Scoping Elements for Biogenic Carbon in Life Cycle Assessment

Background:

Biogenic carbon refers to carbon derived from biogenic (plant or animal) sources - excluding fossil carbon and peat- that is sequestered from the atmosphere during biomass growth and is usually released back to the atmosphere through combustion/respiration of the biomass or decomposition (e.g., of food waste), after being stored in biomass and soils temporarily (IPCC, 2019; Stamford, 2020). The amount and duration of this biogenic carbon storage depend on many factors, including the soil type and climate, the vegetation stand and agricultural practices, etc. For both biomass- and soil-stored carbon, understanding the dynamics of catch and release is key to identify a potentially relevant role at the integrated spatial and temporal scale of atmospheric functioning.

Biogenic carbon is present in many production systems -such as agricultural and forestry and biobased products- and has been depicted as environmentally beneficial for multiple reasons. Given the global importance of carbon storage in soils this may also contribute to climate change mitigation, as developed in the international research program, the '4 per 1,000 Soils for Food Security and Climate' of the Lima-Paris Action Agenda (COP21).

Life Cycle Assessment (LCA) is one method to measure the carbon-derived greenhouse gas balance of bio-based production routes, alongside any other environmental impacts. Yet, decision makers still lack consistent and stable information about the climate impacts of bio-based products and energy sources due to the lack of internationally recommended approaches to account for e.g. (temporary) storage of biogenic carbon. There is a lack of consensus on both the quantification of carbon stocks to be potentially stored (LCI flows) and the characterisation of potential related impacts (LCIA, notably regarding the fate in the case of climate change or effect pathways in the case of other impact categories such as those related to ecosystem services). Due to the flux dynamics, there is a blurry frontier between flow quantification and fate modelling, which further complexifies the alignment of approaches and stakeholders' understanding.

This scoping document aims to identify and define key elements related to the inclusion of biogenic carbon in LCA studies. By considering various aspects, such as land use change, soil carbon, temporary carbon storage in biobased products, and different models for quantification, this project seeks to establish standardized methods to account for biogenic carbon in LCA studies. The project will be conducted through an expert-led multi-stakeholder process to identify science-based approaches and develop consistent recommendations to consider and model biogenic carbon in LCAs. By addressing various aspects related to biogenic carbon, it seeks to enhance the credibility and consistency of LCA results, contributing to more accurate assessments of the environmental impact of bio-based products.

The objective of the work

To produce succinct and harmonised technical guidance to consider biogenic carbon in LCA studies of biobased products and services. The key focus will be on quantifying the climate impact of biogenic carbon, and to the extent possible also its role on soil quality and biodiversity. The main audience are LCA practitioners, although the ultimate beneficiaries are decision makers through more consistent and comprehensive LCA results.

Scope of the work

I. Deliver an overview of how current standards and approaches deal with biogenic carbon, to what extent they are aligned or differ, what their key limitations are. Based on such an assessment, identify the key questions to be addressed to get to a scientifically valid and harmonized approach.

II. Identify the kinds of impacts to be covered; at least climate change, and potentially soil quality and biodiversity (the two latter are up for discussion)

III. Identify which kinds of processes: Must ensure full life cycle processes are included, while maintaining a parsimonious approach.

IV. Then identify the kinds of questions that we need to answer to assess the impact of (changes in) biogenic C (generated by the processes in scope) in the impact categories in scope. E.g., HOW MUCH C? For HOW LONG is C stored? WHERE is C stored (relevant for biodiversity and soil quality)?

V. Purposes of the assessment: to enable product-level LCA. Discuss to what extent the guidance can inform/be consistent with other management objects, such as organisation-level assessments (covered by GHG Protocol?) or national budgets/inventories.

Project Outputs and timelines

I. Project scope refinement (Q1 2024):
The project scope according to the detailed technical implementability including considered impact categories and life-cycle processes is refined and finalized. A clear framework for the project implementation is provided.

II. White Paper Draft (Q4 2024 / Q1 2025):
A “white paper” presenting the different aspects in scope for the approaches, with potential science-based options for modelling Biogenic Carbon in LCA, and the possible implications of such options for the decision-making processes, is drafted.

III. Consultation Workshop (Q2 / Q3 2025)
Workshop/s for stakeholders and experts, to express positions over pre worked white paper(s) and to identify approaches that are backed by the available science and research, is / are conducted.

IV. Clear technical guidance (Q4 2025 / Q1 2026):
Succinct technical guidance required to consider biogenic carbon, including fixation and

decomposition in LCA studies and its associated greenhouse gas emissions and carbon removals, is provided.

Definitions and Sources

Biogenic Carbon:
"Carbon derived from biogenic (plant or animal) sources excluding fossil carbon. Note that peat is treated as a fossil carbon in these guidelines as it takes so long to replace harvested peat." (IPCC, 2019)
"Biogenic carbon refers to carbon that is sequestered from the atmosphere during biomass growth and may be released back to the atmosphere later due to combustion of the biomass or decomposition (e.g., of food waste)." Stamford (2020)

GHG neutrality / balance:
"Condition in which metric- weighted anthropogenic greenhouse gas (GHG) emissions associated with a subject are balanced by metric-weighted anthropogenic GHG removals. The subject can be an entity such as a country, an organization, a district or a commodity, or an activity such as a service or an event. GHG neutrality is often assessed over the life cycle, including indirect ('scope 3') emissions, but can also be limited to the emissions and removals, over a specified period, for which the subject has direct control, as determined by the relevant scheme. The quantification of GHG emissions and removals depends on the GHG emission metric chosen to compare emissions and removals of different gases, as well as the time horizon chosen for that metric." (IPCC, 2021)

Carbon sequestration:
"A natural or artificial process by which carbon dioxide is removed from the atmosphere and stored in a carbon pool." IPCC (2021).

Land use:
"The total of arrangements, activities and inputs applied to a parcel of land. The term land use is also used in the sense of the social and economic purposes for which land is managed (e.g., grazing, timber extraction, conservation and city dwelling). In national greenhouse gas (GHG) inventories, land use is classified according to the IPCC land-use categories of forest land, cropland, grassland, wetlands, settlements, other lands" (IPCC, 2021).

Land-use change:
"The change from one land use category to another. Note that in some scientific literature, land-use change encompasses changes in land-use categories as well as changes in land management." (IPCC, 2021) See also the definition of `land use´.

References

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- Stamford, L. (2020). Chapter5-Life cycle sustainability assessment in the energy sector. In: Biofuels for a More Sustainable Future. https://www.sciencedirect.com/science/article/abs/pii/B9780128155813000051