Project status update

Per Salomonsson

Volvo Powertrain

4th International DME Conference
Hilton Stockholm Slussen
Stockholm
6 – 9 September 2010
Production of DME from Biomass and utilisation as fuel for transport and for industrial use

Starting date: 1 September 2008
Duration: 48 months
Contact: per.salomonsson@volvo.com

Total budget: 28.4 M€
EU funding: 8.2 M€
Energimyndigheten: 9.6 M€
3 Trucks drive to Stockholm 6/9, 400 km

06.30 Göteborg

14.30 Stockholm
Demonstration of an environmentally optimised bio-fuel for road transport covering the full chain from production of fuel from biomass to the utilisation in vehicles.
BioDME consortium

- **Chemrec** and **Haldor Topsøe** develop and build the DME plant in Piteå
- **Volvo Trucks** develops and builds DME trucks and a fuel injection system together with **Delphi**
- **ETC**, the Energy Technology Centre in Piteå, contributes its technical expertise
- **Preem** is responsible for Bio-DME distribution and builds fuel stations in Sweden
- **Total** is responsible for fuel and lubricant specifications
- The project is financed by the participants, the EU and the Swedish Energy Agency
BioDME project
2008-2012

DME plant ready

Construction  DME production
Filling stations and DME distribution
Fuel and lube oil investigations
Vehicle development  Field test

Start of field test

2008  2009  2010  2011  2012
Project start  Project end
Demonstration of an environmentally optimised bio-fuel for road transport covering the full chain from production of fuel from biomass to the utilisation in vehicles.
BioDME plant in Piteå

Down-stream from Chemrec’s existing development plant for black liquor gasification, Chemrec has engineered and constructed a DME plant using novel synthesis technology from Haldor Topsøe.

Existing Chemrec development plant
- Start up Sept 05
- Approx 3 MW BL feed
- 1% of host mill capacity
- 30 bar op. pressure
- ~12 000 op. hours

New BioDME Pilot Site

BioDME Tank Storage for Finished Product
(~500 meter from site)
BioDME – Project overview

Demonstration of an environmentally optimised bio-fuel for road transport covering the full chain from production of fuel from biomass to the utilisation in vehicles.
1. EPCM start 2009-05-01
2. Startup event at site 2009-09-18
3. Construction start in workshop Nov 2009
4. Construction at site 2010-01-15
5. Transport from workshop to site and erection of structure May 2010
6. Plant powered up and start of pre-commissioning 2010-08-16
7. Mechanical completion & start of commissioning 2010-10-01
8. Planned start of operation 2010-11-15
Groundbreaking by the Swedish King
18 September, 2009

Tough weather conditions during initial work
February 6, 2010

-34°C
Steel structure with major equipment and part of piping erected on site on May 23, 2010

Flare put in place June 3, 2010
August 2010: Complex piping! Tracing and insulation still to be completed.

From top of structure mid August 2010

Site Visit Chemrec BioDME Plant – Piteå, September 9
BioDME – Project overview

Demonstration of an environmentally optimised bio-fuel for road transport covering the full chain from production of fuel from biomass to the utilisation in vehicles.
• BioDME production in Piteå
• Four filling stations for BioDME: Gothenburg, Stockholm, Jönköping, Piteå
• Dedicated DME trailer used for distribution
• Monthly DME consumption ~70 m³
Distribution of BioDME

- Spill free coupling for vehicle filling with unique DME key
- Lubricity and odorant additives is added into the BioDME when loading the DME trailer
- Samples for quality control taken for each trailer load
- Dedicated DME card solution for field test customers
- Fossil DME as back up solution

Additiv bottle mounted on trailer

Vehicle filling
Demonstration of an environmentally optimised bio-fuel for road transport covering the full chain from production of fuel from biomass to the utilisation in vehicles.

- **3G vehicle development**
- **WP6** FIE refinement
- **WP7** Vehicle procurement
- **WP8** Vehicle field test
- **WP5** Fuel properties
- **WP4** Distribution and filling
- **WP3** DME pilot production
- **WP12**
- **WP1** DME pilot plant development
- **WP2**
- **WP9** Industrial use
- **BIO syngas from blackliquor**
DME technology for heavy duty trucks

- A DME truck is a modified diesel truck
- With DME we can benefit from the advantages of the diesel engine
- Very robust and energy efficient engine
- Meet emission levels with less aftertreatment
<table>
<thead>
<tr>
<th>Feature</th>
<th>Actual</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base engine</td>
<td>13 litre, 6-cyl</td>
<td></td>
</tr>
<tr>
<td>Fuel supply</td>
<td>Common rail</td>
<td></td>
</tr>
<tr>
<td>Max Engine power, hp</td>
<td>440</td>
<td></td>
</tr>
<tr>
<td>Emission control</td>
<td>EGR, Ox-cat</td>
<td>No DPF, No SCR system</td>
</tr>
<tr>
<td>Emission level</td>
<td>Euro V EEV</td>
<td>National permit (Very low PM emissions)</td>
</tr>
<tr>
<td>Fuel consumption</td>
<td>~ diesel eq.</td>
<td></td>
</tr>
<tr>
<td>Range (40ton)</td>
<td>~ 400 km</td>
<td>~ 7-800 km with larger tanks for later field test vehicles</td>
</tr>
<tr>
<td>Drive by noise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target 80 dBA)</td>
<td>77,6 dBA</td>
<td>Combustion and engine noise are noticeably lower</td>
</tr>
<tr>
<td>Start torque</td>
<td>improved</td>
<td>Low rev torque not limited by smoke emissions</td>
</tr>
</tbody>
</table>
BioDME – Project overview

Demonstration of an environmentally optimised bio-fuel for road transport covering the full chain from production of fuel from biomass to the utilisation in vehicles.
Engine verification

Examples of design improvements from endurance testing
1) Optimised design of DME injector valve seats
2) Material choice in exhaust valves for good durability

DME engine in test cell

2) Exhaust Valves

1) injector detail
Vehicle verification prior to field test

• Vehicle testing in realistic conditions
• Tests on test track and public roads
• 1 BioDME truck has accumulated > 20 240 km

Filling a BioDME truck in winter conditions

BioDME truck on “Belgian pavé” at Volvo test track

• Very good driving performance
• Now ready to learn more from testing by customers
BioDME – Project overview

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Vehicle production
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<tr>
<th>Truck</th>
<th>Customer</th>
<th>In cooperation with</th>
<th>Field test</th>
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</thead>
<tbody>
<tr>
<td>BioDME 1</td>
<td>Posten Norden</td>
<td></td>
<td>Regional distribution transports of pallets between Stockholm and Jönköping</td>
</tr>
<tr>
<td>BioDME 2</td>
<td>J-Trans</td>
<td></td>
<td>Truck transports for Volvo Logistics supplying the Volvo establishments in the southern parts of Sweden with goods</td>
</tr>
<tr>
<td>BioDME 3</td>
<td>J-Trans</td>
<td></td>
<td>Truck transports for Volvo Logistics supplying the Volvo establishments in the southern parts of Sweden with goods</td>
</tr>
<tr>
<td>BioDME 4</td>
<td>Green Cargo</td>
<td></td>
<td>Truck for local transport in Göteborg</td>
</tr>
<tr>
<td>BioDME 5</td>
<td>DHL Freight Sweden</td>
<td>Västra Götalands Transport AB (VGT)</td>
<td>Truck in regional transport around Göteborg and Jönköping.</td>
</tr>
</tbody>
</table>

www.biodme.eu/fieldtest
## Field test, serie 1 sept 2010

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<tr>
<td>BioDME 6</td>
<td>DHL Freight Sweden AB</td>
<td>Västra Götalands Transport AB (VGT)</td>
<td>Truck in regional transport around Stockholm</td>
</tr>
<tr>
<td>BioDME 7</td>
<td>Posten Norden</td>
<td></td>
<td>Regional distribution transports of pallets between Stockholm and Jönköping</td>
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<tr>
<td>BioDME 8</td>
<td>Sveaskog</td>
<td></td>
<td>Truck supplying Smurfit Kappa paper plant in Piteå with timber</td>
</tr>
<tr>
<td>BioDME 9</td>
<td>Br Lindqvist åkeri</td>
<td></td>
<td>Truck transporting paper from Smurfit Kappa paper plant in Piteå to Haraholmen harbor</td>
</tr>
<tr>
<td>BioDME 10</td>
<td>Ragn-Sells</td>
<td>Leverantör GOTAB</td>
<td>Truck in local transport in Stockholm</td>
</tr>
</tbody>
</table>

[www.biodme.eu/fieldtest](http://www.biodme.eu/fieldtest)
This afternoon at Kungens kurva:
• Inauguration of Preem filling station
• Display of Volvo BioDME vehicles

Thursday 9/9:
• Visit to Chemrec BioDME plant in Piteå