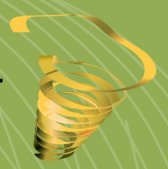




Forest-based Sector
Technology Platform



Strategic Research and Innovation Agenda for 2020





Vision 2030

10 Vision Targets for 2030



Strategic Research & Innovation Agenda 2020

Main Document - Addressing Horizon 2020



Strategic Research & Innovation Agenda 2020 - Annex

Strategic Themes and Research & Innovation Areas

1. The forest-based sector in a biobased society

- 1.1 The performance of the sector in a perspective of global change
- 1.2 Citizens' perception of the sector
- 1.3 Policies and good governance

2. Responsible management of forest resources

- 2.1 Multi-purpose management of forests
- 2.2 Forest ecology and ecosystem services
- 2.3 Enhanced biomass production
- 2.4 Secured wood supply, forest operations and logistics
- 2.5 Cascade use, reuse and recycling systems

3. Creating industrial leadership

- 3.1 Resource efficiency in manufacturing
- 3.2 Renewable energy solutions
- 3.3 Sustainable water stewardship
- 3.4 Biorefinery concepts
- 3.5 New business models and service concepts

4. Fulfilling consumer needs

- 4.1 Building with wood
- 4.2 Indoor environment and functional furniture
- 4.3 New biobased products
- 4.4 Intelligent packaging solutions
- 4.5 Hygienic, diagnostic and healthcare products
- 4.6 Integration of new solutions in printed products

Preface

The Forest-based Sector Technology Platform (FTP) was set up in 2005 to define a vision for the future of the sector and identify priority areas for innovation and research. It is one of 36 recognised European Technology Platforms (ETPs), established as industry-led initiatives encouraged by the European Commission to define research objectives and roadmaps for delivering the agreed goals.

In 2005, FTP produced its Vision 2030, and in 2006 its Strategic Research Agenda. To remain relevant and ambitious as well as to reflect the objectives of Horizon 2020, the EU's research and innovation funding programme for 2014-2020, the two documents have now been revised. This document is the new Strategic Research and Innovation Agenda (SRA). An Annex to this document contains greater detail on the 19 priority research and innovation areas identified for the sector. These have been classified under four Strategic Themes, which together form the framework we believe is required to meet major challenges facing European society.

The forest-based sector includes all stakeholders with a major interest in forestry, forest-based materials and products. It represents 8% of manufacturing added value in the EU, provides income for almost 16 million forest owners and has a workforce of over 3 million people.

In addition to raw materials, forests also provide a wide range of vital ecosystem services. They play an essential role in climate change mitigation, safeguarding biodiversity, providing fresh-water, non-wood forest products and recreational environments. No other industrial sector offers a similar level of products and services to society as a whole.

The sector is also affected by many of the same challenges as society: climate change, increasing competition for raw materials and the growing complexity of manufacturing processes.

But challenges also provide opportunities to innovate and grow. Forest-based industries in Europe already use a natural, renewable and non-food resource in a sustainable and responsible way. By growing and evolving, our sector promises to become a key enabler of the sustainable biobased society of the future.

Extensive work by representatives of industry, forest owners, researchers and public bodies around Europe has gone into this revised SRA. It is intended to help policymakers and funding providers at both the EU and national levels play their part in achieving the forest-based sector's vision to improve our world. Industry and researchers will find the SRA to be an important point of reference for further actions.

Achieving the targets of the renewed FTP Vision 2030 requires far-reaching technical, business and societal innovations. The SRA, which sets out how we will find the technical solutions, takes us to 2020. Up to a decade will be needed for the solutions to be generally adopted and to make the 2030 Vision reality.

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The vision: transforming the forest-based sector

The forest-based sector today

The forest-based sector is one of Europe's largest, and includes the woodworking, pulp and paper, and printing industries, as well as forest owners. It sustainably manages forests covering 37% of the EU's land area. The sector is also Europe's biggest producer and user of biobased energy.

The forest-based sector operates mainly in rural areas and constitutes a vital part of the rural economy. More than 250 000 people work in public and private forest enterprises, while 365 000 mostly small and medium-sized companies of the woodworking industry employ about 2.4 million people. The pulp and paper industry employs 222 000 people in some 700 companies and had a total turnover of € 81 billion in 2011. In addition, the sector provides income to some 4 million people in affiliated sectors including transport, machinery, construction, instrumentation, information technology, chemicals and energy.

For centuries, the European forest-based sector has practised sustainable forest management, a concept that continues to evolve. Healthy and resilient forests are a prerequisite for a sustainable supply of raw materials to industry and the provision of a wide range of other goods and ecosystem services.

Looking forward to 2030

By adopting an innovative approach, the forest-based sector will play an increasing role in society by providing renewable and green energy solutions and by tripling the use of wood in carbon-positive housing and furnishings. The sector will help to replace petroleum-based plastics and contribute to clean water technologies, intelligent communication media, novel medicines, healthy food ingredients, as well as environmentally-friendly, wood-based alternatives to synthetic fibres and cotton for the production of textiles.

As well as providing raw materials, forests will offer improved ecosystem services, which will also create new sources of income in rural areas. The sector will provide society with sustainably-managed, multifunctional forests that are resilient to climate change. Only legally-sourced wood will be used, whether imported or grown in the EU, and the sector will help to reduce CO₂ emissions by providing alternatives to energy-intensive raw materials.

THE FOREST-BASED SECTOR'S VISION FOR 2030

- The forest-based sector is a key actor in and enabler of the biobased society
- Consumer needs and the smart and sustainable use of forest resources are the cornerstones of development in the sector
- The sector is bustling with new entrepreneurial activities that create employment and enrich the rural economy

Achieving this vision will help the EU to tackle major societal challenges and improve the competitiveness of the European forest-based sector. This will require excellence in forest and biomass management, significant investment in research and development and strong, innovation-driven industry leadership.

Introduction to Horizon 2020

The EU's priorities are outlined in the *Europe 2020 Strategy*: focusing on Europe becoming a **smart, sustainable** and **inclusive** economy by 2020. Seven so-called 'Flagship Initiatives' have been identified, within which the EU and national authorities coordinate their efforts so that they are mutually reinforcing. The European *Horizon 2020 Framework Budget for Research and Innovation*, or in short 'Horizon 2020' is one of the policy tools that the Commission will utilise to implement these flagship initiatives. Horizon 2020 is further divided into three 'blocks' focusing resources on creating *excellent science*, *industrial leadership* and *addressing the major societal challenges* as identified in the Europe 2020 Strategy.

Expanding both the depth and breadth of scientific activity is necessary to strengthen long-term competitiveness and wellbeing. The '**excellent science**' block is thus designed to meet the needs of the scientific community, to develop talent within Europe and to attract leading researchers from overseas to Europe. The priorities will be largely identified by scientists, but the activities and results support the more industry-driven activities of stakeholders of European Technology Platforms, such as FTP.

The block '**Industrial Leadership**' is intended to support entrepreneurs and innovative companies focusing on research and innovation to achieve industrial leadership via key enabling technologies such as information and communications technology (ICT), nanotechnology, advanced materials, biotechnology, advanced manufacturing and processing, and space technology. It will also address important market failures such as private sector underinvestment in research and development and insufficient financing to support the growth of innovative SMEs and early stage eco-innovative companies.

The third block of Horizon 2020 focuses resources to tackle '**Societal Challenges**', which correspond to the major challenges identified in the Europe 2020 strategy and flagship initiatives. These societal challenges directly affect citizens in Europe and the wider world. EU-level action is vital to build the critical mass of resources and competences needed to bring together the necessary broad range of actors and enable them to work cooperatively to address these largely global challenges.

The forest-based sector already addresses these European objectives and will be able to enhance its contribution with the help of Horizon 2020. Necessary activities related to its three blocks are further elaborated in this document.

About our Strategic Research and Innovation Agenda (SRA)

The Forest-based Sector Technology Platform (FTP) provides a forum for European forest owners, companies, researchers, regulators and financial institutions to work together in support of the development of new forest management schemes, products, processes, services and business models.

To achieve significant breakthroughs through innovation, the sector needs access to financial capacity

and basic scientific knowledge that is rarely available within one organisation or company. A critical mass of skills and resources is needed to break down barriers to innovation. Creating this critical mass is one of the prime purposes of FTP.

The FTP's recently renewed Vision 2030 reflects the evolving challenges faced by the sector as well as new objectives identified at the EU level.



The forest-based sector and excellent science

Improving industrial competitiveness by achieving leadership in Key Enabling Technologies

1. ICT
2. Nanotechnology
3. Advanced materials
4. Biotechnology
5. Advanced manufacturing and processing technologies
6. Space technology
7. Supporting innovation in SMEs

The forest-based sector addressing Societal Challenges

1. Health, demographic change and wellbeing
2. Food security, sustainable agriculture, forestry, maritime research and the bio-economy
3. Secure, clean and efficient energy
4. Smart, green and integrated transport
5. Climate action, resource efficiency and raw materials
6. Inclusive, innovative and secure societies

This revised SRA builds on the updated Vision 2030, offering the perspective of the forest-based private sector in support of public sector initiatives to stimulate innovation, in particular the new EU framework budget for research and innovation, Horizon 2020.

Nineteen research and innovation areas (RIAs) have been identified as key to unlocking the potential of the forest-based sector and ensuring its fu-

ture competitiveness. The RIAs are organised under four Strategic Themes; *'The forest-based sector in a biobased society'*, *'Responsible management of forest resources'*, *'Creating industrial leadership'*, and *'Fulfilling consumer needs'*. The 19 RIAs are described in detail in the **SRA Annex** document.

Excellent science for the forest-based sector

The forest-based sector depends on a broad range of scientific disciplines and technologies. Recent advances in physics, cell biology and genomics, for example, have enabled new tree-breeding technologies for enhancing wood qualities and pest resilience, and enzymes for use in papermaking.

Three examples show how important fundamental research is to the forest-based sector. First, a better understanding of bonding phenomena of fibres with other fibres and with other components is needed. This will enable the development of new lightweight composite structures with increased functionality, but requires intensive research in the bio-, nano- and material sciences.

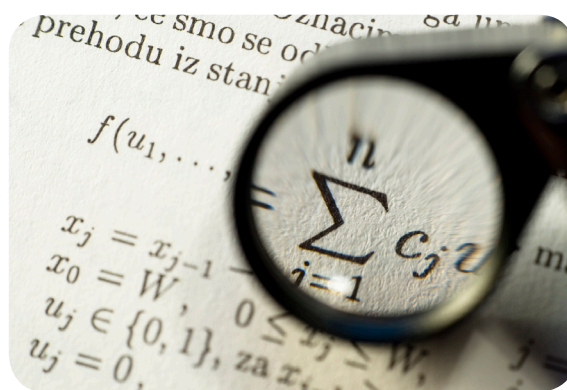
Second, current manufacturing and processing technologies use far more resources than is theoretically necessary. Technologies that radically reduce specific energy and material consumption have to be developed, based on an understanding of relevant physico-chemical properties as well as unit process requirements.

Third, the forest-based sector, society and nature are interdependent; sustainable forest management covering all ecosystem services that forests provide is a prerequisite for healthy and productive forests. Science can offer a holistic understanding of whole ecosystems functioning under changing natural and anthropogenic influences. Ecology, hydrology and climatology are essential basic sciences for this innovative field of research.

In order to understand the implications of interrelated actions of the sector, citizens and policymakers, a wide variety of additional disciplines including behavioural studies and political sciences have to be applied.

A prerequisite for excellent science is the availability of sufficient, well-trained, dynamic and creative scientists. The importance of the sector as a cornerstone of the biobased society has to be promoted to inspire researchers. New young talent needs to be targeted by means of exciting educational possibilities and scientific career opportunities offered through, for example, Starting Grants from the European Research Council and Marie Curie scholarships from the European Research Agency.

Excellent science is a basis for all research and innovation areas described in the SRA Annex document



Creating industrial leadership in the forest-based sector

The 'Industrial Leadership' block of Horizon 2020 aims to support entrepreneurs and innovative companies in research and innovation. It will also address joint public and private sector investment in R&D and support the growth of innovative enterprises and early stage eco-innovative companies, through the following actions:

- (a) Encouraging leadership in the key industrial enabling technologies of ICT, nanotechnology, advanced materials, biotechnology, advanced manufacturing and processing, and space
- (b) Improving access to risk capital
- (c) Supporting innovation in SMEs

The inventive use and continuous development of the key enabling technologies listed under (a) by the forest-based sector is outlined below. Close insight and cooperation with research and innovation in these fields will be a prerequisite for the success of many activities described in the SRA Annex research and innovation areas. The access to risk capital beyond research and development (b) is not addressed in the SRA. The EU's aim to support innovation in SMEs (c) is an important opportunity for the forest-based sector as the majority of its companies belong to this business group.

ICT (Information and Communications Technology)

Information and communications technology (ICT), is often used as an extended synonym for information technology (IT), but is a more specific term that stresses the role of unified communications and the integration of telecommunications, computers and the necessary software and audiovisual systems that enable users to access, store, transmit, and process information.

ICT underpins innovation and competitiveness across a range of private and public markets and sectors, including the forest-based sector. The sector would benefit in particular from investment that supports the development of open platforms and technologies such as the systematic use of radio frequency identification (RFID), embedded components and systems, process control as well as robotics, micro- and nano-electronics. Working together in new applications, these technologies can minimise waste in the production process, prevent illegal logging, facilitate product recovery for recycling, or make it almost impossible to counterfeit important documents.

ICT has reduced production costs both in forestry and the forest-based industries. Mobile ICT solutions will continue to revolutionise the monitoring and management of forest resources. **Light Detection And Ranging** technology (LIDAR), an optical remote sensing technology, and other augmented reality and global tracking systems will play a crucial role in the whole value chain, from forest management and harvesting operations to transportation and logistics, manufacturing and processing, product development and resource management. One challenge will be to come up with ideas for further applications of ICT and for new customer-oriented services using ICT as a platform. In addition, ICT will assist in developing intelligent communication systems allowing complex participation in public decision-making processes concerning the forest-based sector.

All RIAs described in the SRA Annex document are to some degree depending on ICT. However, the following RIAs are particularly relevant:

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|--|--|
| 1.2 Citizens' perception of the sector | 3.5 New business models and services |
| 2.4 Secured wood supply, forest operations and logistics | 4.1 Building with wood |
| 2.5. Cascade use, reuse and recycling systems | 4.4 Intelligent packaging solutions |
| 3.1 Resource efficiency in manufacturing | 4.6 Integration of new solutions in printed products |

Nanotechnology

Nanotechnology is the manipulation of matter on an atomic and molecular scale. Generally, nanotechnology works with materials, devices and other structures with at least one dimension sized from 1 to 100 nanometres. Quantum mechanical effects are important on this quantum-realm scale.

Nanotechnology as a spectrum of evolving techniques has a revolutionary impact on the areas of new materials, ICT and healthcare. It will also become crucial in the forest-based sector. Conventional woodworking relies mainly on the macro-scale properties of wood. In papermaking, processing takes us to micro-scale structures, as fibres are separated from wood and then reassembled. Beyond that it is natural to start looking for nano-scale applications. For example, nanofibrillar cellulose (NFC), with its exceptional properties, will be used to develop innovative lightweight bio-composite materials for car-body parts and other applications. Nano-pigments will be developed to generate functional surface structures that for example can change colour, block UV radiation to preserve the wood underneath, or absorb objectionable chemicals such as formaldehyde in wood composites.

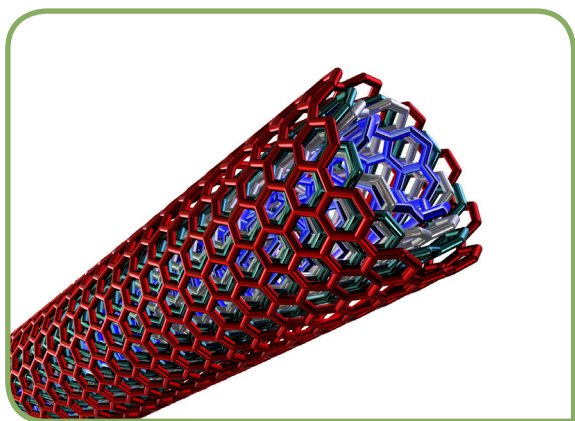
Self-healing and self-cleaning wood and wood-based panel surfaces are also attractive research objectives. Combined with a better understanding of wood biology, nanotechnology will also provide solutions to protect wood products from biological activity such as parasites and mould. The forest-based industries will utilise nanotechnology to improve the chain of custody of forest-based products as well as of nano-materials themselves. High priority will be given to health and environmental aspects of the production, use and recycling of nano-materials.

Nanotechnology in the form of new technical research appliances may also assist in other research areas such as in-depth plant physiology and ecosystem analysis.

Highly relevant research and innovation areas described in the SRA Annex document:

- | | |
|--|---|
| 1.2 Citizens' perceptions of the sector and its products | 3.4 Biorefinery concepts |
| 2.2 Forest ecology and ecosystem services | 4.1 Building with wood |
| 2.5 Cascade use, reuse and recycling systems | 4.2 Indoor environment and functional furniture |
| 3.1 Resource efficiency in manufacturing | 4.3 New biobased products |

Multi-walled carbon nanotube



Advanced materials technologies

The development of advanced materials and composites allowing new functionalities and improved performance is indispensable for the competitiveness of forest-based industries. The rich and complex chemical and physical composition of wood, bark (including cork) and other parts of a tree, contain the potential for a wide range of innovative properties to be developed and incorporated in future wood-based products.

The use of extracted wood polymers, fibres, lignin and other organic macro-molecules will aid the development of ultra-lightweight composites for use in construction, interior design, transport and packaging. Advances in handling of nano- or micro-fibrillar cellulose will enable totally new bio-based materials while reducing resource consumption. This will create the opportunity to substitute a wide range of products based on non-renewable materials with wood-based products.

The generation of smart materials that react in an engineered way to stimuli such as electrical current, temperature fluctuations, or chemical compounds would be useful in a broad range of domains, such as wood preservation, healthcare, packaging and the media. Advanced wood-based materials with innovative self-healing properties will reduce maintenance needs significantly.

The sector is increasingly developing new wood-based advanced materials aimed at enhancing efficient product reuse, recycling and end-of-life use (cradle to cradle), paving the way to a low-carbon economy.

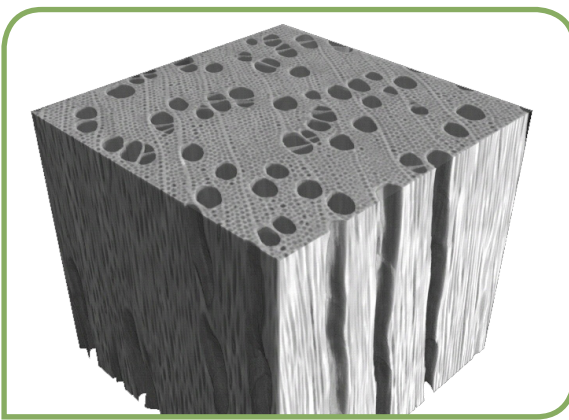
New materials and their functionalities will have to be characterised using suitable new methods and measuring techniques, which have yet to be developed.

Highly relevant research and innovation areas described in the SRA Annex document:

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| 1.2 Citizens' perceptions of the sector and its products | 4.3 New biobased products |
| 3.4 Biorefinery concepts | 4.4 Intelligent packaging solutions |
| 3.5 New business models and concepts | 4.5 Hygienic, diagnostic and healthcare products |
| 4.1 Building with wood | 4.6 Integration of new solutions in printed products |
| 4.2 Indoor environment and functional furniture | |



Poplar 3D



Biotechnology

Biotechnology is the use of living systems and organisms to develop or make useful products.

The forest-based sector uses biotechnology in many processes today and this is expected to increase as the sector evolves to become a cornerstone of Europe's future bio-society. Examples of current uses include process water treatment with microbes and the use of hydrolytic enzymes to decrease energy consumption in pulping. In the future, process water recycling will remain a highly important area, while a multitude of novel uses are also expected to emerge.

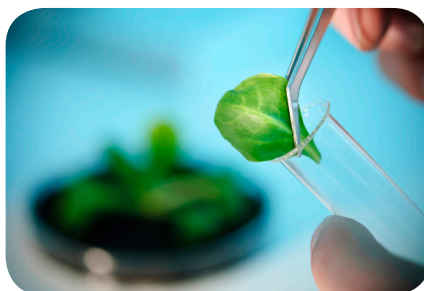
Biotechnology has helped to increase the yield of agricultural crops by both traditional and more advanced techniques (seeding, breeding and genetic modification). While recognising that this should only happen with public acceptance, molecular genetics and plant biotechnology is the key to increasing the yield and specific qualities of woody biomass. The continued development of enzymes will lead to more efficient processes and lower energy demand. This will be especially important to improve or replace current thermo-mechanical and chemical processes for wood treatment, such as the production of nano-fibrillar cellulose and pulp.

Completely new wood fractionation processes will most likely include industrial biotechnology. Biotechnology is also a key enabling technology in the production of novel biofuels, biochemicals and functional biomaterials from wood components. Enzymes will be used for the activation of fibre surfaces as well as for the production of wood-based sugars, which in turn can be fermented by microorganisms into marketable bioproducts.

Finally, with the growth in building with wood and other activities involving wood-based products, biotechnology offers a means to enhance knowledge about how to protect wood from undesirable biological activity. Stricter chemical regulations will drive us to study nature's own defence mechanisms to come up with novel solutions. Conversely, modern biological sciences (including even concepts such as molecular ecology) are intimately entwined and dependent on methods developed through biotechnology.

Highly relevant research and innovation areas described in the SRA Annex document:

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| 1.2 Citizens' perceptions of the sector and its products | 3.2 Renewable energy solutions |
| 2.3 Enhanced biomass production | 3.4 Biorefinery concepts |
| 2.5 Cascade use, reuse and recycling systems | 4.1 Building with wood |
| 3.1 Resource efficiency in manufacturing | 4.3 New biobased products |
| | 4.5 Hygienic, diagnostic and healthcare products |



Advanced manufacturing and processing technologies

Improving resource efficiency and reducing CO₂ emissions is vital to increase the competitiveness of the forest-based industries and expand the markets for their products.

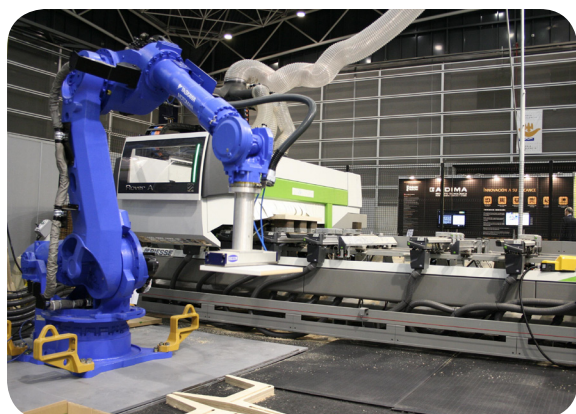
Manufacturing and processing technologies that significantly reduce energy input and optimise energy management are integral to resource efficiency in the value chain, alongside recovery systems for resource-efficient harvesting, treatment and drying processes. Enhanced cutting, breakdown, separation and fractionation technologies will allow the selection of suitable material components and optimise resource efficiency. Manufacturing technologies for composite structures, like multi-layered paper and board, or wood-based panels, allow the production of functional products using the least raw materials. Closed process cycles contribute to resource efficiency and reduce environmental impact. New product design and the increased recovery of used wood and fibre-based products, together with new information and decision-support systems, enable optimal re-use of recovered material.

Innovative manufacturing technologies for wood-based building solutions contribute to more energy-efficient buildings by providing excellent insulation performance, functionalised surfaces and retrofitting potential as well as significantly shortened construction times.

New business models will make use of the full potential of forest-based materials and products by increasing co-production of fibres, chemicals, energy and fuels or by cooperating with related industries and sectors for the efficient use and management of raw materials, residues, heat, water and logistics.

Highly relevant research and innovation areas described in the SRA Annex document:

- 1.1 The performance of the sector in a perspective of global change
- 2.4 Secured wood supply, forest operations and logistics
- 2.5 Cascade use, reuse and recycling systems
- 3.1 Resource efficiency in manufacturing
- 3.3 Sustainable water stewardship
- 3.4 Biorefinery concepts
- 3.5 New business models and service concepts
- 4.1 Building with wood
- 4.2 Indoor environment and functional furniture



Space Technology

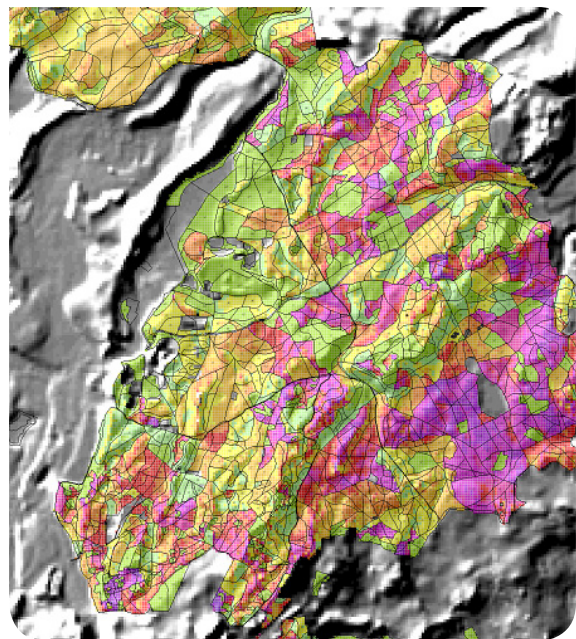
The forest-based sector already depends on 'space technology' in the form of global positioning systems, remote sensing technologies and geo-information technologies. In particular, optimising large-scale forest management, inventory, harvesting and transport operations relies increasingly upon these technologies. Space technology is also important for tracking the trade in legal and illegal wood, monitoring changes in forest cover, disease tracking, modelling of forest ecosystem services and scenario development. The management of practically all forest ecosystem services, including raw material provision (e.g. harvesting of timber and other biomass), landscape and watershed regulation (e.g. prevention of avalanches, landslides, floods), cultural landscape management (e.g. for tourism) and supporting services (e.g. CO₂ sequestration, biodiversity conservation) can be supported by geo-information and remote sensing technology.

Numerous innovative services and applications have yet to be developed. Especially with new high resolution space data, LIDAR and digital air-photo technology, as well as satellite-based stereo and interterrometric technologies providing 3-D information, a new era of geo-modelling and 'tree by tree' forest management and forest operations is expected, as long as the data is easily accessible through web services.

The forest-based sector must further evolve with the aim of becoming a prime integrated civil user of space technology interlinked with aerial and ground-based information. European projects in space technology, especially Galileo (global positioning system) and GMES (Global Monitoring for Environment and Security), are key assets for the development of the sector.

Highly relevant research and innovation areas described in the SRA Annex document:

- | | |
|---|--|
| 1.1 The performance of the sector in a perspective of global change | 2.2 Forest ecology and eco-system services |
| 1.3 Policies and good governance | 2.3 Enhanced biomass production |
| 2.1 Multi-purpose use of forests | 2.4 Secured wood supply, forest operations and logistics |



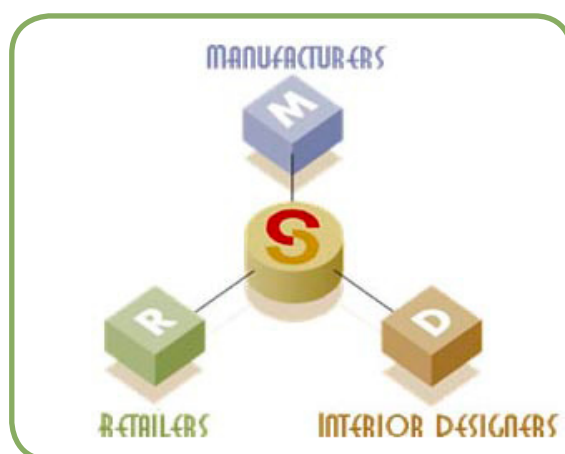
Supporting Innovation in SMEs

Companies in the forest and woodworking industries are mostly SMEs (small and medium-sized enterprises), with a few large companies, typically in the softwood sawmilling, wood-based panel, and pulp and paper sub-sectors, operating on a European and global scale. More than 365 000 SMEs in the European forest-based sector employ over 2.5 million people and cover a wide range of traditional and innovative industrial activities. Their activities include contractor timber harvesting, stand management and transport; sawmilling and pressure treatment; veneer, panel and board production; joinery and carpentry; the manufacture of construction products, pallets, packaging and furniture; printing, wood-related biotechnology and specialist communication and information services. Companies in the forest and woodworking industries are often located in rural areas, where they make an important contribution to the local economy, labour markets and the demographic structure, helping to reduce migration to cities.

SMEs in the forest and woodworking industries are key drivers of innovation thanks to their ability to quickly and efficiently transform new ideas into successful businesses. This strength should help overcome the European dilemma of huge research funding budgets resulting in relatively little private-sector exploitation and commercialisation.

SME-intensive research and innovation areas described in the SRA Annex document:

- | | |
|--|---|
| 2.1 Multi-purpose management of forests | 3.1 Resource efficiency in manufacturing |
| 2.3 Increased biomass production | 3.5 New business models and service concepts |
| 2.4 Secured wood supply, forest operations and logistics | 4.1 Building with wood |
| 2.5 Cascade use, reuse and recycling systems | 4.2 Indoor environment and functional furniture |



The forest-based sector addressing societal challenges

The forest-based sector has a long history of contributing to a better quality of life, meeting people's needs, driving economic growth and creating wealth. Traditional examples include the sustainable supply of wood for home-building and furniture production, to make paper as a carrier of information and culture, to produce board for packaging, and as a renewable energy source. In addition, the multi-functionality of forests supports the production of non-wood forest products for food and other uses, as well as the provision of a multitude of ecosystem services contributing to common welfare. The forest-based sector will make an important contribution to solving the current grand challenges faced by society, as highlighted in Horizon 2020. The activities described in the SRA Annex research and innovation areas will address the societal challenges in a variety of ways.

Health, demographic change and wellbeing

The specific objective as described in Horizon 2020 is to improve the lifelong health and wellbeing of all.

Demographic changes such as an ageing population in the western hemisphere, together with better living standards and growing urbanisation, will change and encourage demand for outdoor activities as well as products and services that improve human wellbeing, health and hygiene.

The forest-based sector can meet these demands in many ways. Forests provide opportunities for outdoor recreational activities proven to promote wellbeing and even contributing to recovery from certain illnesses. As pointed out in the Millennium Ecosystem Assessment¹, their environmental services, including fresh air and water, are essential for the living conditions of the population. The products of the forest-based sector, on the other hand, can support consumer health and safety by, for instance, incorporating new smart features in traditional products. The outcome is improved health and wellbeing at a comparably low cost for society and the environment. To help an ageing population and people with disabilities to live active and independent lives, special emphasis will be put on improved ergonomics and new functionalities in buildings. Bioactive functions will be integrated with tissue products for diagnostic and drug delivery purposes. Embedded smart features (using printed electronics or biosensors) and information carriers in pharmaceutical packaging will help consumers to use medicines correctly.

The use of wood for interior structures and surfaces results in superior acoustics and positive effects for indoor air quality. The overall positive values of indoor wood-based products will be demonstrated to promote the appreciation of the aesthetics and the psychological effects of wood and wood surfaces in different interior applications.

Wood has an amazing natural defence system. The chemical compounds (extractives) that protect wood so well will, in the future, be used increasingly in medical treatments for human and animal welfare.

Highly relevant research and innovation areas described in the SRA Annex document:

- | | |
|--|--|
| 1.2 Citizens' perceptions of the sector and its products | 4.1 Building with wood |
| 1.3 Policies and good governance | 4.2 Indoor environment and functional furniture |
| 2.1 Multi-purpose management of forests | 4.3 New biobased products |
| 2.2 Forest ecology and ecosystem services | 4.5 Hygienic, diagnostic and healthcare products |
| 3.3 Sustainable water stewardship | 4.6 Integration of new solutions in printed products |
| 3.5 New business models and service concepts | |

¹ <http://www.millenniumassessment.org/en/About.html>

Food security, sustainable agriculture and forestry, marine and maritime research and the bioeconomy

The specific objective described in Horizon 2020 is to secure sufficient supplies of safe and high-quality food and other biobased products, by developing productive and resource-efficient primary production systems and fostering related ecosystem services, alongside competitive and low carbon supply chains.

The forest-based sector strives to become a key enabler of the future sustainable biobased society. Virtually all products it generates are based on renewable or recycled resources, thereby contributing to the European bioeconomy. The sector aims to provide yet more and greener products and services.

Sustainable management of forests will help to supply sufficient primary biomass for a variety of uses while maintaining functional and resilient ecosystems. Improved understanding and knowledge of forest ecosystems and innovation in forest management will contribute to better-integrated land management. Forests will improve their provision of wider societal benefits (including cultural and recreational values) and important ecological services like water regulation, erosion protection and carbon sequestration. New businesses will be developed to valorise the ecosystem services of forestry and non-wood forest products.

Planted forests represent today around 7% of the world's forest area and contribute 36% of the annual requirements in roundwood. As global demand for biomass grows, interest will grow in species that are tailor-made for specific purposes such as fibre production, reassembly of larger solid wood items, energy production, or for being rich in particular chemical substances. Different management schemes will be developed respectively. Novel biorefinery concepts are able to provide completely new materials as substitutes for petroleum-based chemicals, polymers and fuels.

Increased use of wood will require the forest-based sector both to make more wood available to the market and increase the growth rate of forests. The visionary target is to increase the sustainable harvest of the valuable forest biomass by 30% by 2030. A secure, adapted and sustainable supply of forest-based raw material is a prerequisite for the further development of the bioeconomy. More precious biomass can also be supplied sustainably by integration along value chains from forest to end-product, shortening lead times, increasing capital turnover, improving profitability of forest ownership and reducing environmental impacts. Economic harvesting and fractionation methods will help industry select the right wood for the right use and thus improve efficiency of wood handling and processing.

Sorting and cleaning technologies will be developed to recycle used wood products. Biobased chemicals and resins will replace fossil-based substances not only in wood composites, and new biomass combinations will further improve the supply of lignocellulosic materials for various uses.

Wood- and fibre-based packaging materials and transportation pallets provide protection for products ranging from food and liquid to other consumer goods. Wood-based textile fibres such as viscose may, to a certain extent, replace cotton and thus enable additional areas of arable land to be used for food production. At the same time this will conserve scarce water supplies. The consumer need for safer food and the need to reduce waste will be met by advanced bio-based packaging materials, offering enhanced protection, reusability and recyclability.

All RIAs described in the SRA Annex document address this societal challenge. However, the following RIAs are particularly relevant:

- | | |
|---|--|
| 1.1 The performance of the sector in a perspective of global change | 2.4 Secured wood supply, forest operations and logistics |
| 1.3 Policies and good governance | 3.3 Sustainable water stewardship |
| 2.1 Multi-purpose management of forests | 3.4 Biorefinery concepts |
| 2.2 Forest ecology and ecosystem services | 3.5 New business models and service concepts |
| 2.3 Enhanced biomass production | 4.3 New biobased products |
| | 4.4 Intelligent packaging solutions |

Secure, clean and efficient energy

The specific objective as described in Horizon 2020 is to make the transition to a reliable, sustainable and competitive energy system, in the context of increasingly-scarce resources, growing energy needs and climate change.

Europe's energy strategy calls for a significant increase in the use of renewable resources for the production of power, heat and transport fuels. By 2020, 20% of all energy used in the EU should be of renewable origin. By 2050, the EU aims to cut greenhouse gas emissions from energy production to 80-95% below 1990 levels. These are bold objectives.

Biomass-derived energy (bioenergy) represents a large part of renewable energy in the EU (approximately 60%). Although the share of bioenergy in all renewable energy is not likely to increase, total production volumes will grow significantly. Wood-based energy will be the most significant subsegment also in the future. Wood-based energy production has the benefit of not competing with food production. Still, it is vital to develop wood-based energy and wood-based high-value products in parallel. The forest-based sector is a prime example of how coexistence can be achieved in a sustainable way. Further improvement of the sophisticated raw material and industrial logistics already in place makes the forest-based sector the most competitive option for bioenergy production in the EU.

The forest-based sector can foster the transition to a low carbon green economy by increasing the output of bioenergy further by:

- Increasing the supply of biomass
- Utilising by-products of current processes for energy production (sawdust, bark, black liquor, etc.) more efficiently
- Fractionating feedstocks for added value and complementary energy products
- Improving the efficiency of resource use (energy, water and raw materials)
- Optimising lifecycle management from product design to end-of-line clean combustion

The forest-based sector leads the way in industrial combined heat and power production (CHP), using various mill and forest residues as the raw material. Significant amounts of additional biomass from European and global forest-based industry operations can be effectively converted to green electricity, district heating, transport fuels and bioenergy carriers. Integration of the current and future wood-processing industry will offer profitable new business opportunities for all partners in the value chain. Decentralised concepts and operational systems of CHPs as well as biochemical, liquid or gasified fuel technologies contribute both through material and energy efficiency to sustainable development and the overall well-being of societies in urban and rural settlements.

The EU's SET-Plan (Strategic Energy Technologies) will help to accelerate the development and commercialisation of new energy technologies. There are more than 1 000 existing sites and more than 500 recovery boilers in forest-based industries, with further capacity to efficiently convert more biomass from agriculture and municipal waste streams to energy.

Highly relevant research and innovation areas described in the SRA Annex document:

- | | |
|---|--|
| 1.1 The performance of the sector in a perspective of global change | 2.5 Cascade use, reuse and recycling systems |
| 1.2 Citizens' perception of the sector and its products | 3.1 Resource efficiency in manufacturing |
| 1.3 Policies and good governance | 3.2 Renewable energy solutions |
| 2.3 Enhanced biomass production | 3.4 Biorefinery concepts |
| | 3.5 New business models and service concepts |
| | 4.3 New biobased products |

Smart, green and integrated transport

The specific objective as described in Horizon 2020 is to develop a European transport system that is resource efficient, environmentally friendly, safe and seamless for the benefit of citizens, the economy and society.

The global demand for the transport of people and goods is constantly growing, causing problems for society and the environment. The forest-based sector is itself transport intensive and complex transport chains from forest to consumer and back for recycling, stretch from 'local and rural' to 'global and urban' transport challenges. Smart and competitive low carbon logistics are thus of major importance.

One priority is to reduce as much as possible the cost and environmental impact of local to global transport by minimising the total transport distance. Trucks, trains and ships can be developed and operated to carry optimal loads and maximum density of goods on each leg of their route. Innovative logistics will decrease energy consumption by the forest-based sector.

The forest-based sector offers Europe's transport system liquid and gaseous biofuels on a large scale for road, marine and air transport. Technical and non-technical barriers include future automotive fuel standards, internal combustion engines adapted to biofuels, fuel cells or batteries, and new public transport systems.

A green transport sector requires new lightweight packaging, perhaps with inbuilt tracking systems, and innovative lightweight vehicle components developed from forest-based biomaterials such as fibres or biopolymers.

Integrated research and innovation approaches are required, jointly with other key actors in the transport sector. Cooperation will lead to co-investments in new European transport innovations that reduce environmental impact and benefit the European and rural economy.

Highly relevant research and innovation areas described in the SRA Annex document:

- | | |
|---|--|
| 1.1 The performance of the sector in a perspective of global change | 3.2 Renewable energy solutions |
| 1.3 Policies and good governance | 3.5 New business models and service concepts |
| 2.4 Secured wood supply, forest operations and logistics | 4.3 New biobased products |
| | 4.4 Intelligent packaging solutions |



Climate action, resource efficiency and raw materials

The specific objective as described in Horizon 2020 is to develop a resource-efficient economy that is resilient to climate change, together with a sustainable supply of raw materials, in order to meet the needs of a growing global population within the sustainable limits of the planet's natural resources. Activities will be aimed at increasing European competitiveness and improving wellbeing, while assuring environmental integrity and sustainability, keeping average global warming below 2°C and enabling ecosystems and society to adapt to climate change.

The forest-based sector will contribute in a number of ways to a resource-efficient and climate change-resilient economy. As the Intergovernmental Panel on Climate Change (IPCC) concluded in its Fourth Assessment Report, “In the long term, sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual yield of timber, fibre or energy from the forest, will generate the largest sustained [climate change] mitigation benefit”².

The focus on creating the highest possible value from the forest biomass used needs to be further extrapolated into a vision of the highest possible value from the land used. This will probably strike a new balance between agriculture and forestry for optimal production of food, fibre and feed, fuels and materials in an economically and ecologically-sound way.

The future provision of forest products and services in different geographical settings will be supported by a wide range of analytical tools and interdisciplinary approaches spanning different spatial and temporal scales of current climate change adaptation and mitigation strategies across the whole forest-based sector. In this context the choice of, and genetic improvement, of tree species will improve the resilience of forests against climate change.

Biobased chemicals and innovative materials will further replace oil-based products. Second-generation lignocellulosic biofuels will replace fossil fuels. This substitution effect will be significant and an additional contribution of the sector to global carbon reduction.

Innovative wood and fibre-based construction products will replace carbon-intensive cement and steel. The increased use of wood in indoor environments and for functional furniture will also mitigate climate change. But wood product properties such as strength, and moisture-, mould-, and fire-resistance need further improvement. One strategy is to treat wood with extracts of its own natural chemicals and polymers.

New hybrid material construction systems will combine the best properties of wood and non-wood materials in high performance, pre-fabricated and fully finished modular elements and structures for housing. The increased use of composite structures also makes it possible to better utilise small-dimension tree stems.

Improved resource efficiency of the sector's main processes requires breakthrough innovations in forest management and in wood and fibre industry technologies, pulping, forming, water recycling, energy recovery and process control. New product design and value chain approaches will also be used to reduce energy consumption. Separation and cleaning technologies will be further developed towards zero liquid-effluent wood treatment and papermaking. By-products and extracted components from process water will be utilised as value-added products rather than treated as waste.

² http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch9sg-4-1.html

So far, the forest sector is the only sector managing with no or very few EU subsidies. In the future, the forest-based industries will create more value from their raw material base, but experiencing greater competition over forest biomass, as other sectors increasingly turn to wood as raw material and energy carrier.

Opening the door to eco-innovation will contribute to the greening of the economy and support the decoupling of economic growth from resource consumption. Market research and communication is however needed to improve the image of products made from recovered wood.

All RIAs described in the SRA Annex document are applicable as the whole sector is affected by climate change and can support climate action, improved resource and raw materials efficiency. However, the following RIAs are particularly relevant:

- | | |
|---|--|
| 1.1 The performance of the sector in a perspective of global change | 2.4 Secured wood supply, forest operations and logistics |
| 1.2 Citizens' perceptions of the sector and its products | 2.5 Cascade use, reuse and recycling systems |
| 1.3 Policies and good governance | 3.1 Resource efficiency in manufacturing |
| 2.1 Multi-purpose management of forests | 3.2 Sustainable water stewardship |
| 2.2 Forest ecology and ecosystem services | 4.1 Building with wood |
| 2.3 Enhanced biomass production | 4.2 Indoor environment and functional furniture |
| | 4.3 New biobased products |

Inclusive, innovative and secure societies

The specific objective as described in Horizon 2020 is to foster the growth of inclusive, innovative and secure European societies in a context of unprecedented change and growing global interdependencies.

Forests provide a livelihood for hundreds of millions of people worldwide. Deforestation in developing countries causes desertification, soil erosion, loss of clean water supply and loss of biodiversity. Social unrest and environmental refugee streams caused by unsustainable forestry practices should as far as possible be prevented by coherent and effective international cooperation and good governance.

Society may also reduce its exposure to geopolitical risk by substituting imported or scarce non-renewable raw materials with sustainable, forest-based products. The forest-based sector will, for instance, play a crucial role in reducing Europe's dependency on petroleum and other, mainly imported non-renewable raw materials.

The social and environmental benefits for consumers are easily taken for granted, but in an increasingly urbanised world, the 'multi-functionality of forests', providing spiritual recreation and more, is very important for the security of society. Forest services are becoming ever more valuable both for society and forest owners. Providing them in the face of changing and potentially conflicting demands, and significant regional differences across Europe, requires continuous research into new management strategies, ecosystem businesses and innovative service concepts.

Economic growth translates into new and higher value-added products and services for society. By achieving its vision, the sector can provide a wide variety of new, highly skilled green jobs across Europe, many in rural areas. With new business areas emerging, the importance of small and medium-sized enterprises will be even more pronounced.

The revised SRA will help the sector to maintain inclusive opportunities in Europe and provide a good example of how to develop a prosperous low carbon society based on sustainable forest resources.

All RIAs described in the SRA Annex document address this societal challenge.



Implementing the SRA

The role of FTP and its National Support Groups (NSGs) is to bring together industry, forest owners, researchers and public authorities in a way that maximises the chances of realising the FTP Vision 2030 through cooperative research, development and innovation projects. Focus and strong support from European policymakers and both EU and Member State funding providers is vital for success, although industry, forest owners and researchers will be primarily responsible for the work necessary. This is a win-win collaboration in which the forest-based sector and society both benefit.

Strengthening the European dimension

Trans-national cooperation removes barriers and creates a 'common market' for research and innovation. Creating a European Research Area (ERA) in the forest-based sector needs to bring together very different national and regional priorities and concepts along all of the forest-based value chains. Strong European collaboration increases international contacts and opportunities for wider international cooperation.

FTP's NSGs have a pivotal role to play in building up the European dimension while strengthening national and regional agendas by implementing their National Research Agendas.

Important trans-national initiatives: ERA-Net projects, (e.g. WoodWisdom-Net+), COST Actions in the Domain Forests, their Products and Services, EUREKA and Joint Programming Initiatives

Creating cross-sector collaborations

The growing political determination to deal with the 'grand societal challenges' outlined by the European Commission allows the forest-based sector to look at radically-different ways to use forests and their renewable raw material. There are no monopoly rights on these resources and other sectors have taken note of the strategic potential of forests as a resource base. An interesting example is the area of biorefineries, where energy and chemical companies have started to develop non-fossil based production capacity. At the same time, many companies in the forest-based sector are focusing more and more of their business on the production of chemicals, biofuels and energy. This has created a new market for biomass suppliers such as forest owners. On the other hand, chemical pulp mills are already today the most efficient and productive biorefineries and have a huge potential to be developed further. They produce materials (mainly fibres), chemicals (like tall oil) and bioenergy (both heat and power).

Cross-sector collaboration is an opportunity for the forest-based sector to gain knowledge and create mutual benefits through integrated production concepts that use all biomass components to create added value via a wide range of renewable products. Expanding this cooperation to include the agricultural sector and the use of agro-industrial side-streams contributes to a more flexible and stable biomass supply chain. This ongoing integration process continues to gather critical mass through knowledge exchange and joint investments. FTP's role (together with other European Technology Platforms) is to help create a new bio-based industrial landscape using local and regional resources for global markets.

The textile industry is facing similar research and innovation challenges to those of the wood fibre-based industries. Some pulp and paper mills have stopped making pulp for paper production and are producing a range of textile fibre precursors. Innovative product development in the sector now includes issues such as weavability and washability. Market research into consumer trends and perceptions has to be refocused towards the clothing and industrial textiles market to ensure that demand is met.

Europe's construction sector uses wood as well as concrete, steel, aluminium and glass. In recent decades, radical advances in wood composite materials and building technologies have seen glulam (glued laminated timber) beams and pre-fabricated construction elements being used in long-span bridges and skyscrapers. Often the challenges and opportunities are similar to those for concrete and steel, a pre-competitive collaborative approach to research and innovation could have a strong positive impact.

The current focus on extracting the highest value from processing different kinds of biobased raw materials needs to be further extrapolated into a vision of the highest value - including common welfare - from land itself. Integrated land-use planning is crucial for finding new balances between agriculture and various forests types and forest management schemes.

Strategic ETP co-operations: *European Construction ETP, Sustainable Chemistry ETP, Biofuels ETP, Textiles ETP, Manufuture ETP, Plants for the Future ETP*

Strategic Partnerships (existing and future): *European Innovation Partnership (EIP) on Raw Materials, EIP on Sustainable Agriculture, EIP on Water Efficiency. Public-Private Partnership (PPP) on Energy Efficient Buildings, Biobased Industries PPP and Factories of the Future PPP*

Improving communication with European citizens

Society places a deep emotional value on forests and the European forest-based sector has based its operations on a sustainable and socially-acceptable philosophy. Nevertheless, studies show that public perception of the sector in Europe is often based on ignorance and misinformation. Important measures taken to improve sustainability are not widely understood, and the sector is considered neither fundamental for job creation nor as a provider of attractive career opportunities. The impacts of this image problem extend to policymaking, consumer behaviour and recruitment. Improving public understanding of what the sector is striving to achieve will be a critical success factor to achieve the FTP Vision 2030.

Strategic communication activities: *FTP's bottom-up approach and network of National Support Groups facilitates communication with the forest-based sector community and in particular with policymakers. Further efforts should be made to ensure easy access to new innovative concepts and research results.*

Measures to promote global innovation

The commitment of large companies is essential to establish conditions that favour innovation for the European forest-based sector. While adequate protection for inventions and intellectual property is crucial, a key element of successful innovation is access to information and knowledge. Open innovation clusters and trans-national networks, such as FTP, help to close the gap between business, research and resources, bringing knowledge-based products to the market faster for those companies that make use of them.

While the management culture and attitude of large companies is important, it is also essential to establish a network of examples of 'innovation leaders' to motivate others. The focus of innovation efforts thus has to be on people and their ideas, not on technology.

Strategic actions: *Targeted activities in Public-Private Partnerships*

Supporting innovation in SMEs

SMEs that already have good innovation management in place need further encouragement and support to invest in research and innovation. They should be able to draw on the full innovative potential of the international market and the European Research Area (ERA) to create new business opportunities in Europe and beyond. Other SMEs need to be motivated to invest in research and innovation. Participation in EU research and innovation activities strengthens the research, innovation and technology capabilities of SMEs, increases their capacity to generate, absorb and use new knowledge, enhances the economic exploitation of new developments, boosts innovation in products, services and business models, promotes business activities in larger markets and makes the knowledge networks of SMEs more international.

Strategic activities: *Cross-border collaborations are an important element in the innovation strategies of SMEs, enabling them to overcome some of their size-related problems, such as access to technological and scientific competences. Partnering events and cooperation within the FTP framework of National Support Groups are ways of supporting innovative SMEs*

Strategic actions: *Targeted activities in Public-Private Partnerships*

Monitoring the progress towards the vision

Implementation of the SRA will generate a continuously-changing research and innovation portfolio of programmes and projects. In order to evaluate the performance of each individual project for further investment at different stages of progress, an effective monitoring system has to be established. For companies as well as public funding bodies, assessing and communicating the uniqueness and value of an investment prospect is essential for success: 'you can't manage what you can't measure'. In this context it should be emphasised that collaboration with competitors in the forest-based sector has traditionally been managed within a relatively open environment.

Strategic activities: *Throughout the 7th European Framework Programme for Research, FTP's 'FP7 Task Force' fulfilled the essential task of monitoring EU-funded projects and trans-national research projects. Moving towards the Strategic Vision Targets and the EU framework budget Horizon 2020, the work will continue with emphasis on more detailed information*

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