Future Biorefinery

Niklas von Weymarn
Program Manager
Forestcluster Ltd.
VTT in brief

Basic research

Applied research

Development

VTT Group
- Turnover 292 M€ (2010)
- Personnel 3,167 (1.1.2011)
- Established 1942
VTT on the map
Biomass refining: An established research areas at VTT

Biorefinery sectors with long traditions at VTT:

- Food and beverages
- Paper & board products
- Energy and energy carries
  - including 2nd gen. road transport biofuels
- New polymers and chemicals (through the cell factory)
What is biorefining?

European definition (IEA Bioenergy Task 42):

- Biorefining is the sustainable processing of biomass into a spectrum of marketable products and energy
Conventional biorefineries in Northern Europe

Grain → Ethanol plant
Rapeseed, etc. → Oil pressing plant
Sugar beet → Sugar mill
Wood → Saw or pulp mill

Something left in the fields and in the forests
Is the value addition already optimised?

Can new (greenfield) biorefineries be established?
Market demand for non-food and non-energy products difficult to forecast

- Renewable
  - Annual use/annual growth
  - Biodiversity

- Energy policies

- Material efficiency
  - Recycling/biodegradable
  - Use of whole biomass
  - Optimise value addition

- Agricultural policies
Building on existing most likely the way to go
Domsjö Fabriker, Sweden

Source: www.domsjoe.com
Interesting products

- **Biochemicals and biomaterials**
  - Cardboard, specific paper grades, tissue, etc.
  - Wood products
  - Textiles (next generation viscose)
  - Composites (esp. lignin and cellulose)
  - Polymers (natural or synthetic)
  - Chemicals, glues and resins (esp. lignin)

- **Bioenergy**
  - Heat & power
  - Syngas-based biofuels
  - LC sugar-based biofuels

- **Health-beneficial products and related**
  - Food ingredients (functional foods)
  - Medicinal molecules
  - Cosmetics
Pulp and paper industry perspective

- **A pulp mill or conventional biorefinery**
  - Kraft cooking to make paper-grade pulp
  - Integrated bioenergy production
  - Also turpentine, tall oil
- **Emerging biorefineries**
  - Pre-hydrolysis of hemicelluloses to make ethanol
  - Recycled fibre to ethanol
  - Gasification to make F-T diesel
  - Flash pyrolysis and torrefaction
  - Wood-plastic composites (nanocellulose)
  - Dissolving pulp
- **Future biorefineries**
  - Syngas to high-value products
  - New products from cellulose, lignin and hemicelluloses
  - New wood fractionation methods
Old Town, USA (hemicellulose pre-hydrolysis to make biofuels)

Source: Prof. Adriaan van Heiningen, Aalto University
Bio-syngas platform

Paper & pulp

Wood, straw, energy crops, peat, RDF

Pulp and paper mill

Energy to drying

Gasification and gas treatment

Bark, forest residues, other biomass

Synthesis-gas

Steam & oxygen

Power plant

Process steam & power

Fuel gas + steam

FT-synthesis & upgrading

F-T diesel
Emerging biorefineries in Finland

- **Stora Enso & Neste Oil & Foster Wheeler: F-T diesel**
  - A demonstration plant (12 MW) in operation at Stora Enso’s pulp mill in Varkaus (forest residues)

- **UPM & Andritz & Carbona: F-T diesel**
  - Pilot tests at GTI facilities, USA

- **Vapo & Metsäliitto: F-T diesel**

- **UPM & others: Waste fibre to ethanol**
  - Pilot tests at VTT

- **Metso, Fortum & UPM: Bio-oil by pyrolysis**
  - Demonstration plants for heat and electricity

- **UPM: Nanocellulose-based products**

- **Chempolis: Straw to paper**
  - Also bioethanol and biochemical production technology

NSE Biofuels
Forestcluster Ltd.
Owners of Forestcluster Ltd.
Focus points of Forestcluster Ltd.

Adapted from Geoffrey A. Moore: “Dealing with Darwin”
Forestcluster Future Biorefinery (FuBio) – Building bridges to non-conventional, growing markets

- Regenerated fiber and chemicals
- Structural composites
- Novel packaging and filtration materials

Future Biorefinery

- Health-promoting products
- Wood preservatives and glues
- Polymers, resins and chemicals
Raw materials for various solid materials

- Fossil
- Biomass
- Minerals

- Plastics
- Textiles
- Rubber

- Wood products
- Paper & board
- Textiles

- Cement
- Tiles
- Steel
- Glass

Forestcluster
Towards bio-economy?

BIO-ECONOMY:
Towards a society, where the role of biomass-based materials (and other products) becomes more important..
Summary

- Oil and other fossil raw materials cannot be replaced as such

- Biorefineries can ease the growth pressure directed to fossil raw materials by producing alternative products from biomass (bio-economy)

- Market demand difficult to assess

- Integrating new processes to existing industry is the most likely way to go
  - Having a transport biofuel as main product can be economically very challenging (needs a strong co-product) → difference in scale the next challenge
  - Biofuels and high value bio-products should be studied together
Thank you!

Contact information:
niklas.weymarn@vtt.fi