

## THE ROLE OF WOOD-BASED PRODUCTS IN SUSTAINABLE DEVELOPMENT

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### ABSTRACT

*Wood is renewable, recyclable, climate-friendly material, and presents an important segment in achieving circular economy and sustainability concepts. To be able to link these two concepts, production and consumption systems need to transform towards sustainability. Wood-based products play a role in mitigating climate change by reducing carbon from the atmosphere. Their special properties, such as carbon storage capacity, high recyclability, renewal of raw materials, and a direct impact on the reduction of greenhouse gases in the atmosphere, make them the best product to combat climate change. This paper aims to present the role of the wood-based industry and its products in achieving sustainable development goals.*

### 1. INTRODUCTION

Sustainable development, bio-economy, and circular economy are concepts that complement each other. Furthermore, the wood-based sector together with forest and forest-based sectors plays a central role in achieving sustainability, because it provides material, bioenergy, and wealth. It is especially important regarding the fact that, besides seas and oceans, wood represents the most important atmosphere carbon storage. Opposite to expectations of individuals that cutting the forests creates an imbalance in the ecosystem, it is important to observe the problem in total to present the carbon balance correctly for certain products, regarding its specific qualities, use of additional material, local energy resources, and technology, possibilities of recycling and, of course, principles of sustainable forestry. Furthermore, the cascade use of wood is a concept with a long history of debate and analysis in EU bio-based industries. The cascade use of wood is the smart way to use a natural resource – putting it to good use before it is reused, recycled, and finally burnt for energy. It strongly overlaps with circular economy and sustainability concepts. To be able to link these two concepts, production and consumption systems need to transform towards sustainability. This paper aims to present the role of the wood-based industry and its products in achieving sustainable development goals.

### 2. WOOD – BASED INDUSTRY IN NUMBERS

According to Forest Products Annual Market Review (2021) [1] the COVID-19 pandemic resulted in a large contraction in economic activity across the UNECE region in 2020, albeit with differences between countries due to the diversity of economic structures and policy responses. Total housing starts in the United States were estimated at 1.38 million in 2020, an increase of 6.9% over 2019 and higher than the historical average of 1.01 million units. Total Canadian housing starts increased by 3.8% in 2020, year-on-year. About 57% of the total in Canada were apartments. The new European Union (EU) Reconstruction Plan is anchored in the European Green Deal. Through its links to the EU's Biodiversity Strategy and Climate Policy, the strategy is expected to have a medium- and long-term influence on

forest product markets. Although the forest products industry in Eastern Europe, Caucasus, and Central Asia was not one of the most affected sectors in the early stages of the pandemic, it did encounter significant reductions in the production, trade, and consumption of wood products. The furniture and wood-based panels segments experienced the biggest declines. Port closures reduced exports of wood-based products from the United States by 32% in 2020 compared with 2019, and the country's imports dropped by 26%. Exports of wood-based products in March 2021 were, however, nearly identical to those in March 2020, and imports were about 36% higher. Value-added wood products are primary wood products that have been further processed into secondary products such as furniture, builders' joinery, carpentry (BJC), profiled wood, and engineered wood products (EWPs). Demand is linked to drivers such as economic growth; housing and construction; home renovation; fashion and design; and demographics. BJC comprises a wide array of wood products, including wooden windows and doors; pre-assembled wooden flooring; posts and beams; and shakes and shingles. EWPs include I-beams (also called I-joists); finger-jointed sawnwood; glulam (sawnwood glued into beams); laminated veneer lumber (LVL); and mass timber panels, including cross-laminated timber (CLT). The COVID-19 pandemic has had a surprising impact on value-added wood product demand, with people suddenly having more time for do-it-yourself projects. Improvements and repairs of owner-occupied homes will remain solid in the United States through 2021 and into 2022. The office-furniture segment has been a clear loser in the pandemic, with stay-at-home orders reducing demand. On the other hand, such orders have meant that workers have focused on their homes and comfort, and many have adapted their spaces to the needs of working from home. This will likely have longer-term effects on office workspace design and use and could lead to a reduction in total required space as more people work remotely at least part of the time. Building with wood has been boosted by the introduction of CLT, particularly in markets with a lower share of wood construction. Global CLT production capacity was estimated at 2.8 million m<sup>3</sup> in 2020, and actual production likely exceeded 2 million m<sup>3</sup>. According to the Eurostat document Agriculture, forestry and fishery statistical book [2] the EU's wood-based industries cover a range of downstream activities, including woodworking industries, large parts of the furniture industry, pulp and paper manufacturing and converting industries, and the printing industry. Together, some 393 000 enterprises were active in wood-based industries across the EU in 2020; they represented one in five (19 %) manufacturing enterprises across the EU, highlighting that - except for pulp and paper manufacturing that is characterized by economies of scale - many wood-based industries had a relatively high number of small or medium-sized enterprises. The wood-based industries employed 3.1 million persons across the EU in 2020 or 10.5% of the manufacturing total. There were more than 900 000 persons employed within both the manufacture of wood and wood products and the manufacture of furniture, whereas the employment of 555 000 persons was recorded for printing and service activities related to printing, representing the lowest employment of the four activities. The economic importance of an industry can be measured by the share of its gross value added (GVA) in the economy. In 2020, the GVA of wood-based industries in the EU was €136 billion or 7.2% of the total manufacturing industry. Within the EU's wood-based industries, the largest GVA was recorded for pulp, paper, and paper products manufacturing (34% or €46 billion), while the manufacture of furniture and manufacturing of wood and wood products each made up between 23% and 27%. After the temporary decrease in 2020, roundwood production in the EU increased by 3.9% in 2021. In 2021 it reached an estimated 507 million m<sup>3</sup>. This is 25.6% more than at the beginning of the millennium. Except for four EU Member States where the roundwood production decreased or remained stable and a further five Member States where lack of latest data does not allow the trend to be evaluated

all EU countries recorded an increase in roundwood production in the period of 2000–2021. The largest relative increase during the two decades in the amount of harvested wood took place in the Netherlands (190%), Czechia (126%), Poland (66%), and Slovenia (65%). In 2021, Germany was the largest producer of roundwood in EU (82 million m<sup>3</sup>), followed by Sweden, Finland, and France (each producing between 50 and 75 million m<sup>3</sup>). Wood has been increasingly used as a source of renewable energy. Almost a quarter (2%) of the EU's roundwood production in 2021 was used as fuelwood, while the remainder was industrial roundwood mostly used for sawnwood and veneers or pulp and paper production. This represents an increase of 6 percentage points (pp) compared with 2000 when fuelwood accounted for 17% of the total roundwood production. In some EU Member States, specifically the Netherlands, Cyprus, and France, fuelwood represented the majority of roundwood production (more than 50%) in 2021. On the other hand, Slovakia and Sweden reported that over 90 % of their total roundwood production was industrial roundwood. The total output of sawnwood across the EU increased by approximately 15% from 2000 to 2021, reaching 112 million m<sup>3</sup> in 2021. Germany and Sweden were the EU's leading sawnwood producers in 2021, accounting for approximately 23% and 17% of the EU's total sawnwood output, respectively.

### **3. WOOD PRODUCTS AND SUSTAINABILITY**

Wood is renewable, recyclable, climate-friendly, and versatile and is increasingly being used to replace non-renewable materials. It is a critical material to the efforts to address the global threats to climate, biodiversity, and the environment caused by the excessive use of non-renewable materials [3]. More precisely, it's renewable, sustainable, recyclable, grown locally, versatile, biodegradable, and has a smaller energy, water, and carbon life cycle footprint than other products. Increasingly, wood is being recognized in the architecture, engineering, and construction communities as a green building product with important environmental advantages over other building materials. Mass timber and engineered wood products in construction, man-made cellulose fiber for textile production, and more modern forms of wood for energy are the most prominent wood products for large-scale substitution of non-renewable materials. According to Salzman et al. [4] forests are natural systems that provide multiple goods and ecosystem services, including raw materials, various non-wood forest products, climate regulation, carbon storage, and biodiversity, while wood and wood-based products can contribute to climate change mitigation through carbon storage in materials and by avoiding GHG emissions through material and energy substitution [5]. In recent years the wood-based sector has been developing new and innovative products that have the potential in achieving sustainability, such as textile fibers, composites, chemicals, and packaging materials [6,7] Sustainable development concept is an effort to achieve the balance between economic, social, and ecological demands, with the final goal to satisfy the needs of nowadays without endangering the abilities of future generations to satisfy their future needs [8]. The socially responsible business regards to responsibilities of a company to contribute to sustainable development with its manufacturing and business activities. The lack of knowledge of the sustainable development concept makes many actors in the chain of creating value for a product misunderstand the principles of sustainability of the environment with activities of decreasing the impact of the production process on the environment. However, according to principles of environmental sustainability, the goal of the so-called green process is to try to decrease the impact of all activities in all life cycle phases of product and/or service (material-production-use-reuse/recycling) on the environment through emission decreasing, giving priorities to renewable material and decreasing the total costs of product/service life cycle [9]. Total tracking of product or service, life cycle in perspective of sustainable development can give

decision makers a clear view and better understanding of three pillars of sustainable development (3P): People, Planet, and Profit/Prosperity during the full supply/demand chain. All activities based on principles of the sustainable environment using suitable methodology, techniques, and tools, and which can contribute to this goal, are recommended. The sustainable use of natural resources, including forests, is a key tenet of the 2030 Agenda for Sustainable Development. The 2015 Paris Agreement also highlights the contribution of forests to climate change mitigation and adaptation. Technical and methodological progress has facilitated better monitoring of the life cycle of harvested wood products. This gives them a key role in strategies for transitioning to low-carbon economies. Concurrently, the impact of sustainable forest management on enhancing livelihoods, contributing to landscapes and cities, and reducing the world's carbon and material footprints, is growing. That kind of approach puts in focus the importance of observing the relationship between sustainable production and sustainable consumption. According to Znkhan and Carlson [10], the primary goal for producers is to choose production, process, and management activities that will have the lowest impact on human health and the environment, and for final consumers the primary goal is to choose product or service which will have the lowest impact on the environment, taking into consideration the costs.

#### **4. SUSTAINABLE ARCHITECTURE, DESIGN, AND USAGE OF WOOD-BASED PRODUCTS**

When it comes to a sustainable built environment, material choices matter. Wood is a natural, renewable, and sustainable material for building. Maximizing wood usage in both residential and commercial construction could remove an estimated 21 million tons of CO<sub>2</sub> from the atmosphere annually—equal to taking 4.4 million cars off the road [11]. Because 80% of a building's embodied carbon comes from the structural materials used to build it, building material specification is impactful. Wood performs better than concrete and steel when it comes to both its carbon footprint and air and water pollution. Its low-carbon benefits, and other sustainability advantages, including certified wood, recycled/reused materials, local sourcing of materials, waste minimization, and indoor air quality, make wood one of the best tools in the toolkit to reach net-zero carbon for buildings.

One example that highlights sustainability principles in the field of wood furniture is IKEA. IKEA has been piloting various initiatives across its European stores to see how they can build circularity into their offer to customers with an aim to support customers to care and repair, rent, share, bring back, and resell their IKEA products to prolong product life.

Concerning eco-friendly furniture, the socio-demographic elements of consumers (income, residence, age, and educational level) and family size have a significant influence on their willingness to buy this type of furniture [12]. Vlosky et al. [13], who investigated furniture consumers in the United States, and Xiaolei et al. [14], who investigated customer preference for kitchen cabinets in China, ascertained that consumers preferred eco-friendly furniture. According to Anderson and Hansen [15], consumers in the United States are willing to pay a premium for eco-friendly wood products. Pirc et al. [16] determined that Croatian consumers most often view domestic furniture as high-quality and well designed, but also expensive.

Regarding the environmental consciousness of the respondents of both countries, the authors theorize that appealing to “green” consumers and consumers that express an indifferent attitude towards the environmental attributes of furniture could create an interesting potential for a market with eco-labeled furniture products. This presumption could be supported by similar findings from other Central-European consumer studies [17,18,19]. Moreover, there are challenges for furniture manufacturers because of Green

Growth and Circular Economy measures and legislative proposals recently adopted in EU countries. The main areas are connected to the waste management policy (e.g. waste prevention program, changes in the waste hierarchy), designing of products, setting up of production processes, and utilization of resources.

The results show that the group of architects that participated in the study in general have had a good experience with EWPs, have a positive attitude towards using EWPs, and think that their use will increase in the future. They have, however, limited possibilities to influence material selection, and the main hindrance to using new EWPs is that other actors with a greater influence over material selection prefer other materials. The level of knowledge of EWPs among the architects is in general moderate and lack of knowledge and information about EWPs is also seen as a hindrance of importance when it comes to introducing new EWPs. Factors that seem to influence the likelihood of increased use of EWPs in buildings are environmental concerns, perceptions of the aesthetic appearance, amount of experience, influence over the material selection, level of knowledge of EWPs, and the architects' attitude towards using EWPs in buildings [20].

Only recently, from a historical perspective of use, has wood been developed to form a range of increasingly functional products, based on a combination of performance and sustainability requirements, i.e. engineered wood products (EWPs) [21]. This has been possible because new industrial processes have been developed for the modification of wood, and because residues and lower-grade trees are being increasingly used for more versatile and consistent products with dimensions considerably larger than that of the tree. The result is a vast array of EWPs used in contemporary architectural design. There are EWPs suitable e.g. floors, walls and roof elements, beams, columns, insulation, cladding, decking, and also a number of engineered panel products that can be used to add bracing and shear strength to timber constructions [22]. Mamić and Domljan [23] analyzed the production processes and observed what is left as residue, how it is produced, and how to turn residue back into valuable raw material from which a new eco-friendly product could be created. The research findings noted that waste raw material can be turned into a more usable raw material, as well as into a final product with a higher added value, and thus contributes to improving the market competitiveness of the company. When it comes to wood residue revision, they pointed out the vast majority of oak-cut veneer waste is selected on an aesthetic basis, due to which the raw material is eliminated. Wood does not have the same characteristic as plastic, for example, so visual defects in wood are a natural occurrence. Today's trends encourage the use of wood that emphasizes the natural appearance and irregularities, in contrast to the recent desirable perfectly flat, uniform grain and wooden strips. The results from Burnard and Kutnar [24] indicated that, under certain conditions, using wood in the built indoor environment may lead to improved stress responses. For example, stress responses indicated by salivary cortisol levels were lower in the test environment with oak furniture than in the corresponding control environment. They discussed that the reduced reaction to stress has a small effect on any single stressful situation, but, over time, even small reductions to stress responses can contribute to improved mental and physical health outcomes.

## **5. CONCLUSION**

Sustainability is increasingly becoming a key consideration of all stakeholders within the wood-based sector and its products since the world is moving towards zero-energy construction. More rational use of raw materials is also very important, particularly when this material has a significant impact on reducing CO<sub>2</sub> emissions compared to other materials. The higher promotion of wood in construction and interior design and encouragement of the use of wood raw materials in production is needed because they

contribute to environmental protection. By increasing the quality of individual and overall life of the population, the increase in well-being is measured. To achieve sustainable development on a global scale level, it is necessary to implement systemic changes from the market and politics to institutions and behaviors that support innovations and feel the need to introduce them. Wood and wood products can be used in any form and they can be a good substitute for other products and that they can compete with materials that people think are stronger, stronger, and better quality. The wood industry with its product, process, and business innovations contributes to the achievement of goals of sustainable development and keeping forests and ecosystems healthy. Therefore, the market is important to inform, educate and direct in sustainable development about the importance of using wood, innovations wood products, as well as recycling and reusing them. Rational by using wood and innovations, we can greatly contribute to the reduction of harmful emissions into the atmosphere and in achieving greater energy efficiency and reduced climate change.

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