

Forest-Based Sector
Technology Platform



The FTP Strategic Research Agenda

Value Chain: Specialties, New businesses



Working-group leader:
Haio Harms, Lenzing AG, Austria



Additional Working-group members:

- ⤵ A balanced participation of industry and academia from 9 countries
 - ⤵ Peter Axegard, STFI, Sweden
 - ⤵ Werner Eigermann, Cordenka, Germany
 - ⤵ Janis Gravitis, Univ. Latvia, Latvia
 - ⤵ Torgeir Hjerde, Borregaard, Norway
 - ⤵ Dieter Lehner, Mare Austria, Austria
 - ⤵ Patrick Navard, CEMEF/ENSMP, France
 - ⤵ Klaus Niemelä, KCL, Finland
 - ⤵ Anthony Pizzi, Univ. Nancy, France
 - ⤵ Jürgen Puls, Univ. Hamburg, Germany
 - ⤵ Karin Stana, Univ. Maribor, Slovenia
 - ⤵ Mervyn C. Witherspoon, Acetate Products, UK
- ⤵ 36 proposals received from national support groups and individuals from 10 countries

Value-Chain domain

- ◉ Forest based value generation outside of the scopes of the traditional mainstream "value chains":
 - ◉ New technologies enabling a more efficient use of the chemical compounds already synthesised by nature in wood
 - ◉ New products on the basis of chemical processing of wood and wood constituents: Materials, Particles, Chemicals
 - ◉ New applications outside of the traditional fields of wood based products: e.g. food, pharma, medical, polymers, basic chemicals, IT,

Key Opportunities and Challenges

- ⤵ Key opportunity is a significant increase of the value generated from European wood resources
 - ⤵ New functionalised products for special applications based on the unique properties of the wood constituents
 - ⤵ Reduced dependency from imported petroleum based raw materials
- ⤵ Key challenge is to build up new wood based value chains, involving
 - ⤵ new technologies
 - ⤵ new intermediate products for new applications including new processing routes
 - ⤵ simultaneous generation of market push and market pull

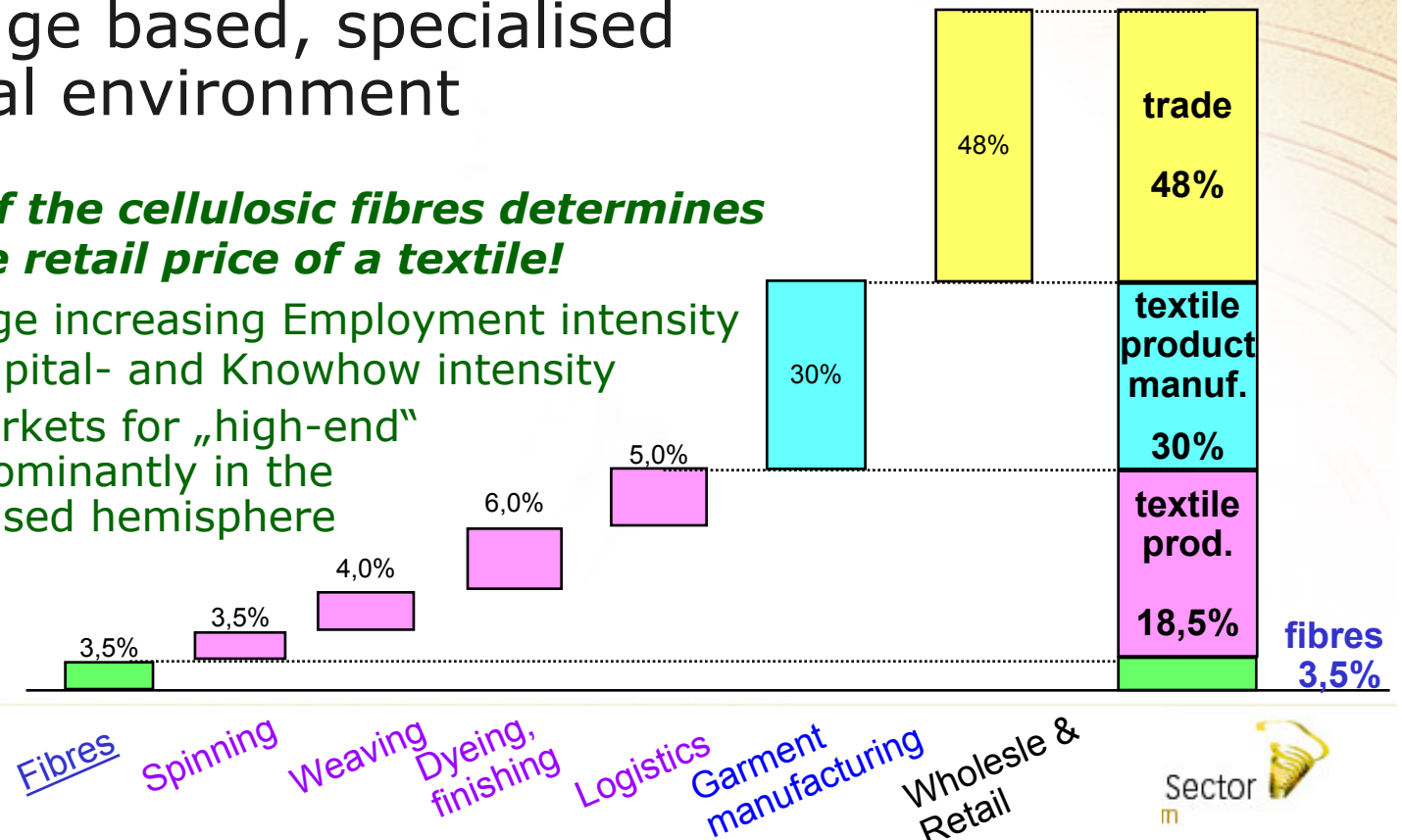
Value added from multistage processing

- Most wood based „specialties“ involve many processing stages before reaching the consumer
- The processes are usually very technology-, capital-, and labour intensive
- They can make good use of a knowledge based, specialised industrial environment

E.g.: The price of the cellulosic fibres determines only 3,5% of the retail price of a textile!

From stage to stage increasing Employment intensity and decreasing Capital- and Knowhow intensity

The Consumer markets for „high-end“ products are predominantly in the western industrialised hemisphere

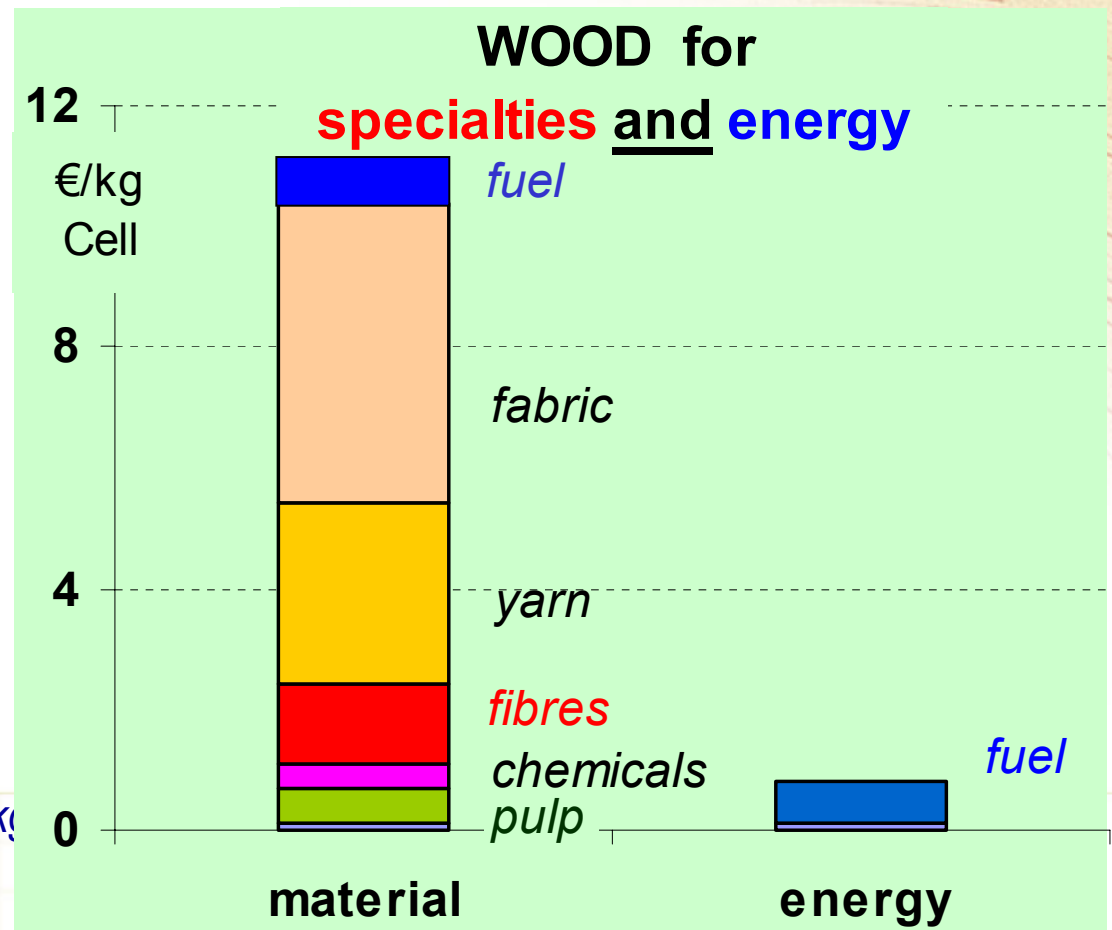


Value added from use as a matter

- Wood is too valuable for just being used as a source for primary energy before prior use for various wood value chain products

Wood prices oriented on the calorific value risk to prevent the best use of the inherent value generation potential!

- > Cellulose in wood ... 0,1 Euro/kg
- > Cellulose as pulp ... 0,5 Euro/kg
- > Cellulose as fibre ... 2 Euro/kg
- > Cellulose as spun yarn ... 5 Euro/kg
- > Cellulose as woven fabric ... 10 Euro/kg
- > Cellulose as a shirt ... 500 Euro/kg



Prioritised Research Themes

- ④ Theme 1:
WOOD-BIOREFINERY:
Optimised production of platform chemicals (basic chemicals, biofuels and pulp) from wood
- ④ Theme 2:
FOREST BASED SPECIALTY CHEMICALS:
from processing of wood based platform chemicals and isolating other forest based substances
- ④ Theme 3:
ADVANCED MATERIALS AND COMPOSITES BASED ON WOOD CONSTITUENTS

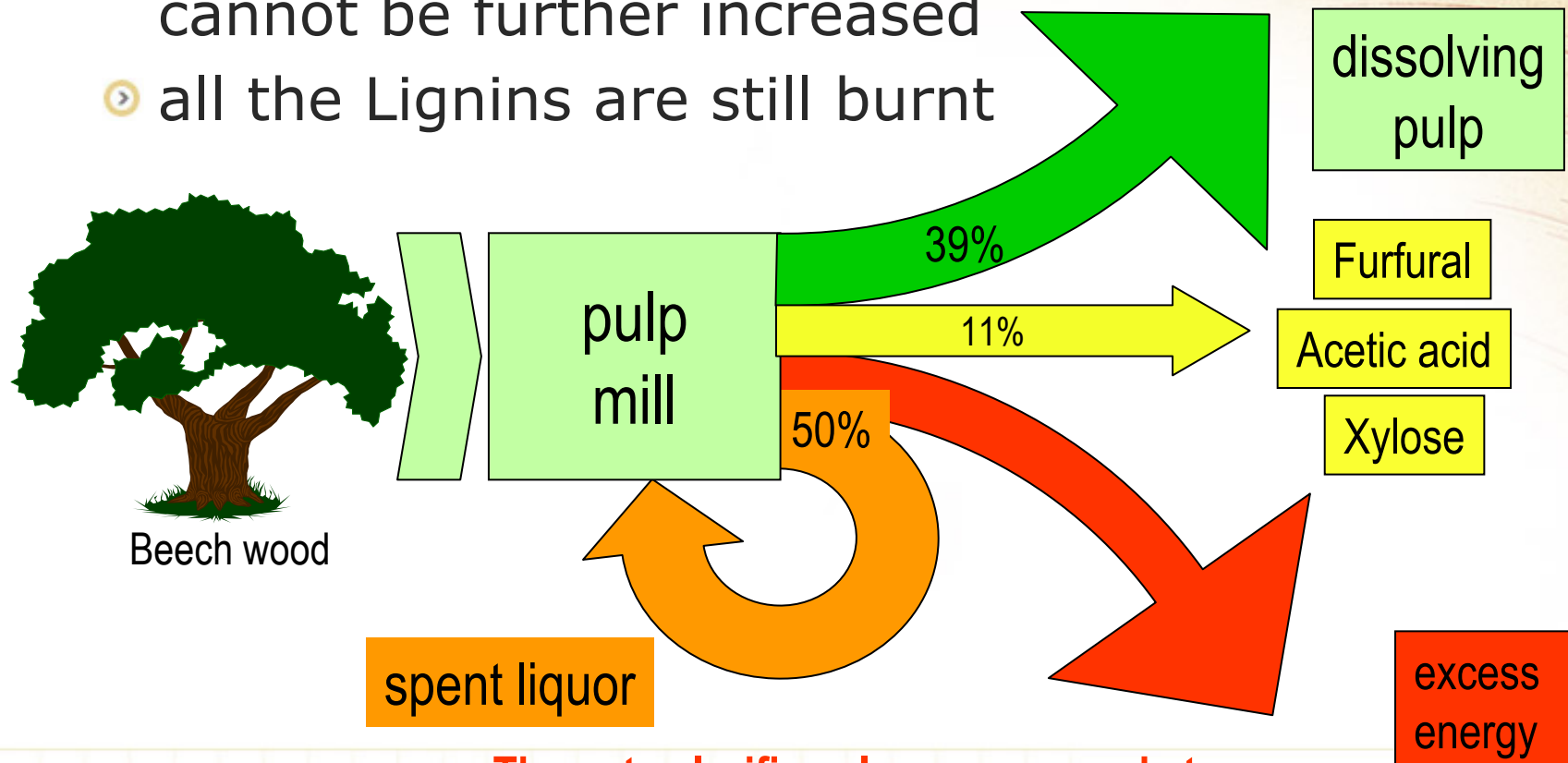
Theme 1: Wood Biorefinery:

- ⊙ The core idea is an optimised utilisation of the wood matter for non petroleum-based “platform chemicals”
 - ⊙ Take advantage from the syntesis performance of nature in different wood constituents
 - ⊙ for use as a structured feed-stock for chemicals and materials, and as high quality biofuels.
 - ⊙ So far, in standard chemical pulp production, only about half of the pulpwood is recovered as paperpulp.
 - ⊙ The rest of the organic wood material is usually just burnt or disposed of in the effluent treatment
- ⊙ Major challenges will be to identify scientific knowledge and techniques which can be developed into feasible mill scale processes
 - ⊙ controlled simultaneous reactions of mixed chemicals
 - ⊙ separation and purification technologies
 - ⊙ using a maximum of the installed production base



e.g. „Wood Biorefinery“ in Lenzing

- › Lenzing achieved a 25% increase of the non energetic use of wood: however ...
 - › the recovery of Hemicellulose derivatives so far cannot be further increased
 - › all the Lignins are still burnt

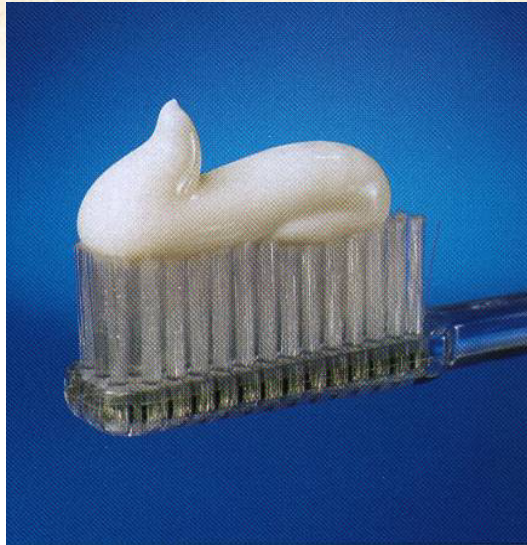


**The net calorific value corresponds to
abt. 220 kg fuel oil per t of pulp produced!**

Theme 2: Forest based specialty chemicals and particles

- › The core idea is to develop new chemistry for a large number of forest based specialty chemicals and their applications
- › converting primary chemical structures
 - › by processing platform chemicals from the wood biorefinery
 - › as isolated from other tree parts (bark, foliage, and different residues),
 - › as per the specific features offered by the different European tree species.
- › Major challenge will be to generate enough critical demand by simultaneously developing
 - › New products and processing technologies
 - › New applications and market demand

Existing „specialty chemicals“: e.g. Cellulose ethers:



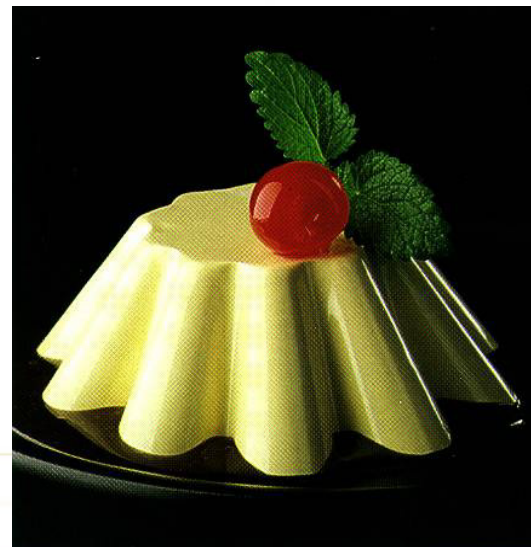
struktural viscosity
bore holes



thickening
Cosmetics,
Food
gelating
Food



gluing
Paper making



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Theme 3: Advanced materials and composites based on wood constituents

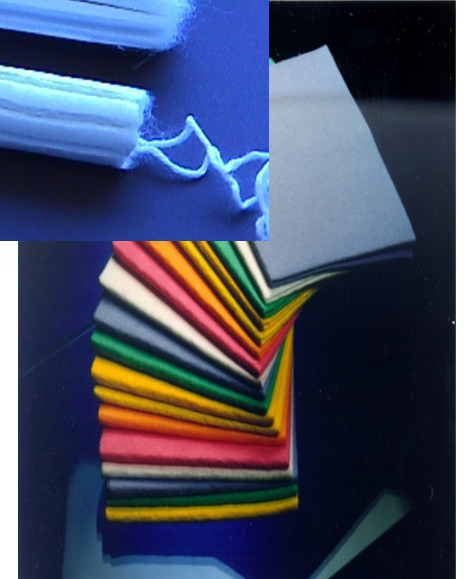
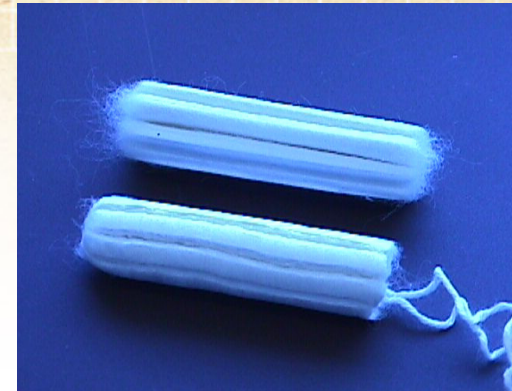
- ⦿ The core idea is to use the unique properties of wood based polymers which so far cannot be obtained from any other synthetic polymer
 - ⦿ for specialised, functional materials and composites
 - ⦿ complementing and replacing petroleum-based materials.
- ⦿ Wood is the most abundant high performance organic composite material in nature!
 - ⦿ Cellulose already now provides a renewable source for a large number of differentiated manmade materials. There is, however, significantly more potential.
- ⦿ Major challenge will be a better understanding of the complex nature of the natural polymers as a precondition for producing controlled and uniform materials properties
 - ⦿ Cellulose research deals with nanotechnological structures
 - ⦿ e.g. Cellulose has specific inherent selforganising properties and nanostructures

Existing „specialty materials“ e.g.: regenerated cellulosic materials

- › Textiles & Nonwovens
- › unmatched properties

Physiological compatibility,
Hydrophilicity, water absorbance
comparably low microbial growth rates
Chemical reactivity (dyeing, finishing),
Stable against chemicals

special optical and haptic: soft, floating, brilliant colours
mechanically and thermally stable, not melting, ...



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ector

e.g. Cellulose esters

organic Esters: CELLULOSEACETATE

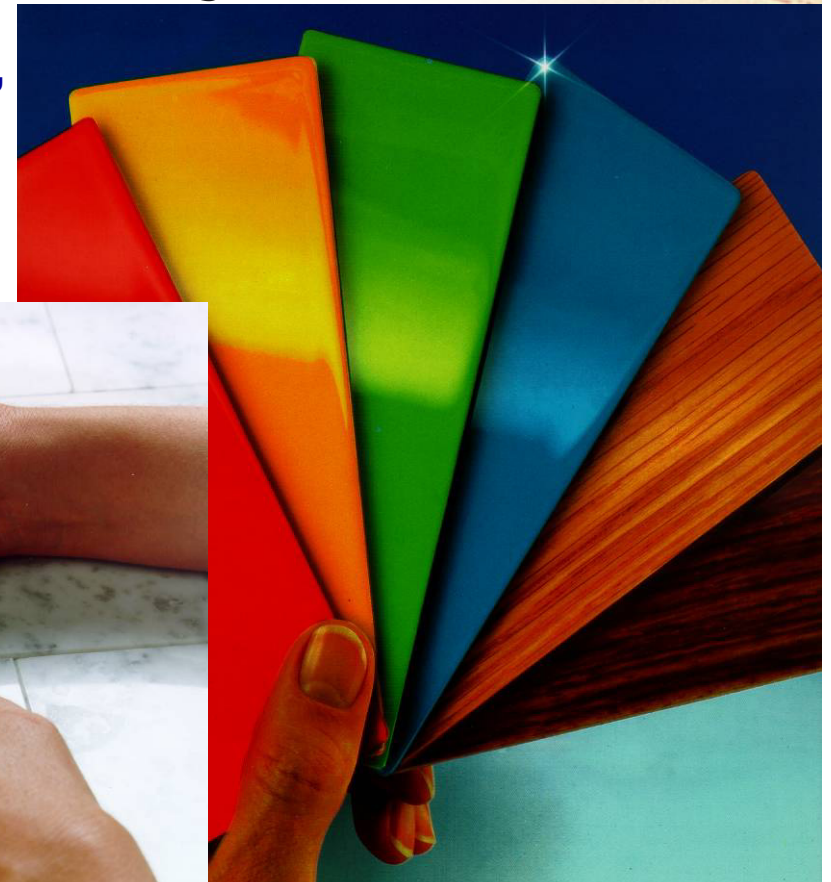
- artificial silk, photographic films, frames for glasses, cigarette filters



**surface activity
impact strength,
brilliance,
transparency**

inorganic Esters: NITROCELLULOSE

- brilliant printing colours, high performance lackers Holz-, Metall-, Papier-, Nagellack



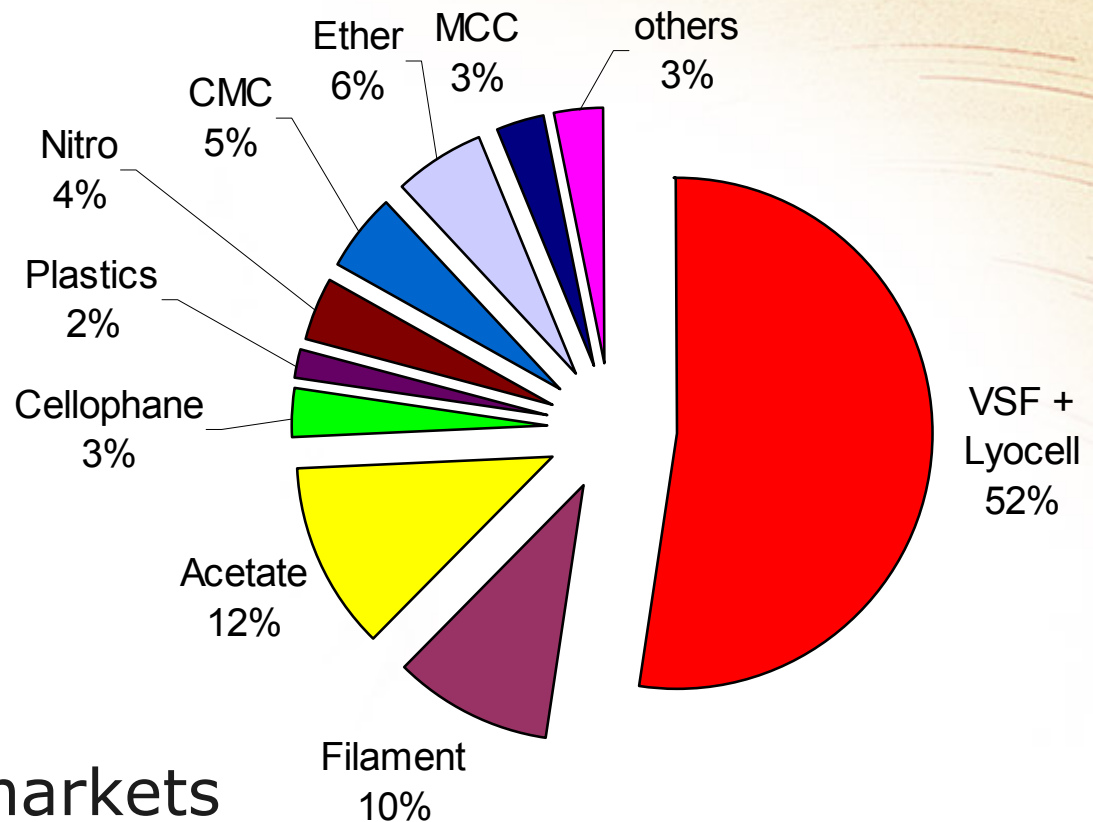
Present Cellulose based „Specialties“

- world wide Dissolving pulp consumption: estim. 3,8 mio tons

- Low volume
- High value
- Chemicals
- Materials

- Segmented markets

- advanced and hightech applications



Summary

- Establish new value chains: „Forest based Specialties“

