Overview of the Carbon Removals and Carbon Farming Certification process

In December 2024, the EU launched its certification framework for permanent carbon removals, carbon farming and carbon storage in products, commonly known as the Carbon Removals and Carbon Farming (CRCF) certification Framework.

As its name suggests, the CRCF aims to certify a variety of practices or processes, namely: permanent carbon removals, carbon farming, and carbon storage in products. Each practice involves specific activities for which tailored methodologies are currently being developed. The methodologies will be published as Delegated Acts, taking on the force of law. Note that the Regulation only offers guidance on the basic rules for developing the methodologies (Articles 4 till 8) and the elements they should contain (Annex I).

Overall, the activities involve:

1. **Permanent removals:** direct air capture and storage (DACCS), biomass with carbon capture and storage (BioCCS) and biochar. Biochar is currently classified as a permanent removal activity - yet uncertainty persists on its storage length. Therefore, a key aspect of the methodology is determining how much of a given biochar batch will be stored for at least several centuries.
2. **Carbon farming emissions reductions**, namely via peatland restoration through rewetting and, in the near future, reduced fertiliser use.
3. **Carbon farming sequestration**, specifically the planting of trees on unused and severely degraded land, soil carbon sequestration in mineral (or agricultural) soils and agro-forestry.
4. **Carbon storage in products**, mainly wooden construction elements.

Note that the list of activities is likely to expand.

As established in Articles 4 to 7 of the CRCF, the methodologies will follow the so-called QU.A.L.ITY criteria. These are the quantification of climate impacts (against a baseline), the additionality of the activity, its long-term storage and liability for early release into the atmosphere, and sustainability. The methodologies should set out robust conditions, tests and safeguards that eligible activities need to comply with to be certified under the scheme. However, as a voluntary framework, the decision on whether to participate in the scheme or not rests with the operators and certification schemes.

While the European Commission and its consultants are developing the methodologies, these are also being discussed within the EU Carbon Removals Expert Group (CREG) of which CMW is a member. Note that, in addition to CREG meetings, numerous online workshops, discussing particular sections of (at times specific) methodologies, e.g. quantification in forestry, are held throughout the year.

Unfortunately, the CREG is largely dominated by industry lobbyists, which skews the balance during discussions and diminishes vital voices from independent experts, researchers, and civil society. As an active member of the CREG and the CRCF process in general, CMW has sought to rectify this imbalance by hiring its own consultants to thoroughly review the methodologies and flag pertinent issues. This document sets out the feedback received for the DACCS and BECCS methodology by Öko-Institut, Carbon Plan and Infras. By sharing this information, we hope to contribute to the debate and shed further light on the numerous issues affecting the methodologies

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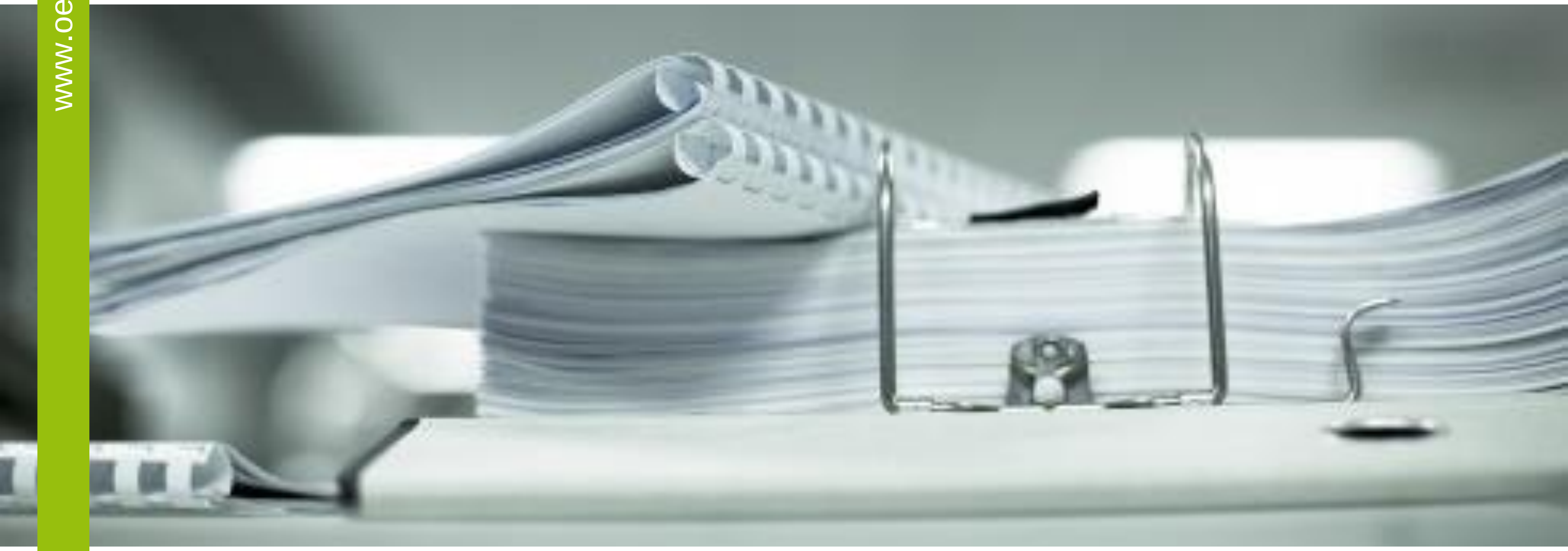

Assessment of the draft technical specifications for certification under the EU CRCF

Permanent carbon removals through DACCS/BioCCS

// Lambert Schneider, Wolfram Jörß, Hannes Böttcher and Florian Krob

Summary of key findings and recommendations

This document provides an assessment of the proposed draft technical specifications for permanent carbon removals through DACCS/BioCCS, dated 1 October 2024. Overall, the methodology identifies and accounts for most relevant emission sources. In its current form, however, it is likely to lead to overestimation of actual removals. We recommend to further improve the methodology, in particular with regard to the following issues:

- **No consideration of the emissions impact of expanded use of biogenic resources:** The methodology implicitly assumes that the combustion of biogenic fuels would also occur in the baseline scenario. Therefore, the methodology does not account for emissions from biogenic fuels (except where these are used for the CO_2 capture unit). However, it is possible that **new bioenergy plants are constructed due to the possibility to capture and permanently store the CO_2 and the reward through the CRCF**. Similarly, the amount of biogenic resources used in existing plants could be expanded as a result of the certification. The methodology allows for an expansion of up to [25%] without accounting for the associated emissions impact. Consistent with the practice in many carbon crediting methodologies such as under the CDM, we suggest that for any increase in biomass use beyond the average of the last three years prior to the implementation of mitigation activity the impact of using more biomass would need to be accounted for. Moreover, the methodology should include a procedure to identify the relevant baseline scenario and account for the emissions impact of expanded use of biogenic resources (see our cross-cutting findings).
- **Lack of provisions on a full mass balance:** The methodology is proposed to be applicable to activities that use common infrastructure. This may include the capture of CO_2 from different sources, different segments of transportation of CO_2, and the injection in geological reservoirs at different points. While the methodology has generally appropriate provisions to identify segments of the infrastructure and refers to an allocation of

emissions, it does not explicitly require establishing a full mass balance that includes all components of the system that belong to the infrastructure used by the credited activity. The methodology should require a full mass balance, including all (non-credited) components of the system used by the certified activity, and elaborate provisions on (i) how a mass balance of the CO_2 flows should be established; (ii) how emissions associated with common infrastructure are allocated to different (credited and non-credited) activities; and (iii) what type of agreements between the users of the infrastructure regarding the allocation should be made and presented together with the certification.

- **Use of storage, rather than capture, as the basis for quantifying removals:** The methodology determines the amount of CO_2 permanently stored indirectly, by quantifying CO_2 capture and subtracting estimated CO_2 losses from storage and transport (equation 2). As CO_2 losses from transportation and storage are associated with significant uncertainties, it would be more accurate to derive the amount of CO_2 permanently stored based on the amount of CO_2 injected at the relevant injection point(s) and, where common infrastructure is used, allocation of that amount to the different capture facilities. Under the current equations, the total credited amount could exceed the total amount injected and actually permanently stored (if CO_2 losses from storage and transport are underestimated).
- **No consideration of public funding:** The eligible mitigation activities may also be funded through public funding. If mitigation activities receive both public subsidies and CRCF units, this could artificially lower CRCF unit prices and implicitly subsidise continued fossil fuel use by the buyers of the units. The methodology should either exclude mitigation activities that receive public funding or proportionally attribute the removals or emission reductions to the financial support provided (see our cross-cutting findings).
- **No monitoring and accounting for CO_2 leakage after the end of the activity period:** The methodology does not address that monitoring of CO_2 leakage from the geological reservoir should continue after the end of the activity period, until the end of the monitoring period. The methodology does also not include any provisions to compensate for CO_2 leakage that is observed in the monitoring period, after the activity period has ended. The storage should only be considered to be permanent once the monitoring period has ended (i.e. after handover of the responsibility for the storage site to a competent governmental authority).
- **Unclear biomass sustainability criteria:** The reference to RED III criteria for biomass feedstocks should be extended and refer to the eligibility for MS financial support pursuant to RED III Art 3(3c) and to compliance with RED III sustainability criteria pursuant to RED III Art 29 (2) – (7); the present reference to RED Art 29 is too vague and insufficient and the methodology seems to be mixing the two RED III provisions.
- **Materiality threshold:** The proposed materiality threshold is inconsistent with the principle of conservative quantification. The methodology should be revised to include all emission sources or sinks, except where the exclusion is conservative (see our cross-cutting findings).

More detailed and further comments are provided below.

Detailed comments

Section 1: Definitions

- **Definition of greenhouse gases:** The draft methodology defines greenhouse gases as follows: 'greenhouse gas (GHG)' refers to any greenhouse gas listed in Annex II to Directive 2003/87/EC.
  - The list of GHGs in that Annex to the ETS Directive is both incomplete and unclear with respect to fluorinated GHGs covered under the EU NDC: NF_3 (nitrogen trifluoride) is missing and the gas groups HFC (hydrofluorocarbons) and PFCs (perfluorocarbons) are not defined.
  - Instead of Annex II of the ETS Directive, the methodology should better refer to Part 2 of Annex V of the Regulation (EU) 2018/1999 (the Governance Regulation) for defining GHGs (see also our cross-cutting findings).
- **Global warming potential (GWP) values:** The draft methodology defines CO_2e with a reference to 'global warming potentials' without further specification in section 1: In section 4, a reference to the GWP100 of 5th IPCC Assessment report is made.
  - The reference to AR5 is ambiguous with respect to methane: in the AR5 two different GWPs for methane are given, with and without climate-carbon feedbacks.
  - In EU law, AR5 based GWP100 values are defined in Annex I of Commission Delegated Regulation (EU) 2020/1044 (in that Delegated Regulation under the EU Governance Regulation targeted for the use in the GHG inventory & projection reporting context). For methane, the GWP without climate-carbon feedback was chosen.
  - For future NDCs, the EU may possibly move to AR6 and in that event Annex I of Commission Delegated Regulation (EU) 2020/1044 would be changed.
  - Instead of the general and vague reference to the AR5, the CRCF methodology could
    - either reference to Annex I of Commission Delegated Regulation (EU) 2020/1044;
    - or copy the values given in the present AR5-based version of that Annex (for future NDCs, the EU may possibly move to AR6 and in that event Commission Delegated Regulation (EU) 2020/1044 would be updated).
  - Both approaches have precedents under EU law, both under the EU-ETS:
    - The definition of GWPs applied for ETS emissions in maritime transport activities is managed in in Regulation (EU) 2015/757 via a link to of Commission Delegated Regulation (EU) 2020/1044.

  - The definition of GWPs applied for ETS emissions in stationary installations (certain activities in chemical industry and metal production) is managed in Commission Implementing Regulation (EU) 2018/2066 by means of copying the relevant GWP values into Annex VI section 3 Table 6 of that Implementing Regulation (and the values in that Table were updated from an AR4 basis into an AR5 basis by means of an amendment of that implementing Regulation in 2020, coming into effect 1 January 2021 (see also our cross-cutting findings).

- A definition of the word 'industrial' is missing. The term is used in the title of the methodology ('industrial capture and permanent storage') and in the first sentence of the scope definition in section 2.

Section 2: Scope

- **Further specification of the scope of eligible activities:** The methodology should further specify to which type of DACCS/BioCCS activities it may be applied. This should include whether the methodology may only be applied to new plants or also to the retrofit of existing plants. Furthermore, it should be specified which (if any) parts of the plants may be pre-existing. For example, it should be clarified whether the methodology can be used to install a CCS component at an existing biomass combustion source or whether only the construction of new biomass combustion plants in combination with CCS is eligible.

- **Only new mitigation activities should be eligible:** The methodology does not include any provisions that prevent rewarding past climate action. The methodology should include provisions to ensure that mitigation activities are only eligible if they are newly implemented and if they have considered the incentives from CRCF units when deciding to proceed with the implementation of the mitigation activities (see our textual proposal in our cross-cutting findings).

Section 3: Activity period, monitoring period and certification period

- The provisions regarding the transfer of CO_2 from the capture facility to the storage facility are unclear. We propose that crediting be based on the amount of CO_2 that is permanently stored (i.e. enters the geological reservoir). Any CO_2 captured but not yet permanently stored should not be credited. It is not appropriate to implicitly credit CO_2 that is still in the process chain.

Section 4: Requirements for quantification

Introduction

- Editorial: the second sentence seems incomplete.

Cross-cutting issues:

- **Consideration of uncertainty and conservativeness.** The methodology introduces a 'conservatism factor' F_C to account for uncertainties (Formula 1 and subsection 7.4). This factor could, in principle, address the requirement for conservative quantification as referred to in Recital 10a, Articles 4(4) and 4(8) and in Annex I of the CRCF provisional agreement. However, the **consideration of uncertainty is limited to measurement uncertainty**. This is inconsistent with, and sets a lower standard than, the requirements under the Clean Development Mechanism (CDM), the Article 6.4 mechanism and the Integrity Council for the Voluntary Carbon Market (ICVCM). The ICVCM requires that, in estimating overall uncertainty, "all causes of uncertainty shall be considered, including assumptions (e.g., baseline scenario), estimation equations or models, parameters (e.g., representativeness of default values); and measurements (e.g., the accuracy of measurement methods). The overall uncertainty shall be assessed as the combined uncertainty from individual causes" (ICVCM 2023). Similar rules apply under the CDM and the Article 6.4 mechanism. To follow best scientific practice, the consideration of uncertainty should include all relevant causes of uncertainty.

- **Lack of provisions on a full mass balance:** The methodology is proposed to be applicable to activities that use common infrastructure. This may include the capture of CO_2 from different sources, different segments of transportation of CO_2, and the injection in geological reservoirs at different points. While the methodology has generally appropriate provisions to identify segments of the infrastructure and refers to an allocation of emissions, it does not explicitly require establishing a full mass balance that includes all components of the system that belong to the infrastructure used by the credited activity. The methodology should require a full mass balance, including all (non-credited) components of the system used by the certified activity, and elaborate provisions on
  - how a mass balance of the CO_2 flows should be established;
  - how emissions associated with common infrastructure are allocated to different (credited and non-credited) activities; and
  - what type of agreements between the users of the infrastructure regarding the allocation should be made and presented together with the certification.

- **Specification of parameters that are not monitored:** The methodology requires to include in the monitoring plan only parameters that are "monitored on an annual basis throughout the certification period." The methodology does not specify where and how the choice of other non-monitored parameters is documented and justified. We recommend that these parameters be provided with the initial certification.

- Equations 11, 20 and 37 and the text above the equations are not clear. Mathematically, it does not work to set emissions at 1% of CR_{total} in order to determine CR_{total}. In addition, the text refers to 1% whereas the formula refers to 2%.

- Emission factors for inputs should refer to the process chain emissions, rather than the "lifecycle emissions", as the inputs are being used under the activity.

- It is not clear why the re-certification audit refers to the “preceding” certification period and not the monitoring period being audited.

Sub-section 1 – Quantification of permanent net carbon removal benefit

- **Use of storage, rather than capture, as the basis for quantifying removals:** The methodology determines the amount of CO_2 permanently stored indirectly, by quantifying CO_2 capture and subtracting estimated CO_2 losses from storage and transport (equation 2). As CO_2 losses from transportation and storage are associated with significant uncertainties, it would be more accurate to derive the amount of CO_2 permanently stored based on the amount of CO_2 injected at the relevant injection point(s) and, where common infrastructure is used, allocation of that amount to the different capture facilities. Under the current equations, the total credited amount could exceed the total amount injected and actually permanently stored (if CO_2 losses from storage and transport are underestimated).

Sub-section 1.1 – Carbon removal sinks and emission sources:

- **No consistent treatment of emissions from electricity and heat:** The list of **emission sources and sinks** provided in Table 1 is relatively comprehensive, but consumption of electricity and heat is not addressed consistently. While electricity consumption is accounted for in the context of transportation of CO_2 and injection in the storage site, it is not accounted for in the context of CO_2 capture. Similarly, heat consumption (e.g. from plants at the same site) is only addressed for CO_2 injection but not for CO_2 transportation of CO_2 capture. The table should be amended to **systematically capture fuel consumption, electricity consumption and heat consumption for all three steps of the process** (capture, transportation and injection).

- **The proposed materiality threshold is inconsistent with the principle of conservative quantification.** The methodology should be revised to include all emission sources or sinks, except where the exclusion is conservative (see our cross-cutting findings for more details). Note also that the materiality threshold of 2% refers to ‘gross carbon removals’ without defining what ‘gross carbon removals’ are, which presumably refers to CR_{total}.

Sub-section 2 – Baseline:

- **No consideration of public funding:** While DACCS or BioCCS are clearly not financially viable, they may be subsidised through other public support schemes. If mitigation activities receive both public subsidies and CRCF units, this could artificially lower CRCF unit prices and implicitly subsidise continued fossil fuel use by the buyers of the units. The methodology should either exclude mitigation activities that receive public funding or proportionally attribute the removals or emission reductions to the financial support provided (see our cross-cutting findings).

- **Lack of clarity on baseline scenario and consideration of relevant biomass emission sources:** As the methodology lacks clarity with regard to its scope, it is also not clear what the assumed baseline scenario is, in particular whether the biogenic sources would be combusted regardless of the possibility to capture and permanently store CO_2 or whether that possibility enables the construction of new combustion process based on biogenic sources. In the latter case, emissions associated with biomass generation, processing and transportation would need to be included. These are currently excluded.

Similarly, the amount of biogenic resources used in existing plants could be expanded as a result of the certification. The methodology allows for an expansion of up to [25%] without accounting for the associated emissions impact. Consistent with the practice in many carbon crediting methodologies such as under the CDM, we suggest that for any increase in biomass use beyond the average of the last three years prior to the implementation of mitigation activity the impact of using more biomass would need to be accounted for. Moreover, the methodology should include a procedure to identify the relevant baseline scenario and account for the emissions impact of expanded use of biogenic resources (see our cross-cutting findings on accounting for biomass for more details).

Sub-section 3 – Installations capturing atmospheric CO_2 from ambient air

- The general approach seems appropriate. It covers all relevant emissions sources. However, it should be improved in several areas:
  - Equation 11 and the text above the equation are not clear. Mathematically, it does not work to set emissions at 1% of CR_{total} in order to determine CR_{total}. In addition, the text refers to 1% whereas the formula refers to 2%.
  - **More guidance necessary on the term '$CO_{2fossil,stored}$':** It is not clear how the term $CO_{2fossil,stored}$ should be 'monitored', given that it would need to be determined based on an overall mass balance. Further guidance is necessary on how to determine this term.
  - **More guidance necessary on the term '$GHG_{capital}$':** It is not clear what the term '$GHG_{capital}$' exactly entails and how it should be determined. The text refers to "capital emissions from construction and installation of the carbon capture facility". It should be further clarified which emissions sources should be considered. This should include at least:
    - Upstream emissions associated with the production of relevant materials (e.g. steel) required for plant;
    - Energy consumption (fossil fuels, electricity, heat) associated with the construction and installation of the plant (e.g. from transport or on-site construction);
    - (Indirect) emissions from land-use or land-use change for land required by the plant (e.g. indirect land-use emissions associated with the conversion of usable land, such as agricultural land, for use under the project);

    It should be further clarified that this may include emissions that have occurred prior to the start of the activity period (e.g. from production of equipment or land-use change occurring prior to the start of the operation of the CO_2 air capture installations).

    It seems also unreasonable to assume that operators have the respective data on these emissions, as proposed in Table 2. It should be further clarified how the respective parameters should be determined, e.g. which data sources may be used, etc.

Sub-section 4 – Installations capturing CO_2 from point sources of biogenic emissions

- **Emissions from operation of the biomass source plant not considered:** The methodology does not consider emissions "associated with the normal operation of the facility generating the biogenic CO_2 source". This is appropriate in cases where the facility is pre-existing and does not increase the use of the biogenic resource as a result of the CRCF certification. However, it is possible that new facilities start operation, or that the production in existing facilities is expanded as a result of the possibility generate CRCF units. In this case, the associated emissions from the biogenic CO_2 source should be considered. The methodology should be revised respectively.

- **Methodology lacks clarity how it should be applied to a facility that generates both biogenic and fossil CO_2:** Some facilities, such as power plants, may use both fossil and biogenic fuels. The methodology lacks clarity how the biogenic fraction of any CO_2 captured from these plants should be determined. The methodology should either exclude such plants in the scope section or provide respective procedures quantify the amount of biogenic CO_2 captured.

- **Further clarity needed on the term '$Q_{biomass}$':** The methodology should provide further clarity how this term should be determined. For example, electricity and/or heat could be used from a biomass-fired combined heat and power (CHP) plant. In this case, determining an emission factor for extracting additional heat (at the cost of some electricity generation) is not straightforward.

- **Term '$CO_{2fossil,stored}$' in equation 16:** It is not clear why this term is added in the equation. As this section refers only to capture of CO_2 from biogenic sources, it does not make seem to make sense to add this term.

- **Further clarity needed on the term '$Q_{disposal}$':** The methodology should provide further clarity on how this term should be determined. For example, it is not clear how any anaerobic methane emissions from disposal or storage of biomass should be quantified.

Sub-section 5 – Transport of CO_2

- **No determination of $GHG_{capital}$ for transport of CO_2:** The methodology considers upstream emissions associated with construction and implementation of facilities for CO_2 capture and CO_2 storage but not for the transport of CO_2. It is unclear why these emissions are not considered given that they could be more material than emissions associated with capture or injection. We note that in the beginning of sub-section 5 it is stated that "transport infrastructure is defined in Article 3(29) of Regulation (EU) 2024/1735) which may be part of one or more transport networks (as defined in Article 3(22) of Directive 2009/31/EC)." Article 3(22) of Directive 2009/31/EC) states the 'transport network' means the network of pipelines, including associated booster stations, for the transport of CO2 to the storage site." The methodology should be revised to also include $GHG_{capital}$ for transport of CO_2.

- The methodology should provide clear rules for the allocation of shared transportation infrastructure (see comment above on cross-cutting matters).
- The example on page 23 is a helpful explanation. However, in the fourth point it is very unlikely that, with shared infrastructure, the injection at any point would exactly equal to the contribution of a specific capture facility. We therefore recommend changing the example.
- The text below equation 21 does not define F_S.
- The determination of the term '$CO_{2vented}$' seems to be based only on "planned" or "expected" venting. The methodology should monitor the actual venting occurring, rather than only estimating this parameter ex-ante.

Sub-section 6 – Storage of CO_2

- **No monitoring and accounting for CO_2 leakage after the end of the activity period:** The methodology does not address that monitoring of CO_2 leakage from the geological reservoir should continue after the end of the activity period, until the end of the monitoring period, as defined in section 2. Any CO_2 leakage from the reservoir should be monitored and reported during this period.
- It is not clear what is meant with the term "relevant" storage site in Table 5. It would be useful to better clarify that the boundary should include all storage sites that the share infrastructure with the certified capture activity.

Subsection 7 – Common principles for quantification

- **Clearer guidance on choice of parameters:** The methodology does not sufficiently specify how measurements should be undertaken, what data sources may be used (e.g. lifecycle assessment tools), what monitoring frequency is appropriate, how conservativeness in the choice of the data will be ensured (e.g. where different data sources indicate a plausible range of values) and how the selection of parameters should be verified. Generally, more information on monitored and non-monitored parameters is required.
- **Electricity emission factors:** The methodology states that operators "may" always report emissions based on a "grid average emission factor for a country in which the activity is located" (page 38). This creates unclarity which other approaches (not average) or geographical boundaries (EU rather than the country) may be used. Such adverse selection has been widely observed in the carbon crediting market (see, for example, Haya et al. 2023). Therefore it is good scientific practice to either require the use of default values or offer default values that are very conservative (and thus overestimate transport emissions) while allowing operators to also use different values. The methodology should be revised respectively.
- **Deviation from default transport emission and conversion factors:** The methodology provides default values for emissions from fossil transportation. The methodology also allows operators to "adopt different emission and conversion factors" if a parameter is "not suitable for their activity". This flexibility could lead to adverse selection of emission factors, depending on which value is more favourable in the context of the certified activity. Such adverse selection has been

widely observed in the carbon crediting market (see, for example, Haya et al. 2023). Therefore it is good scientific practice to either require the use of default values or offer default values that are very conservative (and thus overestimate transport emissions) while allowing operators to also use different values. The methodology should be revised respectively.

- **Clarification that capital emissions may include emissions that have occurred prior to the activity period:** The methodology should clarify that capital emissions (e.g. from the construction of equipment) may have occurred prior to the start of the activity period but should nevertheless be accounted for.
- **Unclear materiality assessment:** The materiality assessment referred to in section 7.3 c) is unclear. As stated above, the omission of emission sources that lead to overestimation of removals is not good practice in carbon crediting. We recommend dropping element c).
- **Exclusion of capital emissions associated with non-biomass renewable energy:** It is unclear why these emissions are excluded in section 7.3 d), while similar emissions from other equipment is included. It seems arbitrary to exclude this emission source. This may also lead to overestimation of total removals. We recommend dropping element d).

Section 5: Storage monitoring and liability

- **No accounting and compensation of reversals from CO_2 leakage after the end of the activity period:** The methodology does not include any provisions to compensate for CO_2 leakage that is observed in the monitoring period, after the activity period has ended. The storage should only be considered to be permanent once the monitoring period has ended. The monitoring period should extend from storage site closure until handover of the responsibility for the storage site to a competent governmental authority and beyond.
- **Further clarity needed as section 5 only considers Directive 2009/31/EC and Directive 2003/87/EC:** Directive 2009/31/EC refers directly to Directive 2004/35/EC, "in particular concerning the injection phase, the closure of the storage site and the period after transfer of legal obligations to the competent authority, should be dealt with at national level." **For clarification, the methodology should also include Directive 2004/35/EC to be complaint with.**
- **Clearer provisions needed with regard to granted storing permits:** Directive 2009/31/EC states that "a storage permit is given for a specific storage site" where the operator is authorised to carry out storage activities. It is not clear yet how potential changes in spatial extent a storage site over time will affect the effectiveness of storage permits (and thus the accounting of carbon removals). For example, an operator (Equinor) has obtained an operation license for the Northern Lights project to carry out storage activities in the Aurora storage complex. It is expected that after a few decades after storage activity has ceased, the CO_2 will migrate, eventually exceeding the limits of the current storage permit. Imminently, the storage site, and thus the storage complex, must be expanded affecting directly monitoring activities. This may have impact on the quantification and certification of carbon removals. The methodology should include clearer provisions

for the entire process chain of the storage activity, including long-term monitoring activities, affecting carbon removal certification. Methodologies should demand a clear plan required to grant storage permits considering how a storage site, and therefore a storage complex (and thus a monitoring plan depending on it) will be extended long after operation ceased.

- **The methodology lacks clarity concerning Article 18, 1 (b) of Directive 2009/31/EC:** …a "minimum period" for handover of responsibility to a governmental authority of a Member State shall not be shorter than 20 years after site closure. The methodology should address whether a minimum period of 20 years is enough to properly quantify and certify carbon removals with permanent storage. Neither the Directive 2009/31/EC nor its the guidance documents provide scientific background justifying 20 years as minimum period.

Section 6: Sustainability requirements

- **Further clarity needed on item (i):** In point (i), the methodology requires the activity to be compliant with the criteria set out in Appendix A to Annex 1 to Commission Delegated Regulation (EU) 2021/2139. However, this provision is not clear:
    - Commission Delegated Regulation (EU) 2021/2139 functions under the Taxonomy Regulation (EU) 2020/852
        - 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.
    - Appendix A to Annex 1 does not list any criteria but rather lists a classification of climate-related hazards, relevant for adaptation-related DNSH (do no significant harm) criteria under the Taxonomy. We wonder whether the reference in the methodology was a drafting error and which reference was intended to be included.
- **Further clarity needed on item (vi):** Reference to Art. 29 of RED needs to be improved:
    - In point (vi), the methodology requires that all biomass used for eligible BECCS activities shall comply with the sustainability requirements detailed in Article 29. It further implies
        - that therefore (quote: "*i.e.*") '*all biomass utilised as feedstock must meet the requirements to be eligible to receive Member State financial support if utilised in energy applications'*
        - and that this '*excludes the use as feedstock of saw logs, veneer logs, industrial grade roundwood, stumps and roots'*.

- In our interpretation of the RED, Art 29 sustainability requirements (as laid out in paras (2) – (7) of Art 29) do apply as minimum requirement for biomass eligible for financial support (see RED Art 29 (1) point c). However, it's not the Art 29 sustainability criteria that exclude saw logs, veneer logs, industrial grade roundwood, stumps and roots from financial support. This exclusion is provided for under Art 3(3c) of RED III.
- In order to safeguard the exclusion of those biomass feedstock types, the feedstock limitation in section 6 of the CRCF methodology should better refer to both, eligibility under RED Art 3 (3c) and compliance with sustainability criteria of RED Art 29 (2)-(7). A simple reference to Art 29 of the RED would be unclear and misleading.
- The authors of this note cannot yet judge whether it would make sense to link biomass sustainability criteria in the DACCS/BECCS methodology also to compliance with GHG emissions savings criteria of RED Art 29 (10). Such a judgement would require an in-depth analysis of energy savings calculations defined in subordinate legislation under the RED.

Section 7: Information to be included in the certificate of compliance

Information to be made available on CRCF units: The information to be included in certificates and publicly available background information should be amended (see the specific proposals in our cross-cutting findings).

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ICVCM (2023): Core Carbon Principles, Assessment Framework and Assessment Procedure. Online verfügbar unter https://icvcm.org/.

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(carbon)plan

NOV 06, 2024

European Commission
DG Climate Action
B-1049, Brussels
Belgium

Comments on the CRCF DACCS and BioCCS draft technical specifications

To Whom It May Concern,

Thank you for the opportunity to provide comments to the draft technical specifications for the certification of permanent carbon removals from DACCS and BioCCS (the “draft methodology”), developed as a part of the Carbon Removal Certification Framework (CRCF) process.

For context, CarbonPlan is a nonprofit organization dedicated to the integrity and transparency of climate solutions, with a particular focus on carbon markets and emerging approaches to carbon removal. We received funding from the nonprofit Carbon Market Watch to provide an independent review of the draft methodology. Below, we offer four recommendations that we hope will be useful to the Commission as it crafts the final methodology.

01 — The methodology must specify the use cases it can support.

There is no single correct way to account for the GHG impacts of a carbon dioxide removal (CDR) project. The accounting methodology applied to assess the GHG impacts of a CDR project should reflect the purpose of the assessment. This is because different accounting methodologies provide distinct insights into a project’s impacts. Effectively evaluating the CRCF methodologies therefore requires specifying the use cases they are designed to support.

Consider, for example, the potential differences in GHG accounting methodologies needed when integrating CDR into (1) national inventories, (2) the voluntary carbon market, (3) a specific compliance policy like the EU Emissions Trading System (ETS), or (4) an innovation policy framework like the EU Innovation Fund. The table below summarizes how accounting approaches might differ across these use cases. While these examples may not be the specific use cases that the CRCF contemplates, they nevertheless illustrate the need to specify a use case in order to evaluate a given GHG accounting approach.

Table 1: Examples of how GHG accounting goals and approaches may vary to support different use cases. This variation implies that evaluating a given GHG accounting approach requires the clear specification of a use case.

Use case	Accounting goal	Accounting approach
National inventories	Quantify removal and emissions fluxes occurring within a national boundary.	Narrow quantification of the novel sink not previously captured by inventory methodologies.
Voluntary carbon market	Issue credits that represent the additional carbon removal due to the carbon credit revenue.	Expansive quantification of any and all sinks or sources that change as a result of an intervention.
EU Emissions Trading System	Issue allowances to EU-based CDR projects that could be sold to give regulated entities the entitlement to emit one metric ton of CO_2e.	Expansive quantification of any and all sinks or sources that change as a result of an intervention. Specific accounting rules may depend on policy goals and context.
Innovation policy	Assess the state of a technology's capacity to remove or store CO_2, and its development over time.	Depends on specific R&D goals; it may be appropriate for accounting rules to focus narrowly on elements of an activity, rather than the activity as a whole or the system it impacts.

We recommend that all methodologies or technical specifications developed through the CRCF process clearly articulate the use case(s) that they are designed to support. This information should be included within each standalone document to enable informed interpretation, assessment, and use of the contents. For the DACCS and BioCCS methodology, we recommend including a use case statement in Section 2, which defines the document's scope. Alternatively, this need could be addressed through a new section.

The remainder of this comment letter reflects our assumption that one role the draft methodology will play is serving as a blueprint for voluntary carbon market standards. This aligns with our perception of how the voluntary carbon market currently anticipates using the outputs from the CRCF process. Crucially, a voluntary carbon market use case requires that the methodology take a consequential approach to accounting for the GHG impacts of a given CDR project.[1] This aligns with some elements of the draft methodology, including the definition of "associated GHG emissions" ("the increase in direct and indirect greenhouse gas emissions over the entire lifecycle of the permanent carbon removal

1 Matthew Brander, "Attributional LCA Is Not Appropriate for Quantifying Net Removals from Offset Projects," 15 Carbon Management 1 (2024).

activity that are due to its implementation").[2]

02 — The methodology should limit departures from a consequential accounting approach, and provide explicit justifications when it uses a proxy for a non-consequential approach.

Despite seeming to require a consequential accounting approach, the draft methodology includes several provisions that are insufficient for quantifying the system-wide GHG impacts of a new activity. Below, we highlight three examples: grid electricity emissions, renewable energy capital emissions, and emissions from increases to biomass consumption.

If this methodology is meant to provide a blueprint for voluntary carbon market accounting — or more generally, to provide a clear understanding of the complete atmospheric impact of investing in a new activity — it should minimize departures from consequential accounting. To the extent that there are technical limitations or policy goals that require alternative or proxy approaches, these departures should be described clearly within the methodology.

Grid electricity emissions For each potential source of grid electricity consumption, the draft methodology quantifies the associated emissions by multiplying the quantity of electricity consumed by an emissions factor.[3] These accounting rules rely on an existing regulatory framework for quantifying grid electricity emissions. However, none of the accounting options presented in that framework represent a consequential analysis of the impacts of grid electricity consumption.

There are two scenarios for grid electricity accounting under the CRCF. First, operators may purchase energy attribute certificates ("EACs") through a power purchase agreement ("PPA") for renewable electricity. Operators must purchase EACs according to the regulations in the Commission Delegated Regulation (EU) 2023/1184, which require temporal matching on a monthly basis, deliverability, and additionality.[4] If projects comply with these regulations, they can apply an emissions factor of zero to their grid electricity consumption. This approach represents a marked improvement over the status quo for electricity accounting in the voluntary carbon market.[5] However, it does not guarantee zero emissions impact.[6]

Alternatively, operators may choose not to purchase EACs, in which case they may assign an emissions factor to the quantity of electricity they consume according to one of the

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2 § 1 (p. 4).

3 §§ 3.2.1 (p. 15), 4.2.1 (pp. 19–21), 5.2.2 (pp. 28–29), and; 6.3.1 (pp. 34–35).

4 Commission Delegated Regulation (EU) 2023/1184 (Feb. 10, 2023). See Annex A of Commission Delegated Regulation (EU) 2023/1185, which points to Article 27, § 3 of Directive (EU) 2018/2001 for the criteria governing when operators can treat grid electricity as fully renewable.

5 Today, it is common practice to allow projects to claim zero carbon electricity by matching their annual volume of electricity consumption with an equivalent volume of EACs. See, e.g., § 7.1.3 of Verra's draft protocol for Direct Air Capture. Some registries have set a higher bar. See, e.g., Isometric's proposed Energy Use Accounting module, which requires hourly temporal matching for energy-intensive projects operating beyond a demonstration scale.

6 Emissions matching over longer than hourly increments is an insufficient proxy for behind-the-meter renewable electricity generation. See, e.g., Wilson Ricks et al., "Minimizing emissions from grid-based hydrogen production in the United States," 18 Environmental Research Letters 014025 (2023).

three options in Annex A of Commission Delegated Regulation (EU) 2023/1185.[7] This may be an average emissions factor by member state (A(6)(a)), an emissions factor of zero when "the number of full load hours is equal or lower than the number of hours in which the marginal price of electricity was set by installations producing renewable electricity or nuclear power plants in the preceding calendar year" (A(6)(b)), or "the greenhouse gas emissions value of the marginal unit generating electricity at the time of the production … if this information is publicly available from the national transmission system operator" (A(6)(c)).

The accounting methods available to operators in either of these scenarios represent simplified proxies for estimating grid electricity emissions — not a consequential analysis of how novel grid electricity consumption impacts the system. Under any of these methods, a DACCS or BioCCS facility's actual grid electricity consumption may cause significant direct and/or indirect emissions, even though the facility can claim an emissions factor of zero. Since this represents a departure from the consequential definition of "associated GHG emissions", we recommend explicitly acknowledging this and providing a justification in § 7.2.1 for relying on these methods.

Renewable energy capital emissions In § 7.3, the draft methodology states that "[a]ny capital emissions associated with non-biomass renewable energy generating equipment shall be excluded from the calculation (p. 42)." This provision is inconsistent with the definition of "associated GHG emissions" in § 1. The draft methodology should either remove this exception, or provide a policy justification for excluding these emissions.

Increases to biomass consumption The draft methodology does not account for emissions from increases to biomass consumption that result from a CCS retrofit, within the 25% sustainability limit. In § 6, the draft methodology states:

> "In order to ensure the avoidance of unsustainable demand of biomass raw material, where the activity involves CO_2 capture from a bioenergy facility producing heat and/or electricity that was already operational on [date of adoption of the CRCF], the activity operator shall demonstrate that the quantity of biomass annually consumed at the facility has not increased by more than [25%] compared to the average annual biomass consumption in the three year period prior to the implementation of the carbon removal activity, excluding from the averaging any period during which the plant was not operational or was operating at less than 30% of its normal output capacity" (p. 46).

However, this provision fails to account for the upstream emissions associated with an increase in biomass consumption within the 25% limit, aside from emissions from biomass that produces energy dedicated to the CCS process.[8] A CCS retrofit of an existing bioenergy facility may increase the facility's biomass demand by making the facility more profitable and/or creating a social license for the facility to operate longer than it would have without the retrofit.[9] A complete consequential analysis must take these possibilities

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[7] Commission Delegated Regulation (EU) 2023/1185 (Feb. 10, 2023).

[8] See § 4.2.1 (p. 19).

[9] See, e.g., Emily Grubert and Frances Sawyer, "US power sector carbon capture and storage under the Inflation Reduction Act could be costly with limited or negative abatement potential," 3 Environmental Research:

into account.

The draft methodology should amend the following sentence in § 4.2.1, "GHG_{bio} refers to emissions due to biomass use for energy consumed by the capture process. . .," so that it reads, "GHG_{bio} refers to any increase in emissions due to biomass use that results from the implementation of the carbon removal activity, up to the 25% limit imposed by the sustainability requirements in § 6." We recognize that this would require additional guidance for quantifying the portion of increased biomass consumption a CCS retrofit is responsible for. Alternatively, the draft methodology should provide a policy justification for excluding these emissions.

03 — The methodology should clarify the treatment of greenfield BioCCS projects.

Given the definition of "BioCCS" provided in § 2 and the provision limiting the expansion of biomass demand in § 6, we interpret this methodology to apply exclusively to retrofits that capture and store biogenic CO_2 from existing facilities — not to greenfield projects that build a new facility and install CCS to capture biogenic emissions. If this is accurate, we recommend stating this eligibility criterion more explicitly in the § 2 scope definition.

If we have misunderstood, and greenfield projects are eligible under this methodology, substantially more clarity is needed around the definition of the applicable activity and system boundaries, and around how capital and biomass emissions would be allocated in this case.

04 — The Commission should consider running a dedicated consultation to identify additional safeguards that ensure that BioCCS relies on robust upstream sinks.

Article 2(1)(a) of the CRCF defines "carbon removal" as "the anthropogenic removal of carbon from the atmosphere and its durable storage in geological, terrestrial or ocean reservoirs, or in long-lasting products."[10] Importantly, BioCCS retrofits do not directly remove carbon from the atmosphere. Instead, they represent the storage of biogenic carbon that was captured via an upstream sink. If the BioCCS activity contributes to ecosystem degradation or relies on an ecosystem in which the stock of carbon is decreasing over time, treating biogenic storage as a proxy for atmospheric carbon removal may be counterproductive.

Given the importance of the upstream carbon sink for understanding the carbon removal potential and system impacts of BioCCS, we recommend that the commission run a dedicated consultation to consider any additional safeguards on top of existing Renewable Energy Directive (RED) regulations that are necessary to ensure BioCCS relies on robust upstream carbon sinks, whether biomass is sourced in the EU or imported from abroad. The commission could also plan to analyze the effects of BioCCS activities on land sector management on a regular interval as part of the review of the CRCF regulation.

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Infrastructure and Sustainability 015008 (2023).

[10] Regulation of the European Parliament and of the Council Establishing a Union Certification Framework for Carbon Removal (Nov. 30, 2022).

We appreciate the opportunity to submit these comments. Respectfully,

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CARBON LIMITS

infras THINKING FOR TOMORROW

Carbon Market Watch

Critical Assessment of EU DACCS/BioCCS methodology

Zürich, 7 November 2024

Quirin Oberpriller, Jürg Füssler (Infras)
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CARBON LIMITS

1. Introduction

1.1. Background

This report provides critical comments regarding environmental integrity on the document entitled "Support to the development of methodologies for the certification of industrial carbon removals with permanent storage - Draft technical specifications for the certification of permanent carbon removals through DACCS/BioCCS" (hereafter called the "methodology") submitted to the European Commission, Directorate General for Climate Action, Directorate C – Innovation for a Low Carbon, Resilient Economy by ICF S.A. in association with Cerulogy and Fraunhofer ISI on 1 October 2024.

1.2. Scope of the methodology

The methodology covers CO_2 capture plants within the European Union and the CO_2 must be stored in regions covered by the CCS directive. Eligible technologies are:

- Direct air capture with permanent carbon storage (DACCS)
- Biogenic emission capture with permanent carbon storage (BioCCS)

1.3. Overview methodology

The permanent net carbon removal benefit of an activity (NCRP) according to the overarching CRCF is calculated as follows:

$$NCR_P = F_C * (CR_{baseline} – CR_{total} – GHG_{associated})$$

The above equation considers baseline removals ($CR_{baseline}$), the amount of CO_2 captured from the ambient air and permanently stored (CR_{total}), and the increase in direct and indirect greenhouse gas emissions over the entire lifecycle of the carbon removal activity due to its implementation ($GHG_{associated}$).[1] The equation also includes a "conservatism factor", F_C, to reflect measurement uncertainties.

For DACCS and BioCCS activities, a standardized baseline $CR_{baseline}$=0 tCO_2/year is applied.

2. Critical Elements

The following list comprises elements that we deem critical, thus compromising the integrity of the methodology. Additionally, we try to present proposals for prospective remedies or exemplary best practices derived from other methodologies, should such information be available and appropriate.

2.1. Additionality and Impact Attribution (critical)

The methodology considers all DACCS and BioCCS activities as additional according to the note in Section 4, chapter 2 "There is currently no commercially viable market for achieving negative emissions through DACCS or BioCCS unless it is enabled through the voluntary trading of carbon removal credits." This should be challenged. Although there is no viable market, government or financial support could be available. Or certain jurisdiction may require the technology (e.g. CCS at waste incineration plants). Thus, a additionality test based on financial viability and regulatory surplus should be undertaken in all cases to

[1] The sign convention is confusing at first glance, as the first two components have to be used as "minus" to yield correct results.

ensure environmental integrity. If other financial support is provided but not sufficient to cover the costs the project may be considered additional, but an impact attribution is necessary.[2]

2.2. Impact on overall biomass usage (critical)

We appreciate that the methodology in general aims to avoiding unsustainable demand for biomass. One way to ensure this, is the methodology's proposal of a top-down threshold of [25]% related to the increased quantity of biomass annually consumed at a facility. We could not find any requirements regarding newly built plants.

- If the specific (bottom-up) requirement on the sustainability of biomass would be sufficient (see following chapters in this document), an increase in output would not be a problem. For example, the financial benefits related to the CRCF certification may allow to recover more sustainable feedstocks, which have not been used before for economic reasons. In this sense the main focus of the methodology should be on stringent bottom-up requirements. But we acknowledge that these may be difficult to implement in practice such that an additional top-down safeguard is valuable.
- If an additional top-down safeguard is needed, a restriction on the consumed biomass of existing facilities is however not sufficient. We assume that increased demand would also arrive from new facilities. It should thus be considered to exclude new facilities from the methodology. This would undoubtedly have a significant impact on the potential scope and impact of the method. However, this would also be the desired outcome if there is no alternative means of preventing unsustainable demand for biomass.
- In general, there is a natural limit to sustainable biomass. Using unsustainable biomass must be prevented, as this would — in the worst case — increase atmospheric CO2 levels.

Finally, one may envision that the baseline would not be affected by CCS. Either CCS is applied to an existing plant (as is for example the case in Ørsted), or there is a new plant. But it is unlikely that a new plant is built because of CCS. The baseline would thus be the construction of a combustion plant, where biomass leakage would be less problematic. Such a baseline would however have to be clearly justified and sustainable souring would still have to be ensured.

2.3. Emission factors of using biomass / biomass sourcing (very critical)

For the emissions related to biomass, the methodology refers to the EU directive [RED III]. Specifically, it says:

"*The emission factor applied in the calculation of emissions associated with any consumption of biomass (through combustion or otherwise) for the activity shall be calculated following the rules for calculating the GHG emissions associated with biomass supply* ***under Annex V and Annex VI*** *of [the RED III], considering the emissions up to the point of consumption associated with the* ***terms*** ***e_{ec}, e_l, e_p, and e_{td}*** *as defined in those annexes, and converting where necessary from emissions per unit of energy produced by a bioenergy facility to emissions per unit of feedstock consumed.*" (p.39)

This reference is incomplete. Under RED II[3] the referenced annexes V and VI contain quantification methodologies but also default values. These default values explicitly do not consider the emissions from land use change LUC (e_l). For that reason, to provide the complete picture of the RED directive, Art. 29 and 31 (and potentially more articles) have to be explicitly referenced as well. For example:

- Art. 31, point 1 requires that default values from annexes V and VI can only be used, if (a) land use change can be ruled out or (b) requires using the full quantification methodology (including inter

[2] See https://www.oeko.de/fileadmin/oekodoc/Attribution-Report.pdf

[3] For this feedback, we assessed RED II, as RED III does not have the cited content yet.

alia LUC) or (c and d) a mix thereof. The unrestricted usage of default values, as implied by the incomplete citation of the reference, is not permitted.

- Art. 29, 2-7 provide a sensible set of requirements[4] that reduce the risk of LUC related risks.[5]

A detailed assessment of requirements related to biomass sourcing is beyond the scope of this document. Including all relevant reference from the RED II directive and stringently implementing those requirements seem however to ensure that biomass sourcing does not entail a large negative impact. It has to be noted however that this is a complex issue, and loopholes may arise from details that are not obvious from the outset. Thus, regular evaluation of the practical implementation and if needed adjustment of these requirement are important to ensure integrity in the long run.

A caveat of the current RED II requirement is that is neglects the impacts of indirect land use change iLUC. It is stated in the preamble of RED II (e.g. para 81) that iLUC is not yet explicitly considered, as quantification is difficult. Rather there are certain criteria and requirements that aim at minimizing its impact. Still, RED II, Annex VII provides some "provisional" iLUC emission factors for three crop types (cereals and other starch rich crops, sugars and oil crops) that seem however not to be taken into account in any formular and thus seem for information only. All other feedstock groups as well as feedstocks that lead to direct LUC are explicitly assumed to cause no emissions due to iLUC. When applying RED II it is thus important to explicitly exclude biomass feedstocks that have a high risk of significant iLUC.

A source of inspiration for requirements on biomass sourcing can be found in the following examples, which are partly more granular:

- Isometric: Module on biomass feedstock accounting
- Puro Earth: Methodology "Geologically Stored Carbon", chapter 6 and the underlying Puro Biomass Sourcing Criteria.

For example, Isometric consider "direct market leakage", where payments to the biomass feedstock supplier directly affect that supplier's behavior in a manner that increases GHG emissions. They also consider "indirect market leakage", where biomass feedstock procurement affects the market price of the feedstock and leads to land use change or other market shifts that affect GHG emissions. Isometric defines eligibility criteria that aim to minimize both types, for example via the prices of the biomass feedstock. For example, if no or only a small price is paid for the feedstock, the feedstock is assumed to be residues (i.e. waste), in which case neither direct nor indirect effects are to be expected and thus can be neglected.

Note that each stakeholder uses different definitions and wording, as there is not yet a generally accepted conceptual framework. This makes discussions and comparison difficult.

2.4. Impact on atmospheric CO2 levels / baseline decomposition (critical)

If biomass is used as feedstock, the carbon removal is not directly drawn from the atmosphere. There is thus no immediate change in atmospheric CO_2 levels. This happens only indirectly when either:

- Trees are being used and replacements are planted which grow and thereby absorb CO_2 from the atmosphere. This process will take many decades, which is a long temporal lag. Furthermore, the methodology does not address the potential risks that re-growth actually occurs. This is potentially addressed via RED II, Art. 29, 7, a, which basically states that carbon stocks must not decrease on national or sub-national level. This requirement is however vague and should be more stringent,

[4] that have to be met to be able to contribute towards EU targets, be eligible for financial support etc.

[5] For example, Art. 29, 3 excludes raw material obtained from land with a high biodiversity value; Art. 29, 6 covers legal issues; Art. 29, 7 require that according to the LULUCF Criteria, NDC have to consider changes in LUC carbon stocks; Reported LULUCF-sector emissions do not exceed removals; management systems are in place at forest sourcing area level to ensure that carbon stocks and sinks levels in the forest are maintained, or strengthened over the long term.

with a clear focus on the sourcing area and considering a potential increases of carbon stock in the baseline. Otherwise, such biomass should be excluded from the methodology.

- The biomass would decay, and the CO_2 would be emitted to the atmosphere within a certain time period in the absence of the project. This should be an explicit requirement in the methodology. See e.g. the requirements in Isometric's module on biomass feedstock accounting, Chapter 2.2.

2.5. Energy emissions accounting (very critical)

For DACCS or BECCS, the availability of renewable (low carbon) energy is crucial. Even if renewable energy is used, various forms of leakage may occur and must be mitigated, either via excluding certain energy procurement forms or via deducting leakage for quantification. In particular, the renewable energy that is used for DACCS or BECCS might not be available for other purposes such as electricity generation, thus requiring the increased usage of fossil fuels.

2.5.1. Electricity

Regarding the emission factor of electricity, the methodology refers to the paragraph 6 of Part A of the RFNBO directive:

- RFNBO, Annex A, 6, allows to use the average grid emission factor. This is inappropriate, as it does not reflect the marginal impact of the load added to the grid. For example, the additional load may be primarily covered by fossil fuels (e.g. natural gas), even if the grid is primarily based on renewables. See the discussions on short-run and long-run marginal emission factors, for example here https://isometric.com/webinars Webinar on "Energy emissions accounting for carbon removal".
- RFNBO, Annex A, 6, b allows to use a grid emission factor of zero gCO2eq/MJ if the "number of full load hours [for each calendar year] is equal or lower than the number of hours in which the marginal price of electricity was set by installations producing renewable electricity or nuclear power plants". If on the other hand the number of full load hours is higher, a factor of 183 gCO2eq/MJ (equivalent to an open cycle gas turbine using natural gas as fuel) has to be used.
  - A grid emission factor of zero gCO2eq/MJ is a questionable assumption.
    - Firstly, renewable energy sources as well as nuclear energy have an emissions factor bigger than zero (if a full LCA is applied).
    - Secondly, even if the number of full load hours is smaller in a calendar year, this does not guarantee that at no instance fossil fuel derived energy is being used. In order to assure this, e.g. hourly matching is an option.
  - The RFNBO has been written for e.g. the production of hydrogen, which can be ramped up and down rather fast and thus may indeed only produce once prices are near zero (which is the case when renewables are price setters along the dispatch curve). DACCCS and BioCCS facilities on the other hand do not fit this pattern. The aim at running continuously to cover the high investment costs and to capture carbon and are thus less responsive to prices. (for that reason, option b) may not be applicable in most cases anyhow).
- Thus, the option provided by RFNBO, Annex A, 6, c is clearly the most preferable one, even though it is complex and data intensive.

A fully analysis of the complexities associated with defining an appropriate electricity emission factor is beyond the scope of this document. Relevant references to other methodologies include:

- Puro Earth methodology on DACCS and BioCCS (chapter 6.2.3/4)
- Isometric module on energy use accounting

2.5.2. Heat

Section 4, chapter 7.2.2 provides the requirements for heat:

- In case biomass is used, our comments in chapter 2.3 shall be considered for this case as well. In particular, the methodology should reference to the fully requirements of the RED directive rather than only referring to the emission factors of Annex VI.
- For "other renewables" as well as nuclear energy, leakage effects due to the replacement effects should be considered. For example, the heat from a nuclear power plant might have previously been used for district heating and the heat's replacement may potentially lead to an increase in fossil fuels to compensate.
- The EU ETS heat benchmark is by design rather low and is thus clearly not conservative in this setting.

2.6. Conservativeness (Critical)

The methodology in Section 4, chapter 7, says

"operators should adopt calculation approaches that are more likely to lead to an underestimate than an overestimate, and that if there is uncertainty in the calculation of associated GHG emissions then operators should adopt approaches that are more likely to leadto an overestimate than an underestimate."

However, the only specific implementation of this requirement is related to measurement by the operator (Section 4, chapter 1: *"the conservatism factor calculated based on the uncertainty in themeasurement of the activity calculated in accordance with section 7.4.")*

This is insufficient. Not only measured values but <u>all</u> relevant input into the quantification should be conservative. This concerns e.g. default values or modelling approaches. A first best solution would be to define all individual default values or modelling approaches conservatively. The next best solution that is sometimes used in carbon markets is to define an overall conservativeness factor, which would lower the methodology's factor F_C (that only covers measurement uncertainty).

Currently, conservativeness is defined using the wording "likely", which is defined by the IPCC as a 66-100% probability. It should be clarified whether the approach as presented in Chapter 7.4 corresponds to that meaning of "likely".

A preferably definition of conservativeness would be "very likely" which is 90-100% probability.

2.7. Eligibility Criteria are lacking (improvement of clarity)

A separate chapter on eligibility criteria is common practice for carbon crediting methodologies, as this allows to quickly and explicitly assess the scope of the methodology. Such a chapter on eligibility criteria is currently lacking and should be added. For example, currently it is unclear whether the following are eligible under the methodology:

- new facilities
- waste incineration plants, where a mixture of fossil and biogenic material is combusted.

2.8. Transport emissions

2.8.1. Measurement of CO_2 at storage site (improvement of accuracy, less monitoring effort)

The methodology requires to quantify transport emissions, which entails considerable effort. We think that it should also be allowed to measure CO_2 directly at the storage site, as this would account for physical leaks during transport. Measurement at the capture site and transport emission may be used for plausibilisation.

2.8.2. Fugitive emissions (less monitoring effort)

The methodology in Section 4, chapter 5.1.2.1 requires that "average emission factors per piece of component per time period, expressed in tonnes CO_2/unit time. $EF_{occur,c}$ shall be determined by the operator for each type of component, and included in the monitoring plan. Such factors shall be reviewed at least every 5 years based on newlyavailable techniques and knowledge."

This will be quite complex and time-consuming to measure and will also be difficult for the auditor to verify. Conservative default values or a database from several operators should be made available.

2.9. Threshold for non-material emissions (minor)

The methodology in Section 4, chapter 4.2.2 allows that "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 equalto $1\% * CR_{total}$, i.e. a group of inputs for which when taking a high-end estimate of expected associated emissions".

Materiality is however defined as less than 2% in the formular following the cited paragraph. The 1% are thus not conservative.

2.10. Further issues

- Section 4, chapter 7.2.2: "In the case that heat is recovered from a process outside the system boundary from which heat was not previously recovered, [the emission factor for heat is] zero". There should be a temporal limit to this rule. Eventually, due to net zero requirements, all waste heat sources will be recovered in the baseline.
- The amortization period of capital emissions is set at 20 years (Section 7.3), which is too long.
  - There is a risk that projects may stop before that time period in which case part of the capital emission would not be accounted for.
  - Amortization is equivalent to ex-ante crediting (that is, credits are issued before the atmosphere sees the benefits).
  - For those two reasons, a period of up to 10 years is more appropriate.
- Capital emissions associated with non-biomass renewable energy generating equipment shall be excluded from the calculation (Section 4, chapter 7.3). Why is this the case? This equipment is clearly part of the system boundary as well.
- The section 5 on storage monitoring and liabilities is very short. We did not assess the references. A question is whether those reference define an upper time limit related to the measurement of leakage from the storage site? Such monitoring should be ongoing as long as the leakage risk cannot be excluded.

3. Neutral Elements

The following list relevant aspects that may improve the applicability and clarity but do not endanger environmental integrity:

- Having two separate documents for DAC and BECCS would improve clarity, as the two technologies are quite different.
- The wording and framing of section 3 is partly unclear. In all cases, it should include a description of the exact meaning of the period and a definition of length. The wording may be aligned with the common wording in the carbon market. A common wording improves understanding across stakeholders with different backgrounds. See e.g. the wording in World Bank's Guide to Developing Domestic Carbon Crediting Mechanisms, chapter 8.

- Project cycle requirement should be modular and not part of this specific methodology.
- Monitoring should explicitly differentiate between fixed parameters (which are fixed over the crediting period, e.g. default values) and monitoring parameters (that have to be determined for each monitoring period, e.g. energy used). In our experience, this improves clarity considerably.
- The sign convention established in Article 4(3) of the CRCF, is reasonable but the resulting overall formula is confusing at first glance, as it is not clear that certain parameters are negative. This is not common in other methodologies in the carbon market and may thus be reconsidered.
- Section 2 says that "Direct air capture with permanent carbon storage activity (also referred to DACCS hereafter) defined as a carbon removal activity resulting from the capture of atmospheric CO2 from ambient air followed". It should be specifically mentioned that it must not be from — or near — a point source, as this would not count as removal. See e.g. the wording in the Isometric Protocol, Chapter 4.0.[6]
- Section 6, points (i) to (v) are relevant but detailed assessments will be very complex and expensive. A whitelist or similar would help to minimize administrative burden.

4. Conclusion

DACCS and BioCCS are essential technologies for achieving net zero emissions. We therefore endorse the creation of a methodology for quantifying the impact of these technologies. It is, however, crucial to set a high standard for environmental integrity. The final version of the methodology should thus include improvements addressing the critical issues identified.

[6] https://registry.isometric.com/protocol/direct-air-capture/1.1#applicability