i.e. $F_C = 1$).

If the total resulting uncertainty estimate is greater than ± 2.5 % and lower than ± 5 %, a conservatism factor of 0.975 shall be applied to the net carbon benefit (i.e. $F_C = 0.975$).

If the total resulting uncertainty estimate is greater than ± 5 % and lower than ± 10 %, a conservatism factor of 0.9 shall be applied to the net carbon benefit (i.e. $F_C = 0.9$).

If the total resulting uncertainty estimate is greater than 10 % and lower than ± 20 %, a conservatism factor of 0.8 shall be applied to the net carbon benefit (i.e. $F_C = 0.8$).

If the total resulting uncertainty estimate is greater than ± 20 %, no units shall be issued for that certification period.

Certification schemes may provide more detailed instructions on the calculation of uncertainty for specific activity types.

2.3.7. Confirmation of origin of CO_2 stream

For carbon removal activities with CO_2 capture and permanent carbon storage, if the facility at which the CO_2 is captured is not subject to monitoring under the ETS of the CO_2 amount stemming from biomass, the operators shall provide access, immediately at request, to representatives of certification bodies, certification schemes or relevant national authorities to allow unannounced random C14 testing of the CO_2 stream leaving the facility prior to the point of leaving the facility (and if relevant prior to being intermixed with any separately captured fossil CO_2 stream) to confirm its atmospheric or biogenic origin. If the atmospheric/biogenic origin cannot be confirmed then no units may be issued for the corresponding certification period, and the certification scheme/relevant national authority must consider whether further action is required.

[12] Penman, J., Kruger, D., Galbally, I., Hiraishi, T., Nyenzi, B., Emmanuel, S., Buendia, L., Hoppaus, R., Martinsen, T., Meijer, J., Miwa, K., & Tanabe, K. (Eds.). (2000) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, IPCC National Greenhouse Gas Inventories Programme, Institute for Global Environmental Strategies ISBN 4-88788-000-6, https://www.ipcc-nggip.iges.or.jp/public/gp/english/.

3. CARBON STORAGE AND LIABILITY

3.1. DACCS and BioCCS activities

The CO_2 captured by the activity shall be injected in an operational geological storage site permitted under Directive 2009/31/EC and operators of storage sites used by DACCS and BioCCS activities are liable for any release of CO_2 from permanent geological storage under the rules set out in Article 16 of Directive 2009/31/EC.

3.2. BCR activity

The H/C_{org} ratio of each batch of biochar shall be measured. No carbon removal units may be issued in respect of any batch of biochar that is measured to have an H/C_{org} ratio greater than 0.7.

The use of produced biochar shall be monitored up to the point of application to soil or incorporation in a product, and carbon removal units shall be issued in relation to the quantity of biochar applied or incorporated. Biochar from certified activities shall be segregated in the supply chain from any biochar produced by non-certified activities until reaching the point of application or incorporation. Certified and non-certified biochar may be mixed at that point and then applied or incorporated. If biochar from multiple production batches produced by certified activities is mixed together prior to application or incorporation it shall be well mixed, and the mixed material shall be treated as consisting of fractions of the original batches in proportion to the quantities originally mixed. A segregated supply for each batch is mandatory unless batches can be demonstrated to be well mixed. The chain of custody shall in particular ensure that biochar is only used in ways that are appropriate to its production and characteristics.

Where biochar is applied to soils and this application is not directly overseen by a certification body, operators shall grant access to the location of application to certification schemes, certification bodies or relevant competent national authorities upon request, during the monitoring period, to allow the soil to be tested in order to confirm that biochar has been applied.

Operators are not subject to further monitoring requirements after the end =of the monitoring period as the risk of reversals is characterised through the assessment of the permanence fraction of the biochar and it is not practically possible to directly identify reversals after the point of application or incorporation.

4. SUSTAINABILITY

4.1. Minimum sustainability requirements

4.1.1. Climate change mitigation

The eligibility requirements listed in Section 1.1 prevent the certification of activities that significantly harm the objective of climate change mitigation.

4.1.2. Climate change adaptation

Operators shall comply with the criteria related to climate adaptation set out in Appendix A to Annex 1 to Commission Delegated Regulation (EU) 2021/2139[13].

4.1.3. Sustainable use and protection of water and marine resources

Operators shall evaluate and address any potential risks due to the activity to the good status or the good ecological potential of bodies of water, including surface water and groundwater, or to the good environmental status of marine waters. In the case that pollutants that are scrubbed from flue gases in order to reduce air pollution may be released to a body of water, the air pollution benefit and the availability of alternative discharge strategies shall be taken into consideration when evaluating the impact on water quality.

4.1.4. Transition to a circular economy, including the efficient use of sustainably sourced bio-based materials

Operators shall evaluate and address any potential risks to the circular economy objectives from the activity, by considering the types of potential significant harm as set out in Article 17(1), point (d), of Regulation (EU) 2020/852 of the European Parliament and of the Council[14].

Operators shall comply with the requirements set in Sections 4.2 and 4.3.

4.1.5. Pollution prevention and control

Operators shall evaluate and address any potential risks to generate a significant increase in the emissions of pollutants to air, water or land from the researched technology, product or other solution.

4.1.5.1. BCR

Operators of BCR activities where biochar is applied to agricultural, forest or urban soils shall demonstrate that:

(a) the biochar complies with the limit values on heavy metals and organic contaminants stated in Section 4.4.1;
(b) the biochar meets all requirements relating to pyrolysis and gasification materials in Regulation (EU) 2019/1009, including the limitations on permissible input materials.

[13] Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives (OJ L 442, 9.12.2021, p. 1, ELI: http://data.europa.eu/eli/reg_del/2021/2139/oj).

[14] Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (OJ L 198, 22.6.2020, p. 13, ELI: http://data.europa.eu/eli/reg/2020/852/oj).

4.1.6. Protection and restoration of biodiversity and ecosystems including soil health, as well as avoidance of land degradation

Operators shall evaluate and address any potential risks to the good condition or resilience of ecosystems or to the conservation status of habitats and species, including those of Union interest or to the achievement of targets or obligations set out in national restoration plans established under Regulation (EU) 2024/1991 of the European Parliament and of the Council[15], from the researched technology, product or other solution.

4.1.6.1. BCR

Operators of BCR activities where biochar is being applied to agricultural soils shall demonstrate that the local agricultural context has been considered and that it is reasonable to expect no overall negative effect on agricultural production or soil health and no significant reductions in the storage of other soil organic carbon through positive priming effects from the application of biochar. Where significant loss of other soil organic carbon or deleterious impacts on agricultural productivity, on biodiversity, on ecosystems receiving the biochar and the ones located downstream in the watershed, soil health, or on any other environmental aspects are considered likely by the certification body, no carbon removal units shall be issued in relation to that applied quantity. Certification schemes may provide additional best practice guidance or soil health monitoring guidance on biochar application to soils.

4.2. Biomass sustainability

(a) All biomass or biomass-derived fuel that is used to generate the CO_2 captured by the activity or as a feedstock for biochar production and any additional biomass or biomass derived fuel consumed to produce energy for the activity shall comply with the sustainability requirements detailed in Article 29 of Directive (EU) 2018/2001, as further specified in the following points:

(i) where Article 29 of Directive (EU) 2018/2001 sets requirements that are to be met in order for biofuels, bioliquids and biomass fuels to be taken into account for the purposes referred to in Article 29(1), points (a), (b) and (c), of that Directive, those requirements shall be applied by the certification body also to biomass or biomass-derived fuel consumed in relation to an activity that seeks to generate carbon removal units, even if the activity does not generate renewable energy that is taken into account under Directive (EU) 2018/2001;

(ii) operators shall report all biomass or biomass-derived fuel used by sustainability characteristics: feedstock; biomass fuel type and the related production systems as listed in Annex V or VI to the Directive (EU) 2018/2001; whether the biomass or biomass-derived fuel constitutes a waste or residue under Directive (EU) 2018/2001; the GHG intensity assigned to the supply of the biomass or biomass-derived fuel;

(iii) Article 29(1) of Directive (EU) 2018/2001 shall apply only in the case of a capture activity taking place at a facility producing heat or electricity or a biofuel or biogas and with regard to heat, electricity, biofuel or biogas produced;

[15] Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration and amending Regulation (EU) 2022/869 (OJ L, 2024/1991, 29.7.2024, ELI: http://data.europa.eu/eli/reg/2024/1991/oj).

(iv) in the event that the biomass or biomass-derived fuel is produced from wastes or residues other than agricultural, aquaculture, fisheries and forestry residues, is not subject to the requirements set out in Article 29(2) to (7b) of Directive (EU) 2018/2001.

Voluntary schemes approved by the Commission in accordance with Article 30(4) of Directive (EU) 2018/2001 shall be treated as providing accurate data for the demonstration of compliance with the biomass sustainability requirements for permanent carbon removal activities of this Regulation. Similarly, any other schemes that have been recognised by competent national authorities in the state where the capture facility is located shall be treated as providing accurate data in relation to the demonstration of compliance with these requirements.

With regard to facilities regulated under Directive (EU) 2018/2001, periodic assessments of the compliance with sustainability requirements by Member State competent authorities shall not prevent certification bodies approving the issuance of units. However, if such assessment subsequently results in any non-conformity with Article 29of that Directive, the non-conformity shall be notified to the certification bodies.

(b) where the process that generates the CO_2 captured by the activity generates energy that is taken into account under Directive (EU) 2018/2001:

(i) the certification body shall verify that the national implementation of Directive (EU) 2018/2001 applies to the operator, and that the operator complies with this national implementation.

(ii) the certification body shall verify that the operator complies with any measures in national implementations of Directive (EU) 2018/2001 that are introduced to ensure that woody biomass is used according to the list of priorities established in Article 3(3) of Directive (EU) 2018/2001, including any derogations introduced by Member States under Article 3(3) of Directive (EU) 2018/2001.

(iii) the certification body shall verify that the operator does not receive direct financial support from Member States to process saw logs, veneer logs, industrial grade roundwood, stumps and roots.

(c) the biomass from which emitted CO_2 is captured shall not be identified as a high indirect land use change-risk feedstock underDirective (EU) 2018/2001;

(d) if biomass is sourced from areas designated by the national competent authority for conservation, including areas covered by the national restoration plan pursuant to Regulation (EU) 2024/1991, or in habitats that are protected, the sourcing shall be in accordance with the conservation and restoration objectives for those areas.

4.3. Avoidance of unsustainable demand for biomass raw material

4.3.1. Requirements for BioCCS

Any biomass from which CO_2 emitted is captured shall be consumed with the primary purpose of generating a product other than CO_2 for capture, and the process shall not be adjusted in a way that increases the generation of CO_2 per unit of output if that adjustment is made solely to increase the quantity of CO_2 that is available to be captured. This shall not be understood to preclude adjustments made to increase the fraction of the facility's output that can be made subject to CO_2 capture – for example if a facility has two combustion units one

of which has a carbon capture unit, the facility may seek to maximise the use of the unit with carbon capture even if this marginally reduces the overall thermal efficiency of the facility – or to increase the overall efficiency of a production system.

Where the activity involves CO_2 capture from a facility other than a waste to energy facility, where the primary purpose of biomass consumption is to produce heat or electricity and that was already operational at least a year before the start of the activity period, the operator shall demonstrate that the nameplate biomass consumption capacity of the facility has not increased by more than the amount necessary to supply energy for the capture process, as compared to the nameplate capacity on whichever date is later out of the date on which the facility became operational and the date three years prior to the start of the activity period. This includes facilities that have been retrofitted in parallel to the installation of carbon capture capacity.

This rule shall also apply to facilities at which biomass is combusted for heat or power for onsite use for an industrial process, but shall not apply to waste-to-energy facilities combusting wastes or residues other than agricultural, aquaculture, fisheries and forestry residues, nor to facilities using biomass for non-energy applications or for energy applications where heat and or electricity are not the primary outputs. The restriction on capacity increase does not apply in cases in which biomass is used as part of a chemical reaction in an industrial process aimed at producing a product other than heat or electricity, even if energy is also extracted from the biomass in this process.

Where the activity takes place at a newly-constructed facility that became operational not more than twelve months before the start of the activity period, operators shall demonstrate that if the facility had been constructed without carbon capture capacity it would still be economically viable, i.e. that the net present value would be positive for a version of the facility without the cost of carbon capture or the revenue from carbon removal units or any other support predicated on the delivery of carbon removals. Newly-constructed facilities include facilities constructed on sites with no history of operation of the CO_2 generating process and facilities constructed on sites where the CO_2 generating process was previously operational under the control of a different economic entity but where operations had ceased and are restarted after a retrofit or expansion.

Where the biomass processed at the installation from which CO_2 is captured includes food and feed crops or food and feed crop-based biofuels, bioliquids or biomass fuels, the consumption of those food and feed crops or food and feed crop-based biofuels, bioliquids or biomass fuels shall not be increased to supply heat or power to the CO_2 capture facility.

Operators shall disclose the biomass feedstock or feedstock mix consumed, disaggregating feedstock to the level required in Directive (EU) 2018/2001 reporting, with an explicit identification of the respective fractions of the feedstock that comes from saw logs, veneer logs, wastes or residues and mixed material that may contain industrial grade roundwood, stumps or roots.

4.3.2. Requirements for BCR activity

Any production batch of biochar in which the produced biochar is expected to account for 50 % or more of the total energy outputs in the co-products of the biochar production facility (see equation [47], Section 2.2.5.4) shall only be produced from waste or residual feedstocks as defined in Article 2, points (23) (‘waste’) and (43) (‘residue’), of Directive (EU) 2018/2001.

Operators shall disclose the biomass feedstock or feedstock mix consumed, disaggregating feedstock to the level required in Directive (EU) 2018/2001 reporting, with an explicit

identification of the respective fractions of the feedstock that comes from saw logs, veneer logs, wastes or residues and mixed material that may contain industrial grade roundwood, stumps or roots.

4.3.3. Voluntary compensation of biomass used by carbon removal activities

According to IPCC emission factors, it takes on average 35 years to emit one half of a given quantity of sawn wood[16]. To support the regeneration of natural carbon stocks used for the generation of permanent carbon removals, operators consuming saw logs as biomass feedstock in the context of their carbon removal activities may compensate potential losses in temporary carbon storage that saw logs could have generated with the purchase of carbon farming sequestration units.

The quantity of carbon farming sequestration units purchased by the operator shall be reported in the certificate of compliance.

4.4. Requirements regarding risks of heavy metal and organic contaminant pollution associated with biochar

4.4.1. Limit values on heavy metals and organic contaminants for biochar applied to soil

Operators shall demonstrate by lab analysis that biochar has no more than the listed concentrations of the following substances in units of grammes per tonne dry matter [g/t dm]:

(a) Lead; 120 g/t dm;

(b) Cadmium; 1.5 g/t dm

(c) Copper; 100 g/t dm

(d) Nickel; 50 g/t dm

(e) Mercury; 1 g/t dm

(f) Zinc; 400 g/t dm

(g) Chromium; 90 g/t dm

(h) Arsenic; 13 g/t dm

(i) PAH_{16}[17]; 6 g/t dm

(j) PAH_8[18]; 1 g/t dm

(k) Benzo[e]pyrene; 1 g/t dm

(l) Benzo[j]fluoranthene; 1 g/t dm

(m) PCB 0.2 g/t dm

(n) PCDD/F 0.000020 g/t dm

[16] 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4 Agriculture, Forestry and Other Land Use.

[17] Sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, dibenzo[a,h]anthracene and benzo[ghi]perylene.

[18] A subset of PAH_{16} being the sum of benzo[a]pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene and benzo[ghi]perylene.

In addition, the biochar shall comply with any relevant national or local requirements.

4.4.2. Additional requirements for biochar incorporated into a matrix prior to soil application

Biochar may be applied to the land either directly without being intermixed with any other material, after incorporation into a mixed soil amendment, intermixed with the digestate from anaerobic digestion following the use of the biochar as an additive to the anaerobic digestion process, or in the manure of livestock animals that have been fed the biochar as a feed additive. Mixed soil amendments may consist of a combination of biochar with any combination of materials permitted to be applied to the soil under the terms of Regulation (EU) 2019/1009, which include manure, compost, liquid fertiliser and anaerobic digestate. Operators may assume that the permanent fraction F_{perm} of the biochar is unaffected by its use as an additive to anaerobic digestion.

If biochar is applied to soils in the form of manure after use as a livestock feed additive, operators shall meet the following requirements, additional to those in Section 4.4.1, with regard to the biochar utilised:

(a) the biochar feedstock shall consist only of pure plant biomass;

(b) the feed hygiene requirements of Regulation (EC) No 183/2005 of the European Parliament and of the Council[19] shall be complied with;

(c) the H/Corg ratio of the biochar shall be no greater than 0.4;

(d) the biochar shall be demonstrated by lab analysis to have no more than the listed concentrations of the following substances in units of grammes per tonne on an 88% dry matter basis [g/t 88% dm]:

(i) Lead; 10 g/t 88% dm;

(ii) Cadmium; 0.8 g/t 88% dm;

(iii) Mercury; 0.1 g/t 88% dm;

(iv) Arsenic; 2 g/t 88% dm;

(v) PCDD/F; 0.75 µg TE/t 88% dm;

(vi) PCDD/F + dl-PCB; 0.35 µg TE/t 88% dm;

(vii) Sum 6 of DIN PCB; 10 µg TE/t 88% dm;

(viii) Fluor; 150 g/t 88% dm.

Operators shall ensure that all manure produced by the animals receiving the biochar adulterated feed product will either be naturally applied to soils by the animal in situ, or be collected and applied to the soil. Operators may assume that the permanent fraction F_{perm} of the biochar is unaffected by its use in livestock feed.

[19] Regulation (EC) No 183/2005 of the European Parliament and of the Council of 12 January 2005 laying down requirements for feed hygiene (OJ L 035 8.2.2005, p. 1, ELI: http://data.europa.eu/eli/reg/2005/183/oj).

4.4.3. Limit values on heavy metals and organic contaminants for biochar incorporated in products

Only BCR activities that incorporate biochar in, cement, concrete or asphalt are eligible for certification.

Operators shall demonstrate by lab analysis that biochar has no more than the listed concentrations of the following substances in units of grammes per tonne dry matter [g/t dm]:

(a) PAH_8[20]; 4 g/t dm

(b) Benzo[e]pyrene; 1 g/t dm

(c) Benzo[j]fluoranthene; 1 g/t dm

(d) PCB 0.2 g/t dm

(e) PCDD/F 0.000020 g/t dm

In addition, the biochar shall comply with any relevant national or local requirements.

[20] A subset of PAH_{16} being the sum of benzo[a]pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene and benzo[ghi]perylene.