Substitution and carbon storage impacts of harvested wood products - Effects of increased cascading with different market responses

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Research

Keywords: carbon stock change, cascading, forest industries, greenhouse gas emissions, harvested wood products, substitution, substitution impact

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Abstract

Background

The climate impacts of wood-based products can be measured by substitution impacts and changes in product carbon stocks. Cascade use of wood aims to increase resource efficiency and minimize the impact on the environment and climate, but it may lead to changes in the product portfolios of industries. Thus, measuring the overall impact is challenging. This study analyses the impact of wood cascading on the climate under varying market responses. Cascade use here refers to discarded sawnwood product utilisation in panel and wood-based composite production. The study utilises explorative scenarios where Finnish wood-based flows are modelled in an Excel-based material flow model, and discarded sawnwood flows are shifted from energy use to material use in the end-of-life stage. The Reference case represents the situation where discarded wood-based products are only used for energy. The scenarios portray plausible market responses to cascading, with cascade production either leading to additional wood-based panel and composite production, or substituting primary sawnwood products thus leading to lower overall harvest levels.

Results

The results show that the cascading can result in 1.6%-5.4% more avoided C emissions compared to reference when considering the substitution impacts, the carbon stock changes in wood products, and the avoided carbon loss from roundwood harvest. Besides the market response, the results vary depending on the time-period selected for the estimation of the average annual carbon stock change of wood products and the emission profile of non-wood products.

Conclusions

The results of this study indicate that cascading can contribute to climate change mitigation regardless of the market response, but it depends on the market response whether the reduction potential origins from wood-based products or indirect changes in the harvest levels. There are less avoided C emission gains in the technosystem, if cascading production substitutes primary production and therefore reduces the wood harvest. However, the opposite holds, if the average substitution impacts are significantly reduced in the future due to decarbonization of non-wood sectors. Thus, in the long-term, extending the carbon residence in the technosystem or in the ecosystem may provide a larger climate change mitigation potential than increasing the substitution impacts. Keywords: carbon stock change, cascading, forest industries, greenhouse gas emissions, harvested wood products, substitution, substitution impact

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

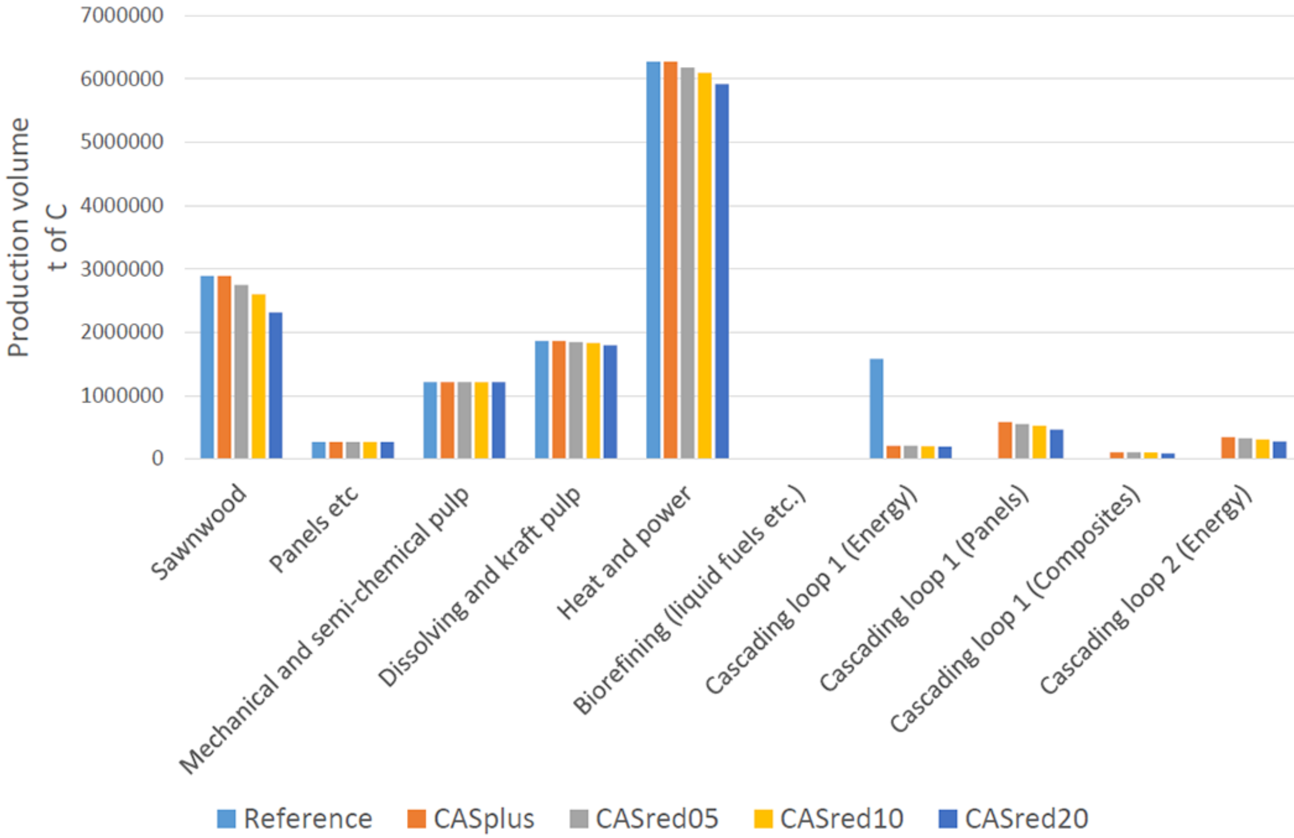

Figure 1

Production volumes in primary and cascading production in the Reference (current Finnish production structure) and in the explorative material cascading scenarios.

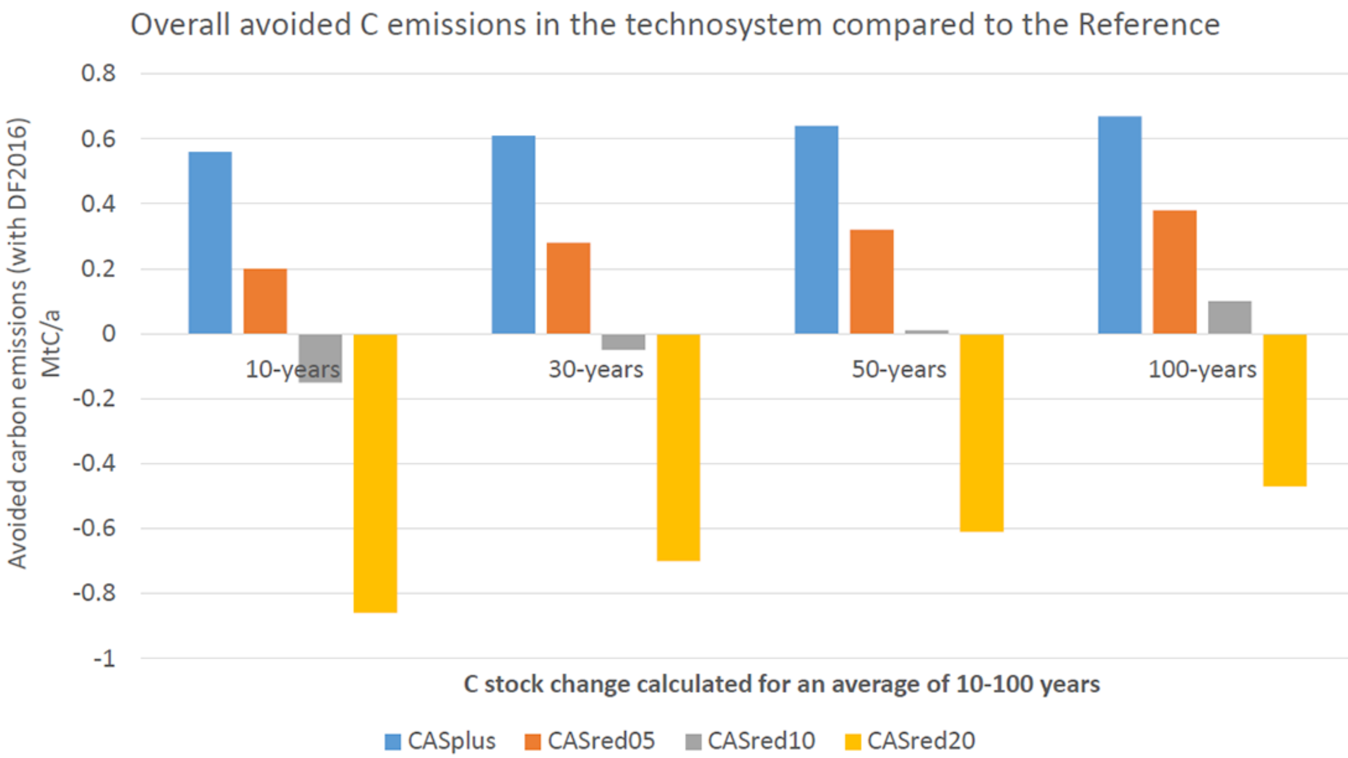

Figure 2

Avoided C emissions (MtC/a) in the cascading scenarios (see 2.2.) compared to the reference including i) the annual total substitution (avoided fossil emissions) with 2016 DF assumptions and ii) avoided carbon loss in the technosystem (annual average of C stock change), with average of 10-100 year periods.

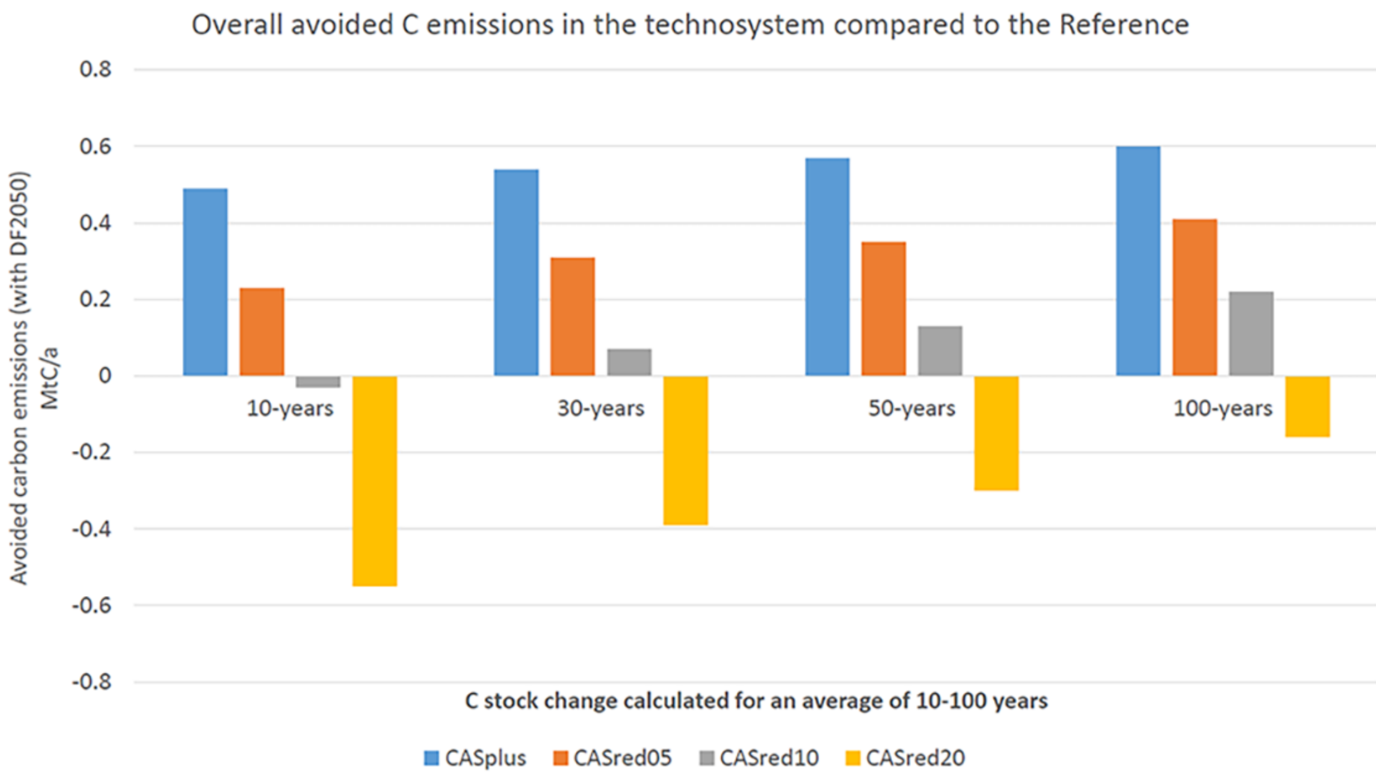

Figure 3

Avoided C emissions (MtC/a) in the cascading scenarios (see 2.2.) compared to the reference including i) the annual total substitution (avoided fossil emissions) with 2050 DF assumptions and ii) avoided carbon loss in the technosystem (annual average of C stock change), with average of 10-100 year periods.

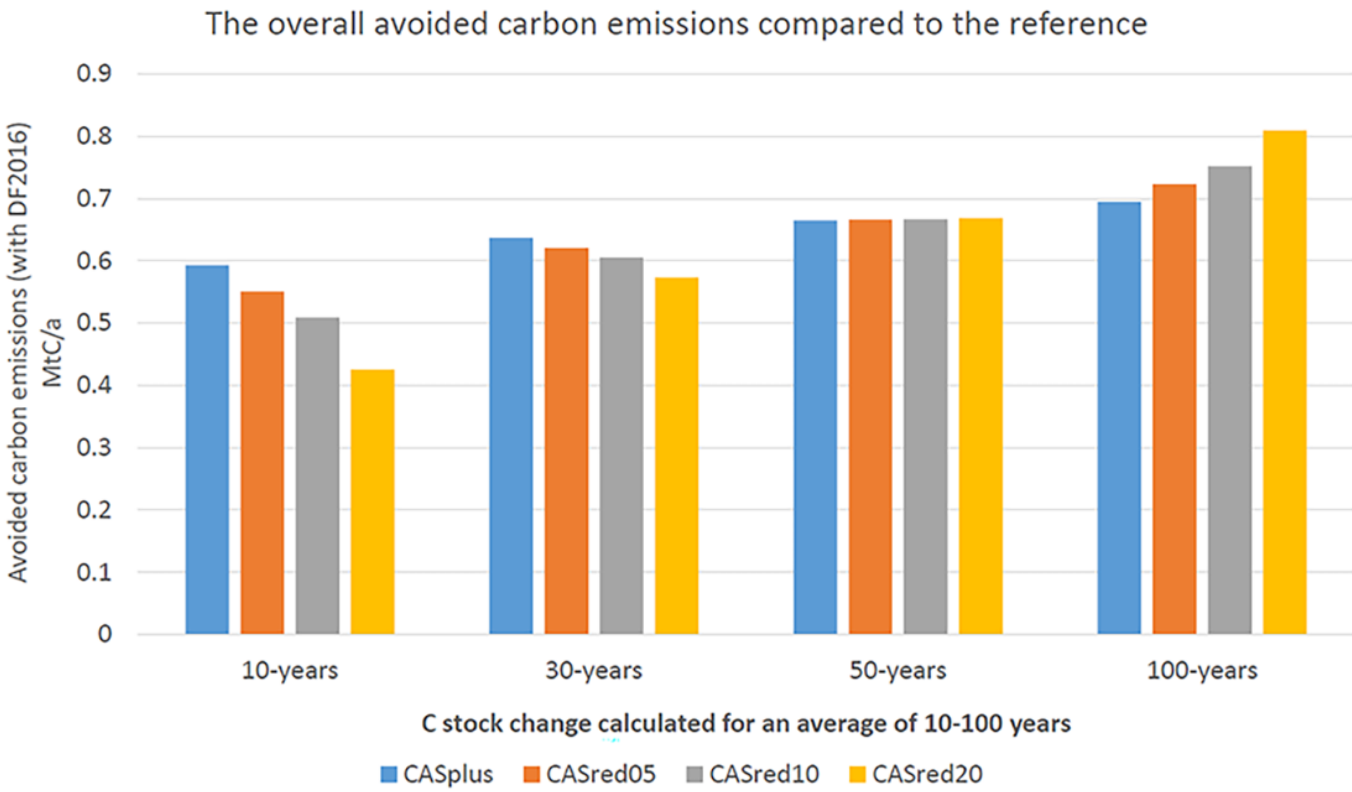

Figure 4

Avoided C emissions (MtC/a) in the cascading scenarios (see 2.2.) compared to the reference including i) the annual total substitution (avoided fossil emissions) with 2016 DF assumptions, ii) annual average of C stock change calculated with range of 10-100 years, and iii) avoided carbon loss due to reduced harvest (biogenic C) based on scenario-specific har- vest levels.

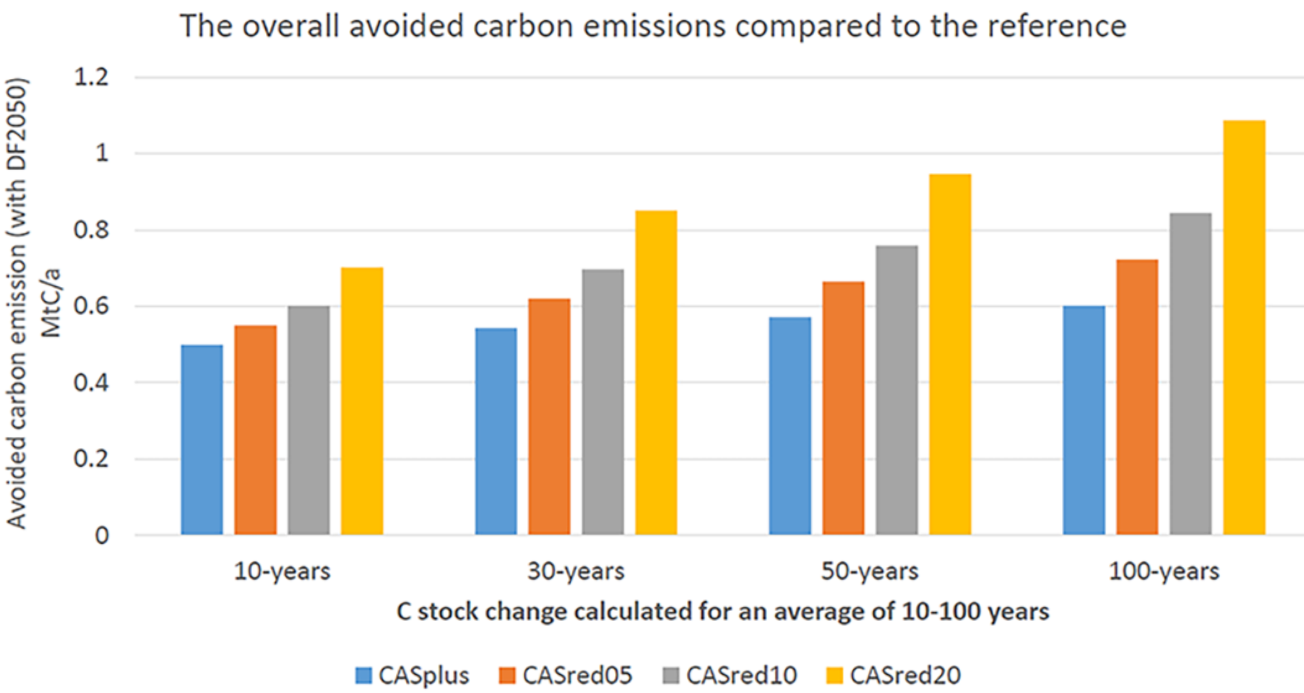

Figure 5

Avoided C emissions (MtC/a) in the cascading scenarios (see 2.2.) compared to the reference including i) the annual total substitution (avoided fossil emissions) with 2050 DF assumptions, ii) annual average of C stock change calculated with range of 10-100 years, and iii) avoided carbon loss due to reduced harvest (biogenic C) based on scenario-specific har- vest levels.

Supplementary Files

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