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Wood waste in a circular economy - dynamic accounting of greenhouse gas emissions from resource cascading

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Introduction

Wood waste is a valuable material with a potential for both energy and material utilization. However the circular economy approach adopted by the European Union clearly favours material recycling over energy recovery, aiming for a society where resource utilization is optimized through sequential applications, i.e. increasing the overall lifetime of the resource and minimizing the quality loss per application (“resource cascading”). The main recycling applications for wood waste are, depending on its quality, production of particleboard, floor boards, insulation materials, wood-composite materials, and pellets. The environmental performance of wood waste recycling alternatives has been previously assessed by the scientific community in terms of Global Warming Potential (GWP), although the quality of the resource and temporal aspects of the recycling systems are generally overlooked. The aim of this study is: i) to dynamically assess the GWP of greenhouse gas (GHG) emissions of alternative wood waste cascading use systems; and ii) to discuss the role of the quality of wood waste with respect to the environmental savings that can be achieved.

Material and Methods

The functional unit is the management of 1 tonne of wood waste from Danish recycling centres. Fifteen scenarios were grouped into two sets reflecting whether different quality grades of the wood waste were kept together (WWmix) or separate (WWquality) during management. Four WWmix scenarios covered recycling to particleboard with one, two, three or four cascading cycles. Eleven WWquality scenarios covered the following recycling applications: particleboard, flooring, wood insulation board (WIB), wood plastic composites, and pellets; up to four recycling to particleboard iterations were included in the scenarios when possible. For the dynamic GWP, biogenic and fossil CO₂ emission profiles were calculated according to Cherubini et al. (2013); accounting of other GHGs followed the approach explained in Levasseur et al. (2011).

Results and Conclusions

The results showed that WWquality scenarios provided larger savings than WWmix scenarios except for the pellet case; recycling to flooring and to WIB achieved the largest savings. This demonstrates that savings can be larger if i) quality-oriented recycling is chosen instead of maximizing the mass sent to recycling, ii) the recycling application is characterized by longer lifetime and/or iii) it substitutes energy-intensive materials.

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