Potential of Wood Based Biofuels and Sustainable Supply Chains

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UPM leads the integration of bio and forest industries into a new, sustainable and innovation-driven future

- 22,000 employees
- Sales 10.4 billion euros in 2012
  - Production in 17 countries
  - Worldwide sales network
  - Listed in the NASDAQ OMX Helsinki stock exchange
- UPM Biofuels is a strategic business unit of UPM Biorefining
Biofuels a key step on pulp and paper industry's transformation path towards biorefining industry

Pulp and paper industry today: Relatively low value-adding products mostly from primary raw materials

Biorefining industry of tomorrow: High value-adding products with all materials, including residues, processed

Woody biomass
- Logs
- Pulpwood
- Energy wood
- Recycled fibre
- Saw dust
- By-products

Sawn timber
Plywood
Pulpwood and recycled fibre
Pulp
Wood residues

End users
- Paper
- Tissue
- Packaging
- Biofibrils
- Pulp residues

Current focus areas
Future growth avenues

Energy

End users
- Labels
- Hygiene products
- Biochemicals
- Biocomposites
- End users

Hygiene products

Biofuels

Biofuels
Wood biomass is in the forefront of new bioproducts development

Wood is preferred biomass; technologies to convert lignocellulosic feedstock into value added products developing fast

Advantages of wood:

- Limited price volatility
- Available year-round
- Easy to transport and store
- No overlap with food-chain

Europe:

- Most forest-rich region (1.02 billion ha = 25% of global resources)
- Forest area expanding (annually 800,000 ha)
- only ~ 40% of increment utilized

Source: Finnish Forest Research Institute
Sustainability is in the core of our operations

- Wood is a renewable and recyclable raw material
- Sustainable forest management
- Good forest management practices
- Environmentally and ecologically sound harvesting
  - State-of-the-art techniques
  - Qualified personnel
  - According to PEFC or FSC standard
  - All UPM owned forests are certified
- Certified fibre to highest possible degree and promote a global increase in the use of certified wood
- Origin of all wood is known, legal and not from high conservation value forests
- All wood supplies covered by a third-party verified chain of custody
# UPM Biofuels strategy

## Advanced biofuels
- Drop-in fuels fully compatible with current vehicle engines

## Wood-based raw materials
- Renewable wood-based raw materials not suitable for food production

## Sustainable operations
- Significantly, even 80%, less greenhouse gas emissions

UPM will be a big player in advanced biofuels market
Revenue targeting > 1 billion €/a
First step: UPM Lappeenranta Biorefinery
**UPM Lappeenranta Biorefinery**

- **Commercial scale industrial investment**
  - Total investment 150 M€
  - Production 100,000 tonnes/a of renewable diesel → 120 million litres
  - Based on patented UPM innovation
    - 150 patents & patent applications
  - Production starts in 2014
  - Employs in total 200 persons (incl. indirect)
  - Contributes approximately 25% of Finland’s biofuel target
  - ISCC certification planned
Raw material: Crude Tall Oil (CTO)

- Contains natural extractives of wood
- Yield 20–50 kg CTO/t pulp
- Global production now > 2 000 000 t/a
  - CTO supply potential above demand globally
  - Significant share burned for energy
  - Production potential 2 600 000 t/a
- UPM is tapping into underutilized lower grade CTO streams
- UPM biorefinery minor addition to total demand, no affect on demand-supply balance

Residue of pulping process
No indirect land-use change
Outside food value chain

Source: Ecofys:, Low ILUC assessment CTO, Pöyry
UPM BioVerno - nearly 80% Greenhouse gas reduction compared to fossil fuel

CTO procurement: 5.0 gCO₂eq/MJ
Transport: 0.5 gCO₂eq/MJ
Processing: 13.6 gCO₂eq/MJ
Distribution: 1 gCO₂eq/MJ

BioVerno Σ 20.1 gCO₂eq/MJ

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<thead>
<tr>
<th>Process</th>
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<td>Raw material procurement</td>
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<td>Processing</td>
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<td>Raw material transport</td>
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*Default value from Directive of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources
Second step: Solid woody biomass to biofuels
Second step in UPM Biofuels business: Solid biomass to fuels

Raw material

- Sustainably sourced **forest residues**: logging residues, woodchips, bark
  - Collected without increasing wood harvesting
  - No change in indirect land-use (ILUC)
  - Added value for wood biomass

Technology concepts

- **BtL**: Gasification – FT synthesis – Wax upgrade
  - Pilot: in Gas Technology Institute, Chicago, USA, developed in co-operation with Andritz-Carbona
  - Input 1 Mton of wood biomass (wet)
  - Output 100,000 tons of biofuel
  - Main product 2nd generation renewable diesel
  - UPM granted EUR 170 million EU NER300 grant
  - Investment decision 2014

- Pyrolysis & Bio-oil upgrade to transportation fuels
  - Ongoing development
UPM Biofuels growth strategy

**ENTERING BUSINESS**
HYDROTREATMENT
Tall oil ➔ UPM Lappeenranta Biorefinery start-up 2014

**EXPANDING BUSINESS**
THERMAL CONVERSION
Solid wood materials ➔ Gasification (BtL) /Pyrolysis

**GROWTH OF BUSINESS**
FUTURE DEVELOPMENT
New technologies, processes & raw materials
R&D activities & co-operation with strategic partners

Products are drop-in hydrocarbons – Ready components for commercial blends