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REWISE

USING DIGITAL TOOLS TO IDENTIFY AND IMPLEMENT RESOURCE-WISE SERVICES AND SOLUTIONS IN THE FORESTRY SECTOR.

SMART PRODUCT-SERVICE-SOFTWARE-SYSTEMS FOR A RESOURCE-WISE INDUSTRY

Combining digitalization, data analytics, artificial intelligence (AI), and machine learning opens new opportunities to embed innovative digital services into traditional product offerings. Merging the physical and digital worlds based on sensors and connectivity, technologies such as the internet of things (IoT) enable smart and connected products and digital services that potentially transform industries. Technology makes it possible to access a large amount of data on the condition and performance of products and how customers use them. This transition, known as digital servitization, calls for new business logic based on product-service-software systems (PSSs). While PSSs can open the door to new business opportunities, these servitization-based business models can also contribute to tackling global problems such as climate change. Thus, we can speak of a triplet transition, including digitization, servitization, and sustainable growth. Digital servitization allows delivering profitability and cost-effectiveness-driven PSSs, which fully consider sustainability-related aspects.

The forestry industry is a case in point. Digital services can be offered for resource-wise wood production by combining statistical and real-time data from different open sources and data generated at various linkages of the industry value chain. These data have the potential to benefit all actors and activities in the value chain, including forest management, harvesting, transport/logistics, and wood processing. For instance, harvesting companies can get information concerning carbon sink capacity, age/quality at three levels through positioning technologies, and fuel consumption and emissions. Instead, logistic companies can get information on road conditions and services related to route and wood load planning. As a result, data/services can help improve the sustainable use of the forest. Moreover, as discussed below, it can be combined with different analytical tools to help us identify the environmental hotspots that could be addressed with new digital services.

IMPROVING ENVIRONMENTAL IMPACTS THROUGH LIFE CYCLE ASSESSMENT (LCA)

Carbon-neutral pledges have become a shared commitment by nations or corporations to meet their climate goals. Emission reduction should take place to reach the pledges. In doing so, the first step is knowing one's emissions. Thus, the 'what' and the 'how' regarding emission reduction can be implemented. The vast amounts and varieties of data being collected through digital devices can be utilized to improve various aspects, including environmental issues. The quantification of environmental impacts can be investigated by employing a life cycle assessment (LCA).

Fig. 1 Scope of LCA of thermally modified wood

Life cycle assessment (LCA) is an analytical tool standardized under ISO 14040 and 14044 used to calculate the environmental impacts of products or services. The effects can cover boundaries of the production process (gate-to-gate), raw material extraction up to the production process (cradle-to-gate), or raw material extraction up to the end-of-life (EoL) stage (cradle-to-grave). LCA can be utilised for carbon accounting, identifying environmental hotspots (which part of the products' supply chain causes the highest impact), and comparing alternatives (e.g., importing steel made through a basic oxygen furnace from a neighbouring country or steel made through an electric arc furnace from overseas).

In the forestry industry, LCA can be applied to analyse the environmental performance of various wooden products. Here the importance of LCA implementation is demonstrated through environmental impact estimation of thermally modified wood. Thermally modified wood is wood modified by applying heat to induce chemical changes that can increase its durability. The system boundaries of the study covered cradle-to-gate (raw material extraction of pine up to EoL management through incineration). The data was collected from public documents, academic literature, and the LCA database. The LCA results showed climate change impact per m3 of wood product that lasted for 25 years.

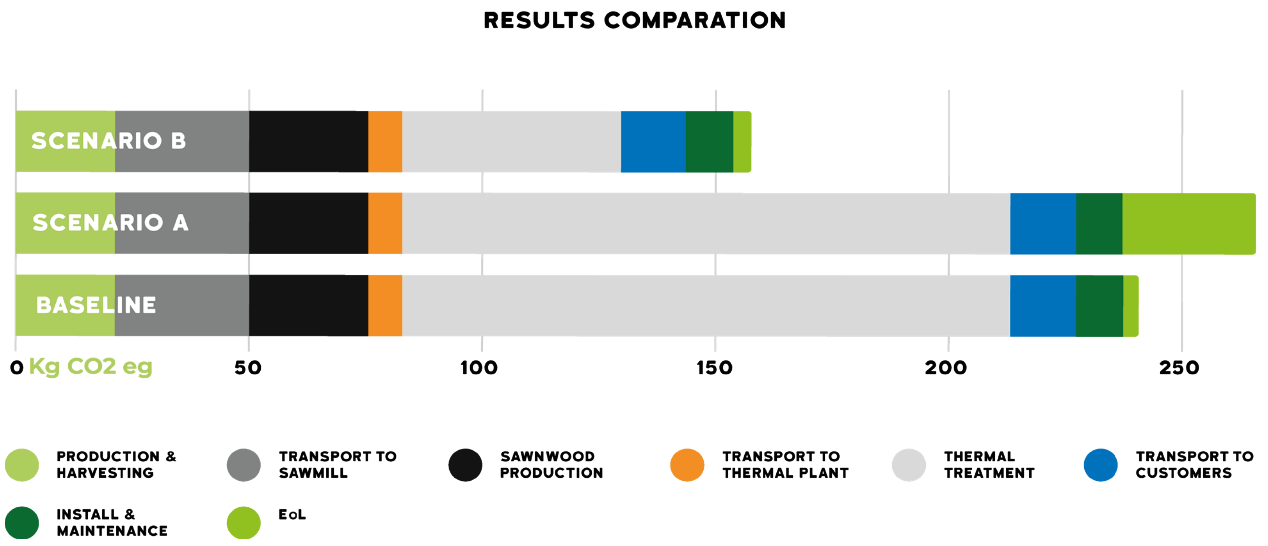

Fig. 2 Climate change impact of thermally modified wood

The study showed that producing 1m3 of thermally modified wood, using it for 25 years, and incinerating it generated 240.5 kg CO2-eq. The total climate change impact occurred at different supply chain stages. The hotspot analysis showed that the highest impact was caused by a thermal treatment which generated 131 kg CO2-eq. (Fig. 2, Baseline). Besides applying carbon accounting, the scenario analysis investigated whether different alternatives could improve climate change impact. In scenario A, incineration was replaced by landfilling the wood. The change led to a worse environmental impact since the climate change impact of landfilling wood was about 8.5 times that of incinerating it. Understanding the supply chain stage that causes the highest environmental impact is essential not to bark up the wrong tree. In scenario B, the environmental hotspot was addressed. Baseline calculation assumed the use of natural gas for thermal treatment; meanwhile, in scenario B, the thermal treatment was fuelled by woodchip. It resulted in an impact that was 2.8 times lower than natural gas.

The study shows the importance of using LCA resource-wise and pursuing carbon neutrality. Measuring environmental impacts is essential to gain insight and develop suitable strategies. It makes the saying from Peter Drucker apt here, "You can't manage what you can't measure."