Forest-Based Sector
Technology Platform

Developing the Strategic Research Agenda (SRA)

for the Forest-Based Sector Technology Platform (FTP)

Collected themes: Pulp and paper products

May 12, 2005

Theme 1

Title: Modeling of P&P related unitoperations/systems for optimal use of water, chemicals and energy.
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Achieving a signifi cant decrease in capital intensity and increased production flexibility through process innovations.
- Responding to new competition from other regions.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.
- Becoming a major producer of "green electricity", biofuels and other bio-energy products.

Description: The suggested modeling approach should simultaneously include the models for physical and chemical phenomena in pulping operations. The model could finally try to cover the control of mill wide process area.
Research approach: This theme requires a cross scientific approach and sofisticated modeling skills.

Theme 2

Title: Fight for time
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Responding to new competition from other regions.
- Attracting young talent to the sector.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: knowing the factors that innfluence customers behavior are essential when trying to keep readers active with printed products
Research approach: large interviews especially among young readers and also to find reasons why new medias are making progress

Theme 3

Title: bioenergy well
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).

Challenges and Opportunities:

- Helping society to mitigate climate change.
- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Developing new industrial activities based on "green chemicals" from wood.
- Becoming a major producer of "green electricity", biofuels and other bio-energy products.

Description: more information also for people from the possibilities of green energy from fibre based products
Research approach:

Theme 4

Title: New fibre mixed innovations
Positioning:

- Society: Expected impact on prioritized social and general economic goals of the EU (employment in rural areas, development of SMEs, etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Responding to new competition from other regions.
- Increasing the share of high value added products offered to consumers.
- Substituting non-renewable materials through innovative solutions from forest-based materials.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Intelligent ink on new formulated fibre to produce ready dry products, energy reduction in ink drying. new intelligent products.
Research approach:

Theme 5

Title: The efficiency of the value chain
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: The key question is how to assure the efficiency of the production and the whole supply chain of the printed products. This theme includes following aspects 1. Minimizing the use of resources in different stages · Minimizing the use of materials (paper, inks, plates, other materials) and the expenses and avoiding the "over quality" – more with less · New material solutions exploiting for example the new opportunities given by nanomaterials and biotechnology · Automation of the measurements and control in the production processes · Record, management and analysis of the vast data amounts gathered from different processes, simulation and optimization of the production systems. · Systems integration, automation of the production workflows and "unmanned" printing production · Life Cycle Analysis of the value chain and Life Cycle Costing of the production technology in use. 2. Meeting the demands of the accessibility, diversity and easiness of use of the printed products and services – in a required format, at the right time, in the right place. This requires for the personalisation, customization and on-demand production technologies and systems and improvement and optimization of the efficiency of the logistics · In production networks (material logistics, insert logistics, adaptation in customers' production lines) · In graphic arts industry especially in finishing and mailroom processes · In the delivery to the customers/readers. 3. Automation of the business chain from the customer (paper mill, publisher, advertiser, print product buyer) to the printing house and from the printing house to the consumer. VISION 2030: Intelligent and efficient manufacturing processes, Sustainability, taking advantage in process and product development of alliances with other sectors and of exploiting emerging technologies

Research approach: The research requires good competence in printed communications, paper technology, ICT and materials technology. The enabling technologies are measuring and automation, RFID-technology, nanomaterials and biotechnology. The knowledge of the future business models and customer and consumer requirements is also needed in order to specify the exact needs for the development. Everything should be considered from the customer point of view. The research should be started with the specification of the common needs among different players of the value chain. The second step will be the definition of the actual projects and work packages with

multidisciplinary research groups. Basic research will be needed for instance regarding material development. The development should be made in good cooperation with the industry, both printing industry and their suppliers like machine manufactures, material and system suppliers and the paper industry. The research resources include technical universities and research institutes as well as organizations specializing in media economics and customer studies.

Theme 6

Title: (Inter)active, intelligent print products
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Meeting the growing impact of large retailers.
- Increasing the share of high value added products offered to consumers.

Description: The ability to increase the competitiveness of the printing in digital era requires new attractive services and products with features that give value added to the customers and consumers. These can be produced basically in three different ways · by printing static markings, codes, etc on printed product and using these as interfaces to digital media based only visual evaluation and use or by using specials reading devices like camera phones · by creating new functionality to the printed product with printing active components, decorations, anticounterfeit effects etc. These components can be only aimed at visual evaluation or they can be read and interpreted by for example camera phones or special reading devices · by printed intelligence which means basically printed optics and electronics (smart or intelligent codes, tags etc. like printed RFID). These printed objects have been made with conductive materials and their status can be read and in the most sophisticated solutions also updated. New ideas and solutions will be needed to add functionality and attractive features in different product categories (newspaper, periodicals, commercials, books and packages). The development has been active on packaging side but more activity is needed to create new solutions for the publication products and printing industry. This requires intensive cooperation with printing and forest sectors as well as ICT because the development requires multidisciplinary resources. Visison 2030: Increasing the share of high value added products offered to the consumers

Research approach: Both basic and applied research is needed. New competencies have to be created by basic research where the students and postgraduate students learn which kind of requirements these new applications will set for the printing industry and print value chain. Basic research includes the requirements set for the printing processes, materials, markings, codes or other special features like RFID. Applied research includes projects where certain selected product / service concepts are developed to the prototype level and tested in practice. Competences are required especially from the fields of printing, paper, electronics and materials and to some extent also from electronic media and information systems.

Theme 7

Title: The media use
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.

Description: The primary mission of the media industry is to produce and deliver relevant knowledge, opinions and experiences responding to the current needs of the customers and consumers. Media industry is thus a part of the basic structures of the information society. Media industry has been in accelerating change during the past ten years. Digitalisation of the contents, new delivery channels, media platforms and end user terminals and the scattering of the media landscape have brought along completely new challenges. There are more and more choices for the consumers, customers and advertisers where to select from. The survival in the ever tightening competence calls for a good knowledge about the media usage and behaviour of the consumers and customers. The contents provided should be the most wanted and the products and services original and high quality. The factors defining media use are the user itself (consumer, member of the society, human being), media and content, context (time, location, everyday life) and social and cultural factors (communities etc.) The media consumption (time and money) has traditionally been studied by media industry. These are typically survey type of studies that look at the present and the past. They don't try to understand the user and his choices more deeply. Plenty of studies focusing on the usability of digital media have been done during past 5-10 years. It is a part of the product development of digital media services. Printed media has long traditions and user interfaces that have been developed during centuries. It doesn't however mean that they shouldn't be developed further. In order to reach comprehensive idea of the media use both printed and electronic media should be studied in parallel. Both the usability, media experience and media usage should be studied in order to find more profound explanations of the customer choices and to be able to develop printed media and multiple media services in the way they best fit to the customer needs. This is a field where basic knowledge, research methods and methodologies need to be developed. Vision 2030: Society, consumer needs and competitiveness

Research approach: Both the basic research and applied research will be needed. Basic research should be made in multidisciplinary research groups consisting of the representatives of psychology, technical sciences, media design and media education. The existing knowledge of the usability studies and methodologies should be utilised but new research methodologies have to be developed as well. Research environments, measuring and analysis methods have also to be developed. Research communities and industry should cooperate in applied research. Companies have plenty of existing knowledge especially of the media consumption. This should be exploited as background knowledge.

Theme 8

Title: SUSTAINABLE FIBRE SUPPLY SOLUTIONS FOR EUROPE
Positioning:

- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.

Description: The Nordic countries are the main producers of virgin fibre based products, whereas in Central Europe the production of fibre based products is increasingly based on the use of recycled fibre. The flow of high quality virgin fibres is essential for the efficiency of this chain. Mechanical produced fibre endures recycling better than chemical fibres. Secondly, chemical additives and fillers and pigments used in the paper products result in waste streams that can not be recycled, and must be discharged in dumping places. The need to reduce waste streams calls for new process and chemical solutions. Chemically produced low cost fibres such as Eucalyptus from Brazil, Bolivia and Indonesia are making their invasion to European markets and displace gradually locally produced hardwood kraft pulps. This development will have a large impact on the employment in the rural areas unless new uses for hardwood species are developed. In many areas of Europe, the investments in production are already restricted by the availability of wood sources. Less wood raw material is needed in mechanical pulping and potentially more paper can be produced using mechanical pulps, provided the energy efficiency and fibre quality can be improved in a breakthrough way.

Research approach: The main objectives are to reduce the consumption of wood raw material by focusing RTD efforts to increase fibre recovery and to substitute chemical fibres with mechanically produced hardwood and softwood fibres. This will call for innovations and new solutions in: o Sorting and controlling the quality of waste paper o Fractionating waste paper into its components and reusing the components o Developing chemical additives solutions having low environmental impact o Upgrading low quality wood raw material and separating low value wood streams o Developing new methods to decrease the heterogeneity raw material o Developing breakthrough technologies in mechanical pulping o Meeting the various paper quality requirements with new fibre furnishes In the beginning, phenomena based research is needed in the determining the basis of the required technologies. As the next step, a synthesis is to be made on how the findings of basic research can be turned into real process concepts. Various competencies such as gentle fibre separation, sensor development, wood and fibre chemistry, wood

material handling, fluid dynamics, modelling and simulation, refining plate design, machine construction and papermaking. This will require a very close co-operation between research institutes, equipment and chemical providers and pulp and paper companies.

Theme 9

Title: NEW FIBRE BONDING SYSTEMS
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity, through sustainable forest management.
- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.

Description: Paper industry has improved her profitability by investing in still larger, highly automated production lines and by improving the production efficiency of her processes. Efficiency of operations has improved throughout the whole value chain. A lot of effort has also been devoted to reduction of environmental impacts of fibre based products. Due to falling product prices, the outlook of profitability is not looking attractive for stake holders. The challenge for paper industry is to reduce capital and operational costs and simultaneously take care about the environmental demands of the society. A generally accepted view of many experts is to produce more from less. The production methods of our main paper grades are the result of an evolution process rather than a process synthesis based on the results of scientific research. The improvement of brightness and the surface properties has been the dominating drivers of development. The movement from simpler to more demanding added value products has always meant more investments. Today, highly refined pulps loaded with fillers and chemicals are used for paper production. High machine speed sets conflicting demands on de-watering and control of paper quality. Furthermore, the increased recycling of water makes the control of process chemistry increasingly more complicated. In future, simpler processes and lower basis weight products are needed.

Research approach: The main objective is to improve the profitability of paper industry by focusing RTD efforts to new production concepts that reduce the capital and energy intensity of papermaking and that at the same time simplifies the control process chemistry. This will call for innovations and new solutions in developing o Methods to utilise the inherent strength of wood and pulp fibres o Technologies for forming of lower density and bulkier fibre networks o Wet end process concepts o Chemicals of the new fibre bonding system o Methods to increase internal fibre bonding – longer distance inter-fibre bonding systems o New filling concepts for the paper surface Various new competencies are required such as refining of pulps, fractionation of pulps, fibre bonding, wet end chemistry and chemicals, forming of paper structures, fluid dynamics, coating methods, modelling and simulation and machine construction. Due to the complexity of

the technology chain, excellent co-operation will be required between research institutes, universities, equipment and chemical providers and papermakers.

Theme 10

Title: WASTELESS PAPERMAKING
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).

Challenges and Opportunities:

- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.

Description: Papermaking uses millions of tonnes of raw materials, produces millions of tonnes by-products and uses huge amount of energy annually. Pulp and paper industry utilises today main part of the by-products as energy and the rest part is disposed as landfills. The goal of development should be easily recyclable products and efficient recovery systems, where the functionality of wood and fibres is firstly utilised and the remaining material is used for energy. Wasteless papermaking leads to sustainable choice of raw materials, minimisation of energy use, closed loop processes, recycling of papers, by-products and process equipment. Raw materials should be bio based materials as thoroughly as possible. Tree fractions should be separated so that each fraction can be utilised as such a product it suits the best. This means development of logging methods, tree crushing, and fractionation of tree fractions. Biomaterials both for paper chemicals as well as energy sources should be developed.

Research approach: Paper production generate by-products as effluent water and sludge, dregs, ashes, residues of paper chemicals, waste energy, gas emissions, metal and plastic material and other miscellaneous materials. These materials should be converted to raw materials for the pulp and papermaking and for the other industries. Bio fuel and biogas and combustion aids should be developed for the pulp and paper processes and for use in surrounding community. By-products should also be processed for consumer products, construction materials and fertilizers for farming and forest growing by combining also possible by-products and materials from other industries. Development of new closed loop process concepts, radical process changes, minimisation of energy use in every process step and control systems are needed to process different fractions to products. The development work needed requires combination of material-, bio-, separation-, measuring technology and ICT, wide utilisation of the experiences and development in the other technological areas.

Theme 11

Title: Paper/board making concept with reduced fixed cost
Positioning:
Challenges and Opportunities:
Description: Develop a paper/board making concept with (at least) 30% reduced fixed cost i.e. capital and labour through for example simple processes, broke free mill, speed increase.
Research approach:

Theme 12

Title: New furnish concepts
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Responding to new competition from other regions.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.

Description: 1. New ways to utilize hardwood: (Aspen, Birch, Euca, Acasia) as raw material especially for (C)TMP 2. Increased quality potential of recycled fiber pulps via new prosessing techniques 3. New low cost furnish components that can be manufactured at mill site significantly reducing transportation and storage costs
Research approach: competencies: fiber properties, linking fiber properties to paper quality, process design, equipment manufacturing, minerals processing, chemistry, forestry, logistics,

Theme 13

Title: New packing board for food
Positioning:
Challenges and Opportunities:
Description: Packing board with barrier properties and with 30-50% reduced weight for food stuff packaging.
Research approach:

Theme 14

Title: Printing paper created with less minerals
Positioning:
Challenges and Opportunities:
Description: Printing paper with current offset printability but created with less than 10% minerals (nowadays typically 20-50%) and organic functional additives playing a key role.
Research approach:

Theme 15

Title: New paper production concepts
Positioning:

- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations.
- Responding to new competition from other regions.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Paper technology needs to be improved to tailor-made structures by pulp fractioning, selective layering, and new surface treatments (smoothening, coating, calendering etc). Energy efficiency must be improved by high consistency forming, new wet pressing and efficient drying conceps, but maintaining or improving paper quality and performance.
Research approach: Paper structures can be studied with new laboratory and pilot equipment where new furnish components and new (green) chemicals also can be tested.

Theme 16

Title: New mechanical & chemi-mechanical pulps
Positioning:

- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: To utilize the forest resouces effectively mechanical pulping is needed. Machenical pulps give also many advantages for the customers. The problem with mechanical pulps is the high specific energy need. That can be helped somewhat by adding certain chemicals during the processing. The big break-through is still missing what comes esp. mechanical pulp made from wood chips (TMP). The shortage of energy needed in transportation, heating etc. may ruin part of the paper industry.
Research approach: By combining novel mechanical approces with wood science and chemistry, there are potentials to develop new mechanical/chemimechanical pulps. These can be easily tested in pilot scale and with low investments other that in knowledge.

Theme 17

Title: Biogradable packaging
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Becoming a major producer of "green electricity", biofuels and other bio-energy products.

Description: The need to utililize the packaging in composting process is increasing. Paper is mostly biodegradable but barrier layers needed in packaging are not, yet.
Research approach: Biodergadable materials available need to be developed so that they can be used as barrier layers or newfunctional, biogradable materials need to be developed - based on natural polymers.

Theme 18

Title: On-demand printing
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations.
- Meeting the growing impact of large retailers.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: A very strong tool to develop the competitiveness of printed products is on-demand printing, in which the production of printing does not start until the order has been received. This brings extreme flexibility to the production chain. The benefits of on-demand printing are that it: - allows the production of customised and tailored products - means shorter delivery times, which helps to improve productivity - decreases the waste of materials, which saves costs and nature - decreases storage costs - shortens production chains and accelerates production, which saves costs - allows the production of printed products to be started after order - allows totally new kinds of printed products and business opportunities to be implemented The modern, effective printing technologies are the key for flexible printing production. Printing can for example be decentralised and done in the locations where it is logistically most economical. Also new digital printing technologies play an important role in developing new operational and business models, because it provides a strong tool for the value addition of printed products. In short, the main benefits of the modern printing technologies are, that they open up possibilities for new ways of marketing and creates logistical savings.

Research approach: On one hand, general printing production trends, such as shorter delivery times, larger selections and smaller quantities, are setting higher and higher demands on on-demand printing production and logistics. On the other hand, developing communication and printing technologies are providing new tools for solving problems, boosting production and giving value addition to printed products. The number of printed products will increase in information societies. Future printed products will thus be much more multifunctional, informative and demand-driven than they are at present. Because of the diversity of printing production, in the development of on-demand production, many different competencies are needed. This is especially true in on-demand package production. There are several process steps, which will have to be taken into account and examined, like graphical reproduction, printing, converting, marketing, material questions etc., so different research institutes, universities and companies have to work close together to solve these challenges. Also different research methods - like paper development, process simulations, cost modeling, data collecting and management – are

needed so that the new kinds of operational and business models can been developed. This requires European wide co-operation in the area.

Theme 19

Title: Nanochemistry and nanopigments for papermaking
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Increasing the share of high value added products offered to consumers.
- Developing new industrial activities based on “green chemicals” from wood.

Description: For creating printing papers with fundamentally new properties and functions, e.g. better printability, high brightness and optical stability, even with high content of mechanical pulps. Nanostructures of natural material giving barrier functions against moisture, oxygen etc., for packaging purposes can be developed.
Research approach:

Theme 20

Title: New printing inks
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity, through sustainable forest management.
- Providing products and services that respond to changes in societal needs.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.

Description: Some printing inks are very difficult to recycle and other inks create substantial yield losses of fibres in the recycling process. Especially water-based inks create problems. Low yield in recycling is a major issue because of decreased competitiveness and higher land-filling/environmental problems. - Also, ink components should be more safe from consumers point of view.
Research approach:

Theme 21

Title: Improved perception of paper products
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Meeting the growing impact of large retailers.
- Responding to new competition from other regions.
- Increasing the share of high value added products offered to consumers.

Description: Customers have been offered similar products based on easy use of current technology and raw materials. It is evident, however,that customers prefere other attributes than currently offered to them.
Research approach: Studies are needed to find out the real customer needs / perceptions. After that new approaches and processes to develop new and diversified products are needed.

Theme 22

Title: Extension of the profitable life time of existing production lines through new innovative solutions
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a signifi cant decrease in capital intensity and increased production flexibility through process innovations.
- Responding to new competition from other regions.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: New innovative solutions or new processes are needed in order to significantly improve productivity of existing mills. Improvement in productivity can be achieved through higher efficiency, production speed, optimized life cycle cost and with higher value added products. Special emphasis is on adaptation to more effective resource use and lower environmental impact. This means for example 1. minimixed water usage - advanced methods for cleaning the process waters - zero effluent mill and closed water loops 2. significantly lower specific energy consumption - online optimization of production process through advanced modelling, simulation and optimization programs - reduced energy consumption of unit processes (mechanical pulping, paper drying etc.) 3. reduction or reuse of waste materials - new methods or reuse applications
Research approach: competencies: papermaking, equipment manufacturing, process design, materials technology, chemistry, process automation, simulation, mathematics (optimization)

Theme 23

Title: New paper production concepts
Positioning:

- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations.
- Responding to new competition from other regions.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Paper technology needs to be improved to tailor-made structures by pulp fractioning, selective layering, and new surface treatments (smoothening, coating, calendering etc). Energy efficiency must be improved by high consistency forming, new wet pressing and efficient drying conceps, but maintaining or improving paper quality and performance.
Research approach: Paper structures can be studied with new laboratory and pilot equipment where new furnish components and new (green) chemicals also can be tested.

Theme 24

Title: New mechanical & chemi-mechanical pulps
Positioning:

- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: To utilize the forest resources effectively mechanical pulping is needed. Mechanical pulps give also many advantages for the customers. The problem with mechanical pulps is the high specific energy need. That can be helped somewhat by adding certain chemicals during the processing. The big break-through is still missing what comes esp. mechanical pulp made from wood chips (TMP). The shortage of energy needed in transportation, heating etc. may ruin part of the paper industry.
Research approach: By combining novel mechanical approces with wood science and chemistry, there are potentials to develop new mechanical/chemimechanical pulps. These can be easily tested in pilot scale and with low investments other that in knowledge.

Theme 25

Title: Biogradable packaging
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Becoming a major producer of "green electricity", biofuels and other bio-energy products.

Description: The need to utililize the packaging in composting process is increasing. Paper is mostly biodegradable but barrier layers needed in packaging are not, yet.
Research approach: Biodegragradable materials available need to be developed so that they can be used as barrier layers or new functional, biodegradable materials need to be developed - based preferably on natural polymers.

Theme 26

Title: European printing surface network
Positioning:

- Society: Expected impact on prioritized social and general economic goals of the EU (employment in rural areas, development of SMEs, etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Substituting non-renewable materials through innovative solutions from forest-based materials.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Printed media is the only information and communication carrier based on predominantly (but not yet entirely) renewable resources. For example, inorganic coatings and deinking residues are waste that is currently dumped. Emerging technologies (bio- and nanotechnology, biomimetics, molecular modelling, etc.) should enable the development of fully recyclable or reusable printed products. Printed products would then be used for sustainable energy production in the end of the product cycle. The goal is to build a European RTD network that enhances product development in printing, packaging, paper and board industries. The research concentrates on developing new printing processes, inks and paper-based printing substrates. The research will benefit European paper companies, printing machine suppliers and ink manufacturers, and printing and packaging companies. Many of these are SME's that do not have easy access to latest research results. Without flow of new technology these face the threat of fading away. Chemical industry (Sustainable Chemistry Platform) has a self-evident role in the development of green inks and coating formulations.

Research approach: bio- and nanotechnology, biomimetics, molecular modelling, surface and colloid science, printing and coating machine suppliers, ink suppliers, coating component suppliers

Theme 27

Title: Systematic development of value chain sustainability
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Substituting non-renewable materials through innovative solutions from forest-based materials.

Description: Paper production relies on the sustainable use of renewable raw materials but we can still improve the sustainability of the whole value chain from forest to customers, recycling and final end-use. For example, the forests that serve as the necessary virgin fiber sources are often located away from the markets of the paper-based and board-based products. The benefits to rural economy balance the burdens of transportation. Recycling always leads to some waste. This can favor end-use in energy production. EU legistlation and the society's incentives to industry should promote holistic solutions that improve the overall sustainability of the value chain. For this the important phases in the value chain must be identified and evaluated. This alone should motivate development of new raw materials and processes. However, new business models or value chains can also be developed to reduce environmental load, to increase social benefits and to improve economic profitability. The goal of this research theme is to develop ways to better evaluate the sustainability of the value chain and to assess new potential technologies and business models. Assessment tools will also be needed by the society in the preparation of legislation and strategies such as Integrated Product Policy and Natural Resource Strategy. Given the number of stakeholders and the range of geographic areas of the value chain, it is clear that the research must be orchestrated at the European level. The interests described here are common with platforms, most notably with the Water Supply and Sanitation Platform.

Research approach: System analysis, economy, social sciences, governmental bodies, NGOs, future awareness

Theme 28

Title: Flexible Papermaking
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a signifi cant decrease in capital intensity and increased production flexibility through process innovations.
- Responding to new competition from other regions.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Paper machines are very capital intensive. New machines tend to operate within a very narrow window with little flexibility to produce different grades or to take advantage of market swings or emerging technologies. This increases investment risks. The main purpose of this research theme would be to increase the overall flexibility of papermaking by changing the manufacturing paradigm of large, efficient and highly specialised paper machines. The result would provide new innovation and development routes for paper manufacturers, to improve the overall life-cycle of a paper machine, to give new technical options to small, aging, paper machines. Key issues that should be looked at are: 1. Increase the modularity of paper machine design. Modularity is the prerequisite for radical innovations. It is very difficult to reinvent the entire paper machine. 2. Identify new add on technologies that can help extend the lifetime of a paper machine by increased flexibility and efficiency. 3. Consider furnish preparation processes that would improve flexibility in papermaking. 4. Examine new process strategies and new product concepts can increase papermaking flexibility. e.g. fractionation, forming layered structures with new techniques, dynamic simulation tools. 5. Consider new unit sub-processes or elimination of unit sub-processes to simplify papermaking e.g. compact wet end. 6. Determine how to increase operating window to allow production of multiple grades at high efficiency. Good pilot-scale demonstration facility is crucial to change the manufacturing paradigm. In addition to this, European co-operation is necessary to ensure a mix of equipment suppliers of different sizes, and research bodies with different competencies (chemical engineering, process control, material science, etc.).

Research approach: Good pilot-scale demonstration facility is crucial to change the manufacturing paradigm. In addition to this, European co-operation is necessary to ensure a mix of equipment suppliers of different sizes, and research bodies with different competencies (chemical engineering, process control, material science, etc.).

Theme 29

Title: Integrated chemical mini mill.
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations.
- Substituting non-renewable materials through innovative solutions from forest-based materials.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: The strategic raw materials for producing the high quality printing papers of the future are water, fibers, minerals and synthetic binders. The production of these materials on site can be expected to bring a lot of savings and flexibility. For minerals the concept allready exists (PCC satellites). If basic chemicals could be produced in miniscale from waste or blackliqour etc. with a rentable process, the possibility to produce binders and other organic strategic chemicals in mill would be possible. This would enable the possibility to build extremely big and efficient paper mills.
Research approach: The theme would require break through innovations in biotechnology, process engineering and organic synthesis/polymerization.

Theme 30

Title: The new printing process.
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: In order to maintain the leading position of print media the print products must outperform other forms of information delivery as perceived by the majority of consumers 2030. One item on the agenda must be to anticipate these perceived properties. Most likely the quality of the image has to be further improved and additional functionality (printed videoclips?) included. The major print methods of today are bulky and unflexible. Thus a new method, which ultimately will replace the existing ones, is needed that is higher in quality than today and feasible at any print volume.
Research approach: The theme would require an unique combination of competences in paper physics, human physiology and psychology, color chemistry, machine building and media understanding.

Theme 31

Title: Brand protected packages
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Background: - 8% of world trade is based on faked products (growing steadily 15% per year) - several protection techniques already available - new way to compete against plastics Possible research topics - the whole value chain has to be optimized. "Brand protection" chain is very fragmented at the moment (board manufacturing vs converting vs retail&end use) - new board grades (high volume and recyclable solutions could be done already in board making process) - integration with electronics and other brand protection technologies
Research approach: competencies: value chain analysis, consumer behaviour, materials technology, converting, board making, electronics

Theme 32

Title: Improving Efficiency of Environmental Control in Chemical and Mechanical Pulping

Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).

Challenges and Opportunities:

- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity, through sustainable forest management.
- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Attracting young talent to the sector.
- Becoming a major producer of "green electricity", biofuels and other bio-energy products.

Description: Environmental legislations gives many quidelines for chemical and mechanical pulping concerning environmental load (effluent, air emission and solid waste). Nowadays the discharge limits is monthly average. However, in the near future they will be measured daily or even hourly. To fulfil those demands new approaches will be needed to avoid problems related to for example effluent loadings from chemical and mechanical pulping or air emissions in chemical pulping. It should be also noticed that the more effluent or air is purified the more solid waste will be formed. So the solids waste handling will be also take care of when the efficiency of environmental Control are improved.

Research approach: This research work needs deep understanding the formation of environmental load from mechanical and chemical pulping. It also needs the development of on-line measurement methods combined with new modelling tools concerning on-line process data analysis. Combining the practical understanding with modelling and reliable measurement methods the environmental loading (quality and quantity) from the processes can be better predicted and right input for exiting external purification methods will be given in a right time. This leads the better handling on environmental load and also prevents the occasional loads. This system will also improve the imago of forest industry.

Theme 33

Title: Improving process control in Pulping industry using novel measurement applications
Positioning:

- Society: Expected impact on prioritized social and general economic goals of the EU (employment in rural areas, development of SMEs, etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Responding to new competition from other regions.
- Attracting young talent to the sector.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Traditionally the functioning of pulping processes is evaluated by using on-line sensors, which are constantly set to the process pipes, tanks or equipments. This gives adequate information for process control and improves product quality. However, the deep understanding of real functioning of process equipmets is still lacking. This problem might be solved by using novel measurement applications, which are developed or will be developed in the reaseach area of nanotechnology.
Research approach: This research work needs deep understanding of the pulping process examined. It also needs new sensor application investigated by nanotechnology researchers. The basic idea is put the small size sensors in pulp suspension and measure on-line theirs behaviour in process (time, pressure, temperature, pH, etc.). The ultimately goal will be use the data for on-line process control and development of new generation of pulp suspension handling equipments. If this approach will be succeed the new kind of industry field will be formed.

Theme 34

Title: Improving Ecology of Chemical Pulping
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).

Challenges and Opportunities:

- Helping society to mitigate climate change.
- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity, through sustainable forest management.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Attracting young talent to the sector.
- Substituting non-renewable materials through innovative solutions from forest-based materials.
- Developing new industrial activities based on “green chemicals” from wood.

Description: Chemical pulping is a very complicated process including chemical, mechanical and physical phenomena. The main task is make cellulose using the wood as a raw material by using sodium hydroxide and sodium sulphide as a cooking chemicals and chlorine dioxide, sodium hydroxide, peroxide, ozone and peracetic acid as a bleaching chemicals. However, in those processes the raw material includes many organic and inorganic components which will be modified during the whole process. The black liquor is burned in recovery boiler, cooking liquor is manufactured in chemical recovery and raw tall oil is collected for further processing. However, there is still untapped streams origin from chemical pulping which contains useful elements form used chemicals and raw materials. For example sodium and sulphur rich effluent form bleaching and CO2-emissions from lime kiln.

Research approach: This research work needs deep understanding of the pulping process examined. It also needs deep understanding of inorganic and organic chemistry in gas and liquid phase. The main aim is evaluate the economical potential of elements in selected streams and find new solution for recovery and modifying those chemicals to re-using in chemical pulping or other processes.

Theme 35

Title: Track, retain and enhance valuable fiber characteristics throughout the process chain from forest to recycled fiber.
Positioning:

- Customer: Expected response to future consumer needs.
- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Helping society to mitigate climate change.
- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Providing products and services that respond to changes in societal needs.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Responding to new competition from other regions.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.
- Increasing the share of high value added products offered to consumers.
- Substituting non-renewable materials through innovative solutions from forest-based materials.

Description: This research theme would concentrate on improvements in fiber segregation, fiber characterization, the ways of fiber processing retaining the "native" potential of different physical and optical properties. The value chain should cover harvesting, wood handling, pulping operations as well as the recycling of fibers in paper consumption loop. In today's situation often the loss of many important fiber properties is more than 30% compared to theoretical potential and in recycling the properties are lost soon. In addition fibers from different sources are not segregated or utilized in a optimum way in final products.
Research approach: At the forest end the theme requires application of ITC technology linked with a knowledge of fiber characteristics within single spieces etc. The other process areas should be optimized in a way which retains best the native potential of different fiber classes.

Theme 36

Title: Sulpfur-free pulping process for fast growing (European) hardwoods to simplify the process and mill design as well as allowing higher efficiency for generation electricity
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Achieving a signifi cant decrease in capital intensity and increased production flexibility through process innovations.
- Responding to new competition from other regions.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.
- Becoming a major producer of "green electricity", biofuels and other bio-energy products.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: The theme would focus on developing new sulpfur-free pulping method for European hardwoods like aspen and some eucalyptus species. The work could try to utilize new knowlegde about lignin's biosynthesis, catalysts like AQ, alcohol extraction etc. The project could be conducted as a joint effort between biotechnology partner (lignin), chemistry and pulping partners.
Research approach: At the forest end the theme requires application of ITC technology linked with a knowledge of fiber characteristics within single spieces etc. The other process areas should be optimized in a way which retains best the native potential of different fiber classes.The development should include the industrial scale demonstration unit of developed technology.

Theme 37

Title: Joint model-based design of products and their production processes
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations.
- Responding to new competition from other regions.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Theme develops and applies modelling, simualtion and optimization for design of properties of products and how they are achieved in manufacturing. At present there exist a models about the processes and models that relate the consituents of paper to paper properties but linking these two paradigms is in its infancy. Theme will work on how processing affect the structure of fiber networks and how the structure affects the product charcteristics. Theme covers the whole chain from wood as a raw material to interaction of printing ink with coated paper web. Verification of models must be verified with measurements the development of which is of central role in theme. Models are made for the lifetime of the product, howere the design phase is emphasized. Vision document: 1) Capital intensity. Systematic model-based design will address the capital costs explicitly and keeping the main issue - the product - on the driving seat. 2) New competition from other regions. European industry has the best background knowledge, but it is scattered and in many formats not easy to combine. Theme unifies this knowledge into pan-European competitve edge. 3) Taking advantage of alliances. Theme is common to many process industries in their way to more flexibiliuty towards markets and hence fruitful alliances are expected.

Research approach: Research approach consists of following activities. 1) Modelling paradigm (structure) to host the vast variety of models needed. 2) Collection of exiting models. 3) transformation of models to the new paradigm. 4) Identification of gaps in existing set of models. Development of models to fill the gaps. 5) Methodology for model validation/uncertainty analysis 6) Measurement technology to support models and their validation. 7) Optimal design of products and processes. 8) Large number of test cases. The activities will be running in parallel with several delevelop-test iterations.
Competences: 1) raw materials, pulping and paper technology 2) physical and physico-chemical modelling of material 3) physical and physico-chemical modelling of processing 4) mathematics of optimization 5) measurement technology

Theme 38

Title: White biotechnology for pulp and paper processing
Positioning:
- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Biotechnical methods applicable in the pulp and paper industry are emphasized by two specific features; sustainability and specificity. Sustainability means that biotechnical methods do not introduce harmful chemicals and can even diminish the consumption of chemicals or energy. Enzymes are generally considered as the most specific catalysts for fibre modification. The goal of the present theme is to design new combined processes, where bio-based unit operations are intelligently combined with traditional or novel physicochemical/mechanical unit operations, resulting in sustainable hybrid processes with substantial energy or chemical savings, or alternatively in improved product quality. The enzymatic unit operations can facilitate refining by eg. increasing the fibrillation, improve the bonding ability or the quality of recycled fibres. Beneficially, the new combined methods could also lead to an optimal fractionation leading to reuse of fibres with higher quality and utilization of the lower quality fibres for production of eg. biofuels. Thus, this proposal meets well the challenges described in the Vision 2030; improved sustainability and eco-efficiency by advanced recycling and increased use of renewables for energy production.

Research approach: During recent years, knowledge on cellulose or othe polysaccharide modifying enzymes has been substantially increased, and novel enzymes are entering markets with a wider divergency and improved specificity. The performance of enzymes has been significantly improved; thus on one hand novel cellulases with low hydrolytic, high fibrillative activity, and on other hand more efficient hydrolytic enzymes have been identified. Additionally, these novel enzymes often are more temperature tolerant, allowing development of combined physical and enzymatic treatments. The proposed theme will focus at exploring novel uses of these enzymes in innovative applications. The methodologies will involve comparison, choice and improvement of enzymes for various applications including combined treatments to improve fibrillation, fractionation of recycled fibres into higher and lower value fractions or hydrolytic degradation of value-less fractions into other potential products. In Europe, only few research laboratories have so far expertise on these novel cellulases and other hydrolytic enzymes. Combined competencies and close collaboration of both top quality biotech and fibre labs are needed. This part will creatly benefit from the Industrial Biotechnology platform.