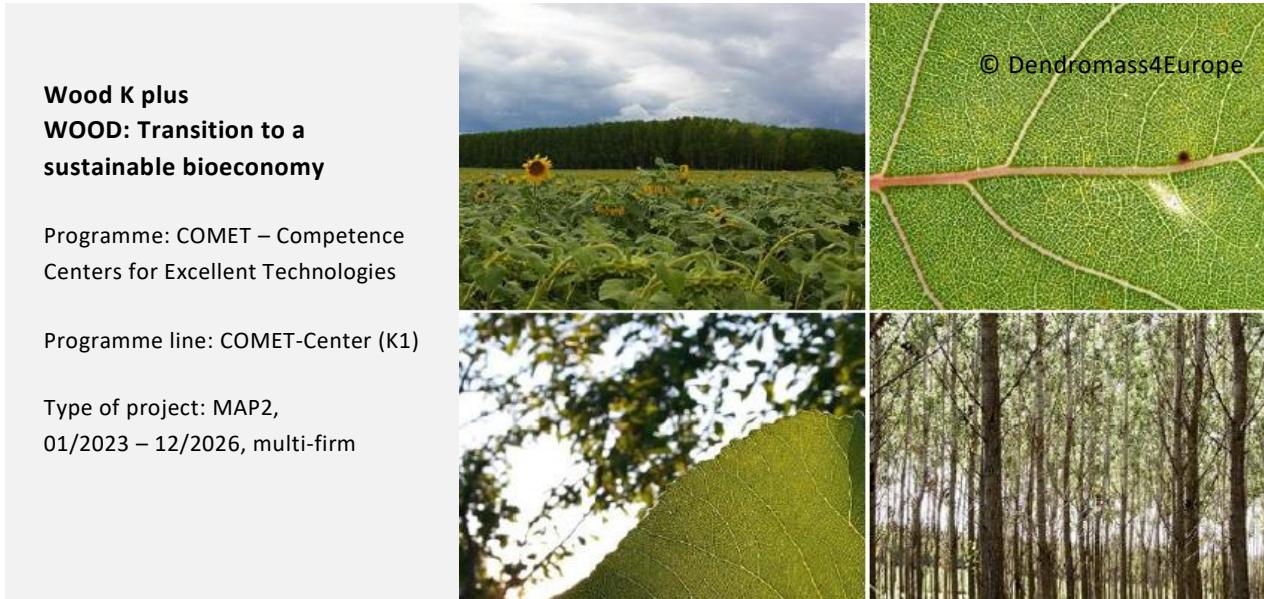


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ECO-EFFICIENCY – LINKING ENVIRONMENTAL AND ECONOMIC IMPACTS OF THE BIOECONOMY

IMPLEMENTING ECO-EFFICIENCY IN THE SUSTAINABILITY ASSESSMENT OF BIO-BASED PRODUCT DEVELOPMENT TO PREVENT BURDEN SHIFTING

A growing demand for wood that flows into the manufacturing of bio-based products entails environmental effects but also claims on economic growth. Therefore, sustainability assessment has become an important standard in product development in order to assess the consequences and potential impacts. A large number of possible effects in the environmental, social and economic spheres of sustainability and their interrelationship require a critical analysis and interpretation of the results. In order to avoid burden shifting between environmental and economic implications, the eco-efficiency assessment is an important method towards a holistic view on sustainability combining Life Cycle Assessment (LCA) and socio-economic assessment.

Ex-ante sustainability assessment

The assessment of product and process development has the advantage that sustainable development can be addressed in the further R&D process, while the adaptation of market-ready products is often challenging. Profit maximisation is frequently the primary focus, while environmental aspects are neglected. However, the product design phase is responsible for up to 80% of environmental impacts (McAloone & Bey 2009), thus bearing a great potential for system improvement.

A case study on eco-efficiency for a regional value chain based on fast-growing poplar crops was carried out. The harvested dendromass is utilised in a cascading system and flows into the production of four new bio-based products (NBBMs) to avoid residual streams. Based on the case study, the

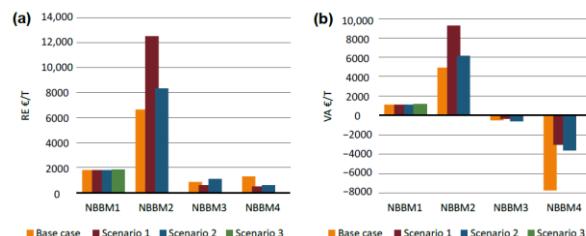
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methodological approach of eco-efficiency could be taken up in the research area as well as the interrelationship of effects could be better understood.

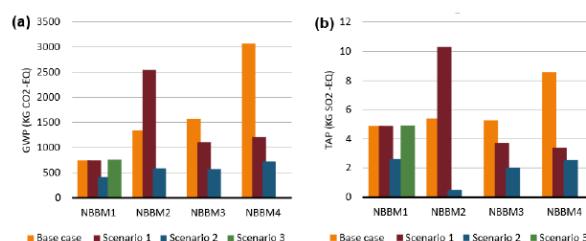
Impact and effects

The eco-efficiency assessment shows the environmental performance compared to the economic benefit (revenue and regional value added) of four products (NBBM 1 – 4) in different scenarios. The best-case scenario and scenario 1 (increased economic output) are associated with the highest environmental impact potential in most categories assessed. NBBM 3 and 4 did not generate value added under the current situation and data availability. Scenario 1 was used to allocate a ratio of dendromass from NBBM 3 and 4 to NBBM 2 for increasing the economic output. However, this has a negative impact on the environmental performance. For optimising the eco-efficiency in terms of environmental impacts the allocation of dendromass to NBBM 1 is required. However, this results in lower eco-efficiency for the whole production system as the economic performance is relatively poor compared to the others. Through an outstanding economic performance NBBM 2 receives the highest eco-efficiency. A comprehensive presentation of results from this project and study were presented to a critical audience representing the bio-based industry, research, and government at the event “Research, technology, innovation: Highlights of the bio-based industry” with a specific focus on “current developments in the biorefinery” organised by the

Austrian Federal Ministry for Climate Action, Environment, Mobility, Innovation and Energy in cooperation with ÖGUT in Vienna in December 2023.



Revenue (RE) (a) and value added (VA) (b) for four bio-based products and different scenarios for eco-efficiency assessment ((© Foto: Hesser et al. 2023)



Global warming potential (a) and terrestrial acidification potential (b) for four bio-based products and different scenarios for eco-efficiency assessment ((© Foto: Hesser et al. 2023)

Sources:

Hesser, F.; Groiß-Fürtner, D.; Woitsch, L.; Mair-Bauernfeind, C. (2023): Ex-Ante Eco-Efficiency Assessment of Dendromass Production: Conception and Experience of an Innovation Project. Land 12, 839.

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Project coordination (Story)

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