2010 2015 2020 2025 2030

Forest-Based Sector
Technology Platform

Annex: *Extended Descriptions of Research Areas*

Strategic Objectives - Forest-Based Value Chains - Research Area

	Forest-Based Value Chains				
Strategic Objectives	**Forestry**	**Wood Products**	**Pulp & Paper Products**	**Bio-energy**	**Specialities**
1. Development of innovative products for changing markets and customer needs	1-6: Commercialising soft forest values	1-1: *A new generation of functional packaging* 1-4: Living with wood 1-5: Building with wood 1-10: *New generation of composites*	1-1: *A new generation of functional packaging* 1-2: Paper as a partner in communication, education and learning 1-3: Advancing hygiene and health care 1-8: *Pulp, energy and chemicals from wood bio-refinery* 1-10: *New generation of composites*	1-7: Moving Europe with the help of bio-fuels 1-8: *Pulp, energy and chemicals from wood bio-refinery*	1-8: *Pulp, energy and chemicals from wood bio-refinery* 1-9: *"Green" specialty chemicals* 1-10: *New generation of composites*
2. Development of intelligent and efficient manufacturing processes, including reduced energy consumption		2-4: Advanced technologies for primary wood processing 2-5: New manufacturing technologies for wood products	2-1: Reengineering the fibre-based value-chain 2-2: More performance from less inputs in paper products 2-3: *Reducing energy consumption in pulp and paper mills*	2-3: *Reducing energy consumption in pulp and paper mills* 2-6: Technologies to boost heat and power output	
3. Enhancing availability and use of forest biomass for products and energy	3-1: Trees for the future 3-2: *"Tailor-made" wood supply*	3-2: *"Tailor-made" wood supply* 3-4: Recycling wood products - a new material resource	3-2: *"Tailor-made" wood supply* 3-3: Streamlined paper recycling	3-2: *"Tailor-made" wood supply*	3-2: *"Tailor-made" wood supply*
4. Meeting the multifunctional demands on forest resources and their sustainable management	4-1: Forests for multiple needs 4-2: Advancing knowledge on forest ecosystems 4-3: Adapting forestry to climate change				
5. The sector in a societal perspective	5-1: Assessing the overall performance of the sector 5-2: Instruments for good forest-sector governance 5-3: Citizens' perceptions				

Italic = addressing more than one Value Chain

Introduction

THE FOREST-BASED SECTOR: JOINTLY DEFINING A STRATEGIC RESEARCH AGENDA

The Forest-Based Sector Technology Platform is the basis for strengthening the competitiveness of the sector and contributing to the improvement in the quality of life of European citizens, through joint R&D activities. For the first time, all stakeholders within the forest-based sector worked together on a common research agenda.

In order to progress the defined Vision 2030, an organisational structure, comprising and taking advantage of the sector's unique network of forest-based companies, organisations and institutions across the EU-25, has been developed. This structure involves not only all stakeholders but also facilitates liaison with the entire network and exploits the potential for input from a multitude of different perspectives.

The forest-based sector has adopted a bottom-up approach to defining the sector's research goals and has used its network to establish some 20 National Support Groups across Europe. The defining of research priorities during 2005 was based on a crosscutting approach of different value chains (forestry, pulp & paper products, wood products, bio-energy, specialities) and impact dimensions (consumer, society, environment, energy, competitiveness). The result has been a wide-ranging pool of research proposals (more than 700). These proposals, encompassing the full range of complexity and variety the sector represents, have fed into the evolution of the Strategic Research Agenda (SRA) at a European level.

The SRA with its Research Areas is aimed at pointing out the directions in which the forest-based sector needs to go in order to realize its Vision 2030. The SRA should serve as an inspiration for all stakeholders to present research projects and ideas for implementation. This Annex will present the Research Areas which were sorted under Strategic Objectives in chapter 2 "Moving towards a Common Goal with Research" of the main document, where they were briefly described mainly with regard to their expected outcome. Here a more detailed description of each Research Area is displayed under the following headings: "Rationale", "Expected achievements", "Examples of activities and research approaches" and "Characteristics".

In addition to meeting research needs, it is anticipated that all Research Areas will, during the implementation phase, contribute to the establishment of a more efficient innovation system, including a better-structured research community with higher efficiency. It is also expected that they will strengthen the sector's scientific basis and take advantage of emerging technologies.

The implementation of the Research Areas is expected to encourage the establishment of education and training schemes and to improving communication with the public and policy makers.

RATIONALE

Wood and fibre-based packaging materials provide protection for a wide range of products and efficient communication of information. Wide use of these renewable materials improves the sustainability of distribution systems through improved durability and protective capabilities. In particular, the materials must provide enhanced consumer safety and prolonged shelf life of packaged, perishable goods. New functionalities and services must be enabled to provide more information and experience about the packaged product and its use. Production costs must be reduced. Flexible production technologies and new distribution models are needed to enable on-demand production and tailoring of wood and fibre-based packaging solutions for customer needs.

EXPECTED ACHIEVEMENTS

- Wood and fibre-based packaging materials that have superb durability and protection capabilities.
- Materials that give zero impact on the packaged foodstuffs and prevent damage otherwise induced by ambient conditions.
- Materials that are non-toxic and immune against microbiological deterioration.
- Technologies to embed information and communication functionality that enables efficient transportation and storage of packages.
- Fibre-based packages that deliver more information to consumers and are easier to use.
- Enhanced usability of wood packaging in worldwide transport of goods.
- Improved means of protecting brand identity, and preventing counterfeit and tampering.
- Technologies for on-demand design and production of packages.
- Technologies and materials that enable new uses for wood and fibre-based packaging materials.
- Solutions for more efficient supply-chain operations.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

Enabling efficient packaging systems:

- Creation of knowledge on consumer perceptions, customer expectations and societal drivers.
- Simulation methods of package performance and safety during transportation and end-use.
- Technologies for flexible, on-demand package manufacturing, e.g. forming, filling and sealing operations.

Development of embedded information and communication technologies:

- Embedding of components for anti-counterfeiting, anti-tampering and package tracking.
- Printing of displays, embedded sensors, interactive electronic components, and biometric components.

Materials development for enhanced durability and protective capabilities:

- Barrier properties, rigidity, surface strength, moldability.
- Chemical and microbiological safety.
- Hygrostability, moisture resistance and microbiological immunity.
- Reduced use of chemicals, use of “green” biotechnological alternatives in the manufacture and treatment of packaging materials.

CHARACTERISTICS

Character of work: basic research, applied research, development, demonstration

Major competences needed: bioscience, ICT, materials science, nanoscience, chemistry, surface science, behavioural science, physics, social sciences, psychology, logistics

Links to ongoing major projects:

- Integrated projects SustainPack and Biosafe paper
- COST Action E36 “Modelling and Simulation in the Pulp & Paper Industry”
- CEI-Bois Roadmap 2010 “Wood in packaging and transport” process

RATIONALE

The ever increasing amount of communication in society and continuing development of life-long learning needs information carriers adapted to human perception. Printed media have served the society well in communication, education and culture. The rapid evolution of information and communication technologies and growing understanding of human perception offer new opportunities to add value by integrating printed and electronic media into so called hybrid media. This requires adding interactive features into newspapers, periodicals and educational materials to provide links to additional up-to-date electronic information. The new products must be recoverable and the materials fully recyclable. Short delivery times and small-scale on-demand production must be enabled. Developments in materials technology open avenues to reduced environmental impacts, improved efficiency, better use of renewable resources and lower costs in the production of printed media.

EXPECTED ACHIEVEMENTS

- New types of products and services that integrate printed media, electronic media and communication technology, human perception and support natural ways of learning.
- New paper-based materials and associated printing processes for efficient production of printed media.
- Information and communication systems that enable cost-effective and efficient delivery chains and flexible on-demand printing.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

Development of materials and printing processes:

- Printing technologies to enable environmentally sound ink systems and full recycling of all material components in printed products.
- Surface-finishing technologies to enhance ink-paper compatibility, printing paper runnability, print quality, and recyclability of printed products.

Information and communication technologies:

- Integration of displays, interactive components, memory units and sensors.
- Development of concepts for interaction between print media and electronic media.
- Development of concepts for information transfer along delivery chains to shorten delivery times and enable on-demand printing.

Studies on human perception and behaviour to develop product concepts that:

- Adjust to changing needs in communication and information transfer of society, business and consumers.
- Support the natural ways people learn.
- Support the vitality of European cultural heritage.

CHARACTERISTICS

Character of work: basic research, applied research, development, demonstration

Major competences needed: ICT, materials science, nanoscience, chemistry, surface science, behavioural science, physiology, social science

Links to ongoing major projects:
COST Action E32 “Characterisation of Paper Surfaces for Improved Printing Paper Grades”

RATIONALE

New hygiene products are specifically needed to meet new and emerging demands due to changes in social habits and social systems, for example within elderly care. They must be characterised by innovative design, not least to assist their functionality.

An important line of development is hygiene products that carry diagnostics. Another is fibre-based antibacterial surfaces that are not harmful to the environment and help to combat the creation of resistant bacteria. New types of hygiene products, both in the tissue and personal care areas, with improved properties to retain liquids and where functions are reached with less raw-material are also needed, as well as more flexible manufacturing processes. Advances in nanotechnology, biotechnology, information and communication technology (ICT) and sensor technology can create dramatic improvements in material and product functions.

EXPECTED ACHIEVEMENTS

- Products with built-in diagnostic functions.
- Products that prohibit growth and spreading of bacteria.
- Products with ultimate acquisition of liquids.
- Products with dramatically improved comfort properties.
- Products with less raw-materials demand.
- Flexible manufacturing processes providing affordable products.

The need to lower energy consumption in so called through-drying processes is dealt with in Research Area 3-3.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Replacing non-renewable materials and chemicals, like absorbents and binders, used in today's products with materials and chemicals based on renewable resources.
- Research on encapsulating biosensors and electronic devices into fibrous structures.
- Research on perception and behaviour linked to product performance parameters.
- Development of more flexible manufacturing systems, including converting operations.
- Combining traditional hygiene products' engineering disciplines with nano-, bio- and medical sciences as well as electronics.
- Intensified cooperation with competence centres for industrial design and ergonomics.
- Research regarding services built on hygiene products.

CHARACTERISTICS

Character of work: basic research, applied research, development

Major competences needed: bioscience, bacteriology, ICT, materials science, nano-technology, organic chemistry, surface chemistry, behavioural sciences

RATIONALE

Wood is a natural material and boasts some excellent environmental properties as a result. Natural benefits as sound insulation properties, air cleaning and the regulation of humidity should be promoted widely considering human safety and well being.

The sector can benefit by developing wood-based systems that allow for easier maintenance of house interiors or of office or garden furniture. Highly flexible, multi-functional materials and product systems can offer a route to more efficient and lower-cost renovation and modernisation for interiors. And with the appropriate solutions, wood and wood-based systems can even take into account that owners' and users' expectations can change over the lifespan of the function provided. In this context, consumers highly appreciate the intrinsic environmental and health aspects of consumer goods, furniture and wood-based interior furnishings.
Future solutions can enhance wood as an excellent material focusing on industrial hygiene areas and even developing the potential of the natural antiseptic properties of wood.

EXPECTED ACHIEVEMENTS

- New generations of wood-based interior systems solutions in private, public and industrial buildings.
- Wood and wood-based materials are fully appreciated by European citizens and form an integral part of every day life because of their renew ability, qualities, environmental friendliness and flexibility.
- Wood-based products provide comfort and contribute to the well being of the growing number of elderly people, small families and singles.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- "Learning from nature" in view of surface properties (Lotus effects, water repellence, hydrophobicity, self-cleaning, antistaticity), durability (environmentally friendly preservatives) and mechanical behaviour (elasticity, strength, shape stability).
- Development of methods for matching the life span of wood and other material components (holistic approach, risk of failure, life cycle cost, life cycle planning, sustainability and durability assessment) to functional needs of the products.
- Multi-material concepts and -functionality in using wood in interior applications, furniture and everyday life products.
- Development of system solutions in buildings providing high flexibility with respect to change of use (ageing inhabitants, new inhabitants, growing-up children).
- Clarification of the role of wood in improving indoor climate and reducing the "sick building syndrome".
- Development of methods for industrial utilisation of the anti-bacterial properties of certain wood species.
- Perception studies and the development of strategies to communicate the advantages of wood (aesthetics, challenging interior-architecture, and sustainability) to designers and end-users.

CHARACTERISTICS

Character of work: basic research, applied research, demonstration

Major competences needed: social sciences, material science, surface science, architecture, systems engineering, physics, biology, chemistry, process engineering, computer science, ergonomics, economics

Links to ongoing major projects:

- COST Action E29 "Innovative Timber & Composite Elements / Components for Buildings"
- COST Action E30 "Economic Integration of Urban Consumers' Demand and Rural Forestry Production"
- COST Action E44 "Wood Processing Strategy"
- COST Action E49 "Processes and Performance of Wood-based Panels"
- COST Action E53 "Quality Control for Wood and Wood Products"
- CEI-Bois Roadmap 2010 "Living with wood" process

RATIONALE

An increased share of wood-based materials in construction, family-houses and multi-story buildings leads to a sustainable living environment and a better quality of life for European citizens.

Novel building concepts (e.g. sound and thermal insulation, fire protection, hazard safety) will increase the amount of wood used for the construction of single and multi-storey houses, dwellings and office buildings. In addition, wood will be widely used for cost-efficient erection of large-scale constructions with high quality and standards. Advanced building concepts incorporating protection by design will minimise the use of wood preservatives.

Modern construction methods (e.g. pre-fabrication, gluing or joining at the construction site, system solutions) will speed up the building process and help to reduce building costs.

Multi-material solutions will lead to wood-based building products with improved properties in terms of strength, shape stability, durability, hydrophobicity, self-cleaning and anti-static aspects.

EXPECTED ACHIEVEMENTS

- Cost-efficient construction systems have increased building with wood in Europe and contributed to the quality of life of its citizens.
- Wood-based system solutions allow a choice of materials meeting the durability and sustainability demands of constructions.
- Wood-based building and construction materials harmonise with non-wood materials in new types of building concepts.
- Architects and public builders appreciate the advantages of using wood in building operations.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Advanced prefabrication systems for efficient rapid and flexible building.
- A holistic approach for developing building systems, which address individuality, composition of families and their changes over time, barrier-free living (e.g. handicapped or elderly people), ergonomics, communication, mobility, and safety aspects.
- Efficient planning and IT-based logistics concepts for rapid industrialised building.
- Revision of timber building performance requirements, regulations and standards based on research results.
- Advanced concepts for perfection of acoustic, durability and strength aspects, as well as fire resistance and reliability aspects (standardisation, labelling, certification) of wood constructions.
- Further development of methods for producing large wooden structures, including appropriate measures for joining and gluing of components at the building site.
- Enhancing the use of European hard woods in structural applications and buildings.
- Development of quickly assemblable pre-fabricated houses for disaster management.
- Development of advanced building concepts incorporating protection by design.
- Smart services facilitating renovation, restoration and reinforcement of building structures.
- Development of harmonized methods for monitoring the carbon-pool created by wood products in use and along the forestry-wood chain.

CHARACTERISTICS

Character of work: basic research, applied research, demonstration

Major competences needed: civil engineering, architecture, physics, process engineering, town planning, life-cycle assessment, social science, materials science, solid mechanics, logistics

Links to ongoing major projects:

- COST Action E29 “Innovative Timber & Composite Elements/Components for Buildings”
- COST Action E31 “Management of Recovered Wood”
- COST Action E34 “Bonding of Wood”
- COST Action E37 “Sustainability Through New Technologies For Enhanced Wood Durability”
- COST Action E40 “Innovative Utilisation and Products of Large Dimensioned Timber Including the Whole Forestry-Wood-Chain”
- COST Action E49 “Processes and Performance of Wood-Based Panels
- CEI-Bois Roadmap 2010 “Building with wood” process

RATIONALE

Forests generate a vast range of products and services, but currently mostly only wood and cork contribute to the financing of forest maintenance and to the profitability of forestry. In many European regions this situation causes forest abandonment, which is a threat to future forest stability and an obstacle for developing better options, also regarding employment and rural development. The lack of the economic incentive to provide recreational or environmental services hinders the efficient provision of these services. The importance of forest externalities is systematically underestimated in relation to their total economic value. Therefore, it is of utmost importance to develop and apply adequate methods to assess the real value of the non-wood forest products and services, to take them into account in environmental policies, and to facilitate the creation of a market system for these products and services.

EXPECTED ACHIEVEMENTS

- A scientific basis for valuing goods, benefits and services of forests.
- Options for assuring an optimum offer of externalities to society (transforming into a regular economic activity, regulations, public subsidies, etc.).
- Evaluation of the efficiency of payment schemes for environmental services, as a key challenge in the internalisation of positive and negative environmental effects.
- Innovations for promoting recreational, health and environmental services, as well as a labour and tourism market provided by forest owners.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Developing and improving product concepts and integrated production methods as a basis for marketing non-wood forest products (water, foliage, berries, herbs, etc.).
- Developing new valuation methods for assessing the socio-economic impacts of forest externalities, including negative externalities affecting forests.
- Options of transforming current externalities into recreation, health or environmental market services, including water and carbon services and tourism in rural areas.
- Improve offer of services for diversifying tourism in rural areas.
- Adapting cork growing for end products, efficient operations, supply-chain management as well as alternative uses of cork.
- Benefit transfer (internalisation) for forest functions and externalities.
- Innovation and research supporting infrastructures and training related to non-wood forest goods and services.

CHARACTERISTICS

Character of work: applied research

Major competences needed:
forest and environmental
economics, policy sciences, social sciences

Links to ongoing major projects:
- COST E33 and E39

RATIONALE

Increasing the share of bio-fuels in the transportation sector, and thereby decreasing the dependence on petroleum oil, is one of the most important and challenging goals of current EU energy policy. A large part of the bio-fuels is expected to be produced from domestic sources. The European forest-based sector has the potential to become the major player in the field of European bio-fuel production. Present-day first-generation domestic bio-fuels, such as rapeseed methyl ester require significant subsidy, whereas advanced processes, such as those based on gasification of forest biomass, could produce bio-fuels at near-competitive prices, even in today's fuel market. Implementation of this EU policy will enhance the sustainability of European society from the points of view of the environment, of energy supply and of employment.

EXPECTED ACHIEVEMENTS

- A prospering, new and significant business area based on the production of second-generation transportation bio-fuels from forest-based biomass.
- The processes, upon which the new business is based, will be developed to operate reliably and efficiently for a wide range of forest-derived feed-stocks. These feed-stocks include biomass obtained directly from forests and tree plantations, mill residues and certain fibre and wood containing streams of waste sorting operations. In-depth assessments will have been made to determine the most suitable feed-stock mix in typical situations.
- The efficiency of forest-based bio-fuel production is maximised, whenever possible, by integrating the energy system of the conversion process with that of an energy-consuming manufacturing facility, e.g. a paper mill, thus enabling efficient utilisation of the by-product energy of the conversion process.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Development and demonstration of processes for producing primary bio-oils that can serve as intermediate energy carriers in bio-fuel production chains (distributed bio-oil production, centralised bio-oil conversion to transportation fuel).
- Development and demonstration of processes for accomplishing the conversion of primary bio-oils into transportation bio-fuels.
- Demonstration of technology for producing ethanol from low-grade fibre-containing wastes.
- Development and demonstration of technologies for producing synthesis gas from a range of forest-derived feed-stocks. Demonstration of the further conversion of the synthesis gas into various second-generation transportation bio-fuels: Fischer-Tropsch liquids, methanol, dimethyl ether, synthetic natural gas, hydrogen.
- Choice of the preferred transportation bio-fuels based on techno-economic studies, life-cycle analyses, engine testing, demonstration with car fleets, etc. (petroleum-industry and car-industry stakeholders will have to carry the main responsibility).
- Development and demonstration of any required new distribution infrastructure (petroleum-industry stakeholders will have to carry the main responsibility).

CHARACTERISTICS

Character of work: applied research (experimental, techno-economic assessment, system studies), demonstration, business studies

Major competences needed: chemical engineering (fuel conversion, pulp and paper manufacture, petroleum refining), mechanical engineering (automobile manufacturing), economic sciences

Links to ongoing major projects:

- EU FP6 Integrated projects and STREP projects "CHRISGAS, RENEW, NILE, BIOCOUP"
- ERA-NET NoE "Bio-Energy"

RATIONALE

New types of forest-based value chains can be based on the bio-refinery concept. A key element here is the close integration of chemical pulp manufacture with the production of bio-fuels and different base or platform chemicals. An essential further element is then (besides using the pulp in papermaking) the conversion of the isolated chemicals and fibrous elements to value-added specialty chemicals and other products, as described in the Research Areas 1-9 and 1-10. As a whole, this would respond to the demands on increased production of bio-fuels and increased overall use of renewable raw-materials (including different types of residues and wastes).

EXPECTED ACHIEVEMENTS

- Full-scale realisation of the zero-waste bio-refinery concept for the production of base or platform chemicals and bio-fuels alongside with chemical pulp production.
- Realisation of similar processes for the handling of different forest residues, bark, and other materials without being integrated with pulp production.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Determination of how to get the best value from a combination of pulp, base or platform chemicals, and bio-energy in the wood bio-refinery.
- Development of the advanced production of specific pulp grades and modified cellulose (for high-value applications) as a part of the bio-refinery concept.
- Determination of the optimal or alternative uses of the side streams in existing pulp mills to produce bio-fuels, base or platform chemicals and feed-stocks for new materials.
- Development of more selective and milder reaction conditions for wood constituents or their products, such as low temperature delignification, novel pulping processes, and enzymatic processes, for the higher specificity of the desired compounds.
- Development of means to enhance the formation of specific substances directly in the pulping processes, e.g. by catalytically or biotechnologically assisted derivatisation reactions.
- Development of new and selective fractionation and isolation methods for various wood constituents and their degradation products (from pulping spent liquors), based on high-performance membrane technologies, ionic liquids, supercritical fluids, chromatographic techniques, and other emerging means.
- Application of the isolation methods on wood and spent liquors from chemical and mechanical pulping.
- Use of pulping spent-liquor components for chemicals and for gasification to methanol/dimethyl-ether, to be used both as a chemical feed-stock and vehicle fuel.
- Development of thermochemical processes, such as steam explosion and pyrolysis, for the production of base or platform chemicals from wood and different types of forest residues.
- Development of small-scale, local bio-refinery units (more typically not integrated with pulp production).
- Development of new analytical and sensoric tools for production control and simultaneous on-line quality monitoring.
- Demonstration of the separation and conversion processes, before their full-scale realisation.
- Established product portfolios for specialty chemicals derived from different European tree species, tree parts and non-wood goods.

CHARACTERISTICS

Character of work: applied research, process design (fractionation, separation), demonstration project(s)

Major competences needed: process technology, chemistry, bio-technology, separation sciences, chemical engineering

RATIONALE

Large quantities of different types of base or platform chemicals can be isolated or produced from wood, pulping liquors and different types of forest residues in bio-refineries (Research Area 1-8). Their upgrading to value-added specialty chemicals would form an essential basis for new types of forest-based value chains. This would create new business opportunities and expanding markets, and would significantly reduce society's dependence on oil-derived chemicals and materials.

EXPECTED ACHIEVEMENTS

- A wide variety of value-added specialty chemicals from the base chemicals derived from wood bio-refineries (Research Area 1-8) form the basis for new forest-based value chains.
- Significant advances in modern organic synthesis, catalytic processes, biotechnology, and nanotechnology, as required for the above manufacturing processes.
- Established product portfolios for specialty chemicals derived from different European tree parts and non-wood goods.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

Specialty chemicals from pulping spent liquors:

- Development of conversion processes for different compounds or compound types to be isolated from chemical and mechanical pulping spent liquors: lignin, hemicelluloses, their degradation products, and other compounds.
- Development of novel catalytic and enzymatic reactions, also based on the potential of nanotechnology.
- Determination of the most valuable ways to utilise lignin and lignin fragments, for example as a macromolecule through derivatisation (adhesives, antioxidants, surfactants, chelants, synthetic lignosulphonates, etc), and as a source of aromatic specialty chemicals.
- Application of the spent liquor-derived hydroxy acids in the manufacture of nutraceuticals, surfactants, descaling agents, specialty polymers, and other products.
- Application of the hemicelluloses and their fragments to make pharmaceuticals, nutraceuticals, perfume compounds, and other value-added products.
- Demonstration and full-scale realisation of the separation and conversion processes.

Specialty chemicals from cellulose:

- Development of new and improved cellulose-based chemicals with specific properties, particularly for various technical applications and for the medical, health, pharmaceutical and food sectors.
- Development of multifunctional cellulosic micro- and nano-particles with controlled shapes, structures and morphologies.

Specialty chemicals from miscellaneous wood and non-wood constituents:

- Determination of the most attractive and value-adding applications and conversion routes for the miscellaneous, unique compounds present in bark, knots, herbs, foliage, and other forest residue materials and non-wood goods. These include sterols, suberin, nutrients, prenols, flavonoids, tannins, stilbenes, lignans, and other aromatic compounds. Potential applications include pharmaceuticals, nutraceuticals, cosmetics, and others.
- Development of new applications for currently available wood-derived extractive fractions (such as tall oil and turpentine).
- Execution and constant updating of market studies for forest-based specialty chemicals.

CHARACTERISTICS

Character of work: fundamental and applied research, product and process design, demonstration

Major competences needed: organic synthetic chemistry, catalytic chemistry, process engineering, nanotechnology, bio-technology, polymer chemistry, chemical technology

RATIONALE

The physical and chemical characteristics of wood and its constituents make it an excellent resource for a large number of differentiated materials, in addition to today's wood and paper products. An increased and advanced use of wood constituents for composites and other materials would expand existing value chains and also form an essential basis for new types of forest-based value chains.

EXPECTED ACHIEVEMENTS

- New types of composites based on wood, fibres, and different wood constituents are available.
- High-performance wood and wood-based products are available for the construction and furniture sectors.
- Advanced, functional cellulose-based materials with specific properties are used for technical and life sciences applications. Specific materials prepared from lignin and hemicelluloses are used in industrial applications.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

Composites:

- Use of material sciences for the development of new types of composites, based (exclusively or partially) on wood, pulp, cellulose, lignin, or hemicelluloses, including their derivatives.
- Manufacturing technologies, including for example moulding, shaping, compounding, melt blowing, and electro spinning.
- Establishment of application areas, such as medical, health, pharmaceutical, and food sectors, and fields such as electronics, construction, furniture, vehicles industry, textiles, packaging and specialty papers.
- Utilisation of natural wood nano-structures as template for silicon- and other ceramics.

Wood-based materials:

- Development of high-performance wood-based products (engineered wood, light-weight panels, light-weight wood-concrete elements, etc) for application in the building and furniture sectors.
- Development of methods for actively influencing and advancing the natural anti-septic properties of some wood species.
- Activation and modification methods for wood particles like flakes and chips, to realize tailor-made wood-based materials.

Cellulose and cellulose-derivatives materials:

- Engineering concepts and technologies for cellulose processing, such as melting, solid-state processing, and moulding.
- Finding new routes of cellulose micro- and nano-scale structure formation, to reach structures with specific functionalities. Main application areas include technical (such as smart materials, sensors, electrical conductivity) and medical, health, pharmaceutical and food sectors.
- Development of new functional fibres, films, barriers, separation materials and highly porous morphology materials from chemically processed cellulose.

Lignin and hemicellulose materials:

- Development of high performance lignin fibres and lignin-based carbon fibres for reinforcement and for ceramics for specific applications, such as catalysts, gas purification systems, gas storage, and many others.
- Development of films, barriers, membranes, hydrogels etc. from hydrophilic and amorphous hemicelluloses.
- Utilizing the specific properties of hemicelluloses to modify pulp and various polymeric materials.

CHARACTERISTICS

Character of work: basic research and applied research, product and process design, demonstration

Major competences needed: physical and polymer chemistry, process technology, nano-technology, materials sciences, process design, product characterisation

RATIONALE

The handicaps of the existing processing technologies for pulp and paper manufacturing – e.g. very high capital intensity and inflexibility – have to be changed. Dynamic and flexible responsiveness to new market needs and ability to quickly implement innovations will be key success factors in the competition with other sectors. This must be a design criterion for future manufacturing concepts. Competitiveness will be increasingly dependent on the overall efficiency of a whole manufacturing chain from raw material to the end product. This encompasses integration of production stages, storage and logistics.

EXPECTED ACHIEVEMENTS

A new manufacturing concept which:

- Is based on flexible and simplified processes, integrated manufacturing concepts and enhanced capital efficiency.
- Uses information technology for comprehensive management of on-demand manufacturing concepts and smart logistics systems.
- Facilitates introduction of new technologies for product personalisation and customisation.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

A new manufacturing paradigm:

- Research on system integration of product innovation and process development processes (innovation networks), higher integration of the production chain (production networks).
- Research for definition of optimum capacity of production units based on location and infrastructure, material supply and product market, transport and logistics.
- Development of capital and material-lean production concepts and simplified unit processes.

New technologies for enhancing innovation:

- Research on application of new technologies (e.g. bio-technology, nano-technology) on pulp and paper production processes.
- Development of new technical options for small-scale, efficient production equipment for personalisation, customisation and niche-type products.
- Reduction of capital employed by using ICT for higher automation of production and supply chains (e.g. enhanced sensors, concurrent design of material and information flows, data mining and decision support).

Flexibility of production units:

- Research on modular concepts and equipment for providing new technical options for efficient, small-scale production.
- Development of unit processes, which allow wide operating windows and different operating modes (examples are fractionation, multilayer forming).
- Development of ICT-tools for control systems of smart logistics and on-demand production.

Cost efficiency of production:

- Development of simplified and compact unit processes having reduced maintenance needs.
- Development of process-modelling and simulation tools for improving process control and stability.
- Research on enhanced understanding of man-machine interaction.
- Development of advanced remote diagnostics tools for increased process availability.

CHARACTERISTICS

Character of work: basic research, applied research, demonstration

Major competences needed: ICT, fluid and solid mechanics, nano-technology, bio-technology, mechanical engineering, complex systems science

Links to ongoing major projects:

- Integrated project ECOTARGET
- COST Action E36 “Modelling and Simulation in the Pulp & Paper Industry”

RATIONALE

Getting "more-from-less" has become an overriding criterion for industrial operations. Society emphasises a sustainable use of renewable materials and industry wants to increase its competitiveness by reducing costs of raw materials and transportation. Fine-tuning of current processes is not enough. Clear reduction in the amount of materials used in paper products is possible only through new manufacturing technologies and product designs. The use of chemicals, pigments and water must be minimized and better use must be made of all wood components. Paper products must be developed for new applications where it replaces non-renewable materials.

EXPECTED ACHIEVEMENTS

- A new generation of fibre-based materials and products where the desired functionalities are achieved with significantly lower consumption of raw materials than to date.
- Reduced use of oil-based chemicals and non-renewable pigments.
- Sheet structures and converting operations that enable paper to replace non-renewable materials.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

Development of technologies that give more performance from the wood raw material:

- Pulping technologies that yield more fibres and non-fibrous fine particles.
- Simulation models and analytical tools to maximize the output of pulping processes.
- Technologies that protect fibres against damage during processing.
- Fibre modification techniques that add functionality: grafting, use of biotechnology, nanotechnology, etc.

Development of manufacturing concepts that:

- Maximize the contribution of all furnish components through e.g. layered structures.
- Minimize water use and extended recycling of process wastes.
- Use of biotechnology instead of chemicals and wood-based components instead of mineral pigments.
- Maximize process stability through on-line sensors, process control and simulation.

Development of manufacturing and converting technologies that enable the use of paper for new applications:

- Simulation of paper-sheet properties and sheet behaviour in new applications.

CHARACTERISTICS

Character of work: basic research, applied research, development, demonstration

Major competences needed: surface science, physics, chemistry, nano-technology, bio-technology, modelling and simulation, process engineering

Links to ongoing major projects:

- Integrated projects ECOTARGET and SustainPack
- COST Action E 36 "Modelling and Simulation in the Pulp & Paper Industry"

RATIONALE

The overall energy efficiency of the manufacturing processes of the pulp and paper industry must be significantly improved. This improves the cost competitiveness and results in an increased potential to provide bio-energy for external uses.

Big energy savings can be realized both by improving current processes and by developing less energy consuming, breakthrough technologies to replace the energy intensive processes in e.g. mechanical pulping, mechanical fibre treatments and drying. These technologies can use, for example, biotechnology and ultra-high solids or dry processes. Efficient energy recovery should be a key design criterion and advanced process control technology used for enhancing energy efficiency.

Strategic energy management tools need to be developed for optimised integration of energy generation, consumption, conversion and recovery in order to achieve the best combination of economic, environmental and societal benefits.

EXPECTED ACHIEVEMENTS

- Strategic energy management concepts will enable an efficient integration of energy consuming, converting and recovery technologies
- Less energy consuming breakthrough technologies will replace the energy intensive technologies in mechanical pulping, refining, forming, pressing and drying. These will, for example, use biotechnology and ultra high solids or dry processes.
- Efficient energy recovery will be a key design criterion for production processes.
- Advanced process control technology will enhance energy efficiency.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

Introduction of strategic energy management concepts:

- Development of new concepts for process-integrated energy production, conversion and distribution.
- Development of integrated energy utilization concepts covering the whole pulp and paper manufacturing process, striving for maximal energy efficiency and maximal product application in energy terms. Integration to other value-chains via the bio-refinery concept etc.
- Development of investigation and simulation tools for balancing energy use of process steps in relation to production efficiency and product properties .

Development of breakthrough technologies for significantly reduced energy consumption:

- Bio-technological pre-treatment (e.g. fungal or enzymatic) for high-yield pulping processes.
- High-consistency forming (> 10 %), dry (air) laid technologies etc.
- New pressing technologies (>50%-80% dry content).
- New drying technologies (e.g. impingement drying technology).
- New coating technologies (e.g. ultra high solid content (>85%), dry coating technologies).

Enhancing energy efficiency of present technologies and processes:

- Research to increase the energy efficiency in energy intensive pulping and papermaking process steps, in particular electricity-demanding processes (e.g. mechanical pulping, fibre treatment like refining, dewatering, machine drives, calendering).
- Research on optimal operational temperature levels of process steps.
- Establishing process integrated energy recovery installations e.g. from the non-paper fraction of recovered paper.
- Development of advanced process control technologies for enhancing energy efficiency.

CHARACTERISTICS

Character of work: basic research, applied research, development of technologies and tools, demonstration

Major competences needed: energy technologies, process technologies, ICT, chemical science, bio-technologies, complex system science

Links to ongoing major projects:
Integrated project ECOTARGET

RATIONALE

Primary wood processing (sawing, cutting, slicing) involves very diverse processes for the production of semi-products. Further research in this area can deliver innovative and safe production processes that fit to integrated production concepts along the value chain.

Advanced sorting and grading systems for round-wood and advanced processing technologies lead to an optimised material efficiency and a more reliable production. Technologies can also be developed to produce new panel-type products and three-dimensional materials. In addition, improved processing techniques can be adapted to the specific requirements of novel products, helping to enhance material efficiency.

The speed of production would increase considerably and specific energy consumption could be reduced through the introduction of new concepts such as techniques to make wood drying faster.

EXPECTED ACHIEVEMENTS

- Woodworking industries have considerably improved their competitiveness compared to non-wood raw material based sectors due to their cost-efficient and added-value manufacturing.
- New generations of wood-processing technologies are available for production of high performance products.
- Europe's woodworking machinery suppliers have consolidated their leadership and continue to export goods and services worldwide.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Development of low energy and faster wood-drying processes.
- Development of biotechnological, chemical, physical (thermal, plasma, mechanical) treatment processes for improving properties of wood for wood-based panel and board productions.
- Non-destructive methods for detection of inherent wood properties (classification for special applications, grading of logs, beams and boards, scanning and 3D-technologies).
- Integration of testing and evaluation models for material efficiency into production processes.
- Noise and dust reduction in wood processing operations and securing high safety and health standards at workplace.
- Optimisation of processes towards production of low-emission building materials, e.g. panels and boards.
- Techniques and agents to create durable bonds between wood and other materials, in green and dry condition, in the factory and at the building site.
- Environmentally friendly wood preservation and surface treatment.

CHARACTERISTICS

Character of work: basic research, applied research, demonstration

Major competences needed: physics, chemistry, process engineering, materials science, chemical engineering, mechanical engineering, ICT

Links to ongoing major projects:

- COST Action E31 "Management of Recovered Wood"
- COST Action E44 "Wood Processing Strategy"
- COST Action E49 "Processes and Performance of Wood-Based Panels"

RATIONALE

New manufacturing techniques enhance the performance of existing products and also can lead to new ones, which will boost overall consumption of wood.
Secondary wood processing also offers potential in terms of integrating existing systems, as well as developing processes that incorporate advanced predictive tools in conjunction with novel quality assessment techniques.

Several areas have already been identified as ripe for development. Examples are thermal smoothing, the application of specialized high performance cutting and planning tools, novel hardening and multi-functional protection techniques, innovative 3-D cutting and forming processes, improved gluing techniques and advanced processing of multi-composite materials.

These advances lead to more efficient wood use, improved product characteristics and new functionalities created by re-engineering particles, flakes, veneers, sawn timber or by chemical, thermal or mechanical modification technologies.

EXPECTED ACHIEVEMENTS

- A new generation of efficient and flexible manufacturing techniques of wood-based products with functionalities adapted to the needs of the building and furniture sectors as well as every-day needs.
- Treatment methods for improving properties and behaviour of wood-based materials.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Development of efficient manufacturing concepts for construction materials based on wood.
- Development of technologies for using the self-bonding mechanisms of wood constituents and the shaping of wood properties for the production of new types of wood products (e.g. panels, boards for load-bearing applications, furniture).
- Development of lightweight wood-based products and combinations of wood with other materials for application in the building and furniture sectors.
- Development of concepts for bonding, joining or connecting structural wood elements with other building materials.
- Development of solutions improving the durability and shape stability of wood (biological attack, fire resistance, shrinkage, distortion, etc.).
- Development of test methods for wood durability and efficiency of wood preservatives, which reflect real life conditions for wood products in use.
- Development of multifunctional and low maintenance surface treatments and finishing systems (antistatic, nano-coating, nano-film technology).

CHARACTERISTICS

Character of work: basic research, applied research, demonstration

Major competences needed: chemistry, physics, process engineering, chemical engineering, ICT

Links to ongoing major projects:

- COST Action E29 “Innovative Timber & Composite Elements/Components for Buildings”
- COST Action E34 “Bonding of Wood”
- COST Action E44 “Wood Processing Strategy”
- COST Action E53 “Quality Control for Wood and Wood Products”

RATIONALE

Through major technological improvements in bio-energy conversion to heat and power, including methods based on upgraded intermediate products, it would be possible to (1) accelerate the decrease in the share of fossil fuels used in the forest-based industrial sector, (2) to significantly increase the electricity-generation efficiencies of large-scale combined heat and power (CHP) plants fired by forest-derived fuels and (3) to considerably increase the amount of heat and power produced from forest biomass in small-scale industrial, communal and household plants. The overall impact would be to substantially increase the total amount of heat and power produced from forest-based biomass in Europe and to thereby enhance the sustainability of European society from the points of view of the environment, of energy supply and of employment. The European forest-based sector has the potential to become the largest producer of bio-electricity ("green" electricity) in Europe.

EXPECTED ACHIEVEMENTS

- Vastly improved and fully competitive processes for heat and power production from forest-derived biomass:
  - The feed-stocks will include: biomass obtained directly from forests and tree plantations, mill by-products such as black liquor and bark and certain fibre and wood containing streams of waste sorting and recycling operations.
  - The processes will cover a wide range of capacities and types, including processes based on production and utilisation of such upgraded intermediate energy carriers as leached chips, pellets, precipitated lignin, fuel oil and fuel gas.
- Utilisation of fossil fuel in the European forest-based sector will be brought down to a very low level; today's level corresponds to about 50 % of total fuel consumption.
- Revenue from bio-electricity production will be at least one order of magnitude higher than it is today, due both to a much higher output and to a significantly higher production efficiency.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Life-cycle assessment of the environmental costs and benefits of the utilisation of forest residues and biomass from coppices for heat and electricity production, at the local and regional level.
- Development and demonstration of novel and compact processes for converting forest-based biomass into intermediate energy carriers for various applications including:
  - Supplying fuel for existing on-site boilers and kilns currently fired by petroleum-derived fuel oil or by natural gas.
  - Providing saleable by-products for mills with excess on-site bio-energy.
  - Serving as integral parts of novel small-scale CHP plants with high electricity-generating efficiencies.
- Development of advanced black-liquor-fired recovery boilers with electricity-generating efficiencies significantly higher than those of present-day standard.
- Significant improvement of fluidised-bed boilers to achieve high steam values (power outputs) with difficult-to-handle forest-based biomass fuels, e.g. fuels which yield fly ashes that have low melting temperatures.
- Development and demonstration of small-scale biomass-fired power plants based on novel electricity-generating techniques; e.g. fuel cells.
- Development and demonstration of advanced gasification combined-cycle technologies for both black liquor and solid forest-based biomass.
- Development and demonstration of an advanced process to competitively produce synthetic natural gas from forest-based biomass, with the aim to partially substitute natural gas in existing grids.

CHARACTERISTICS

Character of work: applied research (experimental, techno-economic assessment, system studies), demonstration

Major competences needed: chemical engineering (fuel conversion, pulp and paper manufacture), mechanical engineering (power-plant engineering), economic sciences

Links to ongoing major projects:

- EU FP6 Integrated projects and STREP projects " BIGPOWER, BioCellus, Green Fuel Cell, NETBIOCOF"
- ERA-NET "NoE Bioenegy"

RATIONALE

On the global scale, tree plantations are expanding rapidly, often in climates and on soils which are more favourable than many forest sites within the EU. To be able to meet competition it is vital for the European forest-based sector to increase its forest production in terms of volume, quality and efficiency. Due to the rapid emergence of biotechnologies, knowledge about gene function, tree genomes and populations, novel breeding strategies have the potential to offer the most efficient and environmentally least disturbing measure to accomplish an increase in production, economic yield and availability of forest biomass, and at the same time reduce the vulnerability of trees towards climatic changes, hazards, pests and diseases. Since the use of genetically modified tree species is a subject of concern, in-depth research is needed in order to find commonly accepted applications.

EXPECTED ACHIEVEMENTS

- Leadership in quantitative and bio-technological sciences related to forest tree improvement.
- Improved understanding of any risks related to economic performance, social acceptance and environmental effects associated with the use of genetically improved trees.
- Better understanding of how wood and fibre properties in growing trees can be modified.
- Strategies for sustainable forestry plantations and tree farming to utilise genetically improved trees under various growing conditions and for different purposes.
- A large increase in productivity and improvement in specific traits.
- Significantly reduced losses due to improved resistance and tolerance to biotic and abiotic constraints.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Development of efficient breeding strategies that include molecular tools aiming at sustainable and high-yield of trees.
- Identification of superior genotypes, including the determination of their stability in variable environments.
- Elucidating temporal stability of trait expressions in superior genotypes.
- Identification and functional analysis of tree genes.
- Studies of molecular, biochemical and physiological processes, determining wood and fibre properties, pest and disease resistance, water and nutrient biology.
- Application of flowering biology for abundant and early propagation of trees.
- Development of technologies for mass propagation through sexual and vegetative methods for the economically most important tree species.
- Elucidation of signal pathways and components required for expression of genes important in tree improvement.
- Genetic engineering of growth and quality of trees, wood and fibre characteristics, adaptive traits and resistance/tolerance to biotic and abiotic constrains.
- Development of tools to perform risk analysis for novel varieties and genotypes of trees.
- Assessment of the economic, social and environmental risks associated with use of genetically modified trees.

CHARACTERISTICS

Character of work: basic research, laboratory and field testing

Major competences needed: molecular biology, genetics, wood chemistry, pathology, tree physiology, systems ecology, silviculture

Links to ongoing major projects:
Integrated project EvolTree

RATIONALE

Forestry and forest-based industries in Europe differ in their focus from region to region due to differences in natural conditions, ownership, industrial structure, markets, social demands etc. To maintain and strengthen the competitiveness of the European forest-based sector it is crucial to secure a high-quality raw-material supply. Improved wood-supply systems and forest management models are therefore needed. The links between forest owners and the industrial users of wood need to be strengthened in most parts of Europe.

By providing raw materials, which are "tailor made" for various end uses and by developing efficient and environmentally friendly forest operations, transport systems and management models for wood-supply chains, it will be possible for the forestry sector and forest-based industries to maintain their viability and increase profitability. It will also facilitate to accomplish the European goals concerning an increased use of renewable energy sources.

EXPECTED ACHIEVEMENTS

- Forest management and wood-supply systems improving the integration along the value chains from forest to end product, shortening lead times, increasing capital turnover and profitability.
- Considerable added value through tailoring raw materials for end products and significant cost reduction as a consequence of more effective operations and logistics.
- Novel wood-quality assessment based on latest IT techniques in forest-operations and at production sites for early measuring and identification of raw-material properties.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Mapping of forest resources with respect to quantity, dimensions, quality and specific properties using field measurements, geographic information systems and novel remote sensing techniques.
- Development of new and improvement of existing techniques for non-destructive and non-touching measuring and modelling methods for assessment of stem and round-wood properties.
- Provision of new systems for marking and coding of stems and round wood allowing follow-up throughout the chain of custody.
- Development of "intelligent", semi-automatic forest operation systems and new solutions for the interface between man and machine aiming at increased productivity, improved energy efficiency, reduced negative environmental impacts and better working conditions.
- Development of logistic and decision support systems for optimized supply chain management, optimizing transport operations for delivery of tailor-made raw-materials to satisfy customer specifications.
- Development of systems for efficient organization of forest work and of models for education and training of contractors and other labour force.

CHARACTERISTICS

Character of work: applied research, demonstration

Major competences needed: forest assessment, information technologies, forest engineering, physics, measurement engineering, logistics, IT, environmental and social sciences, work science, forest economics

Links to ongoing major projects:
Integrated project EFORWOOD

RATIONALE

In Europe today, one of the main raw material sources for new paper products comes in the form of recycled paper. This material can be used and reused throughout its life circle from production and collection, through to recycling and eventually energy recovery.

New collection systems and raw material management concepts can boost the availability of recovered paper further. New processing technologies, quality and impact assessment tools and a more prominent role for recyclability criteria in product design can facilitate the well-balanced use of recycled fibres for a big variety of paper grades.

New applications outside the pulp and paper industry can offer utilisations for recovered material that can not be used for paper. All organic waste can be used for energy generation and energy products. These applications will help minimize the amount of residual waste and make a major contribution towards a sustainable European society.

EXPECTED ACHIEVEMENTS

- Consumers will have developed a deep awareness of paper recycling as a key contribution to a sustainable society.
- Recyclability of fibre-based products is a mandatory criterion of product design.
- Strategic raw-material management concepts will ensure optimal recovery of fibre-based material.
- Regionally optimised recovery structures have been established throughout Europe which ensure sufficient availability of recovered paper.
- Advanced technologies for the treatment of recovered products will ensure a techno-economical-ecological well-balanced total recycling or utilisation for energy recovery.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

Improving the management of material loops by:

- Research about material flows of the main paper products through production, conversion, retailing and households in various types of environments.
- Developing design criteria to ensure optimal recyclability of paper based-products.
- Development of improved collection systems adapted to regional requirements and optimized towards potential utilisation.
- Development of simulation-based decision tools for optimum choice of raw material from recovered paper in terms of product requirements (e.g. fit-for purpose), technology (e.g. sorting, cleaning, enhancement), economy (e.g. capital), ecology (e.g. transport, emissions) and societal boundaries (e.g. collection, employment).
- Development of concepts to utilize the full potential of the “urban forest”, i.e. the use of recovered fibre-based materials in densely populated areas for locally adapted production.

Optimization of recovery and recycling of used fibre-based materials by:

- Development of dry-sorting techniques and on-line methods for the characterisation of recovered paper, e.g. in terms of fibre potential.
- Development of new sets of trade standards to enable the use of recycled paper, constituents for highest possible paper grades.
- Research on the application of new technologies like bio-technology and nano-technology to facilitate optimal cleaning (e.g. separation, deinking, sticky removal) of recycled fibre pulp based.
- Research on enhancing the properties of recycled fibres using new technologies, e.g. nano-technology based fibre repair.
- Development of simplified concepts for recycled fibre treatment plants.
- Development of new external re-use applications for the non-paper fraction out-side the pulp and paper industry (for use in the bio-refinery concept, see Research Area 1-8)

CHARACTERISTICS

Character of work: basic research, applied research, demonstration

Major competences needed: chemical science, bio science, ICT, fluid and solid mechanics, logistics, complex systems science

Links to ongoing major projects:

- Integrated project ECOTARGET
- COST Action E46 “Improvements in the Understanding and Use of De-inking Technology”
- COST Action E48 “The Limits of Paper Recycling”

RATIONALE

Recycling channels provide access to a new raw material resource based on used wood products. This not only contributes to the overall sustainability of the European woodworking industry, it also helps to reduce greenhouse gas emissions by prolonging the carbon fixation. The substitution of materials produced from non-renewable resources provides additional environmental benefits. All this requires infrastructure developments. Logistics for the collection, sorting and cleaning of used wood materials have to be improved. Easily applicable identification and detection methods for chemical compounds in wood products are also needed.

EXPECTED ACHIEVEMENTS

- Advanced systems for recycling of wood products are in operation.
- Considerations on recycling form an integral part of industrial planning and of public and private building activities.
- A new generation of products based on recycled wood materials has gained full acceptance by the European citizens.
- Tools for easy identification and isolation of wood products at the end of their service life are available.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Development of advanced logistic systems for used wood products.
- Development of methods and techniques for identification, classification and separation of recovered wood from other materials.
- Development of techniques and systems for marking of treated wood allowing easy identification, separation and cleaning.
- Continuous analysis and monitoring of recycled wood material qualities, quantities and flows.
- Harmonised and standardised systems for estimating life cycle performance properties (lifespan, risk of failure) and life cycle costs in the construction, wood-packaging and furniture sectors.
- Development of chemical and technological pathways to use recycled wood materials as feedstock for “green chemicals” and for the production of new generations of products.
- Creating the technological capacity and regulatory framework to facilitate the use of recovered wood materials.

CHARACTERISTICS

Character of work: basic research, applied research, demonstration

Major competences needed: process engineering, physics, chemistry, biology, sustainability assessment, material science, systems analysis, market research, chemical engineering.

Links to ongoing major projects:

- COST Action E31 “Management of Recovered Wood”
- COST Action E44 “Wood Processing Strategy”
- COST Action E49 “Wood-based panels”
- CEI-Bois Roadmap 2010 ”Wood in sustainable Development” process

RATIONALE

In national, European and global forest policy processes, sustainability and multifunctionality are the guiding principles for the management of forests. The need for non-wood forest products and services is increasing in an urbanising society. The availability of wood-raw material for manufacturing products and for energy has become an important issue for the sector. At the same time, related mainly to the development of the agricultural policy and trade agreements, there is a space to expand the forest area in Europe.

In multifunctional forestry, the key challenge is to integrate environmental and social aspects into a forest management that is at the same time economically viable. Forest owners and managers need to be able to adjust land use strategies to a rapidly changing "business environment" characterised by increasing global competition, societal developments, technical innovations and new policies as well as to the economic frame conditions. They must also satisfy the needs a variety of stakeholders.

EXPECTED ACHIEVEMENTS

- A socially, politically and environmentally acceptable and economically viable management of forests, providing various forest for the needs of industry and society.
- An efficient monitoring, assessment and reporting on forest sustainability and multifunctionality for communication with society and policy makers.
- Means to allocate existing and new forest lands in an optimal way in order to find a balance between segregative and integrative approaches to multifunctionality.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Development of forest-management methods by applying novel tools based on advanced information and communication technologies, including adaptable criteria, indicators and standards. The methods shall help to balance multifunctional outputs from forests on various geographic scales, and take into account different degrees of integration and segregation.
- Development of advanced tools for forest monitoring and reporting, including performance targets, by utilising integrated information retrieval of geo- and biophysical parameters from various data sources for all relevant aspects of sustainability and multifunctionality.
- New land use and forest-management planning procedures with emphasis on a participatory approach, aiming to ensure socially accepted, sustainable and multifunctional forest management.
- Development of advanced planning methods including multi-criteria decision methods, multi-objective optimisation techniques and knowledge management schemes.
- Investigation of the effects of optional forest-management strategies on environmental services (carbon sequestration, water supply, soil protection, phytoremediation, nature conservation, provision of habitat for endangered species), on social services (human health, recreation, employment) and on protective functions (against soil erosion, avalanches, floods, noise, wind etc.) of forests.
- Development of land-use change concepts and options integrated into a broader context of rural development and land-use planning.
- Prediction of spontaneous afforestation processes which increase forested areas.

CHARACTERISTICS

Character of work: applied research, knowledge management

Major competences needed: management sciences, silviculture, biometrics, statistics and computing sciences, modelling, information and communication technologies, ecology, nature conservation, forest economics, etc.

Links to ongoing major projects:
Integrated projects EFORWOOD and FireParadox.

RATIONALE

The environment is changing at an unforeseen rate. This has an increasing impact on the functioning of natural, semi-natural and cultivated forests, the resources they supply, and the capacity of forests to mitigate pollution and climate change. To guarantee the vitality and biological diversity of the forest resources in the long-term, it is necessary to have a better understanding of how trees and forest ecosystems as a whole respond to climate change and other environmental changes. It is necessary to understand the impacts of these changes on forest productivity and environmental functions, and on the distribution of current and new forest tree and plant species and their communities.

EXPECTED ACHIEVEMENTS

- Better understanding of the role of biological diversity in maintaining the stability and primary production of forest ecosystems.
- A monitoring and modelling framework to analyse the consequences of environmental changes to biodiversity and the functioning of forest ecosystems.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Analysis of the role of biological diversity and other components, such as soil, water, animal, fungi and bacteria organisms, in maintaining and improving the stability and primary production of forest ecosystems.
- Deciphering the buffering capacity of tree species, including phenotypic plasticity, and genetic diversity to climatic changes with the aim of surveying and identifying genetic resources with new adaptive features.
- Forecasting future dynamics of forest biodiversity and of the geographic ranges of communities of forest-plant species.
- Quantifying, modelling and predicting the impacts of environmental changes on forest ecosystems, and their response mechanisms, by:
  - Building scientific infrastructures and knowledge of ecosystem responses to multiple environmental changes and their resistance and resilience to major disturbances.
  - Conducting long-term ecosystem monitoring and research at plot and landscape scale.
  - Predicting the impact of environmental changes on the mitigation potential and resource productivity of natural, semi-natural and man-made forest ecosystems.
  - Assessing the genetic expression, adaptive and vitality traits in trees.

CHARACTERISTICS

Character of work: basic and applied research, ecosystem monitoring

Major competences needed: ecology, biology, tree physiology, forest genetics, microbiology, entomology and phytopathology, soil science, information technology, forest biometrics

Links to ongoing major projects:

- EU FP5 STREP Project, Popyomics (Linking physiology, molecular genetics and genomics in Populus to understand and improve yield and quality for biomass and timber production across Europe),
- NoE EvolTree (Evolution of Trees as drivers of terrestrial biodiversity)

RATIONALE

Climate change is the key environmental driver for European forests, calling for novel silvicultural approaches that help adapt to changes. As a result of changing climate, more frequent natural hazards may occur. New management strategies and regimes taking into account the various risks under different environmental scenarios are needed to maintain and enhance the productive capacity of forest stands, to minimize the negative consequences on production of forests, but also to benefit from improved growing conditions in some regions.

EXPECTED ACHIEVEMENTS

- Novel forest management approaches that help to adapt to climate change.
- Field-tested adaptive silvicultural regimes to improve the resilience and production of forest ecosystems under changing environmental conditions.
- Forest-related risk information systems and land-use plans able to control and manage risk of natural disasters.
- Decision-support tools and methods, taking into account risk and uncertainty, for planning optimal silviculture in the future climate.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Investigation of the vulnerability of different silvicultural and management strategies (selection of native and exotic tree species, rotation age, etc.) towards various risks under different environmental scenarios.
- Development of adaptive forest-management approaches and silvicultural regimes to improve the resistance and resilience of forests, utilising decision support systems able to account for changing environmental conditions.
- Improving adaptive capacity for the reproductive material.
- Natural risk analysis for forest-related early warning systems.
- Silvicultural control mechanisms for minimising the consequences of fires, storms, pests, diseases, and other natural or man-made damages, including natural and artificial restoration.
- Economically sound wood-biomass production methods on afforested lands, and plantation regimes enhancing fibre production.

CHARACTERISTICS

Character of work: applied research, field experiments and testing

Major competences needed: ecology, tree growth, silviculture, management sciences, forest modelling, remote sensing, thermodynamics

Links to ongoing major projects:
Integrated projects FireParadox and Carbo Europe

RATIONALE

To assess the performance of the current forest-based sector in relation to European societal and industrial goals of competitiveness and sustainability, criteria and indicators for the economic, social and environmental dimensions constituting the concept of sustainability are required. New production concepts, technologies and changes in practices also need to be assessed against such criteria and indicators before they are put in operation. Access to commonly accepted tools for sustainability assessment helps the sector to direct its activities towards most sustainable production. They also serve as a tool for sound policy making. For benchmarking, sustainability assessments should also consider other sectors, such as steel and concrete, and other materials, such as aluminium and plastic. Assessments must in certain situations also include the further use of forest-based materials and products in other supply chains, like food and transportation.

Tools for sustainability assessment, and particularly criteria and indicators, need to be regularly reassessed due to changing conditions and values.

EXPECTED ACHIEVEMENTS

- Methods for measuring the performance of the sector as regards economic, social and environmental sustainability, including widely accepted criteria and indicators.
- Assessment of the sustainability of new production concepts and new practices.
- The forest-based sector is seen as leading in sustainability impact assessments.
- Methods for benchmarking the forest-based sector's products with those of competing industry sectors.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Development of criteria and indicators to assess sustainability of the sector and its sub-sectors.
- Development of tools for sustainability impact assessment.
- Assessment of the sustainability of current and new production systems, processes and practices.
- Comparison of the sustainability of forest-based products relative to products from other sectors.
- Exploring sustainability impacts of emerging policies, trade agreements, and other regulations.
- Assessing the sustainability of the sector under changing climate and other potential future developments (scenario studies).
- Assessing the sustainability of wood-based products imported to Europe.

CHARACTERISTICS

Character of work: applied research

Major competences needed: policy, sociology, technology, ecology, modelling, economy

Links to ongoing major projects:
Integrated project EFORWOOD

RATIONALE

The sustainable development and competitiveness of the forest-based sector is dependent on effective, coherent, efficient and knowledge-based governance arrangements and policy frameworks. Designing and/or adjusting governance arrangements, policy frameworks, policy instruments and mechanisms requires reliable data, systematic analysis and evaluation of what is working as intended or not. There is also a need for foresight studies addressing the whole sector as a background for decision making and policy formulation. Foresight studies also provide a basis for developing research strategies.

EXPECTED ACHIEVEMENTS

- Effective institutional arrangements that strengthen the development of the sector.
- Methods to develop and test new governance approaches and instruments (e.g. certification, contractual arrangements).
- Methods to assess existing and new instruments in view of their efficiency and effectiveness.
- A competence base for advanced foresight studies.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Analysis of the effectiveness of forest-policy tools and their implementation, such as regulations, informational means and economic instruments.
- Analysis of governance arrangements to support and strengthen innovation systems of the forest-based sector.
- Analysis of means to address the impacts of cross-sectoral challenges and instruments affecting the forest sector (energy, protected areas, agriculture, regional policies, land-use policies, transport, industrial policies etc.).
- Development of services, co-operations and organizational structures to overcome bottlenecks in resource mobilisation, especially due to the fragmentation of forest ownership.
- Analysis of participatory processes and strategic planning instruments embedded in capacity building structures.
- Comparative evaluation of participatory forestry and decision-making processes (including e-governance) and conflict-resolution schemes.
- Conducting foresight studies.

CHARACTERISTICS

Character of work: applied research

Major competences needed: policy sciences, social sciences, economics

RATIONALE

Understanding societal values and perceptions, their changes and underlying drivers, is essential for the competitiveness of the sector. Adequate forest management and marketing of forest products requires knowledge of the values and perceptions of different socio-economic and cultural groups towards forests and the total sector. The major driving forces impacting values and perceptions of society must be known for early adaptation in the sector.

Research on attitudes and behaviour regarding the sector serves as a valuable source for positioning it within the core of society's values. Communication strategies with stakeholders and end-consumers need to be backed up with research regarding opinions and values and in line with trends to further the role of Corporate Social and Environmental Responsibility.

EXPECTED ACHIEVEMENTS

- Knowledge at the European scale on values and perceptions of different social and economic groups of societies will help the sector to adapt to changes.
- Methods, which are able to identify weak signals of changes in attitudes towards forestry, utilisation of forests and forest products in general.
- Knowledge on the efficiency of various communication strategies applied and potentially applicable in forest-based sector.

EXAMPLES OF ACTIVITIES AND RESEARCH APPROACHES

- Analysis of driving forces behind the development of markets for forest and forest-based products.
- Analysis of perceptions and values related to the forest-based sector as a whole, including review of main cultural and spiritual values in societies in major market areas of the European forest-based sector. (Perceptions on specific product segments are dealt with within the respective Research Areas.)
- Methods to identity weak signals, major social changes and driving forces.
- Comparative evaluation of communication strategies used by the forest-based sector.

CHARACTERISTICS

Character of work: applied research

Major competences needed: sociology, social sciences

THE FOREST-BASED SECTOR

The European Confederation of woodworking industries (CEI-Bois) has been the main body representing the European woodworking industries from the EU since its foundation in 1952. CEI-Bois includes national members, as well as European trade organizations representing the different sectors of the woodworking industry. CEI-Bois counts among its members 8 European (sub-sector) federations and 25 federations from 21 European countries.

The turnover of the EU 25 woodworking industries was 165 000 million in 2003. The woodworking sector includes more than 100 000 companies and provides jobs to more than 2.7 million people in the EU 25.

CEI-Bois
Allée Hof-ter-Vleest 5/4
B – 1070 Brussels
Belgium
www.cei-bois.org

The Confederation of European Forest Owners (CEPF) is the voice of 16 million family forest owners in Europe. It is the only umbrella organization of national forest owner organizations in the European Union and brings forest owners from 23 countries (20 EU) around one table. It represents the interests of family forest owners vis-à-vis the European Union Institutions. Over 60 % of the total forest area in the European Union is owned by families.

CEPF's main objective is to foster reliable political framework conditions that enable long-term responsible investment in sustainable forest management by family forest owners.

CEPF
Rue du Luxembourg 47-51
B- 1050 Brussels
www.cepf-eu.org

The Confederation of European Paper Industries (CEPI) champions the interests of the pulp and paper industry in Europe, representing those interests towards the European Institutions. It monitors, analyses and acts upon EU legislation and initiatives relevant to industry, communicating the industry's achievements and the benefits of its products. Through CEPI, the paper industry makes expert and constructive contributions to the official European consultation process with industry. CEPI directly represents the National Associations of the paper industry in 17 member countries across Europe.

Through its member associations, CEPI represents 850 pulp, paper and board producing companies across Europe, ranging from small and medium sized companies to multi-nationals, including a total of 1250 paper mills. Together, they represent 29% of world production.

CEPI
250 Avenue Louise, box 80
B-1050 Brussels
www.cepi.org

Vision 2030

The European forest-based sector plays a key role in a sustainable society.

It comprises a competitive, knowledge-based industry that fosters the extended use of renewable forest resources.

It strives to ensure its societal contribution in the context of a bio-based, customer-driven and globally competitive European economy.

For further information and detailed contact data, please visit our homepage

www.forestplatform.org

ISBN 92-79-01028-X

printed on ZANDERS ikono silk 170 (300g/m²)