

Biorefineries - bridging sustainable resources and future needs

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What are biorefineries?

- Biorefineries convert biomass into new materials, chemicals, fuels and energy
- Two main raw material sources:
 - **Crop plant biorefinery** ("first generation")
 - Starch and sugar based
 - Corn, sugar beet etc
 - **Lignocellulose biorefinery** ("second generation")
 - Wood, forest industry side-streams
 - Grass plants (switchgrass etc)



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Key technologies in biorefineries

Combined to application-specific processes

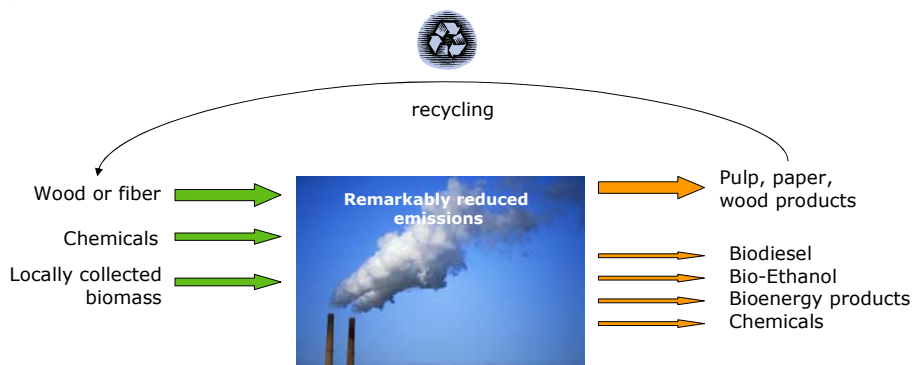
- **Separation and fractionation technologies**
- **Bioconversion**
 - Biochemical conversion of biomass to intermediate sugars
- **Thermoconversion**
 - Pyrolysis to bio-oil
 - Synthesis gas (syngas)
- **Chemical conversion**




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Forest biorefinery

- In addition to present products the forest biorefinery of the future will separate **new materials, chemicals and energy products** from wood creating new business opportunities




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Key drivers for forest biorefinery


- Need to reduce oil-dependency
- Sustainability (climate change)
- Forest industry renewal with new businesses and products
- Enhanced competitiveness of the industry and forestry




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Forest biorefinery 100 years ago...




Workers at a tall oil refining plant in the 1920s



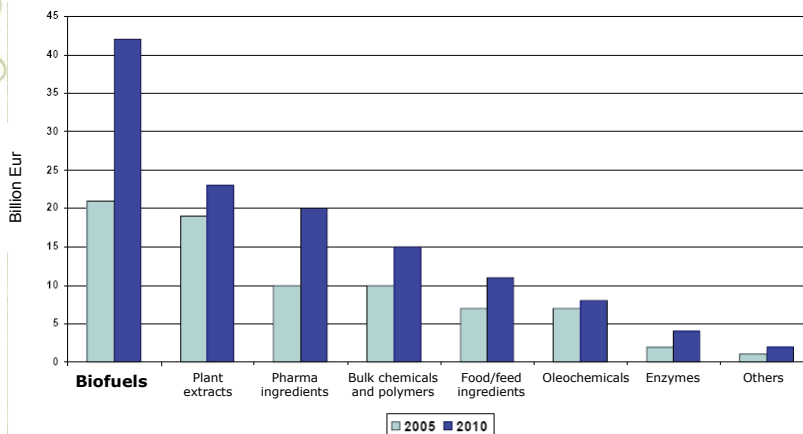
Process line for tall oil soap manufacture, 1929

- Tall oil has been produced and refined for 100 years as a by-product of the pulp industry
- Turpentine has been produced and refined for 130 years as a by-product of the pulp industry
 - Vitamins
 - Perfume ingredients



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Biofuel market increases rapidly Bio-based products market forecast (McKinsey 2006)



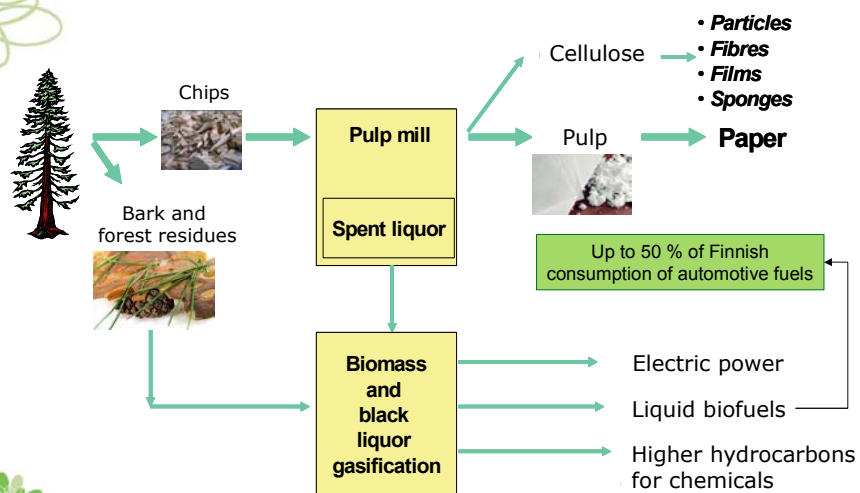
2010: 10% of chemical industry products bio-based (125 billion Eur)

EU Directive EC 2003/30/EC: 5,75 % of energy content basis of all petrol and diesel for transportation purposes from biofuels by 31.12.2010



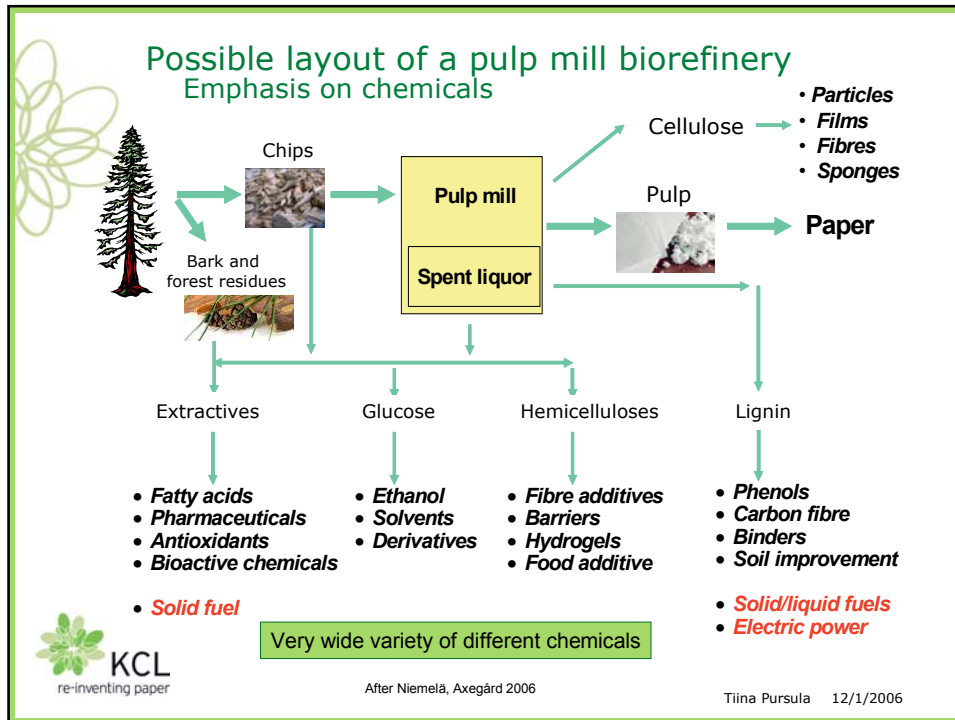
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Possible layout of a pulp mill biorefinery Emphasis on energy and fuel production



After Niemelä, Axegård, Landälv 2006

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- ### Some forest biorefinery on-going activities
- The Finnish ClusterTech project; forest, chemical and energy industry together prepare future R&D focus, global scenarios and roadmaps
 - Bio-diesel; research in Europe
 - Gasification of forest biomass to syngas (Fischer-Tropsch process)
 - Wood thermoconversion to bio-oil and upgrading, BIOCOUP EU project
 - Bio-ethanol; at United States reduced oil-dependency by developing wood biorefinery, emphasis on bio-ethanol
- Logos:** KCL re-inventing paper
- Page Info:** Tiina Pursula 12/1/2006



Conclusions

- Biorefineries convert biomass into new materials, chemicals, bio-fuels and energy
- Sustainability and reduced oil-dependency are key drivers for biorefineries
- New market needs, need for industry renewal are also important drivers for forest biorefinery
- Crop plants are the main raw materials for today's biorefineries, forest biomass is the "second generation"
- Research on biorefineries is currently very active



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