Future Biorefinery

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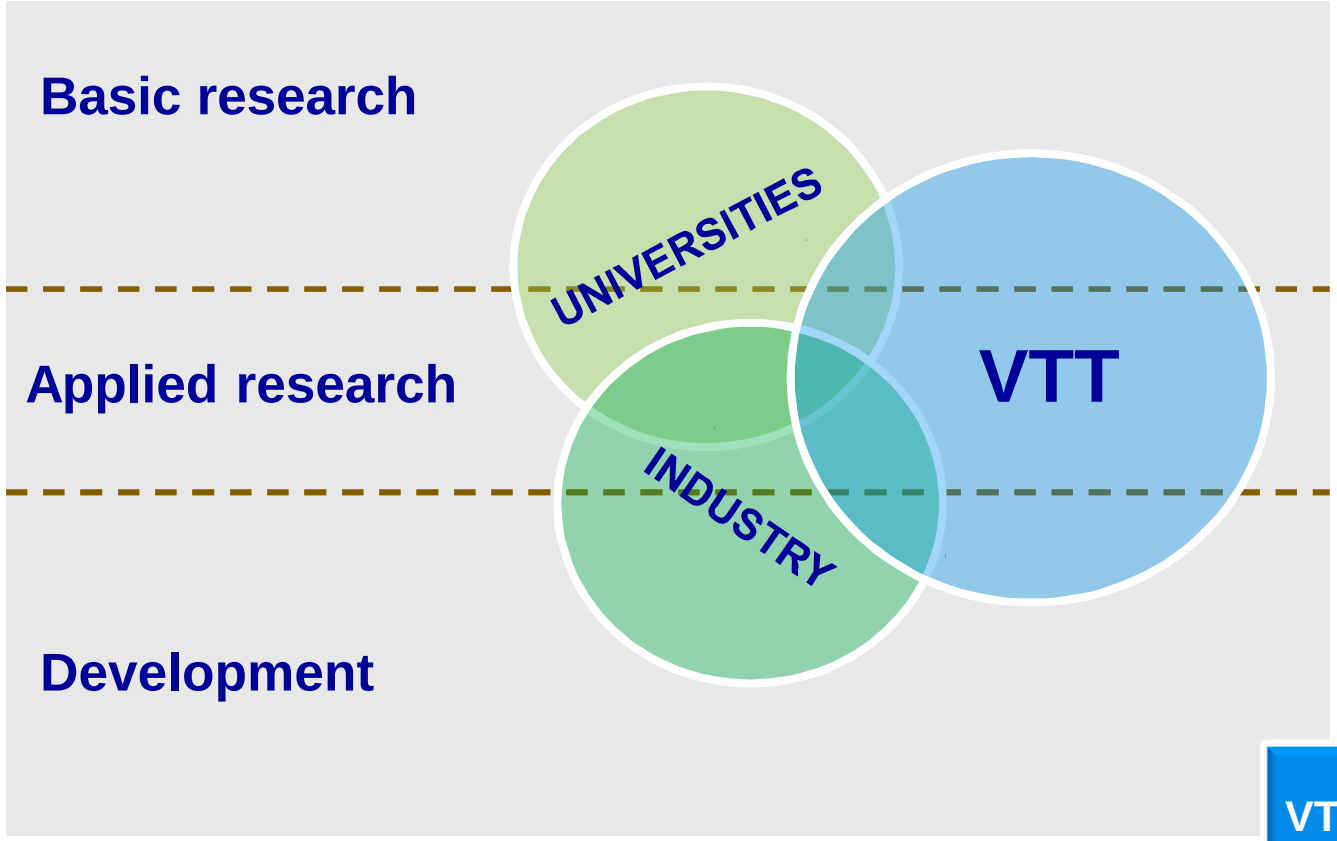
VTT in brief



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

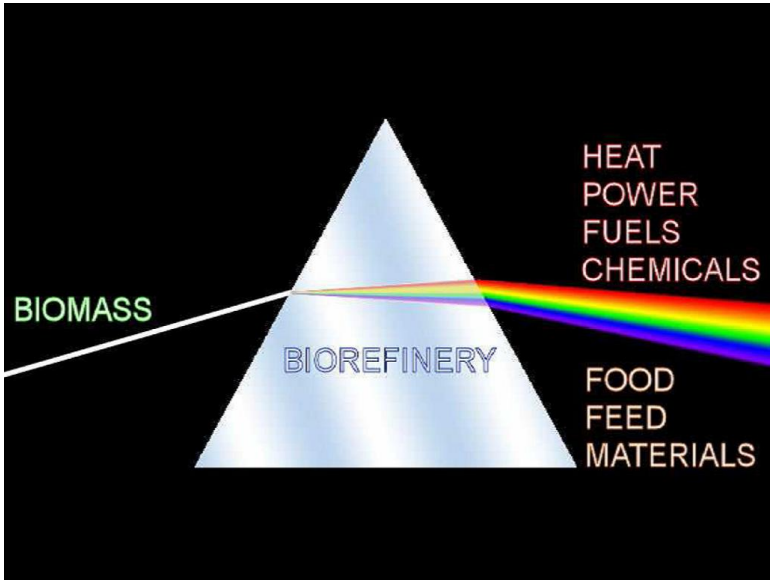
Biorefinery sectors with long traditions at VTT:

- 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



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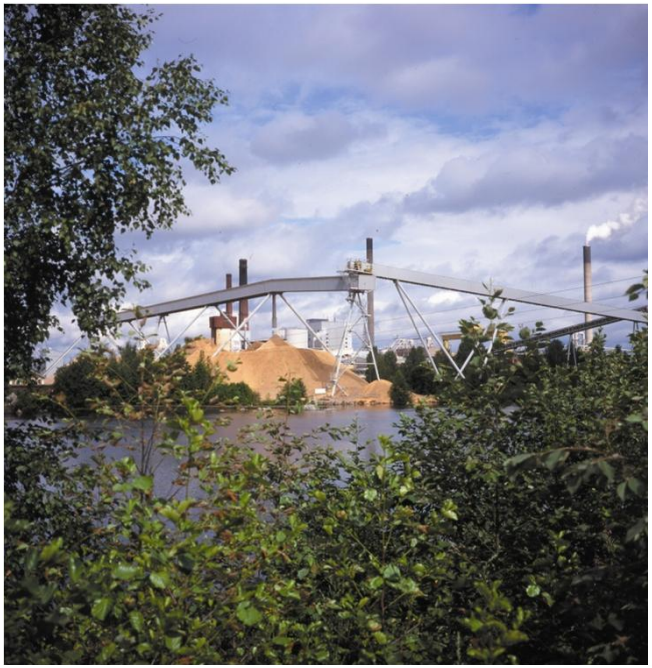
Conventional biorefineries in Northern Europe

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

Can new (greenfield) biorefineries be established?

Something left in the fields and in the forests

Is the value addition already optimised?



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Market demand for non-food and non-energy products difficult to forecast

Renewable
Annual use/annual growth
Biodiversity

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

?

Energy policies

Agricultural policies

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Building on existing most likely the way to go

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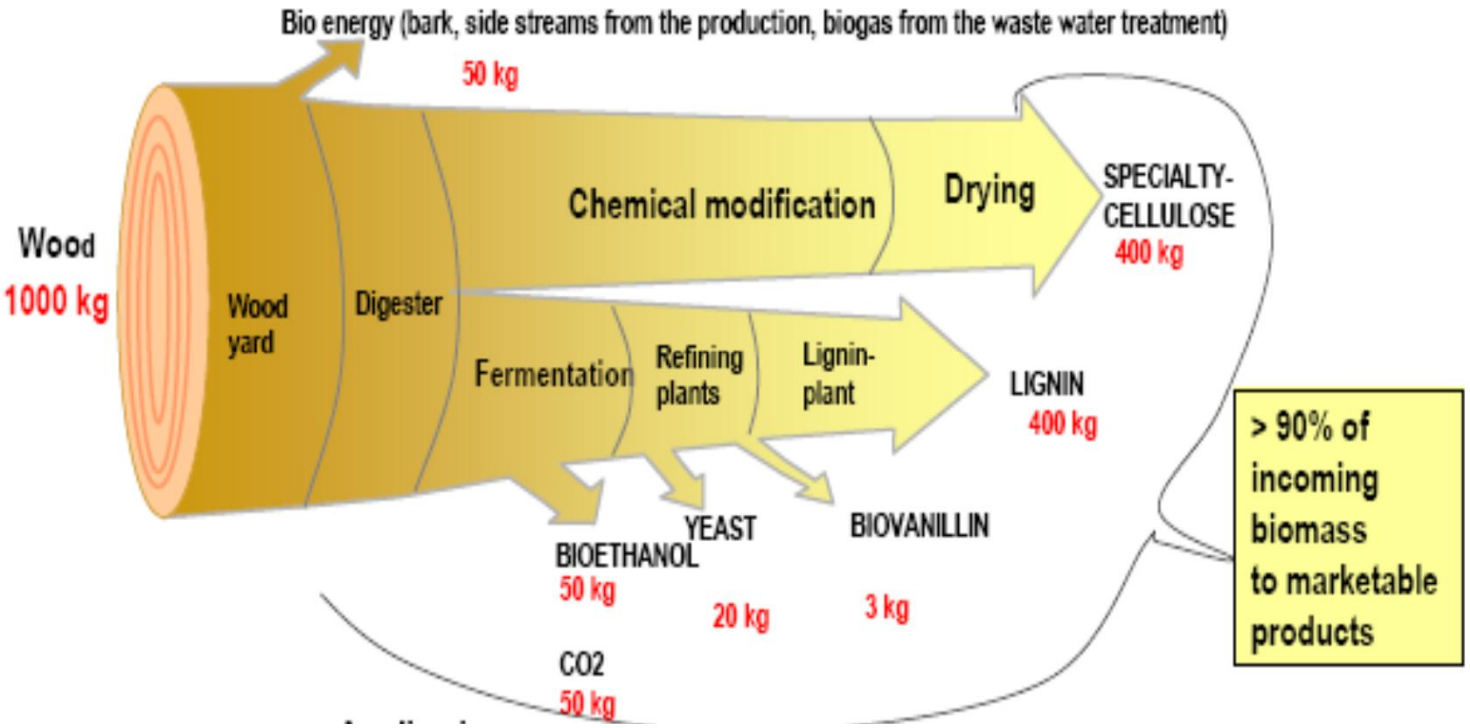
Borregaard, Norway



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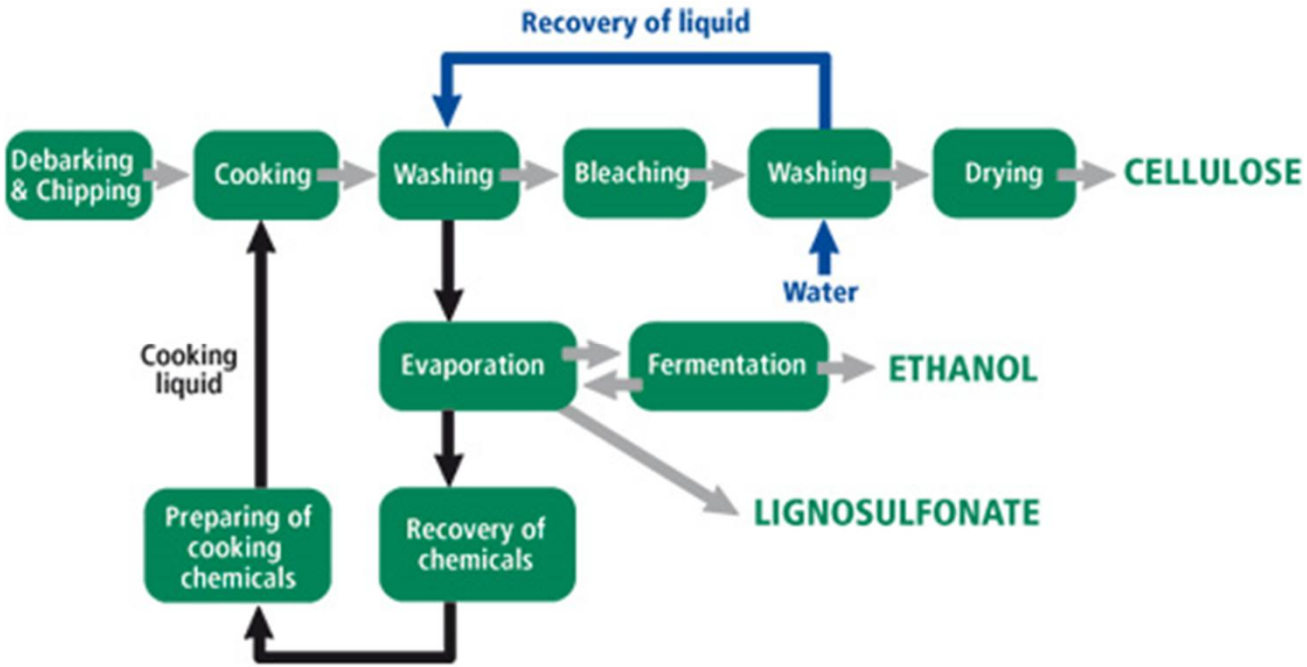
Source: www.borregaard.com

Domsjö Fabriker, Sweden



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Source: www.domsjoe.com

Interesting products

- <u>Biochemicals and biomaterials</u>
  - 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)

- <u>Bioenergy</u>
  - Heat & power
  - Syngas-based biofuels
  - LC sugar-based biofuels

- <u>Health-beneficial products and related</u>
  - Food ingredients (functional foods)
  - Medicinal molecules
  - Cosmetics

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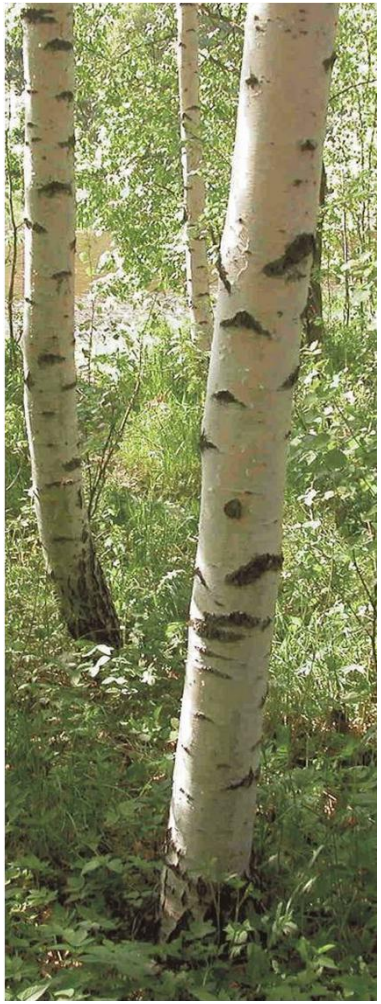
Pulp and paper industry perspective

- 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



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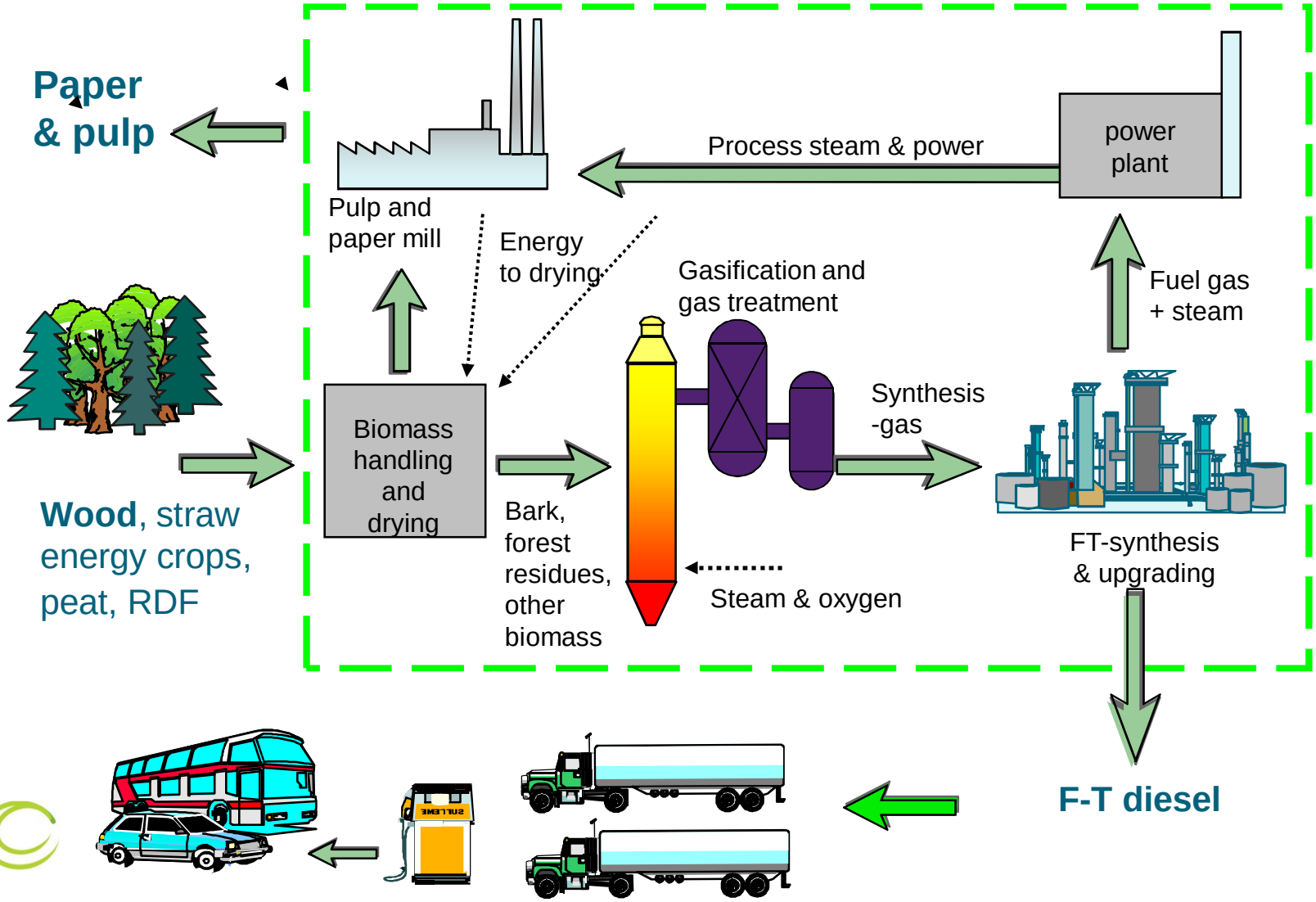
Old Town, USA (hemicellulose pre-hydrolysis to make biofuels)

Source: Prof. Adriaan van Heiningen, Aalto University

Bio-syngas platform



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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 biochemcal production technology

NSE Biofuels

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Owners of Forestcluster Ltd.

UPM
STORAENSO
VTT
TAMPEREEN TEKNILLINEN YLIOPISTO
BOTNIA
MYLLYKOSKI
METLA
Aalto-yliopisto
metso
ANDRITZ
LAPPEENRANNAN TEKNILLINEN YLIOPISTO
JYVÄSKYLÄN YLIOPISTO
m·real
kemira
ÅBO AKADEMI
ITÄ-SUOMEN YLIOPISTO
Metsäliitto
Suomalaisissa käsissä
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UNIVERSITY of OULU
HELSINGIN YLIOPISTO

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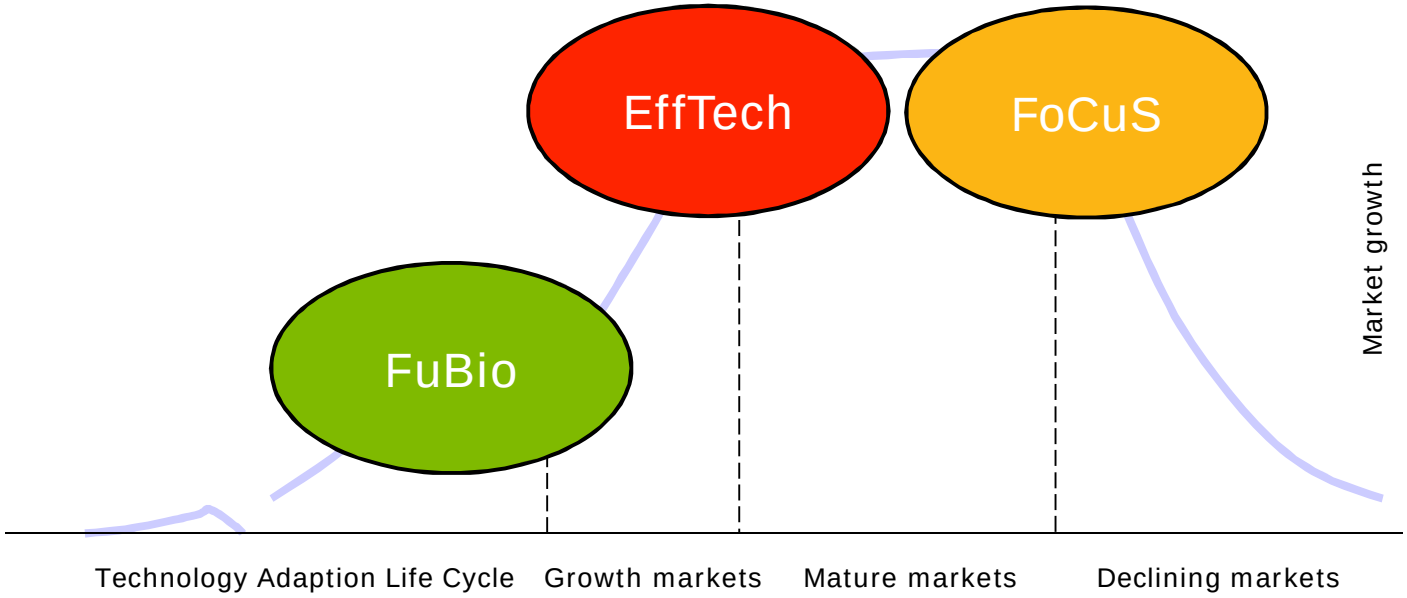
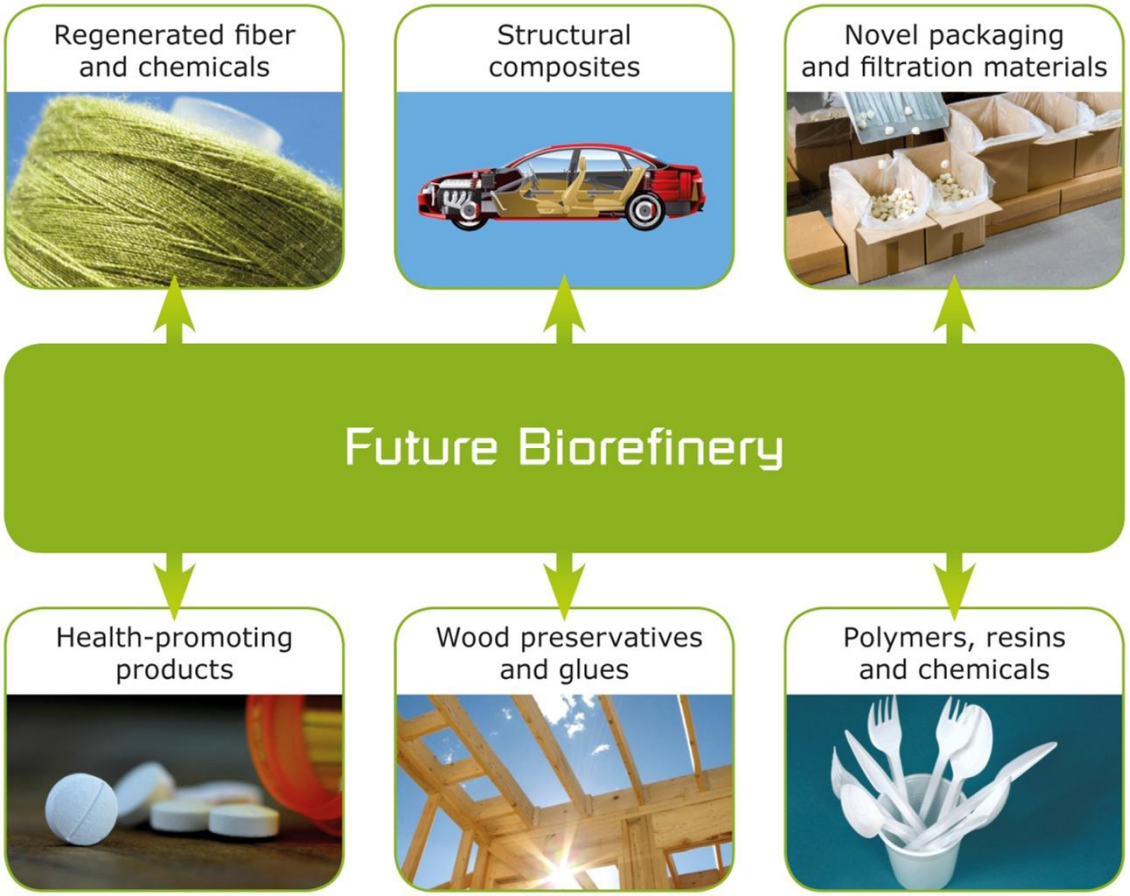
Focus points of Forestcluster Ltd.



Adapted from Geoffrey A. Moore: "Dealing with Darwin"

Forestcluster Future Biorefinery (FuBio) – Building bridges to non-conventional, growing markets



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Raw materials for various solid materials

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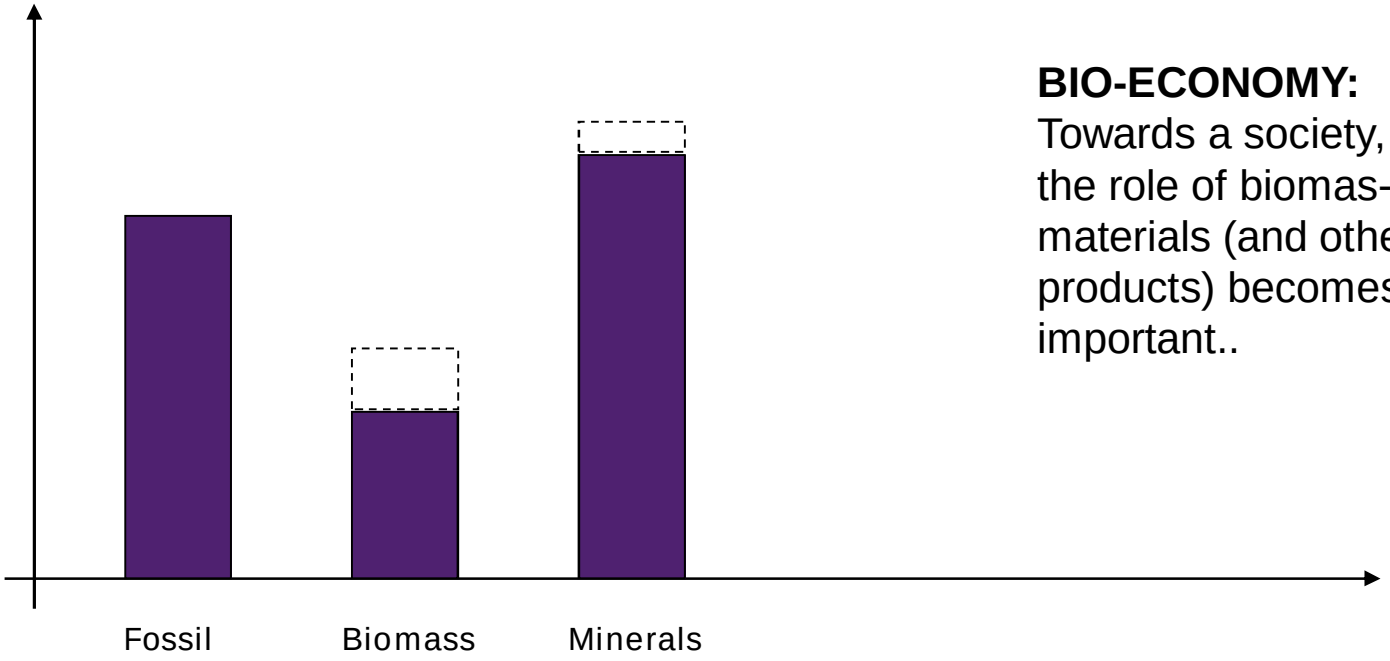
Towards bio-economy ?



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

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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

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Thank you!

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