Factsheet – The Sustainability of Lightweight Board Production

Claudia Mair-Bauernfeind[1], Franziska Hesser [1]

[1] Wood K plus - Kompetenzzentrum Holz GmbH, Altenberger Straße 69, 4040 Linz, Austria

Introduction

Dendromass4Europe demonstrates the establishment of short-rotation wood Cropping in Western Slovakia and its complete dendromass-material use for bio-based materials. Innovations are seen as drivers of economic and social progress as well as environmental degradation. Anticipating the potential impacts of innovations—already during their development—is essential for sustainable development. The objective of this task is to anticipate critical environmental and socio-economic hotspots and derive measures for improvement together with the project partners. In this poster, the focus lies on the results of the lightweight board production (NBBM1) only. The results of the total D4EU impacts as well as of the other product system are presented in separate posters.

Production System

The investigations on lightweight board production begin with the poplar logs at factory gate succeeding dendromass production. NBBM1 is manufactured by IKEA Industry in Malacky, a town of around 17,500 people in the Bratislava region of Western Slovakia. Since all production processes are located in Malacky, it can be defined as a local process. Only the production processes carried out at IKEA Industry site are within the system boundaries. Inputs from outside IKEA Industry site are in the background system. The retail is outside the scope of the study, as it is not part of the project.

People

The results of the social risk analyses (Fig. 3) for the lightweight boards show a low or medium risk level for most indicators analyzed. A low-risk potential was found regarding non-fatal accidents, unemployment among people with advanced education, fair wage potential, incidents of racially motivated crime, and commitment to the sustainability issues of Ikea. Still, 18 out of 28 indicators yield a value equal to or higher than 0.5 – which means that the situation is worse than the performance reference point and special attention should be paid to these aspects. Especially, regarding 3 indicators were a high-risk potential was identified. In Slovakia, a high share of unemployment among people in Roma communities and people with basic education exists. This implies that those people have unequal opportunities in the job market. Another high risk was identified concerning the risk for safe and healthy living conditions for the local community through higher levels of fine particulate matter. These levels are higher in Slovakia than the threshold recommended by the WHO. A more detailed presentation and discussion of these results can be found in the publication from Fürtner et al. (2020) and in D5.6).

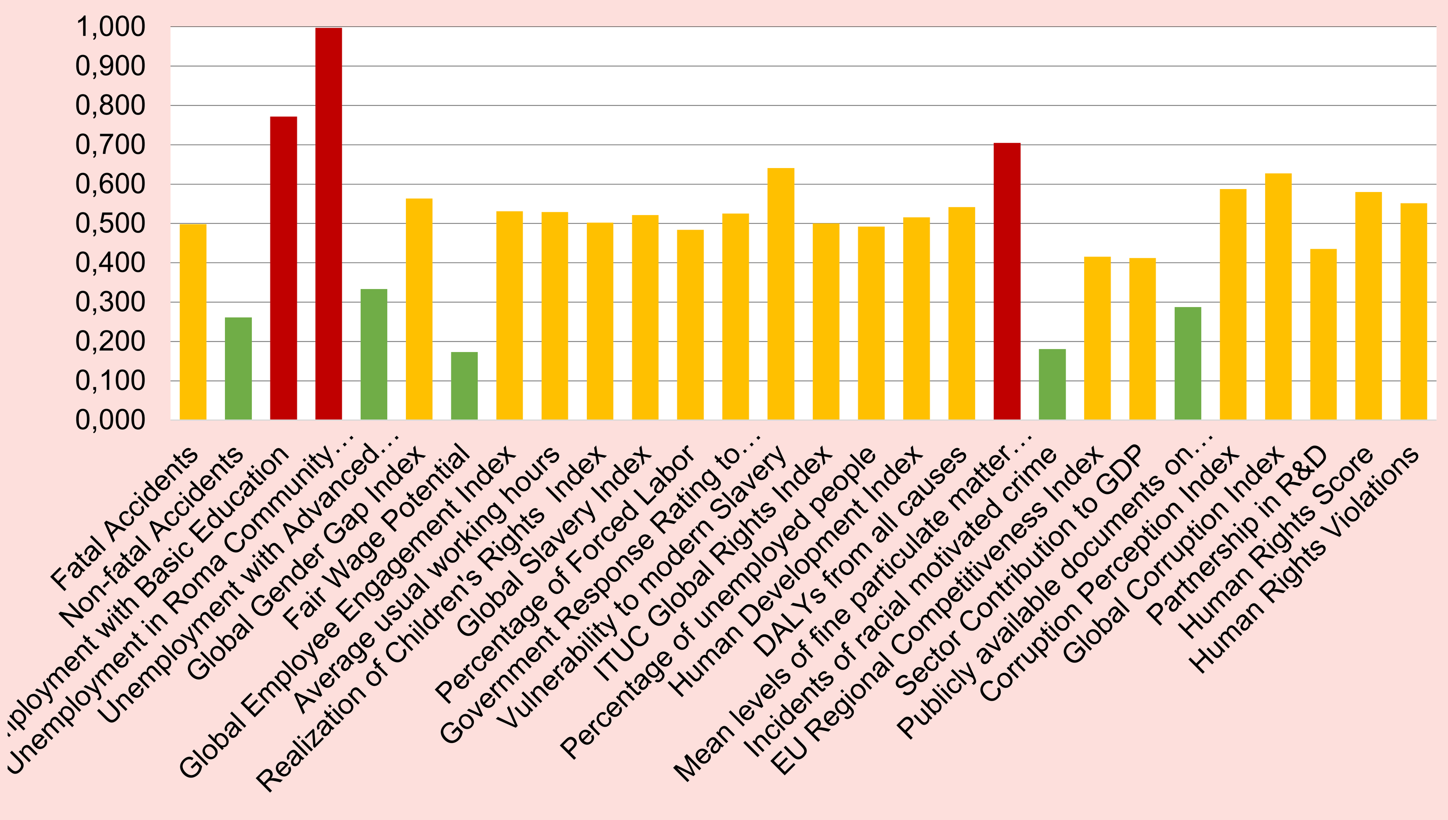

Figure 3: Selected social risks of the lightweight board production (green=lower risks; yellow=medium risk; red= higher risk)

Planet

The environmental impacts of lightweight board production in different impact categories (global warming potential (GWP), terrestrial acidification potential (TAP), ozone depletion potential (ODP), freshwater eutrophication potential (FEP), fossil depletion potential (FDP) and the cumulated energy demand (CED) are listed in Tab. 1. For the production chain of NBBM1, five hotspots were identified which are responsible for more than 90% of the potential impact in all impact categories (Fig. 1). These hotspots are: electricity, phenolic resin production, wax production, MDI production, and transport. Electricity is the largest contributor to the potential environmental impacts of NBBM1. The processes with the highest electricity consumption are drying, forming, pressing, chip preparation, and exhausting. The influences on the environmental impacts of those hotspots were further analyzed in four scenarios i.e. 1) renewable electricity instead of the country-specific electricity mix; 2) reduced amounts of poplar (5% poplar, 95% pine); 3) substitution of phenolic resin by kraft lignin, and 4) transport distances 160 km instead of 80 km because of different poplar suppliers. The results in Fig. 2 show that renewable electricity in Scenario 1 would decrease the potential impacts considerably in all impact categories. Scenario 2 and 3 do not have a high influence on the impacts, though small reductions in some impact categories are possible. Naturally, increase the transport distance results in higher impacts (Scenario 4). More detailed information in the results can be found in deliverable 5.8.

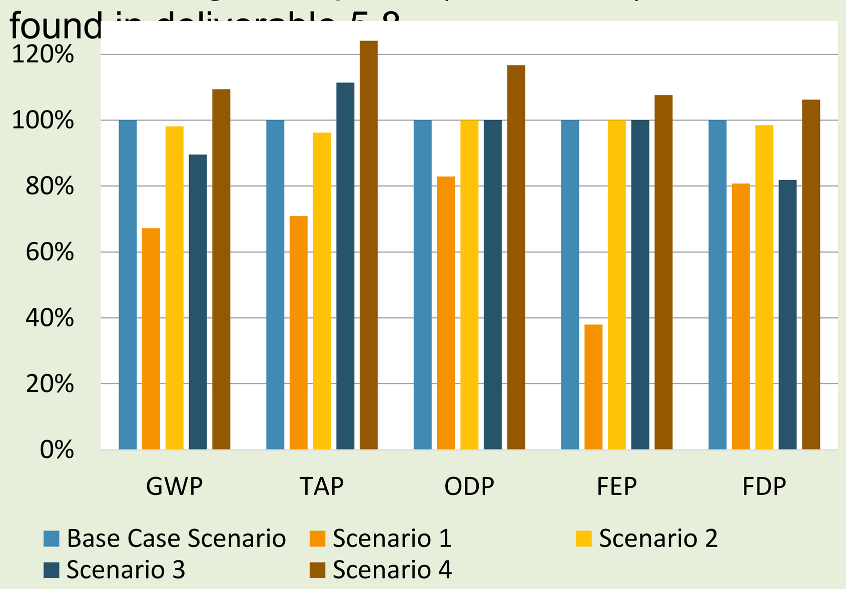

Figure 2: Scenario analysis of NBBM1 relative to the Base Case (100%)

Table 1: Potential environmental impacts of producing 1m³ of lightweight board (LWB).

Impact category	Value/1 m³ LWB
GWP (kg CO_2-Eq)	139.24
TAP (kg SO_2-Eq)	0.76
ODP (kg CFC_{11}-Eq)	$1.28*10^{-5}$
FEP (kg P-Ep)	0.08
FDP (kg oil-Eq)	70.08
CED (MJ)	1965.57

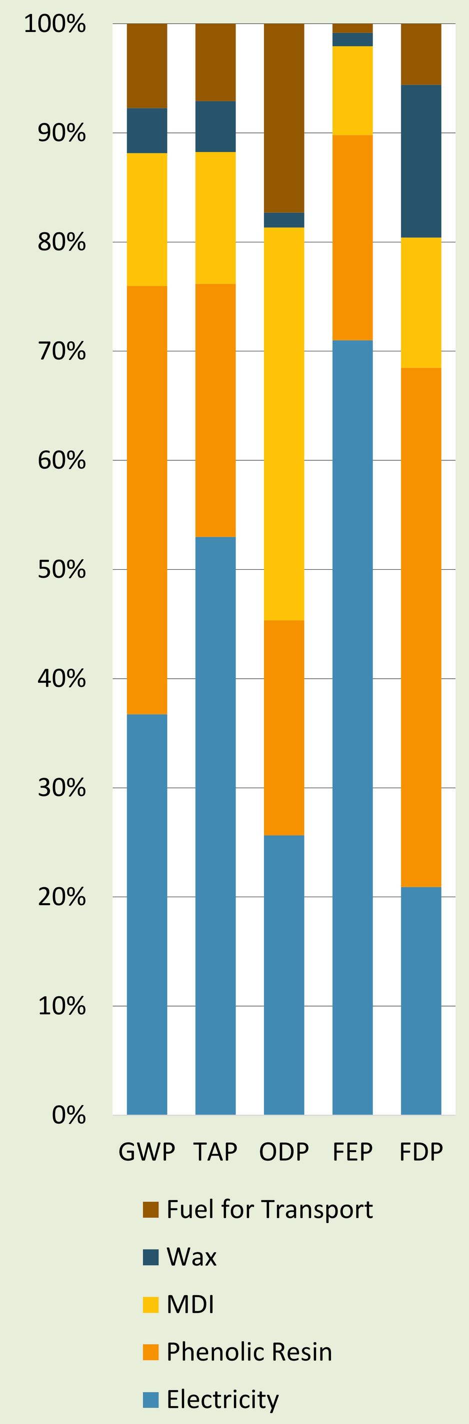

Figure 1: Contribution analysis of the main inputs relative to the Base Case (100%) for different impact categories of NBBM1.

Actions for Improvement

Sustainability assessments during R&D help to generate actionable knowledge for all involved stakeholders, especially for companies. Having identified critical hot-spots, NNBM1 producer now has the opportunity to improve the sustainability performance:

- use renewable electricity to reduce the potential environmental impacts;
- replace fossil-based phenolic raisins by lignin-based phenol to reduce potential environmental impacts;
- reduce the use of toxic substances and emissions through a higher recycling and reuse rate of materials;
- source wood locally to reduce environmental impacts in all categories;
- reduce the fine particulate matter by implementing sustainable managing practices (e.g. reduction of vehicle use, transportation distances or emissions through incineration);
- offer training, social programs and employment, especially targeting disadvantaged groups of people;
- increase the share of regional available inputs for the production processes to increase value creation for the region;
- increase efficiency in energy and material input e.g., through the implementation of innovative products which can increase the revenues;
- increase productivity through enhancing the sustainable use of renewable resources (e.g. cascading use) or by extending the product's life or reuse or recycling.

Prosperity

Value creation happens through D4EU operations and upstream processes (Fig. 4). Only a small part of the input material is assumed to be sourced within the region of Malacky. The chemical input and also the energy sources do no originate in the defined region. It is assumed that the pine wood is sourced within the region which accounts for 35% of all inputs (Fig.4) and thus generates a value-added for the region by upstream processes. The higher the share of regional supplied inputs the higher the value creation for the region. In general, the revenues as well as the regional value added can be expected to be positive for the lightweight board production (Tab. 2) i.e., a potential revenue of € 177,650,000 could be gained. However, the calculations demonstrate a hypothetical production since no data on production quantities and inputs are known due to confidentiality. Tab. 3 summarizes the eco-efficiency calculations in different impact categories and the two bars in Fig. 5 show the eco-efficiency results illustrated as revenue (RE) and the value added (VA) per GWP. The higher the value the better, which means that more value can be created by less environmental impact. More information can be found in deliverables 5.6 and 5.7.

Table 2: Results showing the potential of value creation for NBBM1 in absolute numbers

NBBM1	€/a*500,000 m³
Value Added	117 979.84
Potential Revenue	177 650.00

Table 3: Eco-efficiency based on revenue (RE) and value added (VA) NBBM1 per ton of product

NBBM1	VA (€) / env. impact	RE (€) / env. impact
GWP (kg CO2-Eq)	1.54	2.55
TAP (kg SO2-Eq)	282.79	467.50
ODP (kg CFC11-Eq)	16 790 902.34	27 757 812.50
FEP (kg P-Ep)	2 686.54	4 441.25
FDP (kg oil-Eq)	3.07	5.07
CED (MJ)	0.27	0.45

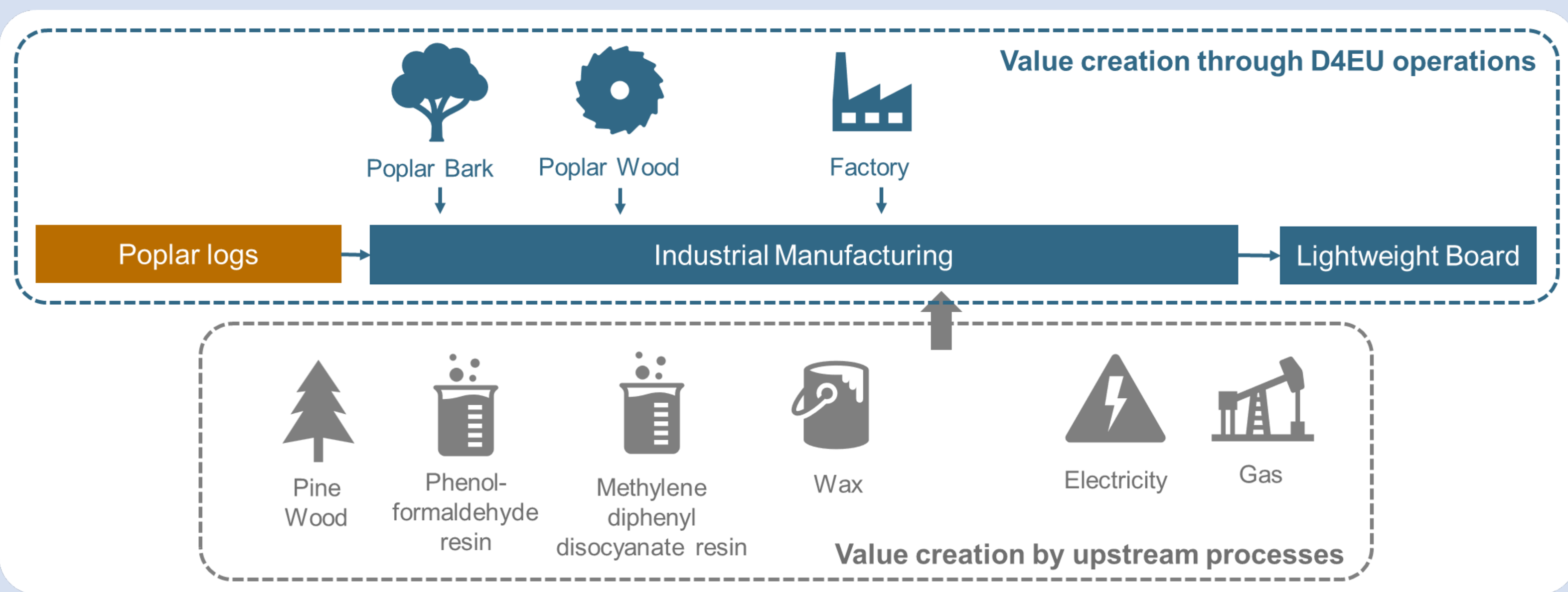

Figure 4: Processes considered for the value-added calculations.

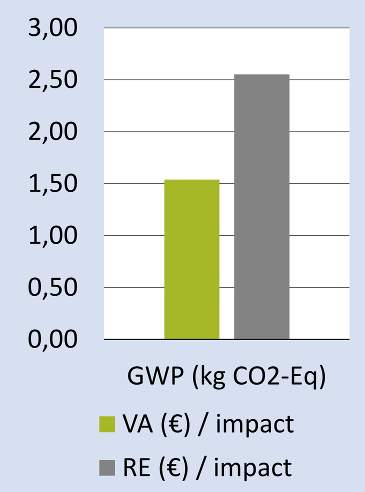

Figure 5: Revenue (RE) and value added (VA) per GWP for 1 t NBBM 1

Further reading

Deliverables 5.5; 5.6 & 5.7 of tasks 4 in Dendromass4Europe

Fürtner, D., Perdomo Echenique, E. A., Hörtenhuber, S. J., Schwarzbauer, P., & Hesser, F. (2022). Beyond Monetary Cost-Benefit Analyses: Combining Economic, Environmental and Social Analyses of Short Rotation Coppice Poplar Production in Slovakia. Forests, 13(2), 349.

Fürnter, D., Mair-Bauernfeind, C., Hesser, F. (202X). Proposing a multi-level assessment framework for social risks of bio-based value chains and its contribution to the Sustainable Development Goals. Progress in Life Cycle Assessment

Project Coordination:
Technische Universität Dresden
Forest Policy and Forest Resource Economics
Pienner Straße 23
D-01735 Tharandt

BBI JU
Bio-based Industries Consortium
Horizon 2020 European Union Funding for Research & Innovation

D4EU has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement 745874.