Biogas potential

Biogas has a wide range of biomass feedstock.

Cities
- Sludge
- Household waste
- Industry org waste
- Landfill

Agriculture
- Manure
- Rest-products
- Energy crops

Forest
- Residues from forest & industry

The largest potential of all biofuels!
Natural gas = a bridge to the future

Natural gas

A fossil society with oil and coal.

A sustainable society with biogas.

Natural gas and Biogas – working together

Biogas → Up-grading → Healing

Natural gas → Industry → Vehicle gas

The Vehicle gas is the first-ever Eco-labelled car fuel!!
Gas to vehicles – current use

**Vehicles**
Today, there is a wide variety gas driven vehicles available - ranging from small passenger cars to buses and special vehicles like ambulances and airport vehicles. Many of these vehicles come from European car manufacturers.

**Customers**
The customer group is just as broad – from private and company car drivers, to public transports, DHL and Swedish Mail, and municipality service cars and taxi.

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Gas to vehicles – coming market

**Heavy Duty Vehicles (HDVs)**
Companies now demonstrate a diesel engine fuelled with 10 % diesel and 90 % methane – which opens up new markets.

Liquefied gas (LNG) can replace diesel in HDVs – about 2000 HVDs are already in use in California and some 70 in the UK.

**Ships**
Huge reduction of regulated emissions with methane in ships, and appr. 20% reduction of GHG compared to bunker oils.
LCNG – filling station

Flexible filling station:
Incoming fuel is liquefied methane, which then can fuel vehicles in either compressed or in liquefied form.

FordonsGas Sverige inaugurated this first station in Sweden in October 2010.

Biogas is ONE way towards the sustainable mobile society.

(1 TWh: app. 100 million liters of fuel.)

Current use for road tpt in Sweden. Biogas potential.

Wood waste

Food, industrial and agricultural waste
Examples of biogas production in Sweden

Upgrading to Natural gas quality biomethane in Göteborg and injection

- Production of 65 GWh upgraded Biogas injected into the Natural Gas Grid.
- Chemical adsorption technology with very low methane slip (<0.1%).
- Investment: €4 million
- Biogas for 5000 cars
- In operation since April 2007.

Biogas upgrading in Falköping, opening up for small biomethane prod.

- Existing plant for biogas production from sewage sludge
- New plant for refining raw gas for use as fuel
- Connection to filling station in Falköping
- Capacity from 5 to 10 GWh
- In operation since January 2008

Production of liquified biogas from industrial waste in Lidköping

- 60 GWh Liquified Biogas in 2010
- Enables more efficient distribution and storage of biogas
- New applications in the field of HDV Waste-based, primarily on the local production of ethanol and other food products

GoBiGas - Gothenburg Biomass Gasification Project

- 2nd generation biomethane production
- Thermo-gasification of biomass
- Commercial scale – approximately 100 MW gas
- High efficiency: 65% methane yield.
- Total efficiency: 90% (incl. surplus heat).
- 800 GWh production – 75 000 cars
- Planned to be in operation by 2012 and 2017 - stage 1 and stage 2 respectively
- Partnership with Eon
GoBiGas – Gothenburg Biomass Gasification

Concept LNG in Göteborg

- GoBiGas
- LNG-ship
- LNG-trailer
- LNG-storage 10,000 m³
- Biogas production from sewage sludge
- Rya CHP
- GoBiGas-ships
- Natural gas pipe
- Railway
- LNG-ship Import/Export/Bunkering
- LNG-trailer Import/Export
Gas to shipping

- NO\(_x\) & SO\(_x\) emissions is a major problem for shipping
- Tuffer emission levels, review of emission trading systems, customer demands are increasing.
- Gas is an interesting alternative with following reductions:
  - SO\(_x\) 100 %
  - NO\(_x\) 90 %
  - PM 100 %
  - CO\(_2\) 20-25 %

Project “Transport gas”

- Göteborg Energi has decided to be an active player on the LNG market.
- Project goal
  2013: A first delivery to a large ship owner
Business model

June 13, 2013

LNG-supplier  Transport Gas Company  Bunkering  Clients

Ship owners

Gas for vehicles

Industry

GE-production

SECA Sulphur Emission Controlled Area
Electricity for transportation

Where can I charge??
1. Business perspective: The value chain

<table>
<thead>
<tr>
<th>Production</th>
<th>Grid</th>
<th>Services</th>
<th>Electricity</th>
<th>Branding</th>
</tr>
</thead>
</table>

Göteborg Energi
Technical perspective: Smart charging

How many banana skins do you need to drive a gas car one km?
Thank you for listening