

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



Upgrading

Vehicle fuel



Crops **Sludge**

Electricity

Gas grid



Flare



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/Nm^3
sulphur < 23 mg/Nm^3
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



Electricity



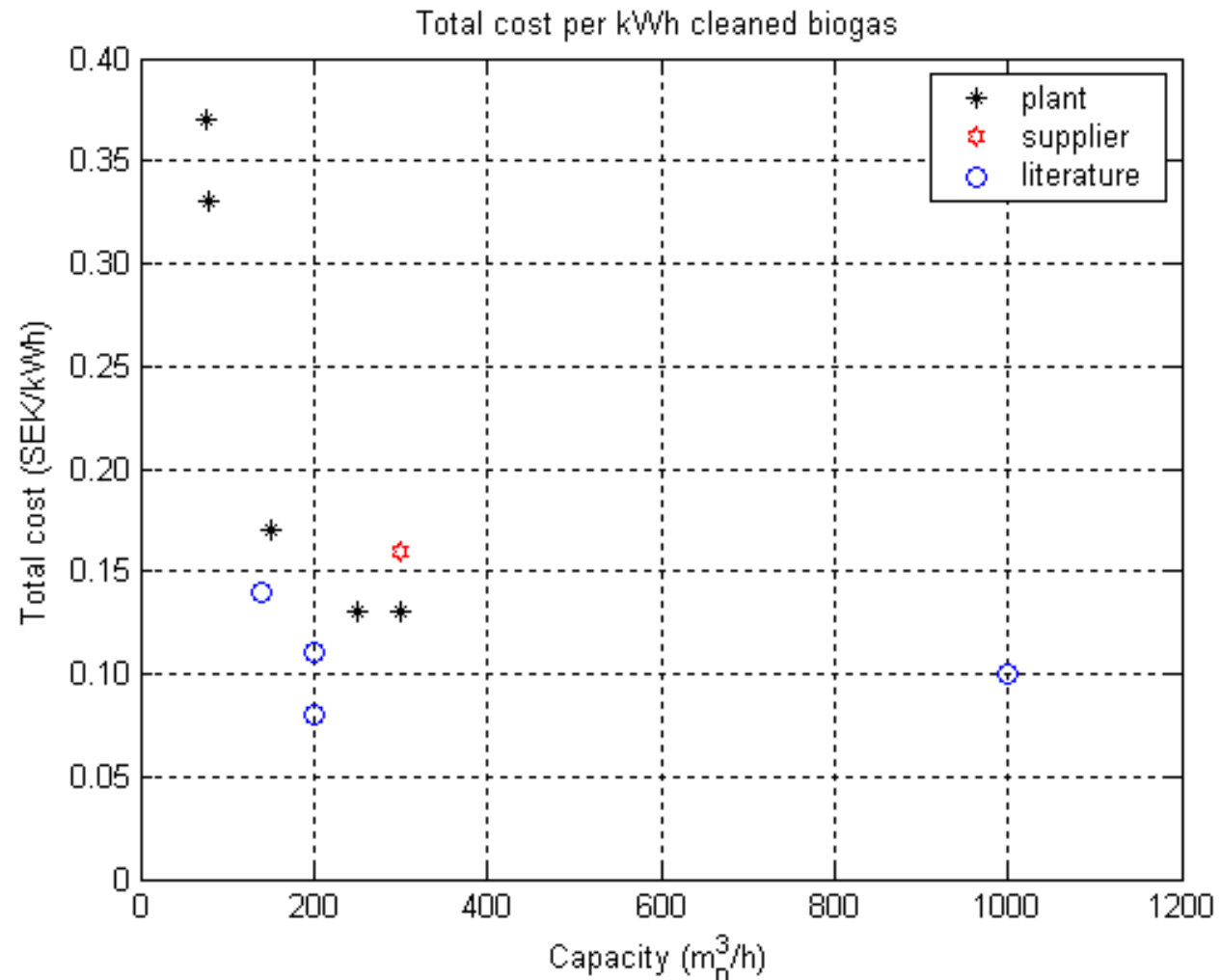
kWh electricity per Nm³ cleaned gas

	PSA	Water wash regeneration	Water wash	Selexol	Chemical absorption
Accordinging to plants	0,5-0,6	0,3	0,4-0,6	0,4	i.u
Accordinging to suppliers	0,3-1,0	0,45-0,9	0,45-0,9	i.u	0,15

The need for electricity corresponds to 3-6 % of the energy content in the cleaned gas.

Treatment costs - biogas upgrading

**Total cost
1-2 €c/kWh**



Source: SGC report 142

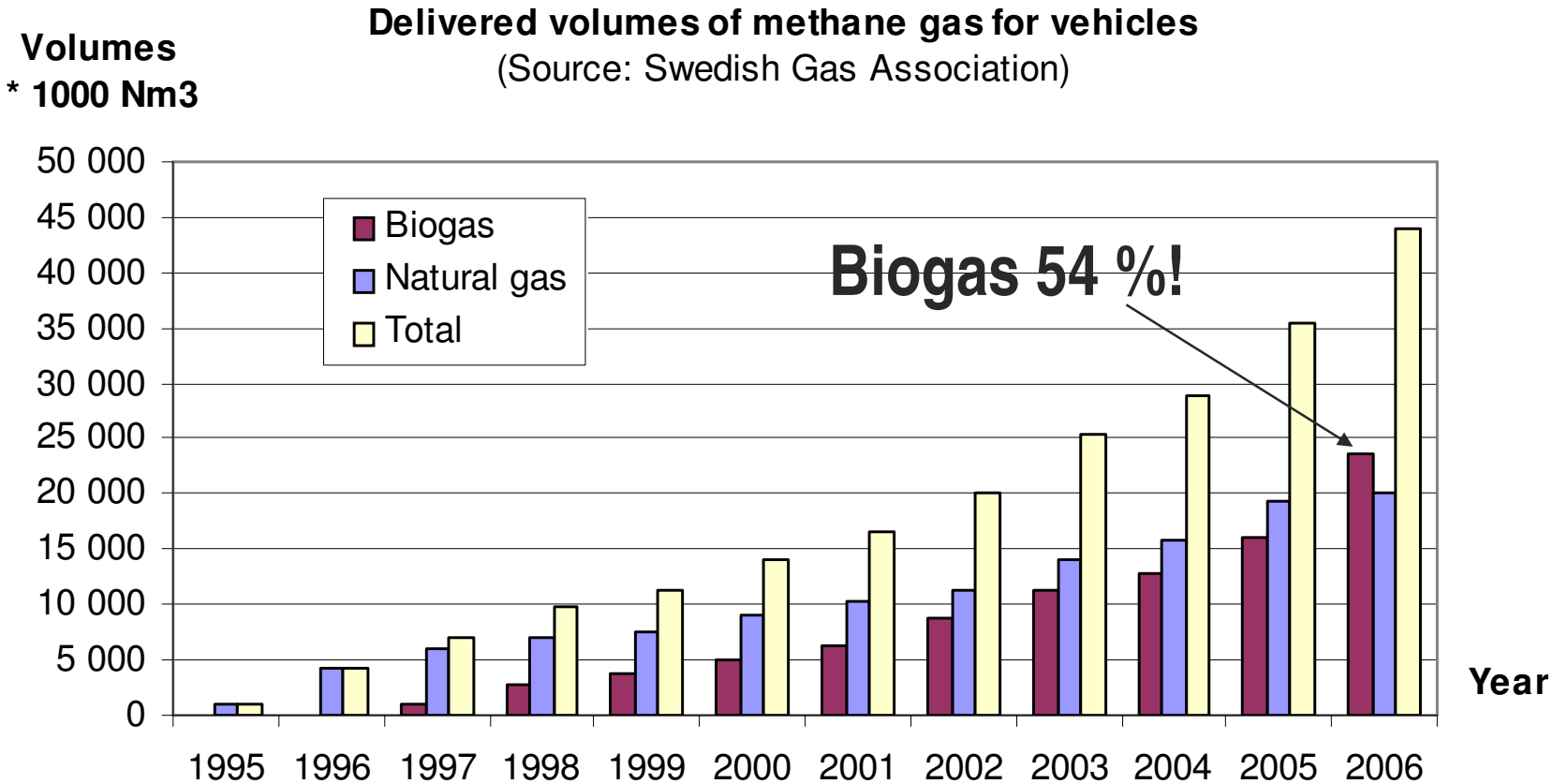
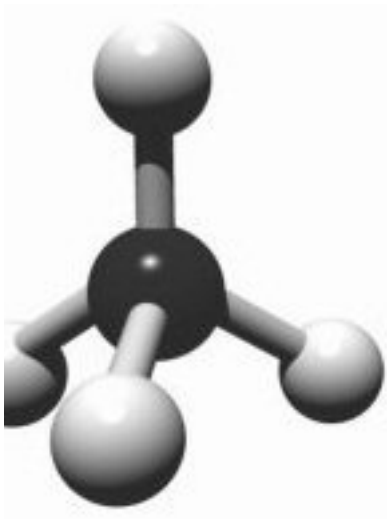
Methane losses

- All techniques imply loss of methane
- Methane is a 20 times stronger green house gas than CO₂
- Economical loss

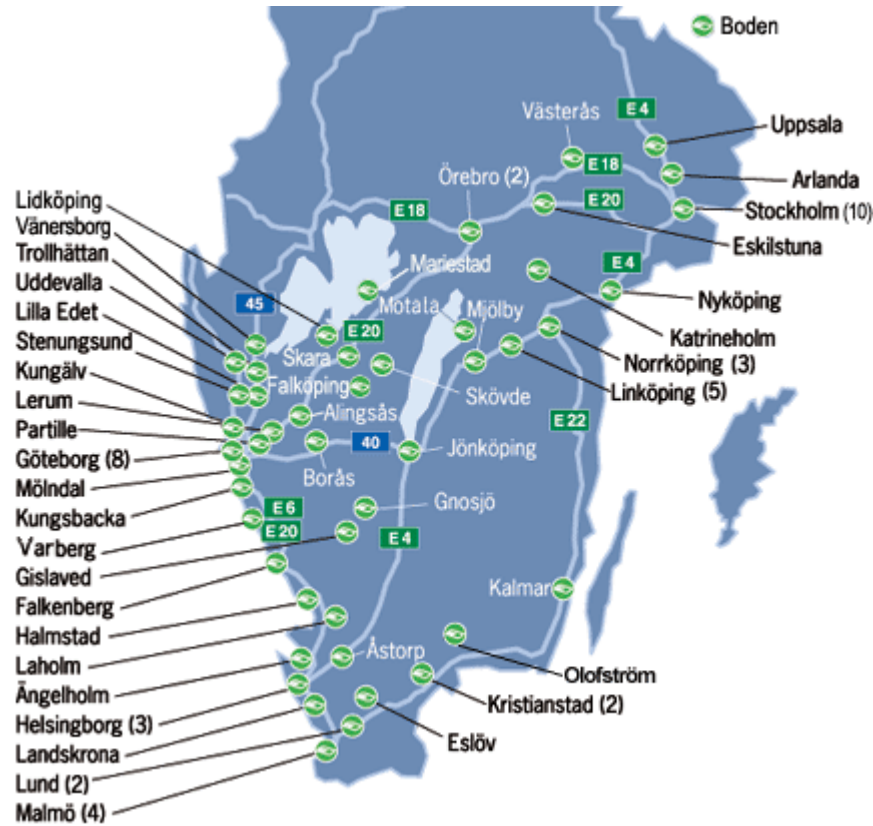
- Water wash, PSA, Selexol max. 2 %
- Chemical absorption, max. 0,1-0,2 %
- Difficult to measure the loss
- CH₄ can be combusted to reduce losses
- Voluntary agreement started in Sweden 2007



Biogas as vehicle fuel in in Sweden



Re-fuelling stations



Source: FordonsGas Sverige



Actors

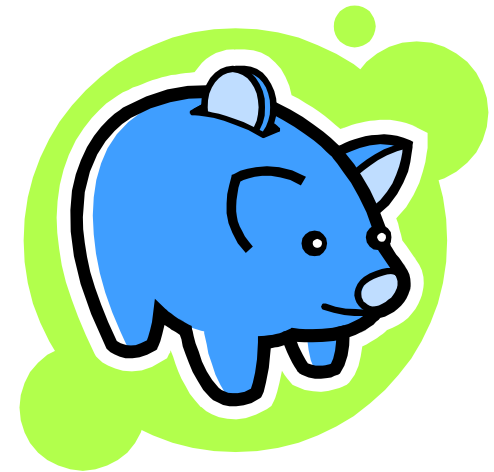
- **Municipalities**
 - Sewage treatment plants
 - Waste management
 - Local public transport authorities
- **Government**
- **Private companies**



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 al ready 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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