Biogas upgrading and utilization as vehicle fuel

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Content

- Biogas as vehicle fuel
- Standard and requirements
- Upgrading methods
- Actors
- Incentives
- Conclusions
Biogas utilization

Organic waste → Heat
Crops → Upgrading
Sludge → Electricity
Flare → Gas grid

Vehicle fuel
Biogas as vehicle fuel

Upgrading → Grid → Compression → Storage

Re-fueling → Dispenser
Gas vehicles
Gas vehicles

Source: Bertil Carlson Svensk Biogas
Transport of biogas to filling stations

- Local gas grid
- Truck (containers)
- Natural gas grid
- LNG – in future?
Biogas injection

- Mobilizes gas, locally → regionally and nationally
- Used whole year independent of local consumption
- Avoid flaring
- Increases security of supply locally
- Possible to use in all applications for natural gas
- Gas grid → back-up
Why clean and upgrade biogas?

- Requirement of gas applications
  - prevent mechanical wear
  - prevent corrosion
- Rise calorific value of the gas
  - increase driving distance
- Standardization of the gas
  - even fuel quality
Treatment process

- Cleaning
  - particles
  - water
  - hydrogen sulphide

- Upgrading
  - carbon dioxide
Vehicle fuel - Swedish standard

- Clean particles < 1 µm
- Water < 32 mg/Nm³
- Sulphur < 23 mg/Nm³
- Oxygen < 1 vol %
- Upgrade methane ~ 97 %

- Same standard used for injection into gas grid
- Add about 8 % propane95, demand on water can be less strict
Upgrading plants in Sweden 2007

number of plants

- Water wash
  - with regeneration 15
  - without 6
- PSA 7
- Selexol ® 1
- Amine scrubbing process 2

- Totally 31 plants
- Biogas as vehicle fuel since 1992
## kWh electricity per Nm3 cleaned gas

<table>
<thead>
<tr>
<th></th>
<th>PSA</th>
<th>Water wash regeneration</th>
<th>Water wash</th>
<th>Selexol</th>
<th>Chemical absorption</th>
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<tbody>
<tr>
<td>According to plants</td>
<td>0,5-0,6</td>
<td>0,3</td>
<td>0,4-0,6</td>
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<td>i.u</td>
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<td>According to suppliers</td>
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<td>0,45-0,9</td>
<td>0,45-0,9</td>
<td>i.u</td>
<td>0,15</td>
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</tbody>
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The need for electricity corresponds to 3-6 % of the energy content in the cleaned gas.

Source: SGC report 142
Treatment costs - biogas upgrading

Total cost
1-2 €c/kWh

Source: SGC report 142
Methane losses

- AI techniques imply loss of methane
- Methane is a 20 times stronger greenhouse gas than CO₂
- Economical loss

- Water wash, PSA, Selexol max. 2 %
- Chemical absorption, max. 0.1-0.2 %
- Difficult to measure the loss
- CH₄ can be combusted to reduce losses
- Voluntary agreement started in Sweden 2007
Biogas as vehicle fuel in Sweden

Delivered volumes of methane gas for vehicles
(Source: Swedish Gas Association)

- Biogas
- Natural gas
- Total

Year

Volumes * 1000 Nm³

Biogas 54 %!
### Actors

- **Municipalities**
  - Sewage treatment plants
  - Waste management
  - Local public transport authorities

- **Government**
- **Private companies**
Incentives

- Investment support
- 40% reduction on valuation tax for company car users
- No tax on fuel, only VAT
- No congestion fees in Stockholm
- 10 000 SEK bonus for cars

- Free parking in several cities
- Biogas ~ 20-30% lower price than for petrol
Increased interest in Europe - worldwide

- Germany, Austria set goals – 20 % biogas to CNG 2020
- Switzerland > 35 % biogas already now
- > 6 million NGV worldwide

Opening of first biogas filling station in Germany – Jameln 2006
Conclusions

- Biogas – excellent vehicle fuel
- > 10 years experience of biogas as vehicle fuel in large scale systems in Sweden
- Upgrading and distribution key-technologies
- Biogas upgrading is a mature technology (improvements possible)
- Injection into gas grid attractive possibility
- Incentives needed (tax exemption etc.)
Thank you for your attention!

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