BIOMASS TO ENERGY AND CHEMICALS
HighBio2
(2011-2013)
Overview

- The project is co-financed by the EU Interreg IV A North Program
- The budget of the project is approx. 1.2 M€
- From June 2011 to December 2013

Persons:

Project coordinator:
- Bodil Wikman (Chydenius)

Persons responsible:
- Prof. Ulla Lassi (Chydenius, OY)
- Prof. Jukka Konttinen (JY)
- Ass. Prof. Xiaoyan Ji (LTU)
- Lic. Sc. Kari Pieniniemi (Centria)
Aims of the project

- Based on distributed energy production model
- Utilization of renewable forest biomass
- Development of the gasification process
  - Optimization of gasification process
  - Purification of product gas (syngas)
- Production of biomass-based end products (fuels and chemicals)
- Utilization of by-products of gasification (CO₂, bioash)
### Added Value of the Refining of the Forest Biomass

<table>
<thead>
<tr>
<th>Source materials</th>
<th>Thermal treatment</th>
<th>Conversion methods of syngas</th>
<th>Value-added end products</th>
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</thead>
<tbody>
<tr>
<td>Forest Biomass</td>
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<td>- wood</td>
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<td>- forest residues</td>
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<td>(crownmass,</td>
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<td>branches, stumps)</td>
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<td>- sawdust</td>
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<td>- organic waste</td>
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<td>- construction</td>
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<td>waste</td>
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<td>Bio-product gas</td>
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<td>- Combined heat</td>
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<td>and power (CHP)</td>
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<td>production</td>
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<tr>
<td>Bio-syngas</td>
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<td>(H₂ + CO)</td>
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<td>Fischer-Tropsch</td>
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<td>synthesis</td>
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<td>Fermentation</td>
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<td>By-products</td>
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<td>Recovery</td>
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<td>Bio-ash CO₂</td>
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<td>Utilization</td>
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</table>

**Forest industry**
- Research

**Energy industry**
- Development
- Innovations

**Chemical industry**
- Applications
Research activities

- WP1 – Optimization of the gasification process
- WP2 – Purification of syngas
- WP3 – Utilization of purified syngas and gasification by-products
- WP4 – Information distribution
Expertise of partners

- Centria: Small scale gasification for combined heat and power production (gasifier pilot plant)
- University of Jyväskylä: Mathematic models for gasification
- LTU: Recovery of CO2, Simulation programmes (Aspen Plus)
- Chydenius: Catalytic conversion of biomass-based syngas, analysis of tar compounds
- University of Oulu: Characterization of by-products
WP1

- **Optimization of the gasification process**
  - Improved control of the gasification process
    - temperature, source material, feed rate, etc.
  - Analysis of syngas quality
    - On-line monitoring of gases
    - Tar collection and analysis
  - Evaluation of material and energy balances
  - Experimental data
  - Mathematical models
WP2

- **Purification of syngas**
  - Analysis of syngas and impurities
    - syngas consists primarily of hydrogen ($H_2$) and carbon monoxide (CO)
    - impurities: particles, metals, halogens, hydrocarbons (tars), etc.
    - even low amounts of impurities may have unfavourable effects e.g. for catalysts
  - Improved purification process
    - scrubbers, fixed-bed adsorbents, catalytic cracking
  - Tar (sampling and) analysis
  - Recovery of $CO_2$
    - economical reasons
    - amines, ionic liquids
Greenhouse 2011-2013

Possibilities - Example of energy and material integration in the greenhouse
WP3

• Utilization of purified syngas and gasification by-products
  – Production of value-added products
  – Fischer-Tropsch synthesis
    • a catalytic reaction that converts syngas into hydrocarbons
    • selective and active catalysts based of Co and Fe
    • end products: synthetic diesel, other hydrocarbons
  – Optimization of reaction conditions
    • temperature, pressure, gas flow
  – Other catalytic routes
    • mixed alcohol synthesis
    • higher alcohols (e.g. butanol)
  – Utilization of by-products
    • CO₂, bioash
WP4

• Information distribution
  – National and international information distribution
  – INFO sheets in HighBio web page
  – Scientific publications
  – Seminars
Thank You!

More information:
www.chydenius.fi/yksikot/soveltava-kemia