

EUROPEAN POLICIES INFLUENCING WOOD SUPPLY AND DEMAND IN SCENARIOS UNTIL 2040

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ABSTRACT: Wood products can play an important role to achieve the European Commission's policies for climate neutrality by fostering a decarbonisation of the construction sector. The study analyses how different policies may impact wood demand forecasted for the sawmill and wood-based panels industry, based on past trends in statistics and expert insights gained through surveys, workshops, and interviews. Two generic scenarios were portrayed: increasing production versus stagnation until 2040. The results indicate an increase of demand for sawnwood, and wood-based panels leading to a potential high raw material and supply competition. We point out policy needs and perspectives for research and innovation addressing both resource efficiency and circular uses of materials, products and building systems.

KEYWORDS: wood product markets, climate policy, sustainable industry, forecasts

1 – INTRODUCTION

Wood industry comprises sawnwood, wood-based panels (WBP), paper and paperboard, and wood fuel. We refer to 'solid wood use' as sawnwood and WBP. The consumption of wood, measured as primary and secondary wood products (i.e. domestic production plus imports, minus exports) is a key indicator for the state and future development of the forest-based industries [1]. A strategic policy aimed at fostering the transition towards a sustainable economy and achieving climate neutrality by 2050 was launched by the European Commission (EC) in 2019 as the 'European Green Deal' (EGD) [2]. Wood and wood-based products are acknowledged as potential levers to support the EGD targets, by reducing green house gas (GHG) emissions of the construction sector, which is the second largest industry sector in the EU and responsible for about 36% of total emissions [3]. The improved performance and environmental benefits of using wood in construction is gaining recognition in Europe and worldwide, but could lead to a higher wood consumption in the future. The EC has initiated and revised a set of policies with a considerable impact on wood supply and wood demand.

1.1 WOOD FLOWS IN EUROPE

Sankey diagrams are a common representation for material flows of industrial supply chains. Fig. 1 shows the flows for primary and secondary wood uses in EU-27 in 2017 (measured in m³ equivalent) with interlinkages

among different wood industries [4, 5]. It provides a global view of large versus small mass streams in the forest-based sector. Industrial roundwood represents the largest initial flow from the forest, which feeds harvested timber into the primary transformation industries. The main use of sawmill industry products is construction, notably as sawnwood and engineered wood products (EWP) for structural purposes, such as cross-laminated timber (CLT), glued laminated timber (GLT), and others, followed by packaging [1], [5]. The pulp industry is the second largest consumer of roundwood: it feeds pulp into paper and paper board industries, and a minor fraction into textiles and chemical industry. By-products from the pulp industry (black liquor) are used for energy production.

The wood panel industry is the third consumer of roundwood, supplying panel products (particleboard, fibreboard, plywood, oriented-strand board (OSB), and others) is mainly the furniture industry, followed by secondary uses in construction [1], [5]. WBP production is partly dependant on primary forest raw material resources, but also on by-products of the sawmill industry. Post-consumer wood or recovered wood is another important source, making the panel industry one main example of material recycling in the forest-based sector.

It is notable that a significant volume of primary removals feed directly into final energy use..

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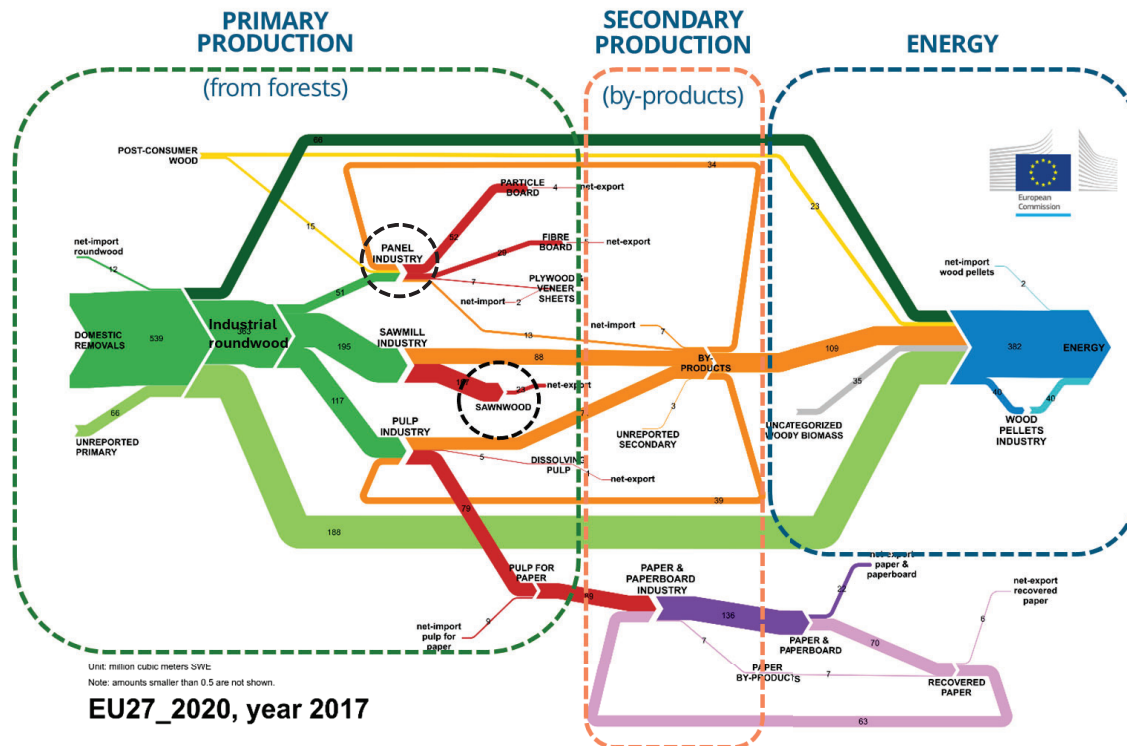


Figure 1. Sankey diagrams of the wood flows in EU-27 by product, adapted from [4]

1.2 EXPECTED FUTURE TRENDS

The most promising products for substituting non-renewable materials are EWP and WBP for construction, cellulose fibre for textiles and wood for energy [6]. Their demand is expected to increase in the coming years in Europe. Sawnwood production is predicted to increase at an annual rate of 1.8% by 2030, mainly focused on softwoods [7]. Half of the production is expected to be used for EWP manufacturing for structural applications in the construction sector, substituting concrete and steel, and the other half for packaging, interiors and furniture. The production of dissolving pulp is expected to increase at an annual rate of 3.9% by 2030. However, newsprint production is expected to be over 50% lower in 2030 compared to production levels of 2012 [6].

WBP will see the strongest increase in demand by 2050, mainly plywood (+ 102%) and particleboards and fibreboards (+72%), followed by sawnwood (+30%) and wood pulp (5%) [8]. While detailed figures per industry branch or country can be debated, there is a wide agreement in industry that the demand for wood in Europe will increase substantially in the long run.

1.3 OBJECTIVE

Forests and forest-based industries are affected by various recent EU policies which also lead to uncertainty for current and future markets. The interplay of different policies will lead to shifts in pathways or scenarios in

wood supply and demand, depending on European and national priorities. The aim of this study is to analyse how European policies can impact on the future trends of the solid wood industry and to identify which significant factors can emerge as opportunities and barriers for mainstreaming wood-based products and enhance their role for the transition to a sustainable bioeconomy.

2 – METHODOLOGY

The study method comprised three main steps: 1) the analysis of the dynamics in sawnwood and WBP in EU-27 and the definition of potential future trends; 2) the analysis of relevant European regulations and directives influencing wood supply and demand for the sawmill and wood-based panel industries; and 3) the exploration of future scenarios together with industry experts through workshops, surveys and interviews.

2.1 TRENDS AND PROJECTIONS

Data from FAOSTAT [9] were used to analyse the dynamics in production of both sawnwood and wood-based panels in Europe. For each product, the annual growth rate (%) was calculated from a linear regression for the defined period, according to (1).

$$b = a(1 + x)^n; x = \sqrt[n]{\frac{b}{a}} - 1 \quad (1)$$

where, b is the production in the last year of the period; a is the production in the period's first year, n is the number of years for the period, and x is the annual rate (%).

Three possible future trends in production were defined for both sawnwood and WBP: 1) long-term historical trend based on the production time series between 2000 and 2023; 2) short-term historical trend according to the production time series between 2009 and 2023; and 3) a stagnation in production at zero growth. Projections of the production trends were calculated from the historical annual growth rates.

2.2 EU POLICY ANALYSIS

Fourteen European regulations with relevance for the wood industry were analysed by the research team of the EUFORE project. The objective was to identify their implications in the solid wood value chains, from forests to industry and markets, considering also competitor markets (pulp and energy). The analysis of regulations is shown in Table 2.

2.3 PARTICIPATORY APPROACH

The interpretative policy analysis described in 2.2 was contrasted with stakeholders' interpretations who are most likely to be affected by the identified legal provisions. Two workshops were organized in Valladolid (Spain, April 2024) and in Prague (Czech Republic, May 2024) with a group of experts in forestry ($n=19$) and wood industries ($n=26$), respectively. The experts feedback addressed how the policies will affect the wood demand by 2040. Results from the workshops were validated via a survey answered by 33 policy experts from six different European regions (Mediterranean 10, West-Central 6, Central 5, North-East 4, West Atlantic 2, South-East 1; others or unknown 6). Finally, interviews with the European Organisation of Sawmill Industry (EOS) and the European Panel Federation (EPF) helped to address three main questions:

1) Which policy assumptions could be related to the different scenarios?; 2) How will major EU policies and global trends impact wood supply and demand? (e.g., boom of wood construction, climate disturbances, trade barriers); and 3) How likely are these scenarios?

3 – RESULTS

3.1 WOOD PRODUCTION TRENDS

Table 2 shows the distribution of wood removals and production in 2023, the latest available data. The total production of solid wood accounted to 171 MMm³. Sawn softwoods show the highest volume of production, followed by particleboards, fibreboards, and sawn hardwoods.

To display potential projections based on past trends, production trends since 1995 were analysed (Figures in Annex I), where the annual rates have been calculated according to Equation 1 from FAOSTAT data [9].

Table 1: Wood removals and wood production in 2023 in EU-27 (million m³), analysed from the FAOSTAT database [9]

Domestic removals (roundwood)		Production (products)	
508 ROUNDWOOD	129 Wood fuel (41 softwoods; 88 hardwoods)		
	222 Sawnwood and veneer logs	111 Sawnwood (EWP included)	101 softwoods 10 hardwoods
	194 softwoods 29 hardwoods	1 Veneer sheets	
	379 Industrial roundwood		
	150 Pulpwood logs, round and split	60 Wood-based panels ¹	31 Particleboard 18 Fibreboard 4 OSB 5 Plywood
	302 softwoods 77 hardwoods		
	104 softwoods 46 hardwoods	34 ² Pulp	
	7 Other industrial roundwood		
24 RECOVERED POST-CONSUMER WOOD			

¹ The panel industry also feedstock of secondary products from the sawmill industry, as shown in Fig. 1 | ² Million tonnes

In the past, both wood fuel and industrial roundwood grew almost continuously (Figure I-1). The production dynamics of sawnwood and WBP by type are shown in Figures I-2 and I-3. It can be observed that sawnwood production is mostly based on softwood species and that all the products which are mainly used for construction show a positive annual growth rate in production: sawn softwoods (+0.6%), OSB (+7.1%), MDF (+1.8%) and plywood (+0.7%). It should be noted that FAOSTAT does not provide data for EWP production before 2022, and its production is accounted under sawnwood.

Figure 2 shows the trends in production until 2023 of sawnwood (green dashed line), both softwoods and hardwoods, and WBP (brown dashed line) for all panel types grouped, plus their future projections until 2040.

Both show a long-term increasing trend, only interrupted by the economic crisis of 2008-2009 and the economic instability of the recent years due to the pandemic Covid-19 and the war in Ukraine. Based on the past long-term (1995-2023) and short-term trends (2009-2023), the projections until 2040 for WBP resulted in two very similar trends. For sawnwood, however, the short-term trend predicts a higher growth than the long-term trend. As alternative scenario, a stagnating production was also projected (horizontal lines, zero growth).

3.2 IMPACT OF REGULATIONS

Table 2 summarises the main objectives of the analysed EU regulations and their implications for wood supply and demand. These results are a synthesis by the authors of the inputs gained from experts during the workshops, surveys and interviews. The summary of selected regulations gives a good idea of the broad range of European policies that are expected to play a significant role in wood supply trends. It was not always possible to identify a clear specific impact of each regulation, and some experts also displayed diverging views in few cases. The overview shows the complex landscape of European policies, and their interplay of different features and directions.

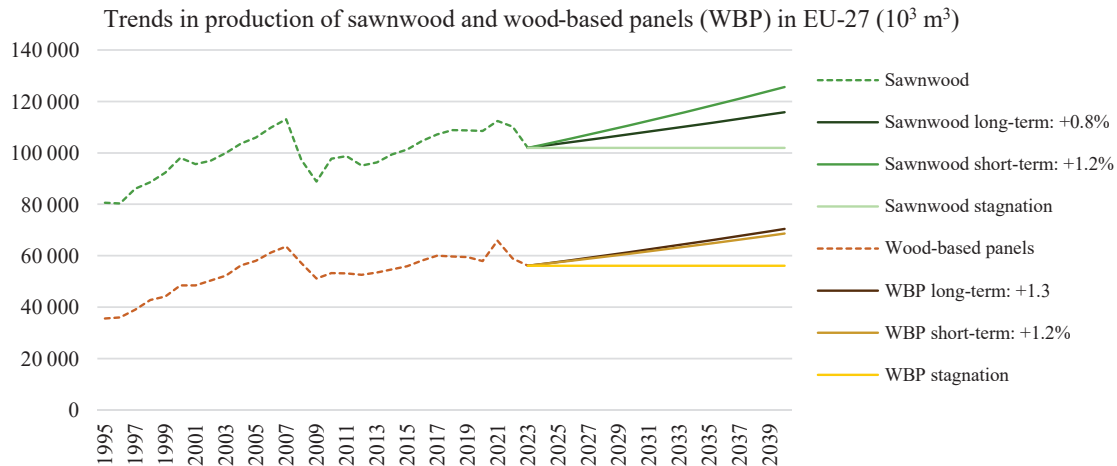


Figure 2. Past trends and future projections in sawnwood and wood-based panel production in the EU-27, 1995-2040

This underlines how difficult it is to conclude a decisive, specific future trend for a certain material stream or value chain. However, the results reveal characteristic impacts and directions of the regulations, which often address different points or streams in the supply and demand network in Europe. They also highlight various aspects that could become important factors of influence in the future, and offered a good starting point of discussion with the different experts.

3.3 POTENTIAL FUTURE SCENARIOS

The first scenario assumes an increasing trend in demand for both sawnwood and WBP, whilst the second one foresees a stagnation of demand. Both scenarios are possible outcomes of the same policy analysis, illustrating the earlier point about the complexity of the landscape: different directions can emerge depending on how various factors interact.

Scenario 1. Increase of demand

From a policy perspective, this scenario assumes that EU priorities place economic stability first, followed by energy security and only then biodiversity. It is assumed that climate [15] [16] [19], financial [13] [17] [18] and industrial regulations [20] will lead to a strong demand for sawnwood and EWP, primarily softwoods, as an alternative to fossil- and high-energy-demanding materials. Hardwoods demand remains uncertain, as markets are underdeveloped and it is unclear which investments are needed or who could become a main driver. Climate policies support the increasing demand for long-life wood products storing biogenic carbon. Sawnwood will be in higher demand also for packaging fostered by the relevant regulation [21]. While demand for WBP used in furniture remains constant, the demand for WBP in construction increases. WBP production will compete even more for raw material with the bioenergy industry and pulp industry. The market availability of raw materials for solid products will decrease as a

consequence of several climate regulations (e.g. LULUCF [16]) and increased climate disturbances (pests, storms, fire, etc.).

Scenario 2. Stagnation of demand

This scenario assumes that the EU continues to strengthen its environmental regulations, aiming to align the forest-based sector with broader climate targets. It introduces also more uncertainty for producers and industries having to follow complex compliance requirements. Eventhough most of the climate-related European legislative framework [15, 16] supports multi-functional forest management, new regulations [10, 11] could increase restrictions on harvesting, leading to a serious expansion of costs for monitoring and administration, potentially decreasing the available supply of wood on the market. Furthermore, the Taxonomy Regulation [7, 18], the Directive on Corporate Sustainability Reporting [13] and the Proposal of Carbon Removal Certification [19] could be favourable for investments in afforestation, land restoration and maintaining carbon sinks in the forest, but be less favourable or even detrimental to the expansion of wood products use.

Despite these regulatory policy drivers, it is expected that the forestry practices at operational level will remain largely conventional. Climate smart forestry or close-to-nature forestry systems aimed at increasing forest resilience are still under development, and are not likely to be implemented on a large scale soon. As a result, forest harvesting is not expected to decrease significantly in the short to mid term (interview 1).

However, climate change is certainly reshaping forest dynamics. Increasing growth rates can be observed in boreal regions (due to longer growing seasons). In southern and central regions, disturbances such as storms, droughts, fires, and pest outbreaks are becoming more frequent and severe.

Table 2: EU regulations, main objectives and potential implications for wood supply and demand

Regulations	Summarised objectives	Potential implications
EU 2024/1991 Nature Restoration Law [10]	Member States must implement effective land and sea restoration measures to cover at least 20% of terrestrial and marine areas by 2030 and all degraded ecosystems by 2050, while monitoring key forest ecosystem indicators such as deadwood, forest structure, bird populations, or soil carbon.	SUPPLY: Stricter harvesting regulations prioritizing low-impact cutting methods may reduce wood supply but enhance other forest ecosystem services. DEMAND: No direct implications for the demand were expected.
EU 2018/2001 Energy from renewable sources [11]	Overall renewable energy target of 42.5% by 2030 implies restrictions on energy production from certain wood products, promoting the principle of cascade use of wood, ending support for electric-only plants, and establishing requirements for guaranteed sustainable biomass sourcing.	SUPPLY: A part of non-exploited wood for energy production could remain in forests. The wood supply for energy use can decrease. DEMAND: Reduced competition between wood industries and energy production, with a long-term decline in wood energy use (which could remain available just in some regions) and more wood raw material becoming available for secondary products.
EU 2022/2448 Sustainability criteria for forest biomass [12]	Guarantee sustainability criteria for producing fuel from forest biomass, with mandatory monitoring to ensure forest regeneration, protection of protected areas, minimising negative impacts on soil, biodiversity and productive capacity.	SUPPLY: Possible limitations of forest biomass supply if criteria are not complied with, and the monitoring activities could lead to an increase of supply costs. DEMAND: No direct implications for the demand were expected.
EU 2022/2464 Corporate sustainability reporting [13]	EU companies must ensure transparency by reporting on social and environmental impacts of their commercial activities as well as the business effects of their environmental, social and governance initiatives.	SUPPLY: Stricter rules for emissions and evaluation, monitoring and compliance with environmental standards will lead to higher operative costs and wood prices, possibly decreasing viable supply. DEMAND: Innovations to reduce polluting emissions could drive industry and consumers shift toward more sustainable products, improving the public attitude towards the role of forests and wood products in carbon sequestration.
EU 2010/75/EU Industrial Emissions [14]	Member States must reduce industrial pollution and waste by implementing environmental permits, enforcing compliance measures, and suspending operations that repeatedly fail to meet environmental standards.	SUPPLY: Stricter rules for emission control and adherence to environmental quality standards will reduce emissions, potentially increasing operational costs and wood prices, while enhancing ecosystem health and other forest ecosystem services. DEMAND: Innovations to minimise polluting emissions could drive industry and consumers towards more sustainable products and improving public perception of the role of forests and wood products in carbon storage.
EU 2021/1119 European Climate Law [15]	Member States must adopt national strategies for climate change adaptation to comply with the objective to reduce net greenhouse gas emissions by at least 55% by 2030. Forests are considered as a tool for the decarbonisation of industries/sectors supported by investment in green technology.	SUPPLY: Focus on forest carbon sinks will limit harvesting and raise costs, reducing the available wood supply. Reversely, a focus on carbon storage in construction products will boost wood supply and lower restrictions and costs. DEMAND: Increasing demand for wood and other biomass for energy and wood products carbon substitution and storage.
EU 2818/841 LULUCF [16]	The net land carbon removal of 310 Mt CO ₂ e by 2030 obliges to develop national forest accounting plans detailing emissions/sequestration, carbon pools, GHG, and sustainable management.	SUPPLY: To ensure GHG emissions reduction, forest management decisions could take the direction to limit harvest intensity, limiting the available wood for production. Only if afforestation is promoted actively, the wood supply could be increased in the long term.
EU Taxonomy: EU 2021/2139 EU 2020/852 [17] [18]	A voluntary market information tool to establish a sustainable investment framework through the creation of a classification system, or 'taxonomy', which defines environmentally sustainable economic activities.	DEMAND: The taxonomy criteria in bioenergy and wood construction can open opportunities to attract investments, in environmental reporting or marketing.
COM(2022)672 Certification framework for carbon removals [19]	Establishment of quality criteria to facilitate investment in carbon removal innovation technology, requiring operators to ensure long-term carbon storage through monitoring and accountability measures.	SUPPLY: It could increase the monitoring costs as a requisite for the certification, creating tension between the need to increase wood supply and increase the forest areas dedicated to carbon capture DEMAND: Sustainability competition boost demand for wood for energy and for wood products for carbon storage.
EU 2024/3110 Construction Products Regulation [20]	Establishes mandatory sustainability requirements for the construction products (Environmental Product Declaration) and circularity, as well as the digitalisation of the information about the environmental, structural, health and safety performance in Digital Product Passports.	DEMAND: Increasing demand for wood and EWP as a sustainable material as alternatives to fossil-based construction materials, for by-products, residues, and reused wood for the development of new construction products with potential for building design for disassembly.
EU 2018/852 Packaging and packaging waste [21]	Harmonise the national measures and standards for packaging management to reduce packaging waste by promoting reuse, recycling and other forms of packaging waste valorisation. It affects solid wood packaging (pallets, crates) and packaging paper.	DEMAND: Increasing demand for more sustainable packaging, with wood as a substitute of plastics. However, the requirements for minimising the weight and volume of packaging will imply a lower volume of wood and cellulose.
EU 2024/1275 Energy Performance of Buildings[22]	Achieve a decarbonised real estate stock with zero emissions by 2050, reducing both construction and operational greenhouse gas emissions in buildings.	DEMAND: Growing demand for more sustainable materials (pulp, wood fibres) and products (WBP) for building insulation. Demand for more by-products supply for WBP (sawdust, particles, etc.), which implies a reduction wood fuel for energy (pellets, chips).
EU 2014/52/EU Environmental Impact Assessment [23]	Guarantee the protection of the environment and transparency in the decision-making processes of various public and private projects, evaluating human health, biodiversity, natural resources, cultural heritage and their interactions.	SUPPLY: Possible reduction of wood supply due to increased administrative and reporting requirements. DEMAND: Environmental impact assessment is required for thermal power stations, industrial plants for the production of wood pulp and other fibre materials, and paper and cardboard products.

These trends can lead to a release of larger raw material volumes into the markets in the short term, but they undermine forest health, productivity and future supply stability in the long term. Geopolitical tensions further exacerbate the situation of wood markets (interview 2).

A serious factor for stagnation would be conflicting policies: policies considering wood as a sustainable material for bioenergy production [16, 17, 18] versus policies promoting the use of more sustainable materials as a substitute for fossil-based ones [11, 15, 20]. Regional differences will remain substantial in the use of wood for energy, because it often is the only economically viable option in local contexts. In the long term, the demand for wood for energy might however decrease, given the continuous rural exodus of younger generations and a serious decline of forestry workforce in rural areas (interview 2).

4 – CONCLUSIONS

The preliminary results, confirmed in the discussions with the experts, show that demand for sawn softwoods for construction and packaging is expected to increase continuously, influenced by a positively growing market in the long term, and fostered by the majority of analysed European regulations. A similar trend can be observed for WBP, which have likewise displayed a steady growth over decades. The case of packaging is less certain, as it could be possibly substituted by novel materials such as bioplastics.

Overall, the growing demand for wood raw materials is largely steered by the general economy, with the building sector being a main driver for the solid wood industries (construction, furniture, interiors, etc). As a consequence, an increase of market competition for raw materials in the near future, both for primary and secondary wood, is commonly agreed by the experts. Depending on the evolution of the policy landscape, this might lead to an increase of domestic removals, and will likely also stimulate more imports from outside the EU (Note: this study was limited to the European context). Because the growing stock of softwoods is still abundant in the medium term, a drastic shortage of timber supplies and stagnation in the EU is not seen as a likely scenario.

A key question is in which directions the energy policies will be steered. On the one hand, policies might lead to favour higher value added products (e.g. in construction), and result in a serious decline of wood for energy. On the other hand, industry could also opt be led to utilise more wood for energy as an alternative to fossil fuel. The question remains a conflicting topic of debate in the sector, with all sides claiming their own perspective of sustainable use. There is a need for science-based priority setting to inform effective policies, alongside governance mechanisms capable of addressing conflicting perspectives, setting clear priorities, and fostering shared visions for the future of forests and related sectors.

An interesting factor is innovation. There is a potential for secondary/reclaimed wood to be reused in sawnwood

products and WBP, opening pathways for more circular loops in the sector. Novel uses might also emerge, e.g. wood pulp in insulation materials. Ongoing research focusses on novel wood products, more material efficient products and underused materials (e.g. small diameter wood, damaged wood, hardwoods, reclaimed wood). These could allow to develop existing and new value chains and enlarge the available raw material base in Europe. Here, the adaptation of the regulatory framework (incl. standards, certifications) will be a decisive part to enable market entry and uptake of such new uses and products. Provided such innovations are competitive, they might even lead to certain shifts of material flows within the sector's value chain network.

Overall, any future policy projection is subject to a lot of uncertainty, as the global context is constantly changing. It remains to be seen how climate policy such as the EGD will evolve under current geopolitical and globalization trends, where a much stronger emphasis is put on competitiveness and economic resilience [25]. It will certainly also have a strong influence on wood markets.

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6 – AUTHOR CONTRIBUTIONS

Uwe Kies: conceptualisation, methodology, analysis, writing, review and editing, supervision. Vanesa Baño: lead researcher, conceptualisation, methodology, workshops, interviews, statistical analysis, policy analysis, writing. Mireia Pecurul-Botines: methodology, workshops, interviews, policy analysis, writing, review and editing. All authors have read and agreed to the published version of the manuscript.

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ANNEX I. Past trends in wood production in EU-27, 1995-2022

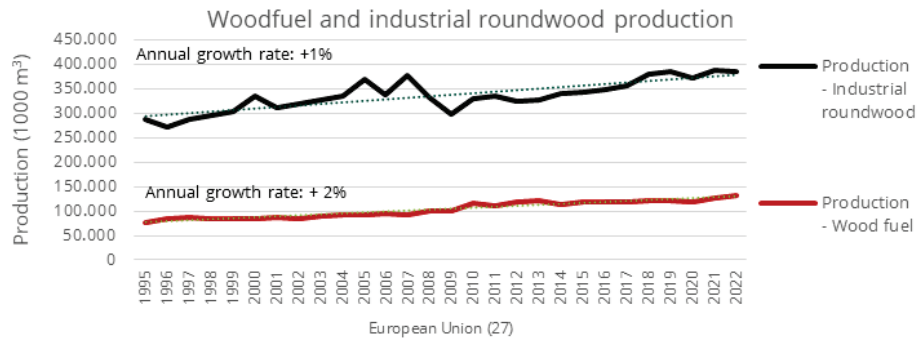


Figure I-1. Trends in production of industrial roundwood and woodfuel in EU-27

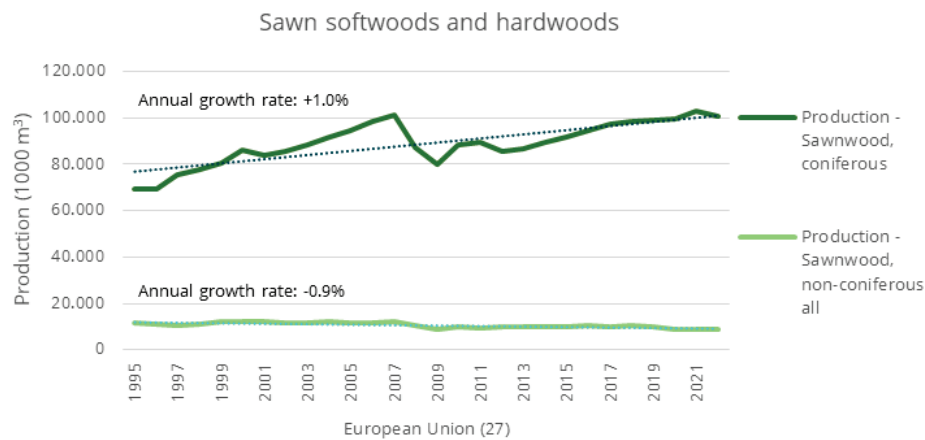


Figure I-2. Trends in production of sawn softwoods and hardwoods in EU-27

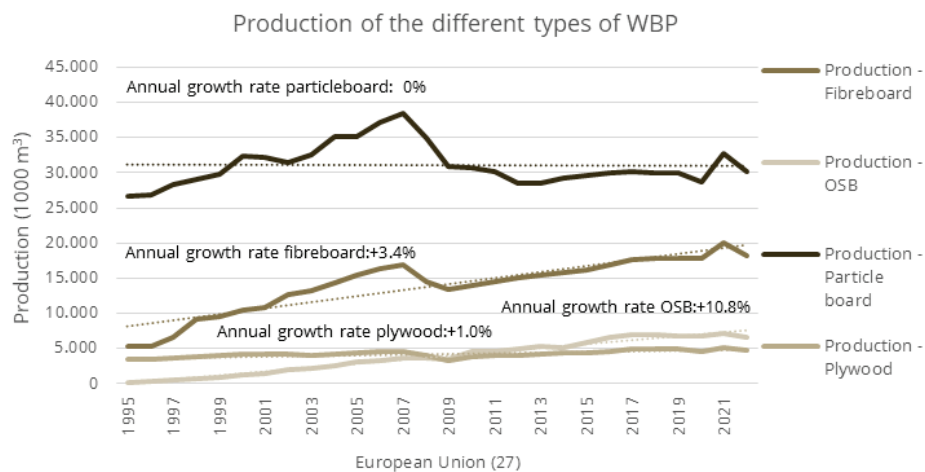


Figure I-3. Trends in production of different types of wood based panels (WBP) in EU-27