VF-notat nr. 1-2022

Critical review report

XyloBond project: Environmental analysis of competing products for lignin from Borregaard

Fredrik Moltu Johnsen

VF-notat 1-2022

Utgitt av Vestlandsforsking
Adresse Postboks 163, 6851 Sogndal

Prosjekttittel Verifisering lignin NORSUS/Borregaard

Oppdragsgivar NORSUS AS
1671 Kråkerøy

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Samandrag

Dette er ein critical review-rapport for LCA som tek føre seg 2022-rapporten *XyloBond project: Environmental analysis of competing products for lignin from Borregaard* (Modahl 2022). Oppdragsgjevar til sjølve LCA-prosjektet er Borregaard. Forfattar av den opphavelege LCA-rapporten som vert vurdert er Ingunn Saur Modahl, NORSUS, Kråkerøy. Den kritiske gjennomgongen er ekstern i samsvar med ISO 14044 avsnitt 6.2, og utført av Fredrik Moltu Johnsen i Stiftinga Vestlandsforsking.

LCA-studien er i samsvar med ISO 14040 og ISO 14044, og godkjent av reviewaren. Denne critical review-rapporten er ein obligatorisk del av reviewet. Rapporten inkluderar:

- Dokumentasjon av reviewprosessen
- Critical review statement
- Diskusjon

Summary

This is a critical review report that concerns the 2022 LCA report *XyloBond project: Environmental analysis of competing products for lignin from Borregaard*. The commissioner of the latter report is stated as Borregaard. Authors (LCA practitioners) is Ingunn Saur Modahl of NORSUS AS, Kråkerøy, Norway. The critical review is external in accordance with ISO 14044 §6.2, and performed by Fredrik Moltu Johnsen, Stiftinga Vestlandsforsking.

The LCA report has been approved by the reviewer, i.e. the study has been found to be in accordance with ISO 14040 and ISO 14044. This critical review report is a mandatory part of a critical review. The report includes:

- Documentation of the review process.
- A critical review statement.
- Discussion of selected issues.

Introduction

A critical review of a life cycle assessment (LCA) study is a process intended to ensure consistency between a life cycle assessment and the principles and requirements of international standards and life cycle assessment, cf. ISO 14044, clause 3.45.

This critical review report was based on an LCA report draft submitted from Ingunn Saur Modahl, NORSUS, to the reviewer, Fredrik Moltu Johnsen, Stiftinga Vestlandsforsking, in January 2021 . The draft was edited after one round of review, and then approved by the reviewer.

The title of the report is *XyloBond project: Environmental analysis of competing products for lignin from Borregaard*. The commissioner is stated as Borregaard. The author (LCA practitioner) is Ingunn Saur Modahl of NORSUS. The critical review is external, ref. ISO 14044 §6.2, and performed by Fredrik Moltu Johnsen, Stiftinga Vestlandsforsking.

The critical review report is intended to be communicated, and includes:

- Documentation of the review process, including a table that details each point of communication between reviewer and LCA practitioner and the related improvements of the report.
- A qualitative critical review statement.
- Discussion.

The critical review only concerns the applicable LCA report. The scope of the critical review does not include other documents referenced in the report, as stated in ISO/TS 14071:2014 §4.4. The review has been based on ISO 14044:2006, clause 6.2. The review was performed at the end of the study. The review includes a superficial assessment of the Life cycle inventory (LCI) model, although not at the detailed level of implementation of data and calculations as

performed in the LCA software. Individual data sets have been assessed to the extent that they are described in the report.

Documentation of the review procedure

The review procedure proceeded as detailed in the following. The first report draft was commented by the reviewer, and a list of improvements were recommended. A response to each recommendation shall be provided by the LCA practitioner, according to ISO 14044, clause 5.2 g) 2). The LCA practitioner responded to each comment and made corresponding changes to the report where applicable.

The communication is documented in table 1. The table follows an adapted version of the format recommended in ISO/TS 14071:2014, Annex A, which in turn cites ISO 14040:2006 and ISO 14044:2006. There has been one round of responses. The phrase "OK" has been used by the reviewer as a sign that the point in question has been checked and approved.

Table 1. Communication between LCA practitioner and reviewer

Round 1	Round 1 reply Ingunn SM (7/2-22)	Round 2
Chapter 2, page 3: ISO 14048 cited. Should be 14040?	Yes, this was a mistake. Has been corrected.	OK
Section 2.1, page 3: Critical review does not look into the calculations, could be rewritten. Maybe better to simply refer to ISO 14044 and ISO/TS 14071.	Rewritten and simplified. Referring now to ISO 14044 and ISO/TS 14071.	OK
Section 2.5: Please consider wording «and the idea is to avoid problem shifting, that is, to solve one environmental problem only to create a new one»	Rewritten to: *'...and aims at avoiding problem shifting, that is, avoiding reducing one environmental problem only to create a new one.'*	OK
Section 4.1: Negative CC results for several products. The statement «This method includes uptake and release of biogenic CO2» is confusing as it seems that the release of CO2 is not modelled in	The word 'includes' has been changed to 'characterizes' to avoid confusion. Emissions beyond gate, for both biobased and fossil products,	OK

the LCI phase. Figures 1 and 2 show cumulative negative emissions, as there is a cradle-to-gate scope. This risks giving a misleading picture of the environmental profile to the reader. If necessary, relevant emissions beyond gate need to be discussed, or the scope or format of presentation needs to be reconsidered, so that the reader can clearly understand that emissions over the full life cycle will not be negative. The methodological choice of cradle-to-gate scope combined with negative uptake emissions appears to be favourable for the LCA commissioner, which is unfortunate as these favourable results can be regarded to primarily be a function of methodological choices. EN 15804 is mentioned in the report, but EN 15804+A2 as well as the +A1 NPCR for wooden construction products require a cradle to grave approach so that uptake and release can be seen as a whole, which in turn allows a more fair comparison against fossil products. This appears to be a considerable flaw of the study, which somehow needs to be mitigated. Ref ISO 14044 § 6.1: «The critical review process shall ensure that (...) the data used are appropriate and reasonable in relation to the goal of the study».	have now been discussed by including extra text in the figure captions for figure 2 and 3 (figure1 and 2 in the first version of the manuscript). This text has been included: *'Release of biogenic CO_2 (degradation/combustion of biogenic content in the biobased products) beyond gate is not included. Neither is release of fossil CO_2 (degradation/combustion of fossil carbon content) beyond gate for the fossil based products. Since this effect is omitted for both the biogenic and the fossil products, these products can be compared in a cradle to gate scope. It is important to realise that as this is a cradle to gate analysis, the values are relative to each other, and negative numbers do <u>not</u> mean that emissions over the full life cycle will be negative.'* Actually, when comparing products containing biogenic carbon with products containing fossil carbon in a cradle to gate scope, using climate change indicators with negative uptake emissions gives a better view of the situation than indicators assuming instant oxcidation of biogenic carbon. However, when comparing products containing biogenic carbon with <u>mineral products</u> in a cradle to gate scope, climate change indicators should <u>not</u> include negative uptake emissions. To avoid wrong comparisons to be made, the products not to be compared have now been blanked out (only vaguely seen) in each figure. Corresponding text has been included in figure 3 (previously figure 3).	
Section 4.1: Negative emissions apparently used in raw materials phase. The methodological justification for this needs to be specified and also discussed. See for instance Tellnes et al. https://doi.org/10.3832/ifor2386-	Extra text is included in chapter 4 before chapter 4.1, to stress that negative numbers do <u>not</u> mean that emissions over the full life cycle will be negative: *'In the three climate change impact categories used, both uptake and*	OK

010 which might be relevant. For forestry products, only the use of certified sustainable forestry (PEFC, FSC) allows negative emissions for wooden construction materials in the Norwegian EPD system. If there is a relevant clause in EN 15804+A2 this could also be specified.	*release of biogenic CO_2 is accounted for, and since the scope of the study is cradle to gate, care has to be taken when interpreting the results. The authors stress that the climate change results are relative to each other (not absolute), and that negative numbers do not mean that emissions over the full life cycle will be negative. '* Additional text have been included in the figure captions for figure 2 and 3 (see explanation above). The Tellnes study refers to EN15804+A1 (outdated), whereas the updated EN15804+A2 use a climate change impact category which includes negative uptake emissions. This is valid as long as native forest is not used. Anyhow, Borregaard use feedstock from certified sustainable forestry only (information added in chapter 2.6).	
A precise description of, or diagram of, system boundaries should be included as per ISO 14044 § 5.1.2 b), and this should include a clear explanation of the difference between the bio-based and fossil products and how this eventually influences the results.	A principal flowsheet (new figure 1) showing the system boundaries of the products have been included, in addition to a comprehensive explanation of the difference between biobased, fossil and mineral products in this respect.	OK
Figures 1 and 2 can easily be misleading to a non-LCA audience if presented without context (i.e., they may give the impression that the bio-based products have a CCS function). As the introduction states that «part» of the report can be disclosed to customers etc., it is perhaps important that each figure is as self-explanatory as possible.	Agree. Additional text have been included in the figure captions for figure 2 and 3 (previously figure 1 and 2) to make them self-explanatory. See details in comments above (our replies to your comments to chapter 4.1).	OK
Ref. ISO 14044 § 5.2 b) 4): Please include a clear statement on whether the study shall support comparative assertions intended to be disclosed to the public.	Such statement is now included both in the summary and more detailed (partly in bold) in chapter 2.1 Goal and scope of t he study. A justification of the use of an external reviewer (instead of a panel) has also been included in chapter 5 Discussion.	OK
Section 2.2: Please justify why the unit 1 kg gives functional equivalence between the products.	A justification for use of 1 kg as declared unit has been included in chapter 2.2.	OK
Please include rationale for selecting the specific impact	The rationale has now been better described in chapter 2.5,	OK

categories, ref. ISO 14044 § 5.2 e) 5).	relating to Borregaard's long-lasting history of using EPDs as basis for their environmental work. The impact category ODP has been included as well, which means that all thirteen core indicators in EPD Norway's template are now included.	
I assume that ISO 14044 § 5.3.1 does not apply as the report will not be disclosed to the public - OK	A statement regarding the comparison with product groups has been included to avoid non-intended use of the results. See chapter 1.1 Background, 2-1 Goal and scope, 5 Discussion and Summary.	OK, as long as it is clearly specified that comparisons against other specific products are not in accordance with the scope of the critical review, I interpret ISO 14044 such that this restricts comparisons to the extent that a panel review is not required. I interpolate that the report *contextualizes* the results in general terms rather than properly *comparing* them to other specific products.
I also assume that ISO 14044 § 6.3 does not apply as the report will not be disclosed to the public - OK	See comment above.	OK
Results in figures 1-3 seem to be very high – they probably refer to kg CO2 eq and not to tonnes CO2 eq?	Yes, you are right. Wrong caption. The figures have been changed, and the unit is now kg CO_2 eq.	OK
Comparison between fossil-based and bio-based products is part of a large and ongoing discussion. This could briefly be mentioned in the discussion, with a few references.	This subject has now been included in chapter 1.1 Background. Three references has been added.	OK
The land use category is not included. Could be quite relevant for this case, as bio-based materials have a much higher land use impact. I suggest that this is included.	Included.	OK
Impact categories could be briefly discussed, e.g., that the specific country of origin will have a substantial effect on results for water use, eutrophication, acidification, (land use).	Good point. Additional text has been included in chapter 2.5 Environmental impact categories, chapter 3 Inventory data and chapter 5 Discussion and conclusion.	OK

Critical review statement

The LCA study in question compares powder and liquid lignin from Borregaard to different chemicals that these products can replace in different applications. The report has been approved by the reviewer, i.e., the study has been found to be in accordance with ISO 14040 and ISO 14044. As suggested by ISO 14044, §6.1 the reviewer further states that:

- The methods used to carry out the LCA are consistent with ISO 14044
- The methods used to carry out the LCA are scientifically and technically valid
- The data used is appropriate and reasonable in relation to the goal of the study
- The interpretations reflect the limitations identified and the goal of the study
- The study report is transparent and consistent

Discussion

Scope of review

The key focus of the verifier has been to ensure the conformity of the LCA report with applicable standards, with particular emphasis on ISO 14044:2006 chapter 5 and section 6.2. The review has not intended to detect errors at a detailed level (e.g. incorrect numbers entered into LCA software, potentially incorrect setup of system in the software, etc).

Scope of comparison, and internal review vs. panel review

The ISO standards give certain guidelines for LCA studies that make comparative assessments intended to be disclosed to the public.

- The report should contain additional information, as outlined by ISO 14044, §5.3. These issues have been addressed by the final version of the report.
- Weighting should not be performed, as pointed out in ISO 14044 §4.4.5. Weighting has not been performed in this LCA study.
- The choice of critical review method.

With regard to the last point, it was noted in the first row of feedback to the LCA practitioner in Table 1 that ISO 14044 §6.1 states: "In order to decrease the likelihood of misunderstandings or negative effects on external interested parties, a panel of interested parties shall conduct critical reviews on LCA studies where the results are intended to be used to support a comparative assertion intended to be disclosed to the public".

It has been assumed by the reviewer that it can be acceptable with the current type of review as long as it is clearly stated that the LCA study is intended as a comparison against the general market, and that it is not the goal of the study to make any claims about the environmental profile of specific products from specific competing producers. A comparison to the generic European market, where it is clearly communicated that any comparison to specific products from

specific producers is outside the scope of the LCA study, as has been thoroughly pointed out in the current report, is thus assumed to void the requirement for a panel review, as it alleviates the potential for misunderstandings and negative effects on external interested parties mentioned in ISO 14044 as per above.

The generic Ecoinvent database is a state of the art database which has presumably been thoroughly quality checked or verified previously. The reviewer assumes that Ecoinvent currently is a well-known actor when it comes to generic data, and that errors in the environmental data from the database and misunderstandings about the scope of the comparison thus are less probable.

It is furthermore important that the limits to the comparison in this LCA study are communicated together with the results in any potential further dissemination of the LCA results. For this purpose, figure texts in the report are quite comprehensive so that figures cannot easily be taken out of context.

Scientific validity

The methods used to carry out the LCA study are judged to be scientifically valid. The sometimes approximate nature of LCA in general should however be noted.

References

ISO (2006) ISO 14040: Environmental management Life cycle assessment Principles and framework

ISO (2006) ISO 14044: Environmental management Life cycle assessment Requirements and guidelines

ISO/TS 14071 (2014) Environmental management – Life cycle assessment – Critical review processes and reviewer competencies: Additional requirements and guidelines to ISO 14044:2006

Modahl, I. S. (2022) XyloBond project: Environmental analysis of competing products for lignin from Borregaard