On the issue of CH4 from biomass storage in relation to calculations of associated GHG emissions for CRCF

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Background

The Carbon Removal Certification Framework (CRCF), established by the European Union in 2024, is a voluntary framework designed to certify high-quality carbon removal activities, aiming to support the EU's climate neutrality objectives by 2050. The CRCF encompasses activities such as permanent carbon removals, carbon farming, and temporary carbon storage in products. To ensure environmental integrity, these activities must meet criteria including quantifiable benefits, additionality, long-term storage, and sustainability.

The quantifications of CRCF are made through LCA calculations of what is called the net carbon removal benefit. Ahead of the carbon removal expert group meeting in March 2025 a proposed equation for CH4 emissions from stored biomass was introduced as part of these calculations. The equation calls for applying an assumed monthly loss of biomass to CH4 if any of the following criteria are not met:

- Biomass stored consists of coarse woody material that the certification body is satisfied will naturally remain well aerated;
- Biomass stored in a form that will not necessarily remain naturally aerated (including wood chips, agricultural residues, sawdust etc.) shall either: o be stored for no more than four weeks prior to processing; or o be stored with a maximum of 30% residual moisture.
- Biomass is pelleted for storage;
- It is demonstrated to the satisfaction of the certification body that biomass is stored in a way that ensures adequate aeration to prevent anaerobic decomposition.

This technical report approach some of the flaws in the assumption and equation. In addition specific comments to other parts of the text is provided.

The non issue of CH4 from stored biomass

Previous research on the degradation of stored solid biomass into CH4 is relatively scarce. As part of developing the knowledge presented here Dr Erik Anerud (Swedish University of Agricultural Science - SLU) was consulted. Anerud has participated in several studies of loss of dry matter from biomass storage, for example:, Anerud et al (2018) Anerud et al (2020), Anerud et al (2021), Anerud and Eriksson (2021), Dahlbom et al (2023). Common for these examples is field measurements on the degradation of stored of wood ships from logging residues and bark.

According to the consultation with Dr Anerud no significant levels of CH4 have ever been measured during trials. Most of the measured dry matter loss takes place in the form of CO2 which is reported as instantly emitted under the LULUCF framework and part of the LULUCF balance. Dr Anerud did put forward though that his research is limited on Nordic conditions, practices and climate.

Among the peer reviewed research Kuptz et al (2020) did a study on stored biomass in a field trial with 90 m3 pile of wood chips for 153 days. In their measurements “only a slight increase in CH4 compared to atmospheric values (i.e. approx. 1.9 cm3/m3) could be recorded”. In the paper the researchers reason on the type of microbial activity taking place. They also find a sharp decrease in microbial activity after the first 15 days.

In another study Prinz et al (2024) did field trials on the long term storage of bark in covered and non covered piles. Their result showed that 1-1.2 kg of CH4 was released during a 131 days storage period. During the same period the total dry matter loss was 2380-2400 kg whereof 1071-1298 kg was released as CO2, which further confirms that the lion part of dry matter loss is to CO2 and not CH4. Further they confirm the results of Kuptz et al (2020) that most of the degradation takes place early, in their results during the first 20 days of storage.

Ferro et al 2010 also came to similar conclusions with a decline in activity after 20 days and made the following statements on CH4:

> “methane was detectable only in the ppmv-range [...], which is a sign of the almost total absence of anaerobic processes [...]. Only in the first stages, i.e., during the highly active microbial phase, methane concentration exceeded the atmospheric concentration, with the highest values to be registered in the core of the pile. Otherwise, methane concentrations were found to be very small and independent of the spatial organization of the heap, suggesting a low and uniform microbial activity under anaerobic conditions from the first 10 days of storage.”

All in all, these published field studies confirms the statements of Dr Anerud on the lack of methane emissions from stored biomass. Further all studies shows reduced microbial activity after 15-20 days, fundamentally challenging the proposed idea of putting a limit on 30 day storage.

Further there is a fundamental problem Other practices exists besides aeration that are effective in reducing dry matter loss. Aeration could lead to increased degradation of the biomass (Prinz et al, 2024). Further the scientific literature show that different solutions is appropriate to reduce dry matter loss for different types of biomass (Anerud et al 2020; Anerud and Eriksson 2021).

As stated above this conclusions is limited to Nordic conditions and Dr Anerud stated that other results possibly might be found in other climate conditions or for other sources of solid biomass such as energy crops.

After carefully considering alternatives of formulating equation 18, the result of consulted expert and published field studies, the authors of this technical report suggest that equation 18 is removed altogether.

In Appendix A, additional comments on the draft Specification are provided.

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Appendix A – Additional comments

TAP Mars text	Proposed change
Definitions	Definitions
‘BioCCS’ means a carbon removal activity in which biogenic CO2 produced by the oxidation of carbon in biomass is captured and transferred for permanent storage;	’BioCCS’ means a carbon removal activity in which biogenic CO2 is captured and transferred for permanent storage;
‘biogenic CO2’ means CO2 produced from a source of biomass by a chemical process acting on the carbon atoms in the biomass (including combustion, fermentation, other oxidation processes, and decarboxylation processes) of carbon in biomass;	‘biogenic CO2’ means CO2 produced from a source of biomass by a chemical process acting on the carbon atoms in the biomass (including combustion, fermentation, other oxidation processes, and decarboxylation processes) of carbon in biomass;
COMMENT: Since Biogenic CO2 is defined there is not need to define biogenic CO2 in another way in the definition of BioCCS. With this change BioCCS encompass more than oxidization. The proposed change align with “section 2: scope” point b) (page 6 of the TAP) where this definition is already used.	
Page 21 section 4.	
This part applies to activities that capture biogenic CO2 from point sources generate a concentrated stream of CO2 to be transported for stored, either as a gaseous stream or dissolved in water.	This part applies to activities that capture biogenic CO2 from point sources generate a concentrated stream of CO2 to be transported for storage, either as a gas or liquid.
Page 55 Section 6: Sustainability requirements	
[…] 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, it must be demonstrated 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. [COMMENT] The writing of the framework mandates that CRCF should avoid the demand for BioCCS to lead to unsustainable demand for biomass. We strongly believe the above part of section 6 is a good safeguard as it does not affect the green transition and the bioeconomy, but limits that BioCCS by itself could contribute to increased demand for biomass. Page 44 section 7.2 [COMMENT] update is good and the text works Page 45-46 section 7.3 [COMMENT] It should be noted that operators of advanced combined heat and power plants change their operations due to external factors such as alternative cost for fuel, demand for heat and power prices. As such a facility might switch operations, most often between 7.3.3. mix of heat and electricity to 7.3.2. heat only. But during certain conditions 7.3.1. electricity only might also be part of the possible mode of operations. As such a single CHP might during a year be relevant for all these modes of operations. These dynamic are further described in Levihn (2016). 7.7.1. Confirmation of origin [COMMENT] C14 dating of flue gases is already applied to ETS opted-in waste CHPs in Sweden and is in itself feasible from a techno-economic point of view. It should be noted that C14 does not necessarily have the precision to differentiate between peat and biomass though.	