St1 Biofuels Oy
Waste-Based Ethanol

2nd Stakeholder Plenary Meeting of the European Biofuels Technology Platform

January 22nd 2009

C₂H₅OH
Ethanol Market Finland – waste based Ethanol

- Estimated fuel ethanol demand by 2020: 400,000 m³
- Theoretical waste based ethanol capacity by 2020: 600,000 m³

Theoretical Volume Potential by type of waste:

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>National potential (mill.liters/a)</th>
<th>St1 Plant type</th>
<th>First Plant</th>
<th>Plants by 2014 (#)</th>
<th>Production / Plant (m3/year)</th>
<th>Production at 2014 (mill. liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food industry waste and side</td>
<td>40</td>
<td>Etanolix®</td>
<td>2007</td>
<td>10-15</td>
<td>750-2000</td>
<td>20</td>
</tr>
<tr>
<td>Municipal biowaste</td>
<td>40</td>
<td>Bionolix™</td>
<td>2009</td>
<td>10-15</td>
<td>500-2000</td>
<td>20</td>
</tr>
<tr>
<td>Household and industry</td>
<td>400</td>
<td>Cellunolix™</td>
<td>2010</td>
<td>10-15</td>
<td>10 000-25 000</td>
<td>200</td>
</tr>
<tr>
<td>Straw</td>
<td>120</td>
<td>Fiberix™</td>
<td>2011</td>
<td>100-200</td>
<td>200-500</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>300</td>
</tr>
</tbody>
</table>
1. “CO₂ good” bioethanol is produced from waste material and industrial by-products using Etanolix® processing plants.

2. The process creates a by-product to be used as animal feed, liquid fertilizer or solid fuel.

3. The 85% bioethanol produced is then sent for dehydration for water removal.

4. Produced bioethanol is blended – as a bio component – to make final biofuel.

5. Biofuel is distributed to service stations.
Low Life-Cycle CO₂ emissions through entire value chain

Value Chain:

- Food Industry
- Market
- Households
- Households & Industry
- Waste handling services

CO₂ emissions:

1. Ethanol (Etanolix/St1)
   - 0,01 kg CO₂/kgoe

2. Ethanol (Sugarcane/Brazil)
   - 0,5 kg CO₂/kgoe

3. Ethanol (Corn/U.S)
   - 1,4 kg CO₂/kgoe

4. Biodiesel NExBTL
   - 1,6 kg CO₂/kgoe

5. Biodiesel RME
   - 1,6 kg CO₂/kgoe

6. Fossil gasoline
   - 2,7 kg CO₂/kgoe

7. Fossil diesel
   - 3,8 kg CO₂/kgoe

Source: WSP Study 2006

kgoe = kilogram oil equivalent
41,868 MJ/kg (EtOH 26,9 MJ/kg)

*Animal feed, Fertilizer, Dry Fuel, Heat, Electricity
St1 Biofuels Production units in operation

Etanolix® – Typical case

- Capex: first units 2m€
- Process heat from renewable source (pellets) or as excess heat from production unit to which Etanolix® is integrated to
- Footprint 25 x 25 m
- Fully automated – remote operation
- Modular: easy to configure, mass production, standard components, fast manufacturing & installation and relocation possibility

Etanolix® – Lappeenranta (Sept, 2007 -)

- "Stand Alone" unit using bakery and sweet industry side-streams
- Capacity: 1.000 m³/a bioethanol
St1 Biofuels Production units in operation

**Etanolix® – Närpiö (May, 2008 -)**
- Integrated unit using potato flake factory side-stream (20,000 tn/a)
- Capacity: 1,400 m³/a bioethanol

**Etanolix® – Hamina (Oct, 2008 -):**
- Integrated unit using bakery and sweet industry side-streams
- Capacity: 1,500 m³/a bioethanol

**Dehydration – Hamina (Aug, 2008 -):**
- Capex: 11m€
- Capacity 44,000 m³/a fuel grade 99,8% EtOH
  - to be doubled 1H2009