

# Innovation Trends

European Forest-based Sector  
Delivering Bio-value



Forest-Based Sector  
Technology Platform



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# The European Forest-based Sector – Delivering Bio-value

The European forest-based sector includes three sub-sectors forming an unbreakable chain: forest-owners, wood-working industries and pulp and paper producers. The common element is their dependence on European forests that do not only deliver the renewable raw material wood for a wide range of products (paper, wood products, energy, specialty chemicals), but also guarantee biodiversity, eco-systems services, act as CO<sub>2</sub> sinks, and supply non-wood products and recreation opportunities.

The sector employs some 3 million people. It is in full transformation, with sustainable practices, technology development, product innovation and high ICT (Information and Communication Technologies) use, while supporting the rural economy. The sector gathers several industries that, in many aspects, are significantly different from each other, while being part of the forest-based biomass value-chain. They compete in a global market, often with regions and countries where forests have a much faster growing period and where production costs are much lower than in Europe.

In spite of that, the sector has remained globally competitive by focusing on its knowledge and competence base and developing technological innovations as well as integrations that take the sector forward. Investments in renewable energy have brought the desired results,

and the sector is today the largest single producer and consumer of renewable bio-energy. In 2008, the share of biomass-based energy in the pulp and paper sector was 54.4% of total primary energy consumption.

Most of this energy is generated by efficiently using the by-products of processing wood and pulp. Combined Heat and Power installations deliver more than 30% efficiency gains compared to conventional installations. These investments have reduced CO<sub>2</sub> emissions by 20% in the past decade.

For the forest-based sector it is important that there is sufficient biomass available for the production of materials and products as well as for generating renewable energy.

Wood is a strategic raw material. It comes from forests that are the lungs of the world. It is biomass, a concept that integrates many different resources.

Wood has ahead of it many different markets, that are interdependent and competing, and that generate a variety of sub-products in many industrial sectors. Construction, furniture, pulp, paper, chemicals, additives, novel materials, bio-polymers, bio-energy, have a transversal identity – wood. Forest and wood-based products are the source of green carbon. They play a major role throughout their service-life in storing the carbon that was captured by forests, they have a low degree of embodied energy and are ideal substitutes for energy and carbon



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intensive materials also used for construction, packaging and other products.

The role of the sector in climate change mitigation is confirmed by the UN Intergovernmental Panel for Climate Change. In its 4<sup>th</sup> Climate Assessment Report, published in 2007, the 2000 climate scientists in the panel clearly concluded that “a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre or energy from the forest, will generate the largest sustained mitigation benefit”.

The forest-based sector is an innovative sector fit for the new bio-economy. Its activities already fall under the European Environmental Agency definition as “providers of goods and services for environmental protection, including the provision of clean technologies, renewable energy, waste recycling, nature and landscape protection and ecological renovation of urban areas”.

The sector is a model of resource efficiency with its renewable raw material and recyclable products. The future of the sector is part of the solution for a sustainable European society, in line with citizens and consumers values.



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# Forest-Based Sector Technology Platform - a European Partnership for Research, Development and Innovation

## *FTP Vision 2030*

The European forest-based sector is a key player in a sustainable bio-based society. It comprises a competitive, knowledge-based industry that fosters the extended use of renewable resources and strives to ensure its contribution to the grand societal challenges in the context of a customer-driven, globally competitive European economy sustained by green carbon.

The Forest-Based Sector Technology Platform (FTP) is an industry-driven platform for collaboration in research, development and innovation. The FTP can rely upon the support of a unique network of 26 so-called National Support Groups (including Russia).

The key objective of the FTP is to assist the forest-based sector and its shareholders in fulfilling their future research, development and innovation needs.

The strategic approach of FTP is to interact with the industry and its research centers, clustering their priorities and facilitating the integration of those priorities in the EU institutions research programs. Collaboration with other Technology Platforms is also an essential part of FTP work. Through these ties, the FTP mobilizes the sector to research and innovation activities that will provide the key competitive advantage to take the industry forward in a global market.

At its inception, the FTP brought together all its direct players to develop a Strategic Research Agenda, setting the roadmap for the coming decades. The Strategic Research Agenda includes 26 key research areas structured according the five major strategic objectives identified for the sector:

1. Development of innovation products for changing markets and customer needs
2. Development of intelligent resource and energy efficient manufacturing processes
3. Enhancing the availability and use of forest biomass for bio-based products and energy
4. Meeting the multifunctional demands on forest resources and their sustainable management
5. The forest-based sector in a societal perspective

# Innovation Trends Matching EU Societal Priorities

The strategic objectives set up for the European Union and supported by all the institutions have, at their core, an economy that is smart, sustainable and inclusive.

The EU 2020 strategy has identified the key challenges that the European society faces and the policies needed to address them. Boosting innovation is a major tool in responding to those societal challenges. And the Innovation Union flagship outlines the pathway to achieving that.

Climate change, energy and resource efficiency, raw materials, health and demographic change are challenges where we need to focus our

efforts and creativity in order to find solutions that will turn them into opportunities.

The key strategic approach to climate change is to replace fossil fuels and oil-based products by renewable products. The natural ground of the forest-based sector.

The forest-based sector is a key enabler to those solutions. Our strategic vision of reconciling sustainability and competitiveness, the inherent properties of our raw materials, and the transformation the sector is going through, are already delivering new products, new technologies, new bio-values, new business opportunities.

## *Green carbon*

Our sector represents a green carbon chain that is constantly renewing itself. The sustainable forest management principles applied by forest owners in Europe take biodiversity into account and ensure that trees grow more than ever and healthier. This enables the capture and removal of green carbon in an endless cycle, and its subsequent storage in products. It beneficially impacts climate change mitigation. New harvesting methods and new plantations will provide more wood to the manufacturing industry. Residues from wood harvesting and processing deliver the leadership that the sector has in bio-energy production and consumption, based on green carbon. The leading companies in the sector are already frontrunners in second generation biofuels.

## *Energy efficiency*

Large investments have been made in energy efficient production. With increasing energy prices and the search for energy security, the industry is constantly looking for improvements in its processes that will generate energy gains. From harvesting machines operating with biofuels, to integrated saw mills, and performance efficient pulp and paper machines, a very high number of improvements and innovations have been introduced. Many of them are proprietary to individual mills, others have become standard.

## *Key enabling technologies*

Back in 1949, it was predicted that wood had the potential to meet all the chemical needs in place of petro-chemicals. With wood, and key enabling technologies such as ICT (Information and Communication Technologies) and nanotechnologies, the industry extracts an increasing number of products, making the most out of renewable resources. Vegetal chemicals, additives and bio-polymers, are some examples. Nanotechnologies applied to wood and paper already deliver innovative bio-materials, some as strong as steel, which have a place in the EU Lead Markets Initiatives for bio-based products.

## *Resource efficiency*

Recycling encompasses resource efficiency. The paper industry in Europe already recycles more than 72% of the paper put on the market. New technologies are being developed to increase the efficiency and overall performance of the recycling operations, while recycling residues and sludge find numerous applications, including in energy. Also, insulation material is being produced with paper recycling residues, closing the loop of energy efficiency.

## *Sustainable products*

Already today a pulp or a paper mill has more ICT devices than an aircraft, and the trend will continue. Electronics are applied to wood products and to paper, replacing other equipment such as alkaline batteries.

Flexible houses can be adapted to ageing owners, packaging comes in sizes and shapes to suit different age groups and living standards, electronic features in pharmaceutical packaging remind users when they have to take medicine, the whole range of tissue products makes life easier for babies and elders.

The forest products sector has a matching role to the political instruments addressing the key societal changes. It is a modern high tech sector anchored in a traditional heritage, and a key driver of Europe's sustainable green growth future.

The **Erdberger Steg** crosses the Danube Canal near the centre of Vienna. It was inaugurated in October 2003 and is the first wooden bridge to connect both side of the canal in over 100 years. This great example of wooden architecture highlights the advantages of the glulam construction technique and spans more than 85m over the canal.

Zeininger Architekten - Ing. Büro A. Pauser





# SHOWCASING INNOVATION

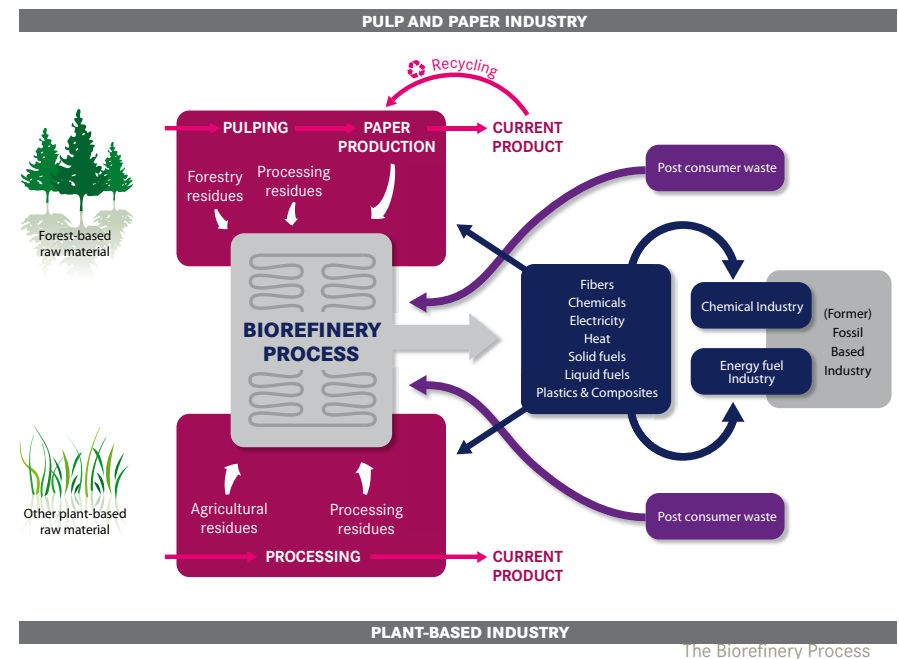
# Biorefinery

*Doing more with less* is one of the ultimate aims of research, development and innovation in the sector.

Biorefinery can be described as the efficient use of the entire potential of raw materials and by-streams of the forest-based sector towards a broad range of high added-value products, through cooperation.

With the same wood, four broad categories of products can be obtained; plywood and sawn timber, pulp and paper, biofuels and biochemicals. Residues from wood, from recovered paper, and from agriculture are also feedstock for biorefineries. The final result is radical reduction of CO<sub>2</sub>, efficient use of raw materials, zero-waste processes, bio-based products that can replace oil-based products.

By integrating biorefinery operations in the pulp and paper-making process, the industry is set to produce a wide variety of sustainable materials, from chemicals to fuels and paper products. In this way, pulp and papermakers can increase the value of the European economy of each cubic meter of timber and each tonne of recovered paper.



# Innovation from Seeds to Products

It is interesting to note that 10 years ago, focus on research and development and innovation in our sector was in improving production and parts of the machines. Today, progress is being made in microcellulose.

Although research in the forest-based sector covers many different areas, the most innovative results come from the integration of key enabling technologies and the development of new products.

At the same time, companies constantly undertake technical and technological developments to excel in what they do best – harvesting, wood processing and paper-making.

Recent and current activities focus on industrial production eco-systems with reduced use of raw materials, energy and water, bio-sourced materials and lignocelluloses, vegetal chemicals, safe and efficient packaging, added-value to recovered paper products and recycling process, printed electronics and high performing tissue.

## Forest

**Planting.** Latest tree-planting machines can now deliver effective soil preparation and planting on all types of soil. They provide full scope regeneration functions, from scarification to planting.

In spite of earlier attempts to develop planting machines, none had quite succeeded to the high-quality level and cost-efficiency of today's model, which have been achieved both through close co-operation with forest researchers and foresters.

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**Harvesting.** New harvesting head machinery combines excellent geometry, precise measurement, powerful feed and cutting, optimally efficient and economical for foresters.

From thinning sites with small trees to regeneration felling, harvesting heads are also used for multi-stemming, speeding up harvesting and improving results. Multi-stemming does not hinder the functioning of the harvester head's features when handling single trunks.

The multi-functionality of the head makes it more cost-effective for the entrepreneur to buy the machine and harvester head.



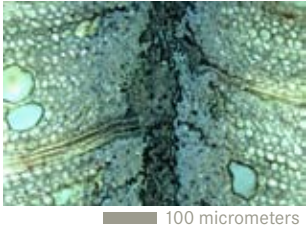
### Wood construction

**Glulam.** Further research in gluing and application technologies and advanced technical developments have opened up new and innovative applications for glued laminated timber.

Glulam, strong as steel, can be used in impressive lengths of up to 300m without needing a support beam or structure. This is particularly sought-after for constructions such as fair and exhibition halls to prevent the use of pillars. (see Arboreal Tower images below)

**Wood welding.** A joint Swiss-French team was awarded for their work on wood welding, which is a mechanical friction process allowing the assembly of timber without any adhesives. A wood bonding process has been developed that eliminates the use of adhesives. The wood welding process is very quick and consists of applying mechanical friction, under pressure, alternately to the two wood surfaces to be welded.

© BUAS - AWCE



100 micrometers

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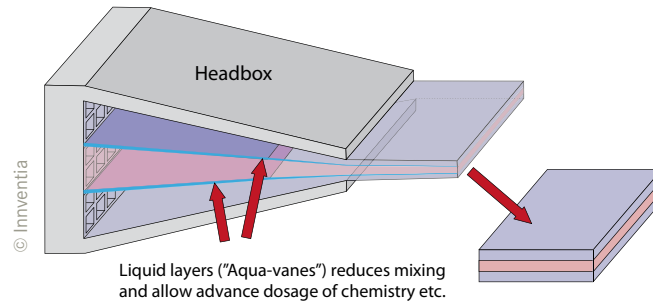
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## Process efficiency

**Stratified forming.** New technologies allow to make multilayered paper products, opening up for a wider range of paper uses, notably by increasing the strength and the surface characteristics of paper – which can be different on each side - whilst significantly reducing energy and fibre consumption.



**Lignoboost** is a complete system that extracts lignin, a component of wood, from black liquor, a residue of the pulping process. The result is a high heat value solid biofuel. The extracted lignin is a renewable substance that opens the way for production of new innovative chemicals, carbon fibres, etc.



**Black liquor gasification.** The main goals in black liquor gasification are to produce a combustible mixture of gases from pulp-making by-products, as well as to separate out the inorganic pulping chemicals for the pulping process. It can deliver up to 30% power efficiency in comparison to conventional boilers. Coupled with bio CCS (carbon capture and storage) the process becomes carbon-free.

**Innovative optical sorting technologies** enable improved material separation and therefore higher quality recycling on different paper grades (and also of other materials).

**Water treatment.** Wood is cleaned and treated anaerobically and residues from this process can then be used to produce energy. Other sectors such as the food industry have also adopted the process.



**Light weight construction system.** A start-up company developed not only innovative lightweight panels made from wood especially for automotive and furniture solutions but also for specifically needed production technologies. The panels offer specific strength properties and are used in caravans and cars today. The panels have similar static properties but are 70% lighter than the “usual” materials.



**Recycled fibre-based cellulose wadding for insulation uses.** Five to fifteen times less energy-consuming than competing insulation materials, cellulose wadding can be used in flake form or semi-rigid panels as a very effective insulation material for passive housing and buildings. Once cleaned, waste paper is mixed with boron salt (or boric acid) to increase its resistance to fire but also to pests. It is also an excellent temperature stabiliser and sound insulator.

## Materials

**Materials Science applied to pulp and paper delivers bio-based materials that can advantageously compete with alternative materials.**



© Innventia

**Microcellulose.** This material is composed of nanosized cellulose fibrils and is usually made from wood (pulp fibres). The properties of microcellulose e.g. mechanical properties, film-forming properties, viscosity, etc., make it an interesting material for many applications i.e. as barriers in packaging, reinforcing plastics, as an additive in paper coatings to improve printing properties, in hygiene/absorbent products, as a substitute to a low-calory carbohydrate additive, and in a myriad of other applications.

**Panels and composites.** Only two millimetres thick, DuraPulp can bear weight, tension, and humidity, as well as temperature changes. Resin made from Polylactic Acid encapsulates the paper fibres to create a material as strong as wood, steel or hard plastic. A renowned trio of designers made use of this durable material to wow guests at the Milan Furniture Fair with their design of the children’s chair ‘Parupu’ (meaning pulp in Japanese).



© Södra

## Intelligent paper



Future paper and board products interact with the user by delivering additional and timely information. Paper of the future can be temperature sensitive (e.g as packaging for baby food), warn when the “use before date” is over by changing colour, even helps to follow health records and reminds of the moment for taking medicines.

There are a variety of markets for printed electronics. ICT technologies applied to paper products have a substantial potential

**Memori.** The ‘Memori’ card takes healthcare to new levels. Combined with the Health Journal, Memori enables caregivers to understand whether a drug regime is working for a patient. It allows to keep more accurate records of their patients’ levels of pain.

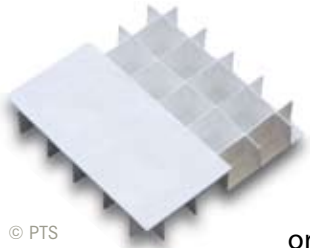
**Decarte.** Outwitting the confines of space on packaging, the Decarte can provide in-depth product information such as dietary compatibility or culinary advice, etc. The consumer needs only to make use of their mobile phone to capture all the available information.

**Pharma DDSi** is an intelligent packaging solution which will improve compliance monitoring and provide cost savings for outpatients. The time of removal of tablets from the package and information on the patient’s subjective symptoms are recorded. A data reader placed at the patients’ homes transmits information in real-time, enabling treatment staff to contact the patient within hours should there be any irregularities.



**Pre-ceramic paper.** A new technique for producing ceramic elements from pre-ceramic specialty paper allows the production of high-performance membranes for separating gas or fluids.

**Paper batteries.** Flexible and thin, paper-based lithium-ion batteries can adapt to any situation e.g. in the roof or the steering wheel of an electric car, where they could be linked to photovoltaic sensors to supply the secondary circuits. They can also be used in textiles, flexible screens and so forth.



## New products

**Viscose applications.** Viscose is a specialty cellulose used for the production of textiles, as well as cosmetics and industrial applications. Viscose textiles can easily replace “water intense” cotton (Tree-shirt).



© Sappi



© Borregaard

**Food Vanillin from wood.** As one of the “side” products, the biorefinery process also produces several food additives, like varieties of vanillin. They are used in pharmaceutical, food, cosmetics and flavour applications.

**Hydrophobic Paper.** This water-repellent paper has extensive usage i.e. barrier films and webs for the packaging and building sectors, filters and membranes, medical and healthcare products. Using chromatogenic chemistry, an environmentally-friendly process, hydrophobic paper is low-cost and opens up new opportunities for cellulose applications in green recyclable and bio-degradable products.



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# Enabling the Fulfilment of the Sector's Potential

Society is striving for social responsibility in business models, for solutions to climate change, for the sustainable use of natural resources, for innovation that expands the use of renewable resources, for markets that respect nature, for new ecosystems services that raise the economic value of forests. The forest products industry model may hold the path to reach those aims, bringing answers to many of the questions society has to face.

The sector is at the crossroads of major EU policies: climate change, energy efficiency, sustainable consumption and production, resource efficiency, eco-design. It needs to be supported under the different research and innovation programmes of the European Union.

Addressing society's aspirations, economy needs and policy priorities requires resource strategies that include renewability, recyclability and efficiency. The forest-based sector is the unique sector that can deliver all those factors. And it has already been doing so. In order to continue and fulfill its role in those ambitions, the forest product sector needs right policy balance that will deliver availability of its raw material wood.

Realising the potential of forests and wood needs an integrated political approach of industrial policy, agriculture orientations, environmental priorities, energy strategies, competition rules, rural development vision, and a land use balance. Forest accounting methods for CO<sub>2</sub> must bring certainty and incentive to investors and generate profits for bio-based products.

The investment community is showing interest in ecosystems services, including forestry, biodiversity, wetlands and eco-tourism.

Natural resources such as biodiversity, water, fibre and forest are crucial for economies and for human well-being. The provision of those services should be taken into account in the post 2013 CAP (Common Agricultural Policy) through a strong rural development programme where the forest-based sector has a central role to play.

The renewable energy policy must be complemented by a renewable material policy, and by a "carbon sink" policy. Wood is a much envied resource as it can be applied in numerous areas and has the potential to replace both oil and other less sustainable products in many situations. For that reason, it has to be used in the most value adding and most efficient way. Incentives and support mechanisms to push wood for bio-energy must be set up in line with sustainable forest management (SFM) principles, with its criteria and indicators, to ensure a balanced use of the resource and avoid over harvesting and other negative effects.

Meeting EU Climate Change objectives needs the forest-based industries. Consistent and well designed forest policies are indispensable. Incremental as well as breakthrough technologies in our processing activities will be needed which require a relevant place in EU innovation strategies and funding programmes.

The Raw Material Policy should include a focus on wood and recovered paper equivalent to the focus on other raw materials to ensure its availability to the industry.

Implementation of the Waste Framework Directive will deliver more recovered paper. And enforcement of the provisions of the Waste Shipment Directive will retain more recovered paper and wood for European added-value. Recycling needs a consistent set of policies that reinforce each other.

The Action Plan on Sustainable Consumption and Production should give more relevance to current environmental industries such as ours.

Our sector has the right components to be a major contributor to the future bio-economy. It needs the appropriate framework conditions to bring major breakthroughs to that future. To be successful in its bio-economy path, it is of utmost relevance for the forest-based sector to be fully considered under the Innovation Union. Other instruments such as the Lead Markets Initiatives must also integrate our sector. We will build strategic partnerships across all sectors to complement our knowledge base.



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