



Biorefinery – uhka vai mahdollisuus?

Soodakattilayhdistys ry:n
Vuosikokous
29.3.2007
Vantaa

- **Main components in wood**

- Bark, branches, leaves/needles, knots, and normal wood
- Cellulose, lignin, hemicelluloses extractives, minerals, proteins and water

- **Main process alternatives**

- Extraction, distillation, precipitation, membrane separation, pyrolysis, gasification, steam explosion, hydrolysis, chemical and enzymatic processing

- **Main process streams**

- Bark, knots, black liquor (BL), BL evaporation condensates, process stage filtrates, bio-sludge, green liquor dregs, lime

Multiple by-products already today

A modern SW kraft mill that produces 630 000 t pulp/y yields as by-products products:

- 750 000 t of organic material in black liquor:
 - 330 000 t lignin
 - 220 000 t hydroxycarboxylicacids
 - 75 000 t extractives
 - 37 000 t aliphaticacids
 - 7 000 t methanol
- 20 000 t bark
- 22 000 t tall oil
- 2 600 t turpentine

Source: Axegård, 2005

Content

- The use of renewable energies is increasing
 - Main reasons
 - Implications to pulp and paper industry
- Biofuels from forest biomass – a new opportunity
- Current Finnish focus
- Conclusions

Renewable energy

- **The key drivers of increased utilization of renewable energy sources globally are**
 - fluctuating oil prices
 - the uncertainty of supply
 - ratification of the Kyoto Protocol
 - rapid development of renewable energy technologies
- **EU targets for renewable energy and energy savings**
 - Double the share of renewable energy in national gross energy consumption from 6% to 12% by 2010 and 20 % by 2020.
 - **A significant part of this is covered by wood based biomass**
 - Increase the share of green electricity in total electricity consumption from 14% to 22% by 2010
 - Raise the share of biofuels in the transport fuel market to 5.75% by 2010 and to 10 % by 2020
 - Reduce energy consumption by 20% by 2020

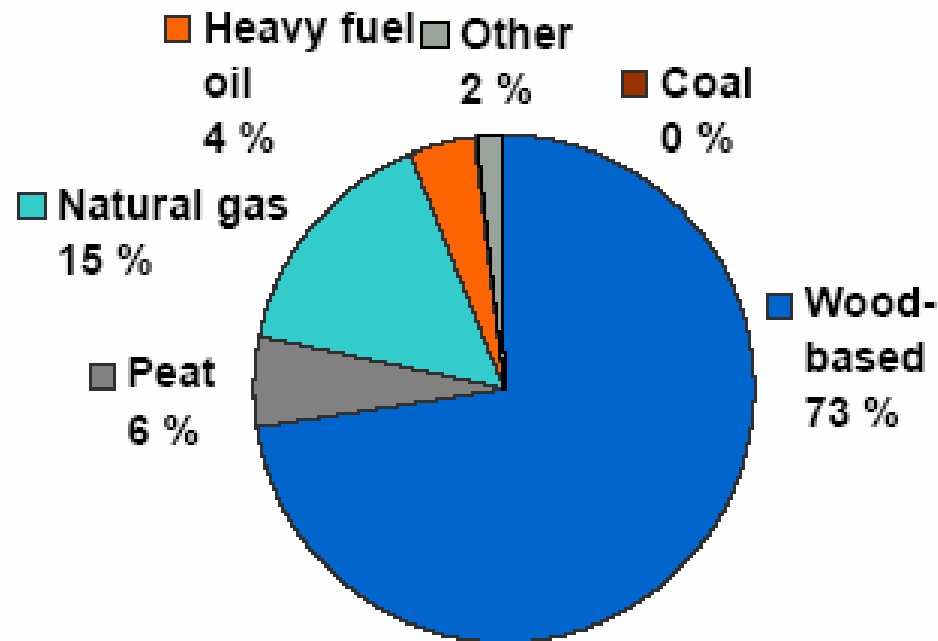
Renewable energy

- The pulp and paper industry is **one of the biggest users and producers of renewable energy sources.**
- Increased interest in and support for renewable energy sources may have **a negative impact on the pulp and paper industry's competitiveness**
 - availability of the main raw material
 - unfair competition through subsidies to energy production from wood burning
 - recovered paper is also considered a potential source of renewable energy and may be directed to energy generation instead of paper production.

The pulp and paper industry is one of the biggest users and producers of renewable energy sources



Mill Fuels of Forest Industry in Finland 2005 Total 244 000 TJ



Finnish Forest Industries Federation

SOURCE:
Confederation of Finnish Industries EK

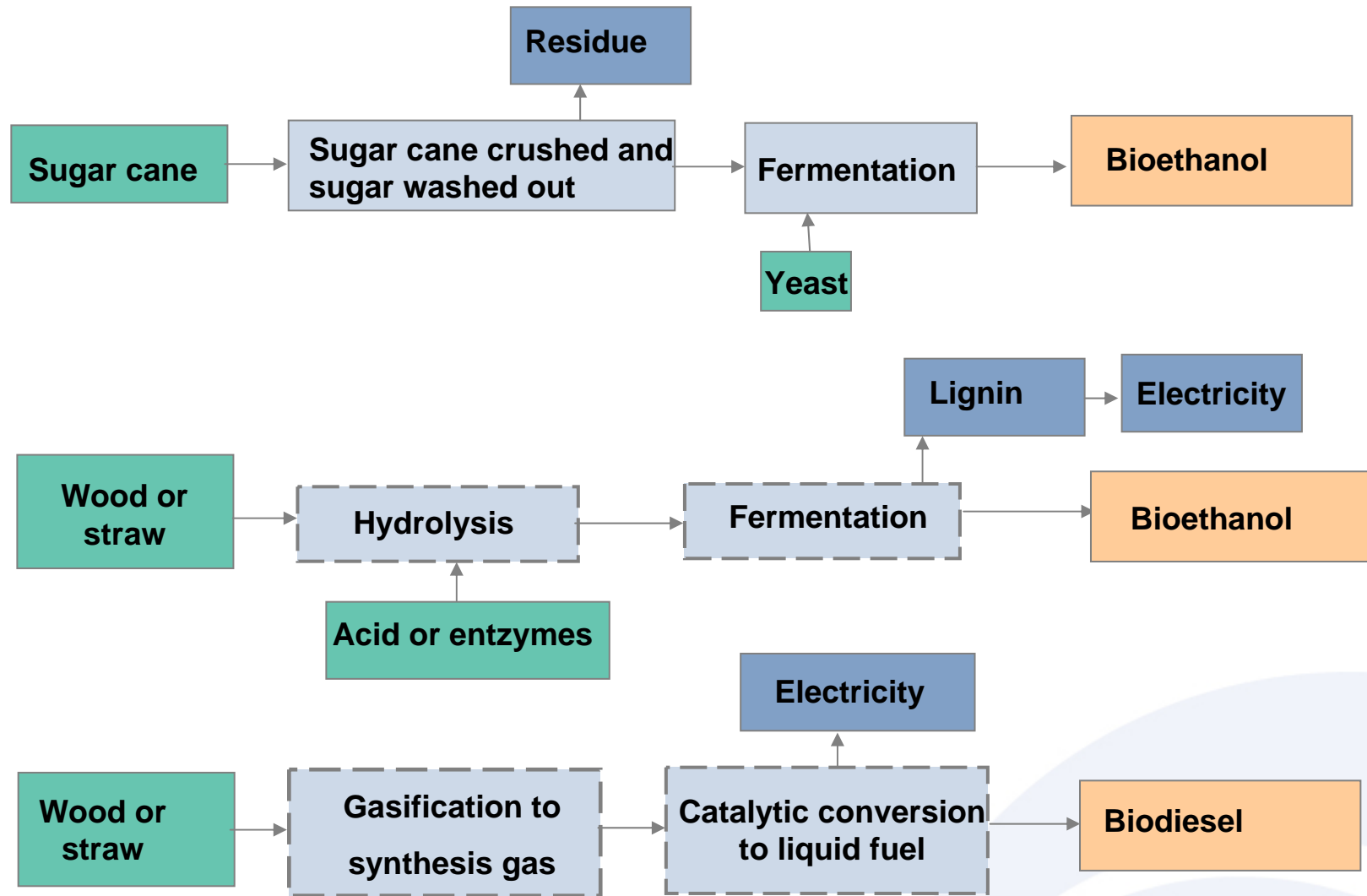
Biofuels from forest biomass – a new opportunity

Biofuel from forest biomass

- One of the **most important sources of renewable energy is biomass**, that can be used to produce electricity and heat as well as **transport fuel (biofuel)**.
- **Co-production of biofuels, electricity and heat** can be made profitable by integrating them with pulp, paper or oil production.
- The main benefit from integration is **the high utilization factor for biomass, up to 90 %, which is a significant competitive advantage** in the future markets, where competition for renewable energy and raw material is much intensified.
- Typical size for a plant in forest industry could be 50 000–150 000 tons of diesel fuel per year, which corresponds to 150–400 MW of biomass
 - Potential of diesel generation in European forest industry (app. 100 mils) could theoretically achieve 11 Mtoe/a

Sources: KTM, 2006, Pöyry.

Some examples of alternative production technologies

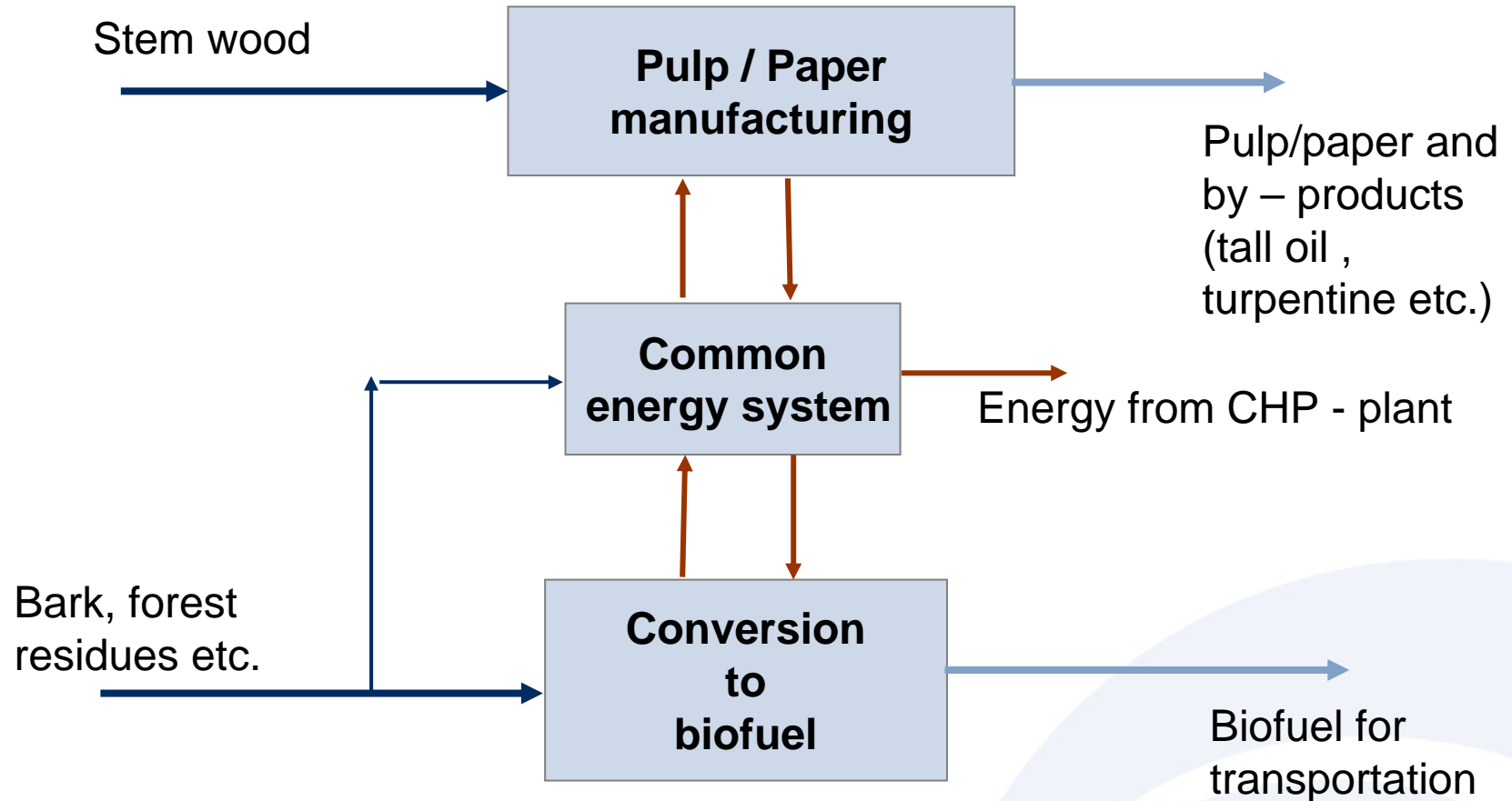


Productivity comparison of first generation biofuels

Raw Material	Production, kg / ha	Raw Material / Liter of Ethanol	Amount of Ethanol / ha
Sugar Cane (Bra)	85 000	12 kg	7 080 l
Corn (US)	10 000	2.8 kg	3 570 l
Barley (FI)	3 500	2.8 kg	1 250 l

Sources: MAPA (Bra), KTM, 2005

Co – production at pulp and paper mills



Advantages of integration

- **Integrated wood procurement and harvesting chain** for both fibre wood and forest residues for mill energy generation.
- **CHP plants on mill sites are already utilizing** residues and side products from pulp and paper processes and other wood based fuels.
- **Optimization** of both energy generation (steam and power ratio) and usage possible
- Synthesis gas production and conversion produces a large amount of high grade by – product energy, which offers **a significant potential benefit if integrated to any energy – demanding industrial facility.**

Technical and economical challenges

- **process technology risks**

- related to limited process yields, process thermal efficiencies, manufacturing materials, gas cleaning requirements, etc.

- **process flexibility**

- a mill should be able to achieve targeted returns for the integrate under a range of volatile market and economic circumstances.
 - optimization and adjustment of carbon consumption to produce pulp and paper, bioenergy, green chemicals or structural material products.
- What are the most attractive process variations that a mill should consider?

- **energy generation**

- how the energy systems are best integrated and optimized between the BTL - plant and the existing mill.

Technical and economical challenges

- **existing pulp and paper production must remain efficient and be able to sustain target product quality**
 - contaminants (distribution between pulp and paper manufacturing and biorefining operations)
 - need of additional process stages for NPE removal
 - evaporator scaling issues
 - sulphur in the biorefinery feedstock?
 - Na/S ratio adjustments in the pulping process?
 - environmental impacts?
- **the risks will increase with increased process complexity**
 - e.g. an integrated forest biorefinery vs. integrated biofuel production

Current Finnish focus

VTT's test plant launched in October, 2006

- VTT's gasification plant will be able to exploit any carbonous raw-materials, e.g. forest industry residues, bark, biomass from fields, refuse-derived fuels and peat
- In the process, synthesis gas will be refined from biomass for the production of diesel fuels.
- Synthesis gasification is specifically being developed to be realized in connection with forest industry plants.
- The production of liquid fuel in the forest industry plants will be remarkably competitive because of its high efficiency and practical raw-material logistics.



Choren Industries GmbH

- CHOREN is constructing the world's first commercial industrial scale BTL-plant (Beta-Plant) at its Freiberg site.
- The planned production capacity of this facility is 15,000 t/a.
- The first "SunDiesel – made by CHOREN" is due on stream by 2007.



- UPM will strongly increase its stake in **second generation bio-diesel in the next few years and prepares to become a significant producer of bio-fuels.**
 - Currently, UPM is developing the business concept and the respective technical solutions.
- **Decisions to invest in the first commercial scale production plant** can be expected within the next few years, rather sooner than later.
 - The plant will be located adjacent to one of UPM's paper mill sites in Finland, France, Germany or UK.
 - The main raw material used in bio-diesel production will be wood based biomass
 - Biodiesel will be produced utilizing Fisher-Tropsch - method

Stora Enso and Neste Oil join forces in biofuel development, March, 2007

- Stora Enso has signed an agreement with Neste Oil to join forces to develop technology for producing new-generation biofuels from wood residues to replace fossil fuels in transportation and thus cut greenhouse gases.
- The first step will be to design and build a demonstration plant at Stora Enso's Varkaus Mill in Finland. The demonstration plant, which will be owned on a 50/50 basis by the parties, is expected to start up in 2008.
- Stora Enso is pioneering in developing its business in the new direction of producing biofuels for transportation. This will enable it to utilise its broad know-how and long experience in wood-based industries and wood sourcing in a new way to create business opportunities. Expertise from Stora Enso, Neste Oil and VTT (the Technical Research Centre of Finland) will be utilised to implement the development phase and commercialise wood-based biofuel production.
- The EUR 14 million demonstration plant will be integrated into the energy infrastructure of the Varkaus Mill, where the gas produced will equal the energy needed to heat 4 300 homes and cut carbon dioxide emissions significantly.

Conclusions

- Many countries and organisations are promoting the use of renewable energy through various development policies.
 - One of the most important sources of renewable energy is biomass which can be used to produce electricity and heat as well as transport fuels.
- Pulp and paper mills have been producing their own energy for many years, with some almost entirely self-sufficient in biomass.
 - new competitors could soon drive up prices as bioenergy continues to climb on governmental agendas.
- The forest industry in general supports the target of increasing the use of renewable energy sources, such as forest biomass, provided that the availability of the main raw material is secured at the same time.

Conclusions

- Preliminary calculations indicate that the **wood paying capability of paper production is still significantly higher than that of BTL**
 - taxation and subsidies will determine the competitiveness of liquid biofuels
- However, some assessments of economic performance indicate that the **profit from co – production of FT (Fischer-Tropsch) liquids could be of similar magnitude** to that from paper production. (VTT, Lahti, Nov. 2006)



POVRY