

New Report: On the Science of Carbon Debt

A report focusing on the emissions resulting from biomass supply and use will be published by the PBL Netherlands Environmental Assessment Agency on 25th October 2024. Entitled, “On the Science of Carbon Debt”, the report focuses mainly on the CO₂ emissions associated with the use of forest biomass as an energy source, but also considers wider use of biomass for non-energy products. Agricultural biomass is also briefly considered.

The report is written by an international group of scientists with a track record of research into the carbon balance of forests and the emissions from biomass supply chains.

Main narrative of the report

The report does not support the view that biomass produced from ‘well managed’ forests is automatically a zero or low-emissions energy source, neither does it support the claim that biomass is invariably a ‘dirty’ energy source with CO₂ emissions higher fossil fuels.

It is concluded that the carbon cycles of biomass (‘biogenic carbon’) and fossil fuels (‘geological carbon’) do have some similarities, but also important differences. The specifics of the biogenic carbon cycle mean that emissions from using bioenergy cannot be understood simply by measuring the emissions coming out of a chimney (sometimes referred to as ‘smokestack emissions’).

Simple examples are used to show how supplying and using biomass from forests can lead to very high emissions (a ‘carbon debt’), negligible net emissions (‘carbon neutrality’) or net-negative emissions (a ‘carbon gain’). Decisions about forest management practices involved in supplying biomass, and about how biomass is utilised, determine which of these outcomes happens.

Scientific literature reports very wide-ranging estimates of CO₂ emissions from bioenergy resources. It is proving challenging for stakeholders to reach consensus on the implications of scientific findings for using biomass as an energy source or for other products. Scientific studies arrive at divergent findings because individual studies:

- Look at differing types of forests and forest management practices
- Assume different end uses and processing chains for the biomass
- Apply differing (and sometimes inappropriate) calculation methods
- Address differing research questions (not always explicitly stated).

The report warns against drawing generalised conclusions from the results of individual scientific studies or based on simplistic interpretations of forest carbon balances.

Having reviewed the science and available literature, a chapter in the report is devoted to considering the implications for policies towards forest biomass supply, particularly for use as bioenergy. A tentative outline is provided of technical methods that could support the effective use of biomass, for energy and non-energy end uses, ensuring zero or low associated CO₂ emissions.

The assessments and conclusions reached in the report are supported by detailed technical analysis provided in five appendices.

Citation

Strengers et al. (2024) On the Science of Carbon Debt. PBL Netherlands Environmental Assessment Agency: The Hague.

Report authors

Bart Strengers (PBL), Robert Matthews (Forest Research, UK), Göran Berndes (Chalmers University of Technology, Sweden), Annette Cowie (NSW Department of Primary Industries/University of New England Armidale, Australia), Jérôme Laganière (Canadian Forest Service, Québec, Canada)

Key recommendations

Six key recommendations are drawn from the discussion and analysis presented in this report:

1. When developing or reviewing policies directed towards supply and use of biomass, for bioenergy or non-energy purposes including for wood products the following points should be taken into account:
 - Openly acknowledging and addressing the risks that supplying biomass can incur a carbon debt.
 - Recognising the possibility for biomass to be carbon neutral.
 - Actively considering the potential opportunities for synergies between producing biomass and conserving or enhancing carbon stocks in terrestrial vegetation and soils.
2. Significant caution is advisable when considering whether published scientific studies of the greenhouse gas emissions associated with biomass use, particularly those concerned with 'biogenic carbon' emissions (see definition earlier in this note), are relevant for informing policies on biomass sustainability. A set of key critical tests could be developed for referring to when reviewing studies, covering points such as whether a clear research question is stated, whether this question is relevant for informing policies, and whether the technical methods are appropriate for addressing the question.
3. Simplistic statements and claims about the climate impact of biomass-based products including bioenergy, such as illustrated by examples in this report, should be avoided in communications about biomass policies and biomass sustainability.
4. Existing technical methods supporting policies, such as biomass sustainability criteria, should be compared with the refined and elaborated methods proposed tentatively in this report, to identify where they are consistent and where there may be gaps.
5. Consideration should be given to further development and testing of the technical methods described in this report, where needed to ensure the use of biomass contributes positively to climate change mitigation objectives.
6. It must be recalled that biogenic carbon emissions represent one issue amongst several that need to be addressed by sustainability frameworks addressing biomass use. It is important to clarify the relationship between policies addressing the greenhouse gas emissions of biomass and wider sustainability frameworks, to ensure their effective and efficient integration.