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Material Value Chains

Wood-polymer composites: a step towards circular economy?

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Introduction

The Finnish strategic governmental programme on circular economy (Prime Minister's Office, 2015) emphasises the use of wood as a key raw material, as well as promotes materials recycling. This is in line with the circular economy strategy of the European Commission, calling for transforming waste into high value-added products (European Commission, 2015).

Production of wood-polymer composites (WPC) creates a possibility to utilise sawdust, a side product of the wood processing industry, as well as waste wood from construction and packaging sectors (Manninen et al., 2016). Sawdust represents an underutilised by-product of forest industry, typically recovered for bioenergy. Both virgin and recycled post-consumer plastics waste can be used in the production of WPC. Therefore WPC production may represent a step towards circular economy.

Materials and methods

In our study we performed an attributional environmental life cycle assessment (LCA) of a WPC terrace board (Fig. 1). The study was performed in the openLCA software. The impact assessment was performed according to the ReCiPe (H) midpoint method. The results presented here are for climate impacts only. The functional unit of the study was defined as 1 m^2 of terrace flooring.

Figure 1. Studied system for the WPC terrace board.

Results and discussion

Different scenarios of WPC production, as well as end-of-life (EOL) options, were studied in order to assess the influence of material and EOL choices on the overall impacts. The two different shades of the bars in Fig. 2 represent results based on different methodological choices concerning the modelling of EOL in LCA.

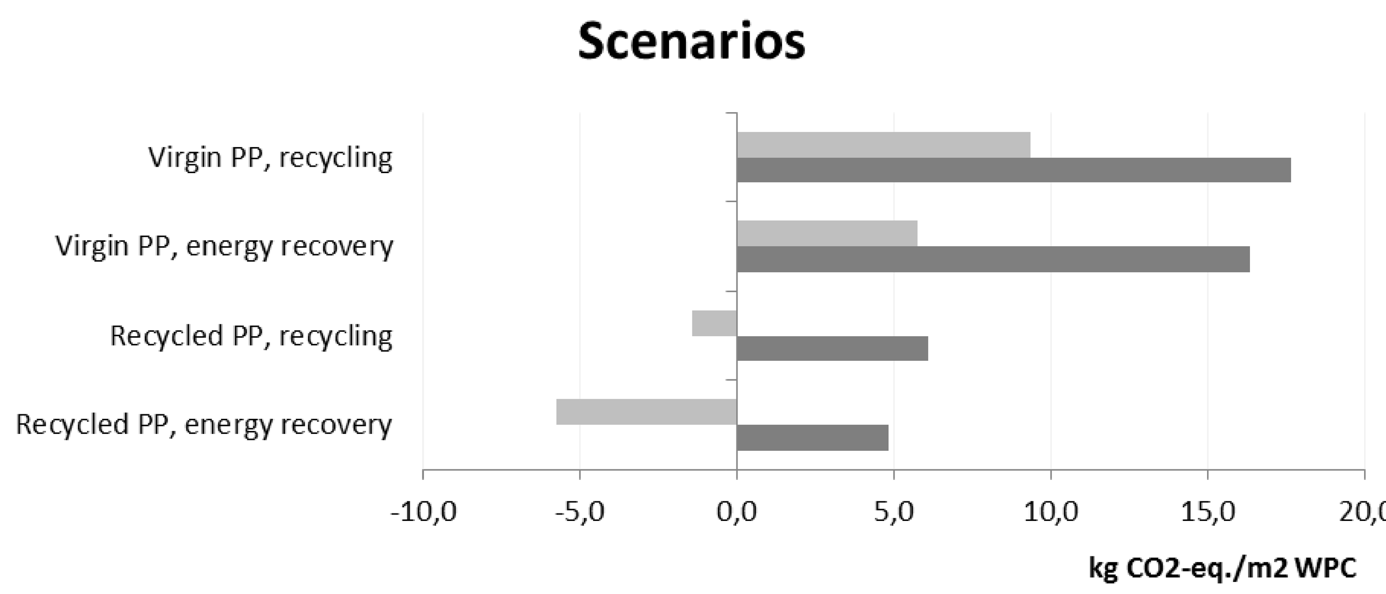

Figure 2. Climate impacts for WPC scenarios with different EOL options.

As seen in Fig. 2, climate impacts of the WPC life cycle strongly depend 1) on the used raw materials, 2) on the chosen EOL scenario, as well as 3) on the methodological approach. Depending on the methodology applied (light and dark grey bars), climate impacts of WPC may be even negative in some cases, thanks to system expansion credits attributed to the studied system.

Overall, the preliminary results indicate that utilisation of recycled polymer contributes to a significant reduction of climate impacts of WPC. Second main finding is that energy recovery is a favourable waste management option, compared to recycling. This is due to system expansion, a methodological approach in LCA when the studied product system is given credits for energy and heat production. However, a further analysis unveiled, that if only half of the credits originally considered were attributed to the studied system, the preferred EOL option would be recycling.

Conclusions

Wood waste and sawdust, as well as post-consumer plastics, are commonly used in energy production in Finland. Their utilisation in WPC production effectively extends their lifetime as products. Moreover, WPC can further be recycled into a new WPC product before it will be recovered for energy. Therefore WPC can be seen as an example product of the circular economy.

Nevertheless, the widespread of WPC production and application can be hindered by the availability of recycled raw materials, as well as presence of hazardous substances in them.

The case specific conditions related to the EOL management of WPC strongly affect the results. In regions with high share of renewables in both in electricity and heat production recycling of WPC may be a more preferred option. However, in other regions it would be energy recovery.

References

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