ECONOMIC, SOCIAL, AND ENVIRONMENTAL SUSTAINABILITY IMPACTS OF BY-PRODUCT UTILIZATION SCENARIOS IN FINLAND, FRANCE, GERMANY AND POLAND

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The use rate and uses of by-products directly influence the profitability of wood product industries. On average, just in the sawmilling process, by-products including sawdust, wood chips and bark form 50-55\% of the total outcome of the processed round wood. Thus, utilization of by-products play a major role in the Circular economy action plans aiming to improve resource efficiency and sustainability. However, the most sustainable utilization of by-products remains unclear, as there are external factors affecting the total impacts. In general, international policies and regulations affect use rates and applications the most. Furthermore, due to country-specific circumstances the very same by-product utilization model may have very different sustainability impacts depending on the implementation country. These country-specific circumstances are forest resources and their use, industrial structure, export and import rate, and market forces. In the earlier study, three preferred future scenarios for Finnish by-product allocation were determined by using an expert panel. The aim of this study is to assess the economic, social, and environmental sustainability impacts of those scenarios in Finland, France, Germany, and Poland, and to analyse their feasibility in national conditions. The scenarios are;

I) Pulp and bioenergy: By-products are mainly used for pulp and energy production. This scenario reflects the current Finnish industry structure.

II) Versatile uses: by-products have a great variety of uses including new bioproducts. Experts highlighted the economic risk diversification, as well as fossil fuel and material substitution potential in this scenario.

III) Long-lifetime products: By-products are only used for wood composites-, and particle- and fiberboards, aiming to maximize the long-term carbon storage in harvested wood products.
The study will be implemented by combining the scenarios with existing forest value chains in Poland, France, Germany, and Finland, and comparing the sustainability impacts in alternative scenarios to the current situation. This analysis will be implemented by using ToSIA (Tool for Sustainability Impact Analysis), which is a process-based tool calculating material flows in forestry value chains and quantifying sustainability indicators. The national forest value chains start from forest management to end-use of final products, including export. The particular focus of the study is on primary wood product processing, by-product formation, and their further use. Sustainability indicators include carbon storage in harvested wood products, greenhouse gas emissions, energy generation/use rate, production costs, value of products, and employment. Some scenario assumptions are needed, for example, how reallocation of by-product streams affect the harvesting rates of pulp- and energy wood, domestic use of wood products, and export rate. National realities are taken into account: Finland has extensive forest resources and dominating pulp industries, France utilizes nearly half of its harvested roundwood as fuelwood and has high interest in circular economy development, Germany has extensive sawmilling industries and investments on material circulation, and Poland is one of the biggest furniture producer countries with minor fuel wood production.

The expected results may show better feasibility of ‘Pulp and bioenergy’ scenario in Finland and France compared to the other countries, considering the existing industrial structure. Similarly, ‘Long-lifetime products’ scenario may result in increased carbon storage, but negative energy generation/use rate elsewhere than Poland. These results can be utilized in decision making in the European level to set a common frame for bioeconomy development, but create tailor made national strategies. Industries as well as policy experts are able to utilize these results to adjust their wood utilization to improve resource efficiency, employment, or for example self-sufficiency, depending on the existing demands.