Biogas to the natural gas grid

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Background

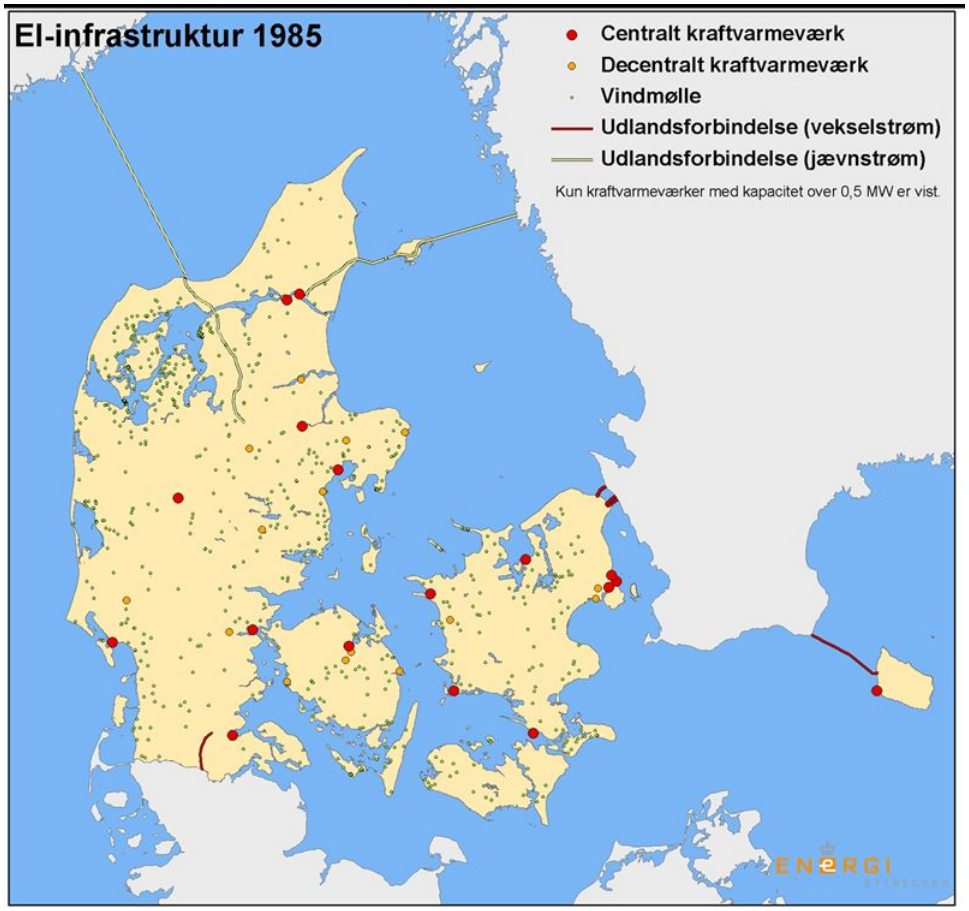
Political agreements favouring increased biogas production

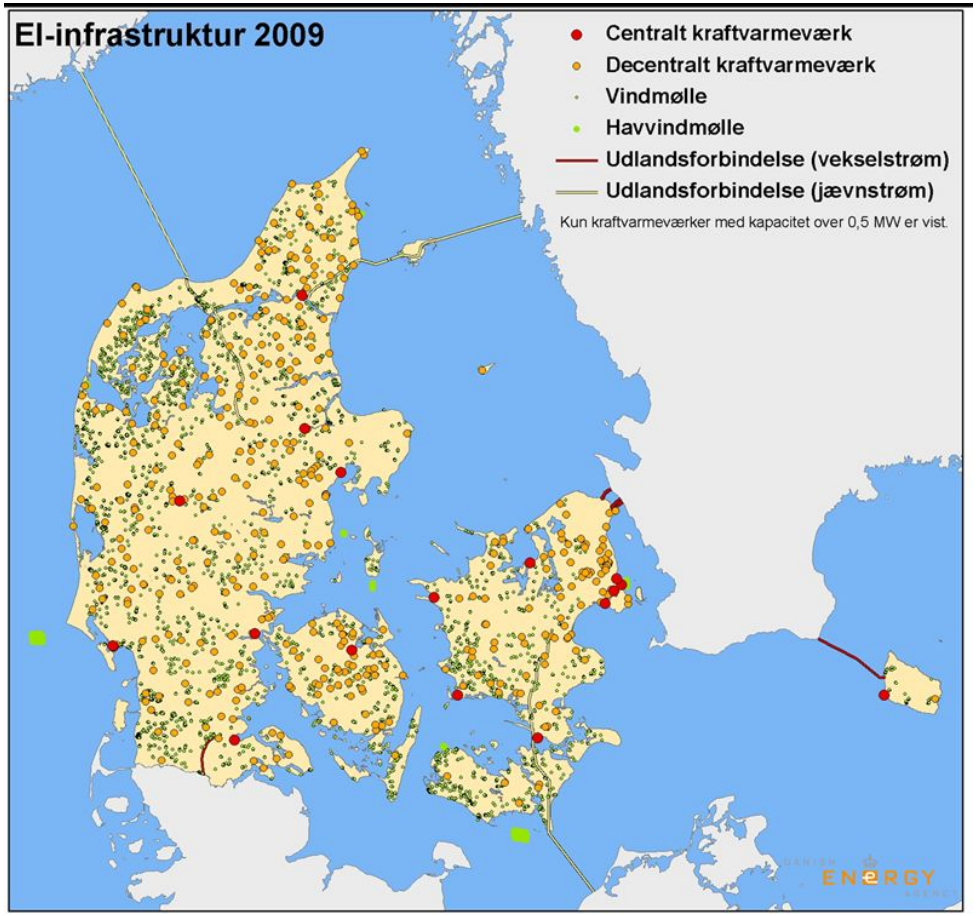
➔ Need for new biogas applications

Possible alternative applications of biogas

- Separate biogas pipe to an existing CHP
- Injection into the natural gas grid
  - Upgrading to natural gas quality
  - Degrading the gas quality in a section of the natural gas grid

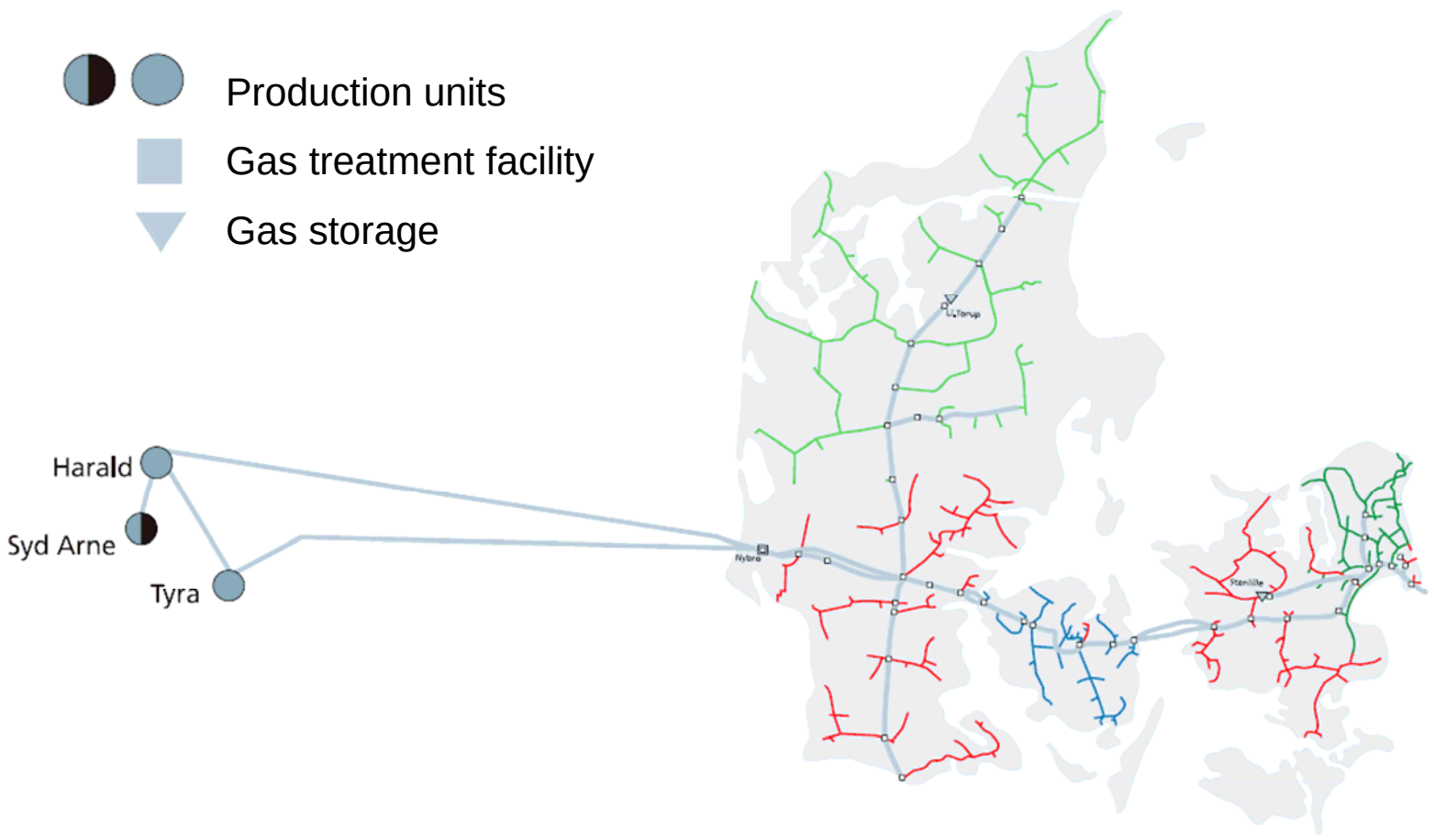
Electricity infrastructure in Denmark





The Danish natural gas grid

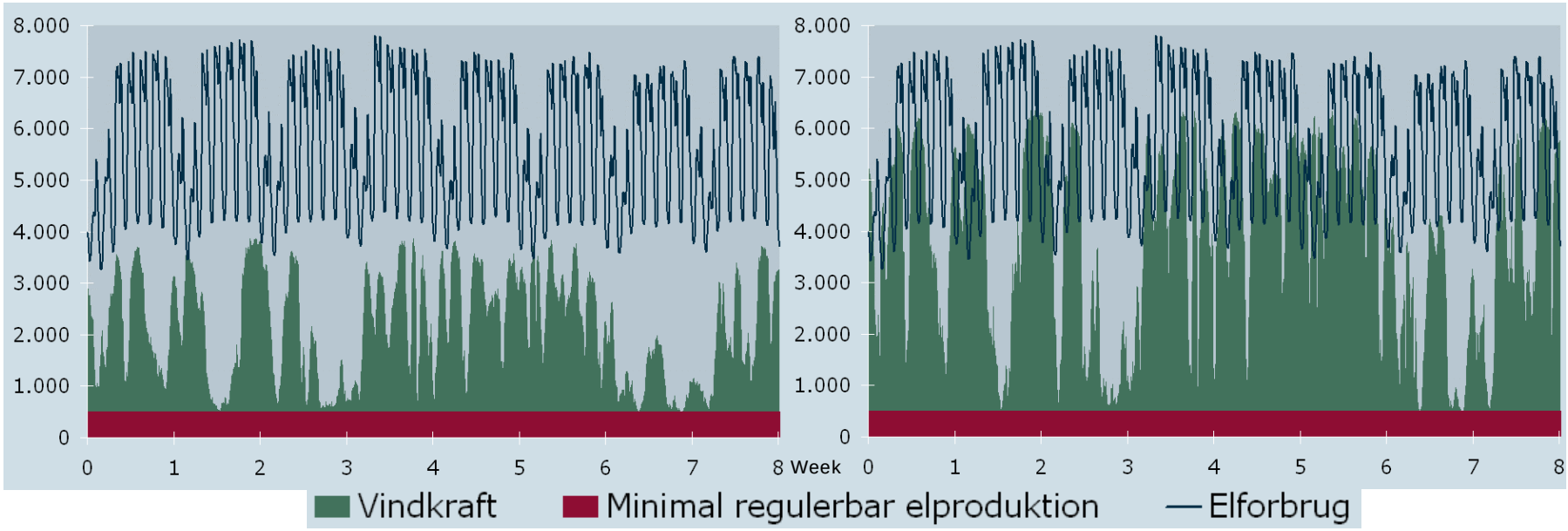
Transmission grid and overall distribution networks



Biogas in an electricity system with wind energy

Denmark today

Denmark with additional 3000 MW wind power



(Wind power) **(Minimum base load electricity production)** **(Electricity consumption)**

Source: Energinet.dk

UPGRADING OF BIOGAS

Biogas to the grid - What is required?

- Removal of CO_2 from the biogas
- Gas cleaning (S, NH_3, moisture etc.)
- Injection and odorisation units
- If necessary, heating value adjustment

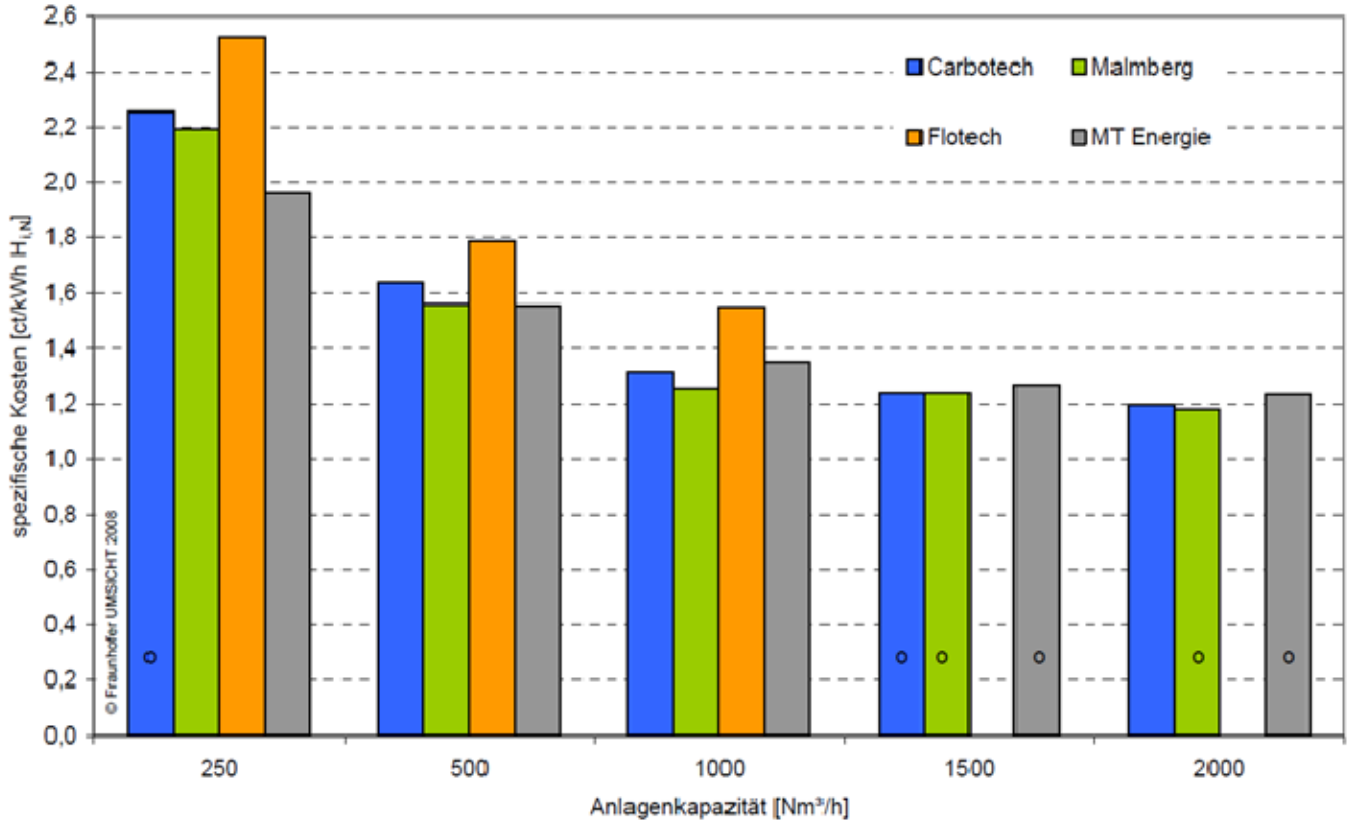
- Commercially available technology

Pros and cons of upgrading

- Biogas can by applied by all natural gas devices
- No limitation due to lack of heat demand
- Conversion of base load electricity production
- Commercially available technology

- Upgrading costs

Upgrading costs



Source: Fraunhofer UMSICHT

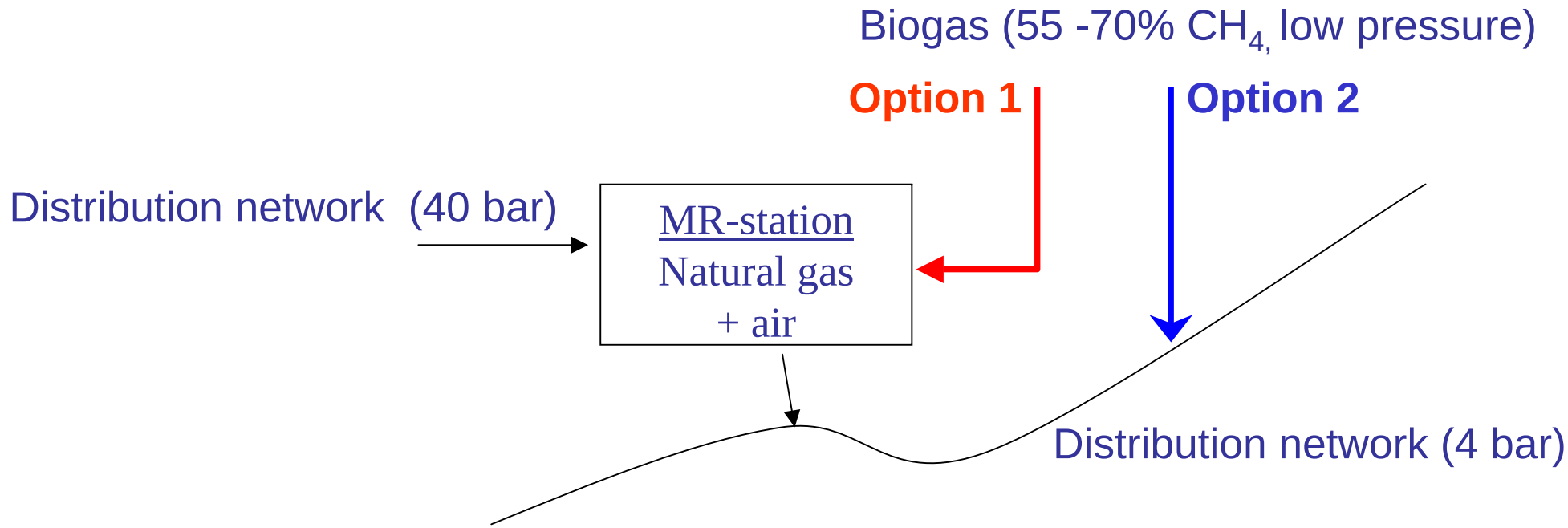
DEGRADING A NATURAL GAS NETWORK

Gas families according to EN437:2003

Appliances are approved for one or more gas families

- Gas family 1: Town gas.
  - Wobbe index: 22,4-24,8 MJ/m3(n).
  - Gas pressure: 8 mbar
- Gas family 2, Natural gas group H.
  - Wobbe index: 45,7-54,7 MJ/m^3(n).
  - Gas pressure: 20 mbar
- Wobbe index biogas (65 % CH4, 35 % CO2) : 27,4 MJ/m^3(n).
  (no smaller appliances approved for biogas)

Degrading of gas quality in a natural gas network



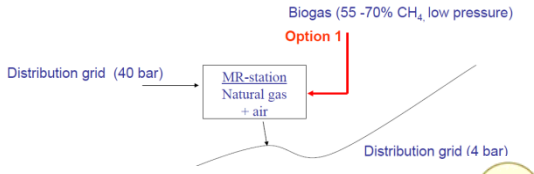
Lower heating value:

Biogas: 5,5 - 7 kWh/m^3(n)

Natural gas: 11 kWh/m^3(n)

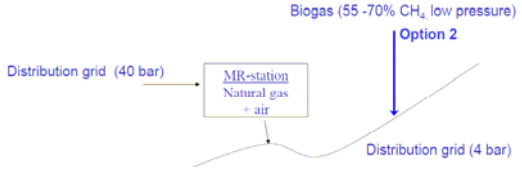
Pros and cons

Case 1



- Possibily of fixed gas quality
- Higher costs for transport of biogas
- Reduces grid capacity

Case 2

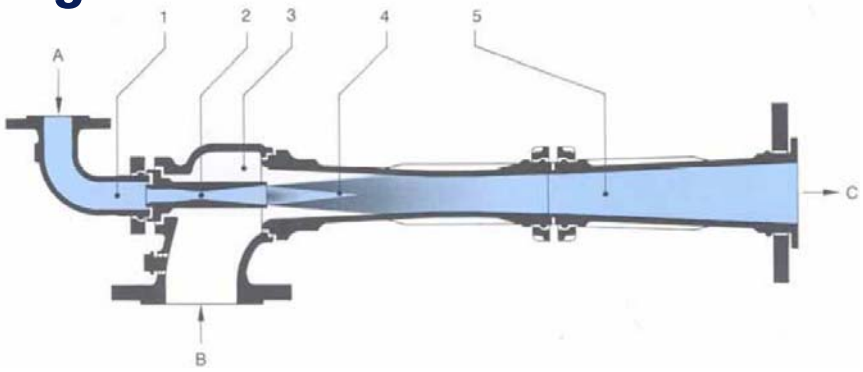


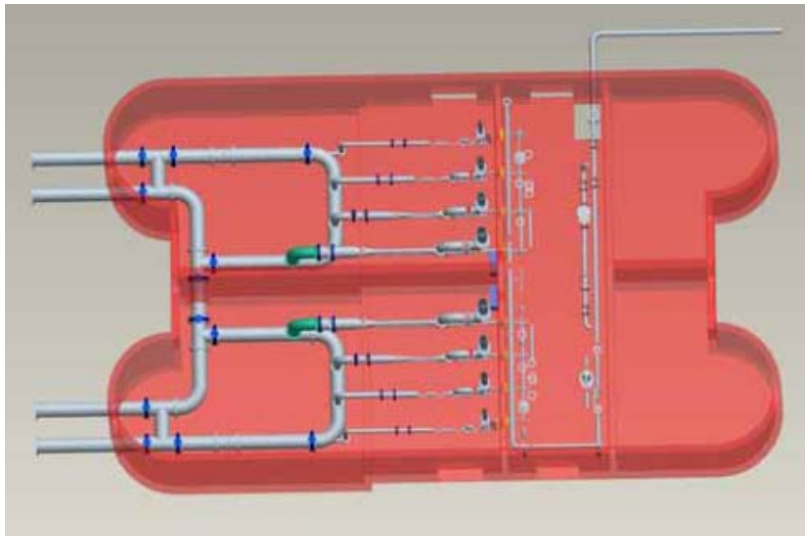
- Varying or lower gas quality
- Lower costs for transportation of biogas
- Appliances?

Degrading of gas quality

-An example, town gas in Copenhagen

- Air is mixed with natural gas
- Four parallel lines
  5300, 2600, 1400 and 700 $m^3(n)/h$
- Two redundant systems





Biogas in the town gas network in Göteborg (Sweden)

- Biogas was distributed in the period 1999–2007
- In 2005 it was decided to close the town gas network at the end of 2010
- Limitation: Max. 30% biogas in the town gas

Biogas network in Revninge (Denmark)

- Network dedicated to distribution of biogas
- Back-up with natural gas-air mixture
- In operation 1992–2005
- No gas quality control
- Only limited gas cleaning

- Appliances
  - 6 gas engines
  - 64 houses (boilers, not condensing)
  - No cookers

Foto: Torben Skøtt/Biopres

Technical challenges…

By lowering the heat value in existing grids

- Lower capacity in the gas grid (approx. 40% lower)
- Gas quality variations, cleaning, control, billing
- Appliances
  - No approved cookers or boilers on the market for biogas
  - Cookers – will they ignite?
  - Efficient gas boilers – will they ignite?
  - Gas engine can run on biogas. Modifications required?

Economy and degrading

- Economy – hmm…
- Degrading of quality is the smallest part.
- Additional gas grid or gas boosters required?
- Replacement of meters, regulators and appliances?