Chances and Challenges of liquid biomethane
Feasibility of a new pathway for biogas use

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Introduction

• Production and use of liquified natural gas (LNG) increases
• Liquefaction of biogas is possible after upgrading to biomethane – the product is liquefied biogas (LBG)
• Processes are equivalent with liquefaction of natural gas but in a much smaller scale
• LBG-production is working only in few pilot plants (e.g. Lidköping, Sweden; Albury, UK)

LBG: Pro & Con

• Advantages of LBG
  • Increased energy density (5-fold compared with CBG)
  • Less Volume and weight of tanks (in vehicles)
  • Much longer activity ranges, up to 2,000 km for trucks
  • Reduction of greenhouse gas emissions compared with fossil alternatives (e.g. 85 % reduction when gas comes from waste against diesel)
  • Energy storage in the energy market
  • Increasing number of LNG-applications (e.g. blue corridor and others)
  • Diversification of biomethane applications and marketing routes
  • Decentralised fuel supply
LBG: Pro & Con

- Disadvantages of LBG
  - Additional energy demand for LBG production and storage
  - Additional technology demand
  - -> feasibility needs advantages shown; minimum necessary range for trucks: 500 km

Challenges

- Requirements for biomethane quality [Flynn 2005], but this is depending on the technology:
  - \( H_2O: 0,5 \text{ ppm} \)
  - \( H_2S: 3,5 \text{ ppm} \)
  - \( CO_2: 50 \text{ bis } 125 \text{ ppm} \)
- Requirements regarding operational safety
- Tax exemptions and certification
- Combination of upgrading technologies and liquefaction shows optimisation potentials
Increased efficiency is possible!

- Primary energy demand for liquefaction: 12 to 23% Biogas
- Combination of existing upgrading technologies with a mixed refrigerant process are most efficient today
- Others: little practical experience
- Major impacts on overall efficiency:
  - use of low value excess heat
  - combination of technologies (pressure and gas quality)
  - methane losses

![Bar chart showing different technologies and their efficiency.](chart.png)

**LBG supply costs**

- biogas production: 5.0 - 6.0 ct/kWh
- biogas upgrading: 1.5 - 2.5 ct/kWh
- Biomethane liquefaction: 2.0 - 3.5 ct/kWh

**LBG net costs:** 8.5 bis 13 ct/kWh (without any incentive)

→ Comparison with diesel:
  - gross price: 11.5 ct/kWh
  - incl. mineral oil tax, without VAT

Chances for competitiveness:

- Tax exemptions (Diesel fuel mineral oil tax: 4.5 ct/kWh)
- Biofuel quota (in 2012: 2.1 - 2.7 ct/kWh)
- Cost reduction potentials resulting from technology development
Vehicles with LBG technology available

- **Volvo**
  - *Volvo FM Methan-Diesel*
  - **Technische Daten**
    - **capacity** 338 kW (460 PS)
    - **max. torque** 2.300 Nm at 1.100 - 1.400 U/min
    - **Tank** 126 kg LNG (+ 150 or 330 l Diesel)
    - **Operation range** ca. 600 - 1.000 km

- **Iveco**
  - *Stralis LNG*
  - **Technische Daten**
    - **capacity** 243 kW (330 PS)
    - **max. torque** 1.400 Nm at 1.080 - 1.660 U/min
    - **Tank** 200 kg LNG + 48 kg CNG
    - **Operation range** ca. 750 km

- **Mercedes**
  - *Econic LNG large capacity lightweight stainless steel tanks. Option: two tanks.*
  - **Technical specifications**
    - **capacity** 205 kW (279 PS)
    - **max. torque** 1.000 Nm at 1.400 U/min
    - **Tank** ca. 162 kg LNG (1 tank) ca. 324 kg LNG (2 tanks)
    - **Operation range** not given

source: erdgasmobil

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**LBG-plant - Lidköping**

- **LBG and CBG from bio waste**
- **operating since April 2012**
- **Investment:** 20 Mio. €
- **capacity:** 50 GWh/a LBG + 10 GWh/a CBG
- **80.000 t/a biofertilizer**

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LBG-plant - Albury

- LBG from landfill gas
- operating since June 2008
- capacity: 5,000 to/a LBG or 6 million diesel litres equivalent
- product offered\(^1\): 15 % LBG, 85 % LNG
- 20 % CO\(_2\) savings compared to diesel\(^1\)
- 20 % cost savings compared to diesel\(^1\)

\(^1\) gasrec: Future-Proof-Fuels-Handbook-2013

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Local feasibility study

- Typical biomethane project – local added value possible!
Local feasibility study

• Simple & efficient small scale solution possible!

Challenges:
• new technology, new fuel, new vehicle technology
• Competition with Agro-diesel
Biogas & Biomethane – key technologies in the future energy and nutrient circulation systems

More on biomethane:

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