The Integrated Forest Biorefinery

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Outline

- Transformation: an industry in transformation prompts action and change in forest cluster structure
- Two supplementary platforms, FTP (Forest-Based Industries Technology Platform) and BFT (Biofuels for Transport) outline major transformation efforts
- How we communicate with EU-level roadmaps: The Finnish ClusterTech project
- Technology Development: Trends and Examples
- Conclusion
# Business Environment

## Paper Industry in Transformation

<table>
<thead>
<tr>
<th>≤ 90’s</th>
<th>Today</th>
<th>2010+</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry behavior</strong></td>
<td><strong>Industry behavior</strong></td>
<td><strong>Industry behavior</strong></td>
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</table>
| - Struggle within the industry going from regional to global | - Strong consolidation started  
- Adaption to media competition  
- Uneven global growth (stagnated, mature and growing markets) | - Response to media competition  
- Understanding of regional differences in mature and emerging markets  
- Additional management of non-paper business (Revised strategy) |
| **Customer requirements** | **Customer requirements** | **Customer requirements** |
| - Quality and grade development driving forces | - Quality and grade streamlining as driving force  
- Increasing markets in emerging countries | - Quality and grade specialization as driving force  
- Choice between different media |
| **Capabilities needed** | **Capabilities needed** | **Capabilities needed** |
| - Top management production focused  
## Forest Industry Roadmap
### Future Papermaking Visions

<table>
<thead>
<tr>
<th>Time period 0-5 a</th>
<th>Time period 5-10 a</th>
<th>Time period 10+</th>
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<tbody>
<tr>
<td><strong>Driving force</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Energy scarcity</td>
<td></td>
<td></td>
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<tr>
<td><strong>Technologies</strong></td>
<td></td>
<td></td>
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<tr>
<td>• Simplification of paper making processes</td>
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<tr>
<td>• Embedded automation and measurement systems with ICT</td>
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<tr>
<td>• Layering concept/fractionation with embedded chemistry</td>
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<tr>
<td><strong>Solutions</strong></td>
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<td></td>
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<tr>
<td>• Global</td>
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<tr>
<td><strong>Driving force:</strong></td>
<td></td>
<td></td>
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<tr>
<td>• Water scarcity</td>
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<tr>
<td>• Logistic shrink</td>
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<tr>
<td><strong>Technologies:</strong></td>
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<td></td>
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<tr>
<td>• Higher web forming consistencies</td>
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<tr>
<td>• Natural and bio-degradable process chemicals / fillers and binders</td>
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<tr>
<td>• New energy and water saving processes</td>
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<td></td>
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<tr>
<td><strong>Solutions</strong></td>
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<td></td>
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<tr>
<td>• Emerging &amp; regional</td>
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<tr>
<td><strong>Driving force:</strong></td>
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<td></td>
</tr>
<tr>
<td>• Raw material scarcity (fiber, oil-based polymers, pigments)</td>
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<td></td>
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<tr>
<td><strong>Technologies:</strong></td>
<td></td>
<td></td>
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<tr>
<td>• Utilization of biomass for multiple purposes</td>
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<tr>
<td>• Biorefinery</td>
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<tr>
<td>• Nanotechnology applications</td>
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<tr>
<td>• Application-specific optimization of raw materials by genetic engineering</td>
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<td></td>
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<tr>
<td>• “One-man paper machine”</td>
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<tr>
<td><strong>Solutions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• All regional</td>
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</table>
**Forest Industry Roadmap**

Forest cluster today and in long-term

- **Machine**
- **Bioenergy**
- **Printed intelligence**
- **M/C with embedded automation**

**Process and product innovations**

**Process, product and service innovations**
Forest Industry Roadmap
The Priorities of the Finnish Forest Cluster’s Research

1. Smart wood and fibre products
2. New products made from wood-based materials
3. A biorefinery that utilises wood diversely

4. Sustainable forest management
5. Increased value for wood biomass

6. Intelligent, resource-efficient production technologies
7. Customer solutions for the future

Next steps for implementing?
European Industrial Technology Platforms

• The supplementary platforms – how to develop thorough multidisciplinary co-operation?
Roadmap Pulp and Paper Processing Technologies

Re-engineering the fibre-based value chain
- Process technologies for wood-based bio-refineries
- Creation of flexible and scalable production systems
- Production technologies for new fibre-based products
- Technologies for flexible, on-demand printing and packaging manufacture

Increasing resource efficiency in pulp & paper production and converting
- Efficient materials usage, including recycled materials, water and waste
- Development of radically new technologies substituting energy-intensive processes

Energy carriers from wood-biomass
- Technologies for converting wood-based biomass into energy carriers

TARGETS
- Flexibility in production
- Customer-oriented Products & Services
- Enhanced Efficiency
- Improved Sustainability

Source: Fraunhofer
2005: 77 billion EUR IB related sales in chemicals (7% sales of the chemical industry)
2010: 125 billion EUR IB related sales in chemicals (10% sales of the chemical industry)

McKinsey - 2006
In this way, the wide interests of the participants can be best covered – and an EU-level roadmap constructed.

National and EU-level Roadmaps
ClusterTech approach

- Cases focussing more narrowly on a topic linked to new technologies and processes
- Cases focussing more narrowly on a topic linked to bioenergy
- Cases taking a broader, national view with an emphasis on new technologies and processes
- Cases taking a broader, national view with a biofuel emphasis

Technology and processes

Narrow focus

Broad focus

Bio-energy
National and EU-level Roadmaps
ClusterTech Cases

Emphasis: Bioenergy to process, material and technology

Focus: Narrow to Broad

Technology and processes

Bio-energy

Narrow focus

50/60 for growth
Finland2020

Reducing fossil fuel dependency

Broad focus

ExtremeTech
During the last five years the majority of new pulp mills and pulp making lines have been built in China.

Source: Pöyry
Traditional pulp and paper making on the way to China!

How we can specialize to stay competitive?

Source: Hannu Oinonen
Technology Development Options for forest industry

Forest biomass in future also urban waste and straw - Southern hemisphere plantations

Paper and Market pulp

Wood handling

Pulp & Paper Mill

Power Heat

< 500 MWf

Bark boiler

Bark residues

Power Steam

Biofuel production < 400 MWf

BioElectricity

Biochemicals

Optional Biofuels: (pellets) bio crude EtOH/MeOH Synthetic Diesel

Wood handling

Bark

< 500 MWf

Bark boiler

Power Steam

< 400 MWf

Refrery

Crude Oil

Source: VTT
The heating value of forest residues can be doubled by waste heat dryer. The moisture content from 50 to 30 w-%.

- Low value residues instead of roundwood

- Double heating value achieved
- Reduced emission level
Technology Developments Near Future

• For some time, evolutionary development with larger and streamlined mills and logistic chains.

• More careful segregation of wood raw material. Non-wood and recycled fibers seeking new position.

• Potential breakthrough technologies in pulping can include: sulphur-free pulping for hardwoods... higher consistencies in paper making... functional and add value products for consumers

• Gasification of solid biofuels/black liquor for production of bioenergy
The Integrated Forest Biorefinery

Conclusions

- The European forest industry, for the first time, gathered its collective strength in both FTP and BFT – and is seriously examining future technology options.

- First time, in the Finnish ClusterTech project, a wide cross-cluster base of forest, energy and chemicals together prepares future R&D focus. Outcome is both national and EU-level global scenarios and roadmaps, such as “50/60”, “ExtremeTech”, “Cut down oil dependency”.

- Concrete RTD&D&D plans.

- The forest industry and the food industry offer the only short term options for concrete solutions – in the forest case, based on wood residues.
Technology Development
Power Without Greenhouse Gases

- Source: Andritz Oy / P. Rahkila