Forest-based Sector
Technology Platform

Recommendations

for the Work Programme 2018-2020 of Horizon 2020

Industrial Technologies

Nanotechnologies, Advanced Materials, Biotechnology, Advanced Manufacturing and Processing

Societal Challenge 2

Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research, and the Bioeconomy

Societal Challenge 3

Secure, Clean and Efficient Energy

Societal Challenge 5

Climate Action, Environment, Resource Efficiency and Raw Materials

October 2016

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for the Work Programme 2018-2020 of Horizon 2020

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INDUSTRIAL TECHNOLOGIES
Nanotechnologies, Advanced Materials, Biotechnology, Advanced Manufacturing and Processing (NMBP)

The scope of Industrial Technologies and NMBP covers several challenges and opportunities for the forest-based industries, which is reflected in the number of suggested priority topics for 2018-2020. However, we wish to emphasise the significant importance of the following topics:

- Nanocellulose – new products & composite uses
- Advanced biobased construction products
- Wood preservation methods

Nanocellulose – new products and composite uses

Nanocellulose, also called micro-fibrillated cellulose (MFC) forms the basis for a new material group with diversified and exceptional properties of tensile strength, viscosity etc. Applications of MFC-based materials span from innovative lightweight bio-composites for the automotive and transport industry to filler and emulsifier in concrete, paper, soil and food products.

In recent years, the production capacity for MFC in Europe has increased from laboratory scale to industrial tonnes per day. It is now timely to launch a concerted, cross-sectoral European R&D&I programme focusing more on products development and standardisation together with automotive-, construction-, food- and space-sectors.

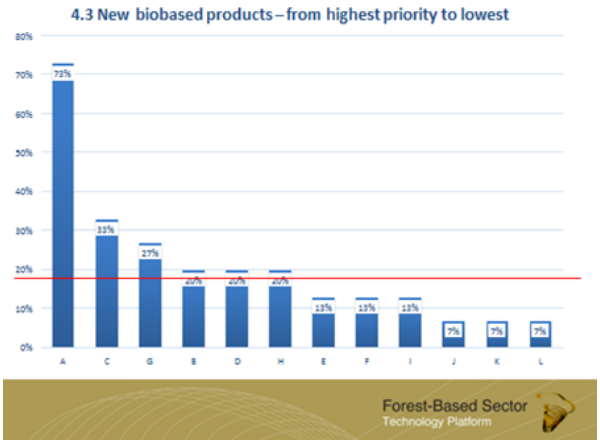

Figure 1: Nanocellulose topics (extreme left) were ranked highest priority with in FTP Stakeholder Consultation 2016.

New industrial value-chains and ecosystems will emerge but the transition needs support. Public support to innovation is particularly critical for cross-sector actions together with manufacturing industry, designers, researchers and customers.

MFC is a renewable biobased material that will contribute to developing a circular economy. However, on challenge is developing systems for reuse, recycling and end-of-life use (cradle to cradle), paving the way to a renewable circular economy.

New MFC-based materials and their functionalities have to be characterised using new methods and measuring techniques, which have yet to be developed.

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Advanced biobased construction products

One of the most sensible investments the EU can do on the path to fulfil EU's commitments under the COP21 Paris Agreement is to encourage the use of wood in the construction sector.

Meanwhile, the percentage of new wooden (multi-storey) buildings are around 9% in the EU (with significant differences between Member States) compared to e.g. 30-40% in North America and Japan.

Despite this, the technical competence of European wood construction industries is world leading, so now when the Chinese are developing a national timber construction standard, they have chosen to cooperate with the European woodworking industry.

FTP believes that advanced biobased construction has been poorly addressed in Horizon 2020 Work Programmes so far and recommends that the NMBP Work Programme 2018-2020 together with the Societal Challenge 2 launch several demonstration and innovation actions in 2018-2020 that will support environmentally friendly and advanced biobased construction.

Wood preservation methods

The wood preservation industry is going through a very challenging period as many of the biocides and preservatives used in the sector have disappeared from the market over the last years and for some the future is very bleak. Therefore, a lot of research is ongoing on the future of the wood preservation industry.

The market and uses for treated durable wood is much larger than commonly believed. For instance, the French railway buys several million wooden railway sleepers each year. The sleepers are expected to last for 60+ years while being in contact with the ground. Due to the EU bans on several impregnation chemicals, it is becoming difficult for European industry to guarantee durability.

EU actions on new biobased treatments to enhance the long-term durability of wood-based products would give the industry a chance to find environmentally friendly solutions.

Table of proposed Call Topics for NMBP in 2018, 2019 and 2020

Proposed Call Topic title	Description and potential impact 5-10 years	Possible participation from other WPs
(a) The Factories of the Future (FoF) contractual Public-Private Partnership		
Industry 4.0 and resource efficiency in manufacturing	○ Manufacturing and processing technologies that significantly increase agility and production flexibility. ○ Apply new product design approaches, models and simulation tools and the necessary new production technologies for more functionality from less material and energy input, e.g. lightweight wood construction or reduced paper grammage.	○ Circular economy ○ Cross-sector cooperations, e.g. textiles, ICT, automotive industries

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(b) The Sustainable Process Industries (SPIRE) contractual Public-Private Partnership		
○ Next generation wastewater treatment ○ Resource efficiency in pulp & paper production ○ Next generation bleaching concepts ○ First of its kind bark biorefinery ○ Clever use of the CO2 from lime kilns and flugasses in the pulp & paper process	○ Hundreds of large, highly-integrated pulp mills are in operation globally. Any efficiency gain will have significant impact. ○ Recycling and end-of-life use (cradle to cradle), paving the way to a circular economy. ○ Making use of the bark represents around +10% of biomass from a tree.	○ Partly BBI JU ○ Circular Economy
(c) The Energy-efficient Buildings (EeB) contractual Public-Private Partnership		
Advanced biobased construction products	○ Biobased construction products in the EU has doubled its market share from 2010 level due to a more widespread use of energy-saving modular housing structures & functional furniture. ○ Wood-based construction is perceived as a cornerstone of the biobased economy, generally credited as low carbon footprint construction.	○ Societal Challenge 2: Bioeconomy ○ Circular Economy
Biobased indoor products and furniture	E.g. creating new functional bio-based and composite products for home and urban furniture.	○ Societal Challenge 2: Bioeconomy ○ Circular Economy
(d) Industrial biotechnology		
Biotech strategies to increase wood durability – wood impregnation	It is becoming ever more critical to come up with viable alternatives to chromated copper arsenate (CCA) and other banned or questioned chemicals for wood preservation. Billion-Euro market at stake! Environmental concerns.	○ Circular Economy ○ Raw Materials ○ Environment
New molecular genetic tools to determine wood and fibre properties	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. Progress will in the end lead to more efficient processes and products.	Societal Challenge 2
(e) Nanotechnologies and advanced materials pilot lines for industrial value chains (pilot lines) *(f) Nanotechnologies and advanced materials for healthcare* *(g) Nanotechnologies and advanced materials for energy applications* *(h) Generic domain for nanotechnologies and advanced materials, including modelling*		
Nanocellulose – new products & composite uses	○ Nanocellulose is a new tool in the green manufacturers toolbox. ○ New renewable materials and their functionalities are characterised using suitable new methods and measuring techniques ○ Standardisation and certification	Circular economy
Intelligent surfaces	Nano-pigments will be developed to generate functional surface structures that for example can change colour, block UV radiation to preserve the wood underneath.	

Functionalisation of fibre surfaces **Wood-polymer composites products and markets – light weight**	New functional surface treatments such as layered curtain coating, including nanocellulose, chemical grafting and surface activation enables bulk material reduction and enhanced product durability and functionality. E.g. EU Building norms allowing paper and corrugated materials and wood-polymer composites to become established construction materials.	
Packaging materials in the circular economy – design for recyclability	○ Biobased food packaging eliminates plastic waste. ○ New functional surface treatments such as layered curtain coating, including nanocellulose, chemical grafting and surface activation enables bulk material reduction and enhanced product durability and functionality.	○ Circular Economy ○ Raw Materials

SOCIETAL CHALLENGE 2
Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research, and the Bioeconomy

In the scope of SC2, around 40 FTP SRA activities have been prioritised for 2018-2020, this notwithstanding activities that fall in the scope of the Biobased Industries Joint Undertaking (BBI JU) such as "*New biobased products*", "*Intelligent packaging solutions*", "*Biorefinery concepts*" and partially also the area *Integration of "new solutions in printed products"*). The prioritised research and innovation activities sort under the following proposed topics:

- *Enhanced forest biomass production*
- *Secured wood supply, forest operations and logistics*
- *Advanced biobased construction products*
- *Biobased indoor products and furniture*
- *Citizens' perceptions of the forest-based sector and its products*
- *Multi-purpose management of forests*
- *The performance of the sector in a perspective of global change*
- *Forest-ecology and ecosystem services*

Sustainable and resilient primary biomass production is fundamental for an emerging circular bioeconomy that substitutes resource-intensive, non-renewable products with resource-efficient, biobased products and services. In a growing bioeconomy, an increase of the harvested timber volumes would be expected. However, contrary to commonly held beliefs, wood harvesting volumes in the EU is still significantly lower than before the global financial crisis in 2007-2008. Reliable foresight models do not predict a return to pre-2008 harvesting levels anytime soon. Still, it is true that many times the incentives for forest-owners to harvest are insufficient.

FTP argues that a significant limitation to growing the forest-based bioeconomy is market related. This is also reflected in our stakeholders' prioritisation of advanced, biobased construction systems.

FTP recommends that the SC2 WP2018-2020 reflects that advanced biobased construction systems and innovative wood products are also part of a circular bioeconomy. Green and sustainable building practices could be increased all over Europe by a more systematic approach. An increase of new multi-storey biobased buildings would in fact be one of the most economical investments on the path to fulfil EU's commitments under the COP21 Paris Agreement.

FTP recommends a cross-sectoral cooperation with the Industrial Technologies and the Energy Efficient Buildings PPP to launch demonstration and innovation actions in the area of advanced biobased construction. Hybrid-material construction systems, improved performance and broadened applicability of biobased building materials have not so far been properly considered in Horizon 2020 or the Work Programmes of the Energy Efficient Buildings PPP.

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Table of proposed Call Topics for SC2 in 2018, 2019 and 2020

Proposed Call Topic title	Description and potential impact 5-10 years	Possible participation from other WPs
Enhanced forest biomass production	Sustainable harvesting possibilities in Europe have increased by 30% until 2030 (bearing in mind the full range of demands and production constraints on forests).	○ Climate Action ○ Space ○ Biotech
Secured wood supply, forest operations and logistics	Recovery, reuse and recycling of forest-based products account for 70% of all recyclable material.	○ Circular Economy ○ Raw Materials ○ Climate Action ○ ICT
Advanced biobased construction products	○ Biobased construction products in the EU has doubled its market share from 2010 level due to a more widespread use of energy-saving modular housing structures & functional furniture ○ Wood-based construction is perceived as a cornerstone of the biobased economy, generally credited as low carbon footprint construction	○ NMBP ○ SC3 Energy ○ Energy-efficient Buildings
Biobased indoor products and furniture	E.g. creating new functional bio-based and composite products for home and urban furniture	○ Industrial Technologies (NMBP) ○ Energy-efficient Buildings
Citizens' perceptions of the forest-based sector and its products	○ Map the emotional vs fact-based societal perceptions of forest management practices, reused and recycled wood-based products, bio- and nanotechnology and its derived products. ○ Develop foresight methodologies to predict market changes and consumer behaviour and create business models that target evolving consumer needs and behaviours.	○ Socio-economic ○ Sciences
Multi-purpose management of forests	Support decision-making processes by increasing knowledge transfer between forest managers, science and citizens (including civil society, customers and policymakers).	○ Environment ○ Space
The performance of the forest bioeconomy in a perspective of global change	A better understanding of the availability and valorisation of forest-based raw materials in Europe in the global context under changing economic, social and climatic conditions.	○ Socio-economics
Forest-ecology and ecosystem services	New markets for non-wood forest goods & services (berries, clean water, eco-tourism...) is well on its way to reach the 2030 target of a 10-fold increase	○ Environment ○ Socio-economics ○ Space

SOCIETAL CHALLENGE 3
Secure, Clean and Efficient Energy

The activities of the forest-based sector cover much of the scope of **Societal Challenge 3: Secure, Clean and Efficient Energy** – from the primary biomass production (EU forests supply around 97% of solid biomass used for energy in the EU) to downstream industries. However, the forest-based sector has agreed to emphasise three topics for action in the WP2018-2020:

Fuel, Forest, Freight

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.

The amount of carbon stored in European forests is currently increasing but on a longer timeframe, the uptake and release of CO2 from European forests will reach a steady-state.

Therefore, the strongest carbon footprint reduction originates from substituting fossil-based or energy-intensive materials with renewable wood materials and the second strongest effect come the contribution of wood products as carbon sinks. This should be considered when supporting the development of innovative products and technologies.

Advanced light-weight buildings with low embodied energy

The embodied energy should be a very important performance indicator for energy efficient buildings. Partly substituting energy-intensive materials with renewable and light-weight construction elements might be the most sensible investments the EU can do on the path to fulfil its commitments under the COP21 Paris Agreement.

The percentage of new wooden frame (multi-storey) buildings are around 9% in the EU (with significant differences between Member States) compared to e.g. 30-40% in North America and Japan.

Despite this, the technical competence of European wood construction industries is world leading. This creates a unique opportunity to address both job creation and competitiveness and climate change at the same time. Wood-based construction materials have several advantages compared to steel and concrete; they are light-weight, insulate well, are modularized and only assembly remain at the construction site. All this have great secondary positive environmental effects on logistics and transport.

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Reducing energy consumption and carbon footprint in the paper and saw milling processes

The forest-based industries produce renewable paper products, packaging, construction, furniture, transport, textiles and hygiene products. Developing design concepts for ensuring recyclability of increasingly more complex products and the separation and reuse of used material components are high on the agenda.

Table of proposed Call Topics for SC3 in 2018, 2019 and 2020

Proposed Call Topic title	Description and potential impact 5-10 years	Possible participation from other WPs
Alternative fuels and mobile energy sources		
Fuel, Forest, Freight	The bioenergy sustainability framework supports intelligent ways to mobilise unused "homegrown" biomass. In combination with break-throughs in transport and logistics, a reduction of the carbon footprint of more than 80% in the EU transport fleet can be foreseen until 2030.	○ Transport
Energy-efficient Buildings		
Advanced biobased construction products	○ Substituting energy-intensive materials with renewable and resource efficient biotic materials would reduce carbon footprint with more than 60% in an average multi-storey building. ○ Embodied energy has come to be considered as an important performance indicator for energy efficient buildings from cradle to cradle.	○ NMBP (EeB PPP) ○ Bioeconomy ○ Circular Economy
Reducing energy consumption and carbon footprint		
Reducing energy consumption and carbon footprint in the paper and saw milling processes	○ Hundreds of thousands of saw-mills and integrated pulp mills are in operation globally. Any efficiency gain will have significant impact on global energy demands. ○ Recycling and end-of-life use (cradle to cradle), paving the way to a circular economy. ○ Focus on light weight products, clever use of the CO2 from lime kilns and industry 4.0 could be envisioned.	○ BBI JU ○ Circular Economy

SOCIETAL CHALLENGE 5
Climate Action, Environment, Resource Efficiency and Raw Materials

In the scope of SC5, the stakeholders of the forest-based sector have prioritized 30 FTP SRA activities for 2018-2020 (these activities are described in detail in the Annex). Based on these activities, FTP proposes nine "topic themes" in the attached table.

Climate change mitigation is one important ecosystem-service provided by forests and an intrinsic component of the forest-based industries. EU strategies on climate change mitigating should always include forests and the forest-based sector.

Protecting the environment, sustainably managing natural resources, water, biodiversity and ecosystems

Understanding the ecological functioning of diverse European forests is a basic requirement. Forests capture 10% of the EU's CO2 emissions, host biodiversity at species and gene level, ensure water conservation, mitigate natural hazards, offer recreational opportunities and provide employment in rural areas. Through these services European forests provide great socio-economic value. The challenge is to find the right balance in space and time for providing this palette of benefits.
A better understanding is needed to create a variety of management systems - for everything from strict reserves and semi-natural forests to intensively-managed plantations - using improved silvicultural practice based on advances in functional ecology and genetics.

Ensuring the sustainable supply of non-energy, non-agricultural raw materials

The cooperation under the EIP Raw Materials between the Mining, Minerals, Aggregates and Woodworking sectors are very stimulating and important.
Wood and wood-based products have the potential to be re-used repeatedly as raw material. Waste from harvesting operations and wood processing is regularly used as high-value raw material for other types of processing.
The circular economy requires the collection of residues from harvesting and processing with priority for separate collection and quality assortment classifications.

Enabling the transition towards a green economy and society through eco-innovation

Develop concepts and upscaling to production scale for the manufacture of 100% biobased, recyclable packaging and design approaches for the easy-to-dismantle building components and precise material characterisation to facilitate optimal sorting and recycling

An increase of new multi-storey biobased buildings would be one of the most economical investments on the path to fulfil EU's commitments under the COP21 Paris Agreement.
Eco-innovation developing nanocellulose as a biobased material substituting non-renewables in lightweight bio-composites for the automotive and transport industry to filler and emulsifier in concrete, paper, soil and food products and contributing to a circular economy.

Table of proposed Call Topics for SC5 in 2018, 2019 and 2020

Proposed Call Topic title	Description and potential impact 5-10 years	Possible participation from other WPs
Protecting the environment, sustainably managing natural resources, water, biodiversity and ecosystems		
Multi-purpose management of forests	A resilient and diverse European forest is sustainably managed by a variety of owners and owner cooperatives who provide all the functions of the forest including raw materials for the circular economy, biodiversity, climate change mitigation and recreational opportunites.	○ SC2
Next generation wastewater treatment	○ New methods for separation of water soluble molecules from fermentation ○ Recycling and end-of-life use (cradle to cradle), paving the way to a circular economy.	
Forest-ecology and ecosystem services	New markets for non-wood forest goods & services (berries, clean water, eco-tourism…) is well on its way to reach the 2030 target of a 10-fold increase.	○ SC2
Ensuring the sustainable supply of non-energy, non-agricultural raw materials		
Secured wood supply, forest operations and logistics	Sustainable harvesting possibilities in Europe have increased by 30% until 2030 (bearing in mind the full range of demands and production constraints).	○ ICT ○ NMBP ○ SC2
Resource efficiency, reuse and recycling systems	○ Recovery, reuse and recycling of forest-based products account for 70% of all recyclable material. ○ Making value-added use of the bark which represents around +10% of biomass from a tree.	○ SC2
Packaging materials in the circular economy – design for recyclability	100% biobased packaging	○ NMBP
Enabling the transition towards a green economy and society through eco-innovation		
Advanced biobased construction for a circular economy	Wood-based construction is becoming a cornerstone of the biobased circular economy, generally credited as low carbon footprint construction.	○ Bioeconomy ○ NMBP
Eco-innovation strategies to increase wood durability – wood impregnation	Green alternatives to banned wood preservatives for long-term durability wood products.	○ NMBP

Nanocellulose – new biobased products for the circular economy	○ A new renewable, biobased material in the green manufacturers toolbox help to fulfilling the consumer needs of a circular economy. ○ New renewable materials and their functionalities are characterised using suitable new methods and measuring techniques.	○ NMBP
Forest-based textiles for the Circular Economy	Replacing petroleum-based textiles with new cradle-to-cradle circular value chains for biodegradable textiles from renewable, recyclable fibres coming from cultivations that does not require irrigation, pesticides or fertilisers.	

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Annexes

Stakeholders' priorities for 2018-2020 indexed according the FTP Strategic Research & Innovation Agenda 2020

Stakeholder priorities concluded in the 2016 Prioritization Process (for action in 2018-2020).
The research and innovation activities are organised according the Research Areas of the FTP SRA.

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Annex to NMBP priorities

2.3 Enhanced biomass production

D. Develop new tree breeding strategies that include quantitative and molecular genetic tools aiming at sustainable and high yield of biomass, improved wood quality and resistance to stress.
F. Study molecular, biochemical and physiological processes, determining wood and fibre properties and matrix architecture, as well as pest and disease resistance, water efficiency and nutrient biology

2.4 Secured wood supply, forest operations and logistics – Wood mobilization

E. Develop intelligent forest operation systems and new solutions for human–machine–terrain interactions
A. Develop new inventory techniques for determining quantity, quality, dimensions and specific properties of forest resources.

2.5 Raw Material reuse and recycling systems – Wood mobilization

A. Generate a better knowledge of useful or harmful chemical compounds in different tree parts and wood biomass fractions for cascading purposes
D. Develop value-added applications of extracted wood polymers, nanofibrils, lignin, xylan, pulp fibres and paper, for example, for carbon fibres or ultra-lightweight composites in the fields of construction, interior design and packaging.
K. Develop new process technologies like separation, fractionation or extraction with improved selectivity for various components in recycling stock which enables a utilisation in value-added applications inside and outside the production chain.
J. Develop innovative sorting systems using new sensors for detection and robotics technologies for paper, wood waste and forest residues to separate according to different types of fibres, inks and fillers, contaminants and soil residues and resulting in higher sorting accuracy and velocity

3.1 Resource efficiency in manufacturing

E. Develop production technologies with significantly optimised energy efficiency and energy management in defibration of wood, drying of sawn timber, production of panels, paper and board or in transportation.
B. Apply new product design approaches, models and simulation tools and the necessary new production technologies for more functionality from less material and energy input, e.g. lightweight wood construction or reduced paper grammage.
G. Devise functional surface treatments such as layered curtain coating, including nanofibrillated cellulose, chemical grafting (chromatogeny) and surface activation (plasma) to enable bulk material reduction, enhance durability or extend life.
F. Develop enhanced separation and fractionation technologies for material components to enable their optimal use in layered or composite structures

3.3 Sustainable water stewardship

E. Improve separation and cleaning technologies (using physical chemistry and/or industrial bio-technology) for a further closure of water cycles and to reduce the amount of effluent.
F. Develop innovative technologies for the value-added use of separated and extracted components from wastewater treatment.

3.5 New business models and service concepts

H. Create business models based conversion of traditional mills to new markets.
B. Develop foresight methodologies to predict market changes and consumer behaviour and create business models that target evolving consumer needs and behaviours.

4.1 Advanced wood-based construction

A. Identify barriers to sustainable and environmentally-friendly construction and develop further urban building solutions.
D. Develop cost-effective integrated pre-fabricated timber building systems including hybrid and composite materials

K. Develop advanced wooden structure joints to improve performance and broaden the applicability of wooden structures to substitute for carbon-intensive materials.
F. Develop design concepts taking into account changing building services during the building's lifetime
G. Improve building physics, indoor air quality and the behaviour of wooden constructions
I. Develop advanced scientifically-justified lightweight wood and fibre-based products, engineered wood products and composite materials with superior performance, low emissions, produced with novel, high quality environmentally-friendly biobased adhesives
M. Develop construction systems and biobased treatments to enhance the long-term durability of high performance wood-based products.

4.2 Indoor environment and functional furniture

F. Develop and establish design criteria to ensure the full recyclability of packaging materials, in particular barrier layers and embedded electronics.
B. Improve the performance of packages and wood- or fibre-based packaging materials, not limited to mechanical properties but including resistance to moisture and microbial contamination, in particular prevention of microbial activity in food packages with the help of shielding gases or active substances
A. Enhance the material efficiency of packaging with, for example, new lightweight construction approaches.
G. Develop concepts and upscaling to production scale for the manufacture of 100% biobased packaging
C. Integrate sensor and information systems in packaging materials – printing applications using functional inks and tags carrying anti-counterfeiting information

4.3 New biobased products

A. Develop new products from wood fibre (nano/microfibrillated cellulose (MFC), nanocrystalline cellulose (NCC), fibre/polymer blends, novel derivatives, some even with improved thermoplastic properties, etc.)
C. Develop new products from lignin (e.g. chemicals, in composites and as carbon fibre) and hydroxy acids (chemicals and polymers).
G. Develop weatherproof panels, fibre-based insulation materials and wood-polymer composites suitable for exterior use
B. Invent new textile fibre qualities based on cellulose for replacement of cotton fibres in textiles

4.5 Hygienic, diagnostic and healthcare products

G. Explore the applicability of wood- and fibre-based material in medical applications
E. Develop and establish design criteria to enable recyclability of relevant product categories and methods for the safe disposal of non-recyclable materials.
C. Develop production concepts of layered tissue products with multi-layer properties

4.6 Integration of new solutions in printed products

D. Develop smart and intelligent features for applications based on printed electronics or printed biosensors, e.g. in packaging.
B. Develop high-precision paper substrates and surfaces that enable the printing of electronics and safeguard their functionality and durability
E. Develop design concepts for ensuring recyclability of hybrid products and technologies for the separation and reuse of used material components.

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Annex to Societal Challenge 2 priorities

1.1 The performance of the sector in a perspective of global change

A. Assess and develop scenarios for the availability and valorisation of forest-based raw materials in Europe in the global context under changing economic, social and climatic conditions.

1.2 Citizens' perceptions of the forest-based sector and its products

A consumer-inclusive research area developing a new kind of partnership with customers and citizens would have four action areas:

A. Raise public awareness of the role of forest biomass and forest-based products in climate change mitigation.
B. Strengthen citizens' knowledge of the role of forest-based industries in a biobased society.
C. Monitor emotional and fact-based societal perceptions of forest management practices, reused and recycled wood-based products, bio- and nanotechnology and its derived products.
D. Improve decision-making processes and knowledge transfer systems by taking into account both scientific knowledge and citizens' perceptions (including civil society, customers, forest managers and policymakers).

2.1 Multi-purpose management of forests

D. Try out new business models to activate small forest owners to improve their long-term social and economic sustainability
E. Research the raw material requirements of the production of wood products, as well as new forest-based products, specialised products and the provision of a variety of non-wood products and ecosystem services.

2.2 Forest ecology and ecosystem services

C. Improve the understanding of biodiversity development in managed forests, and the role of biodiversity for the production and variety of raw materials, prevention of pests and diseases, water quality and water-related services, soil protection and other eco-system services.
A. Improve understanding of the complex system dynamics of forests in relation to human society and global change, considering non-linearity of processes, threshold phenomena, feedback and feed forward loops, resulting in alternative stable states; derive improved concepts of resilience to disturbances and adaptive capacity
E. Develop criteria and indicator tools to quantify ecosystem services, identify their trade-offs, estimate the value of socio-economic benefits and assess the social and human impacts of rural, urban and peri-urban forests.
F. Improve insight into the value of environmental services to society in an integrated land use setting and analyse efficiency of various financial incentive systems and instruments for enhanced provision of these, including payment for ecosystem services (PES) and PES-like schemes

2.3 Enhanced biomass production

D. Develop new tree breeding strategies that include quantitative and molecular genetic tools aiming at sustainable and high yield of biomass, improved wood quality and resistance to stress.
B. Improve existing and develop new techniques for silviculture and efficient forest management systems to reduce vulnerability to climate change including changing fire and storm patterns.
J. Translate scientific information into a risk-management framework for resource managers.
A. Improve monitoring, empirical modelling and space technology tools for assessing forest growth and biomass production trends on different spatial and temporal scales.
C. Develop decision support tools to help forest managers optimise growth, resource efficiency and water productivity in changing environmental conditions.
F. Study molecular, biochemical and physiological processes, determining wood and fibre properties and matrix architecture, as well as pest and disease resistance, water efficiency and nutrient biology.

2.4 Secured wood supply, forest operations and logistics – Wood mobilisation

G. Develop decision support systems for optimised supply chain management, including reuse of wood, fibres and biomass, linked to forest planning tools for multifunctional forest management.
B. Assess the future availability of woody biomass for different uses.
E. Develop intelligent forest operation systems and new solutions for human–machine–terrain interactions

A. Develop new inventory techniques for determining quantity, quality, dimensions and specific properties of forest resources.

4.1 Building with wood

A. Identify barriers to sustainable and environmentally-friendly construction and develop further urban building solutions.
D. Develop cost-effective integrated prefabricated timber building systems including hybrid and composite materials, glue-lam, cross-lam and similar composite products.
K. Develop advanced wooden structure joints to improve performance and broaden the applicability of wooden structures to substitute for carbon-intensive materials.
F. Develop design concepts taking into account changing building services during the building's lifetime.
G. Improve building physics, indoor air quality and the behaviour of wooden constructions, especially in low-energy houses.
I. Develop advanced scientifically-justified lightweight wood and fibre-based products, engineered wood products and composite materials with superior performance, low emissions, produced with novel, high quality environmentally-friendly biobased adhesives
M. Develop construction systems and biobased treatments to enhance the long-term durability of high performance wood-based products.

4.2 Indoor environment and functional furniture

K. Create new functional wood and composite products for home and urban furniture
B. Clarify the role of wood and wood-based products in securing good indoor environments and contributing to perceived comfort.
F. Develop environmentally-friendly multifunctional varnishes and lasuring coatings with micro-encapsulations (aromas, biocides, UV filter absorbents and fire retardants)
G. Develop intelligent furniture surfaces (integrated sensors and electrical conductivity) and use a 'learning from nature' approach towards state-of-the-art surface qualities, durability and mechanical properties of wood-based materials
I. Develop natural bio-adhesives and other biopolymers to enhance bonding in furniture components
J. Continue to develop environmentally-friendly methods for modifying wood and improving the long-term properties of wood-polymer composites to increase their resistance to deterioration.
M. Develop biobased lightweight 3D furniture components

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Annex to SC3 priorities

3.2 Renewable energy solutions

A. Quantify the green energy potential of present production sites including their biomass supply potential
F. Maximizing value of by-products to fast-growing green energy markets
B. Engineer new technologies to increase energy production and reduce energy consumption

2.4 Secured wood supply, forest operations and logistics

E. Develop intelligent forest operation systems and new solutions for human–machine–terrain interactions
A. Develop new inventory techniques for determining quantity, quality, dimensions and specific properties of forest resources

3.1 Resource efficiency in manufacturing

E. Develop production technologies with significantly optimised energy efficiency and energy management in defibration of wood, drying of sawn timber, production of panels, paper and board or in transportation.
F. Develop enhanced separation and fractionation technologies for material components to enable their optimal use in layered or composite structures

3.5 New business models and service concepts

G. Research new business models between local communities of forest owners, forest operators and industries for the creation of new value chains.
H. Create business models based on opening up the raw material pool and conversion of traditional mills to new markets

4.1 Advanced wood-based construction

A. Identify barriers to sustainable and environmentally-friendly construction and develop further urban building solutions
D. Develop cost-effective integrated prefabricated timber building systems including hybrid and composite materials
K. Develop advanced wooden structure joints to improve performance and broaden the applicability of wooden structures to substitute for carbon-intensive materials.
F. Develop design concepts taking into account changing building services during the building's lifetime.
G. Improve building physics, indoor air quality and the behaviour of wooden constructions
I. Develop advanced scientifically-justified lightweight wood and fibre-based products, engineered wood products and composite materials with superior performance, low emissions, produced with novel, high quality environmentally-friendly biobased adhesives
M. Develop construction systems and biobased treatments to enhance the long-term durability of high performance wood-based products.

4.2 Indoor environment and functional furniture

F. Develop and establish design criteria to ensure the full recyclability of packaging materials, in particular barrier layers and embedded electronics.
A. Enhance the material efficiency of packaging with, for example, new lightweight construction approaches.
C. Integrate sensor and information systems in packaging materials – printing applications using functional inks and tags carrying anti-counterfeiting information

Forest-based Sector
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Annex to SC5 priorities

2.4 Secured wood supply, forest operations and logistics – Circular Economy

E. Develop intelligent forest operation systems and new solutions for human–machine–terrain interactions

A. Develop new inventory techniques for determining quantity, quality, dimensions and specific properties of forest resources.

2.5 Raw Material reuse and recycling systems – Circular Economy

A. Generate a better knowledge of useful or harmful chemical compounds in different tree parts and wood biomass fractions for cascading purposes

D. Develop value-added applications of extracted wood polymers, nanofibrils, lignin, xylan, pulp fibres and paper, for example, for carbon fibres or ultra-lightweight composites in the fields of construction, interior design and packaging.

K. Develop new process technologies like separation, fractionation or extraction with improved selectivity for various components in recycling stock which enables a utilisation in value-added applications inside and outside the production chain.

J. Develop innovative sorting systems using new sensors for detection and robotics technologies for paper, wood waste and forest residues to separate according to different types of fibres, inks and fillers, contaminants and soil residues and resulting in higher sorting accuracy and velocity

3.3 Sustainable water stewardship

A. Study the effects of various forest management practices on water use and lifecycle perspective in a context of climate change, ecosystems and biodiversity.

C. Hydrological and hydro-chemical modelling focussing on combined effects of climate change, tree species choice and mixtures as well as management regimes in different geographical settings.

D. Research on quantification of the economic value of the ecosystem service, 'sustainable water supply'

E. Improve separation and cleaning technologies (using physical chemistry and/or industrial bio-technology) for a further closure of water cycles and to reduce the amount of effluent.

F. Develop innovative technologies for the value-added use of separated and extracted components from wastewater treatment.

4.1 Building with wood

A. Identify barriers to sustainable and environmentally-friendly construction and develop further urban building solutions.

D. Develop cost-effective integrated prefabricated timber building systems including hybrid and composite materials

K. Develop advanced wooden structure joints to improve performance and broaden the applicability of wooden structures to substitute for carbon-intensive materials.

F. Develop design concepts taking into account changing building services during the building's lifetime.

G. Improve building physics, indoor air quality and the behaviour of wooden constructions

I. Develop advanced scientifically-justified lightweight wood and fibre-based products, engineered wood products and composite materials with superior performance, low emissions, produced with novel, high quality environmentally-friendly biobased adhesives

M. Develop construction systems and biobased treatments to enhance the long-term durability of high performance wood-based products.

4.2 Indoor environment and functional furniture

F. Develop and establish design criteria to ensure the full recyclability of packaging materials, in particular barrier layers and embedded electronics.

B. Improve the performance of packages and wood- or fibre-based packaging materials, not limited to mechanical properties but including resistance to moisture and microbial contamination, in particular prevention of microbial activity in food packages with the help of shielding gases or active substances

A. Enhance the material efficiency of packaging with, for example, new lightweight construction approaches.

G. Develop concepts and upscaling to production scale for the manufacture of 100% biobased packaging
C. Integrate sensor and information systems in packaging materials – printing applications using functional inks and tags carrying anti-counterfeiting information

4.3 New biobased products

A. Develop new products from wood fibre (nano/microfibrillated cellulose (MFC), nanocrystalline cellulose (NCC), fibre/polymer blends, novel (solvent-free) derivatives, some even with improved thermoplastic properties, etc.)
C. Develop new products from lignin (e.g. chemicals, in composites and as carbon fibre) and hydroxy acids (chemicals and polymers).
G. Develop weatherproof panels, fibre-based insulation materials and wood-polymer composites suitable for exterior use
B. Invent new textile fibre qualities based on cellulose for replacement of cotton fibres in textiles

4.4 Intelligent Packaging solutions

F. Develop and establish design criteria to ensure the full recyclability of packaging materials, in particular barrier layers and embedded electronics.
B. Improve the performance of packages and wood- or fibre-based packaging materials, not limited to mechanical properties but including, for example, resistance to moisture and microbial contamination, in particular prevention of microbial activity in food packages with the help of shielding gases or active substances
A. Enhance the material efficiency of packaging with, for example, new lightweight construction approaches. Explore the applicability of wood- and fibre-based material in medical applications
G. Develop concepts and upscaling to production scale for the manufacture of 100% biobased packaging

About FTP

FTP is the European Technology Platform for the forest-based sector. The long-term strategy of FTP's stakeholders is established in the FTP *Vision 2030* to be implemented through the *Strategic Research and Innovation Agenda for 2020 (SRA)*. Since 2005, FTP has been organising European cooperation across the whole forest-based sector value chain. The FTP network consists of stakeholders organised in 25 National Support Groups; four shareholder Confederations/Associations: CEI-Bois, CEPF, CEPI and EUSTAFOR; and three Research Umbrella Organisations: EFI, EFPRO and InnovaWood.
FTP is active in 25 countries.

The EU forest-based sector in figures

- 35% of the EU land area is covered by forests sustainably managed by 16 million forest owners
- The forest-based industries contribute 8% of EU's total manufacturing added value
- The sector supports 3-4 million industrial jobs in the areas of wood processing, transport, machinery, construction, instrumentation, ICT, chemicals and energy
- The woodworking industries employ some 2.4 million workers in 365 000 SME's
- € 81 billion was the total turnover of the European paper industries in 2010
- 70% of Europe's Freshwater repository comes from forest land

Forest-based Sector
Technology Platform

The European hub for research and innovation in the forest bioeconomy

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FTP SHAREHOLDERS:

CEI-Bois
Confederation of European Forest Owners
cepi confederation of european paper industries
eustafor MANAGING STATE FORESTS RESPONSIBLY