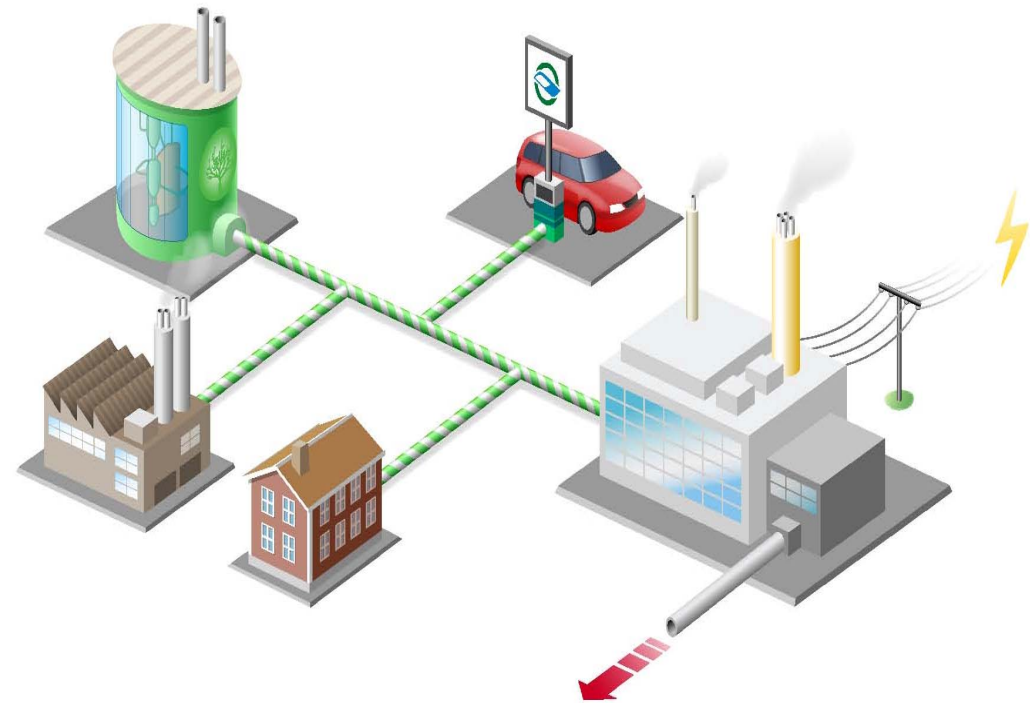


Upgrading biogas to Natural gas quality

Emma Jacobsson
Development engineer



Göteborg Energi – from gasworks to a leading energy company



- 1846 Sweden's first gaswork open in Göteborg.
- 1988 Natural gas introduced for the first time in Göteborg.
- 1998 Introducing CNG in Göteborg
- 2006 Rya Combined Heat & Power Plant commissioned.
- 2007 Gasendal biogas upgrading plant commissioned

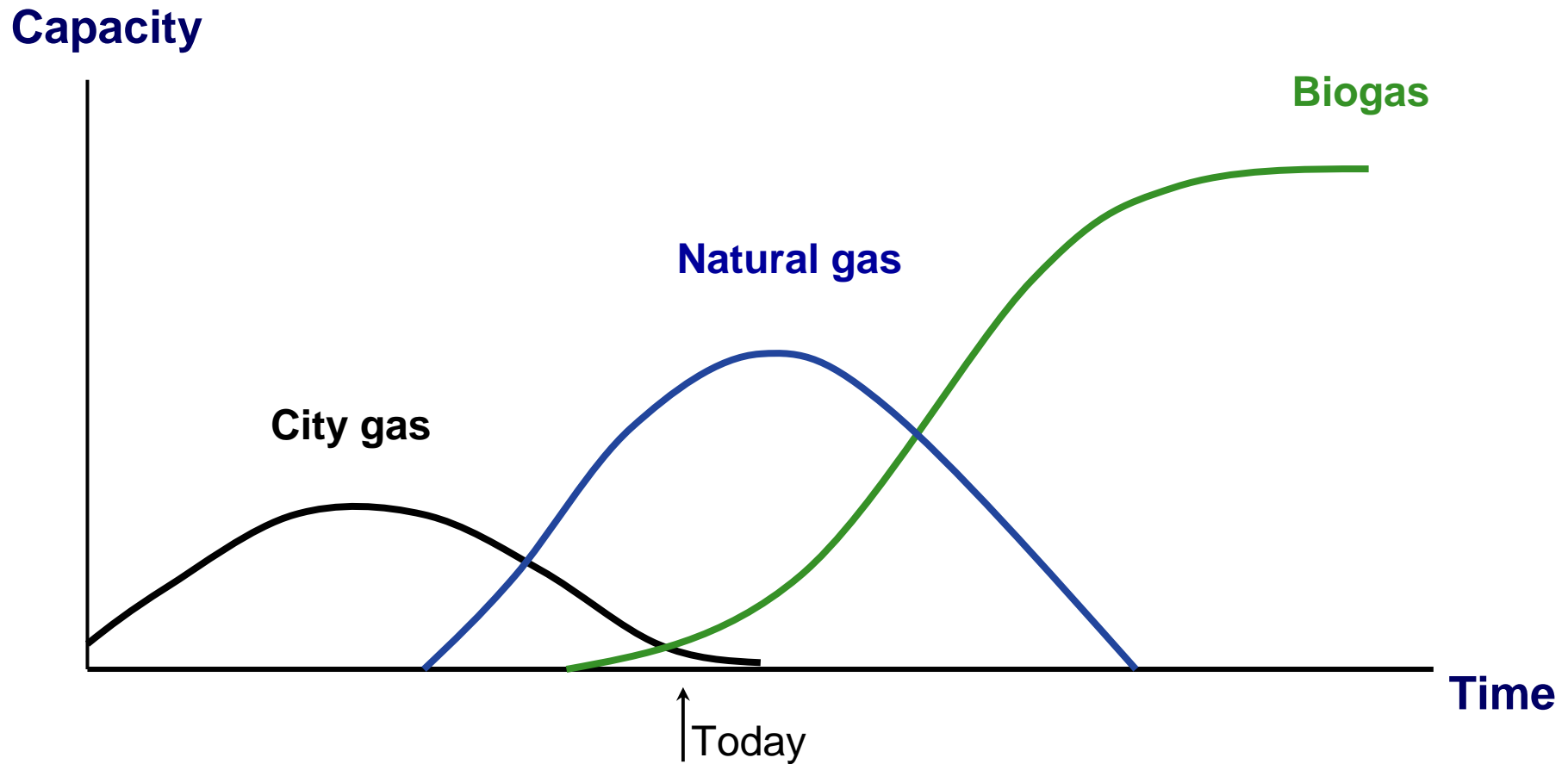


Our corporate vision:

A sustainable society of Göteborg



Our vision for biogas



EU's renewable Directive

- 20% reduction of CO₂
- 20% renewable energy
- 10% renewable fuel

Producers of Biogas in EU will be guaranteed the right of distributing biogas in the natural gas grid, as far as the technical specifications is fulfilled.

Biogas to the transport sector- How much waste is there?

40 TWh



50 TWh



60 TWh



10 TWh



Gas grid and gas customers in Göteborg

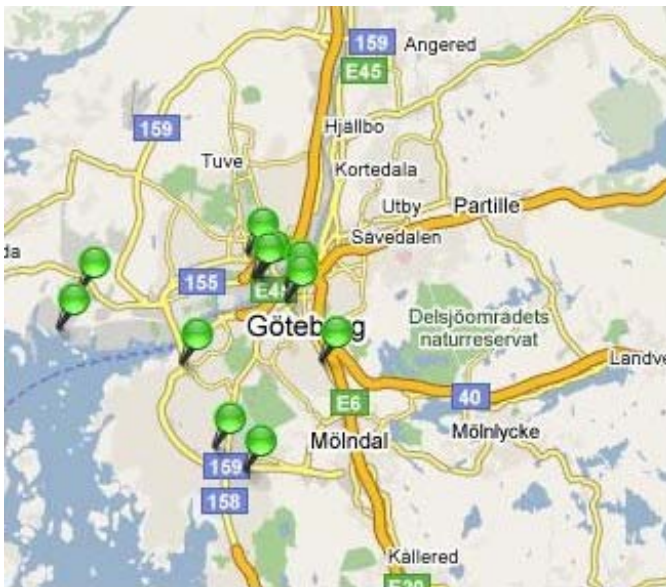
Grid

Natural gas	1700 m
City gas	3300 m
Total	5000 m

Customers

Natural gas	800
City gas	15 000
Vehicles	6 000

Gas at Göteborg Energi today



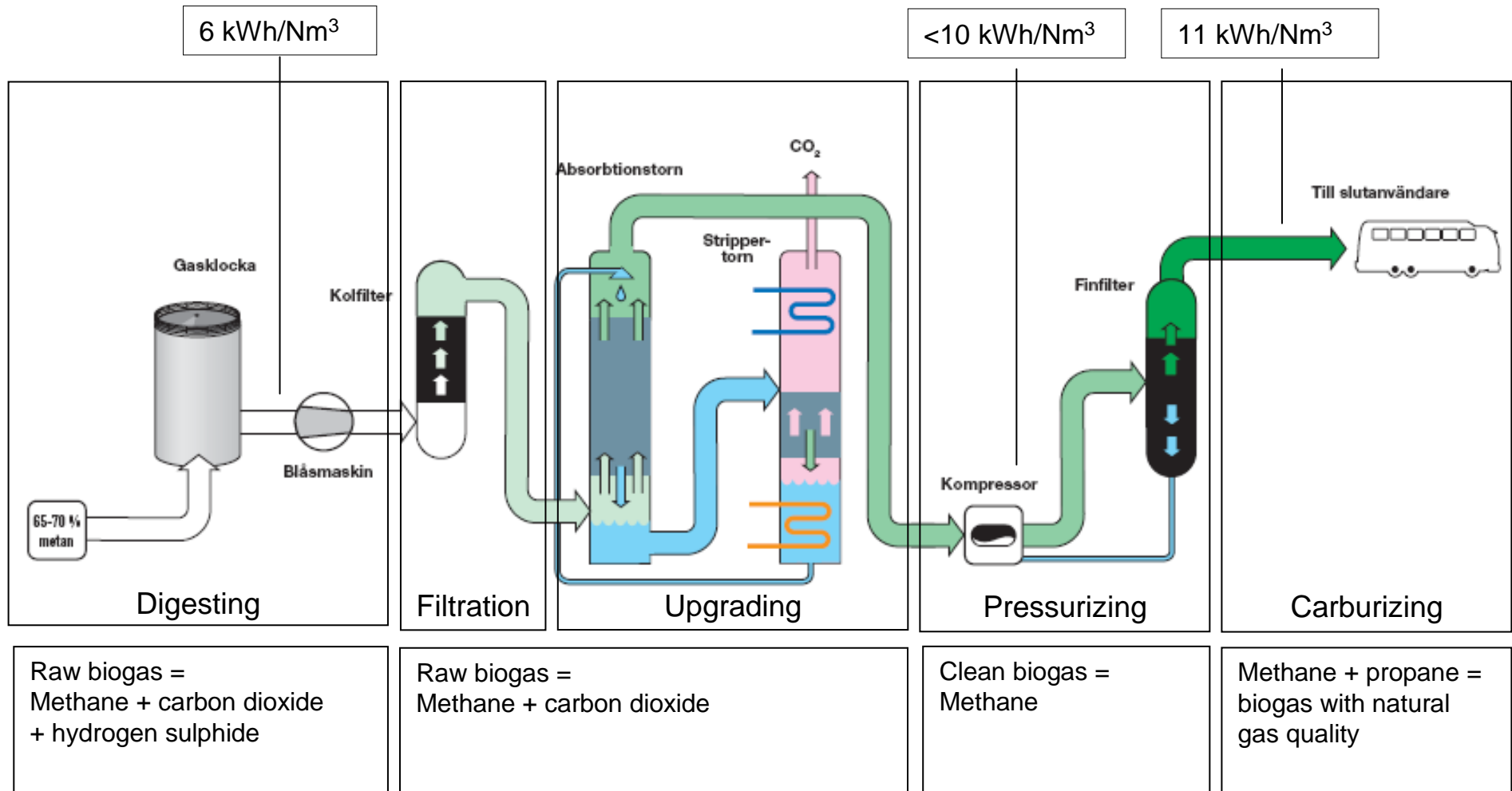
We've been “thinking big” from the start



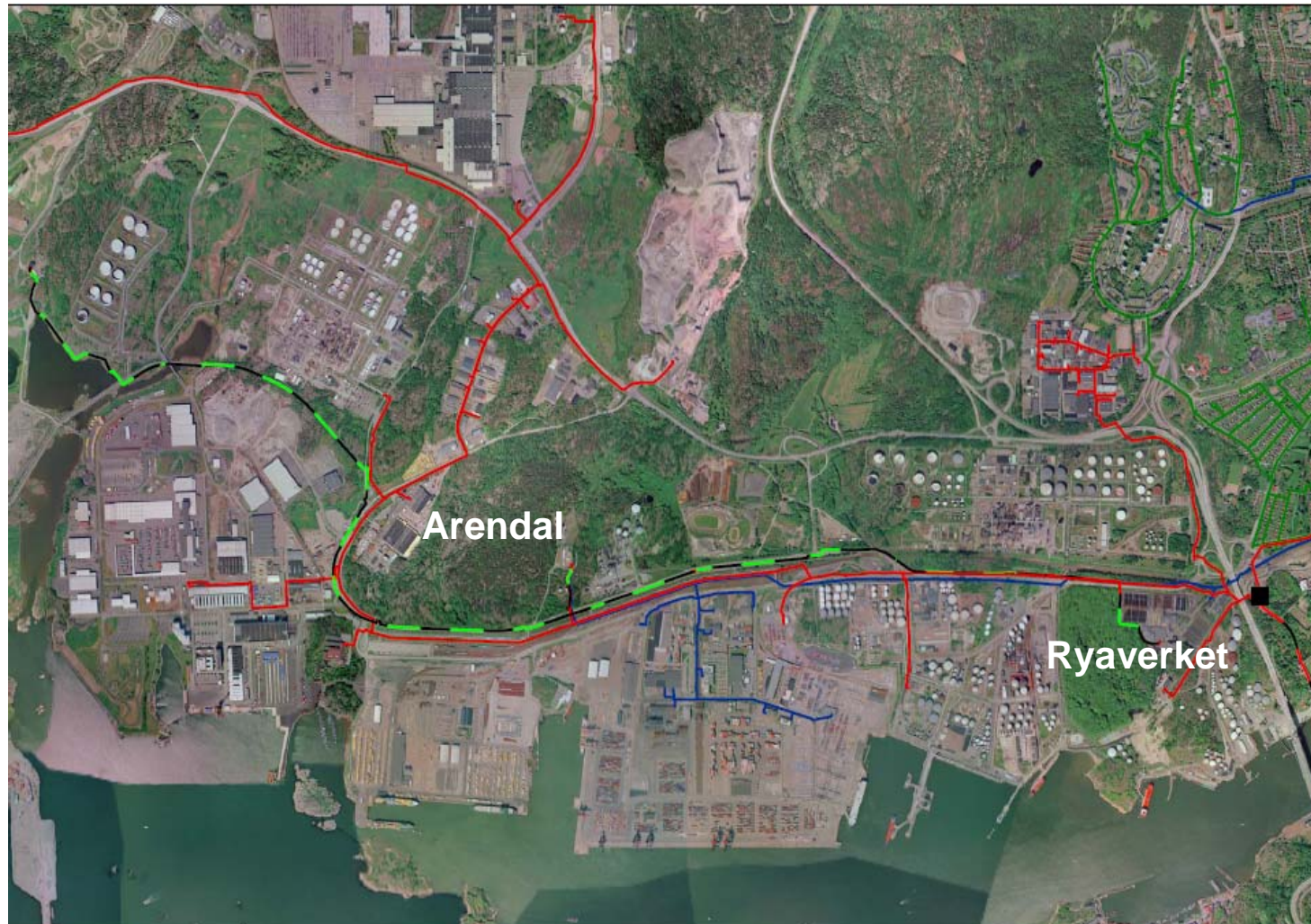
- Production of 60 GWh/a upgraded Biogas injected into the Natural Gas Grid
- Chemical adsorption technology with very low methane slip
- Investment: € 4 million
- Supported by Swedish KLIMP-programme and BiogasMax
- In cooperation with City of Göteborg and the WWTP
- In operation since April 2007



CO₂ - absorption (LP Cooab)



The Gas grid in Arendal



Quality on upgraded biogas

Before adding propane 95:

CH ₄	> 96 Vol%
CO ₂	< 0,5 Vol%
O ₂ +N ₂	< 4 Vol%

After adding propane 95:

Calorific value 11 kWh/Nm³



Regulation for biogas quality

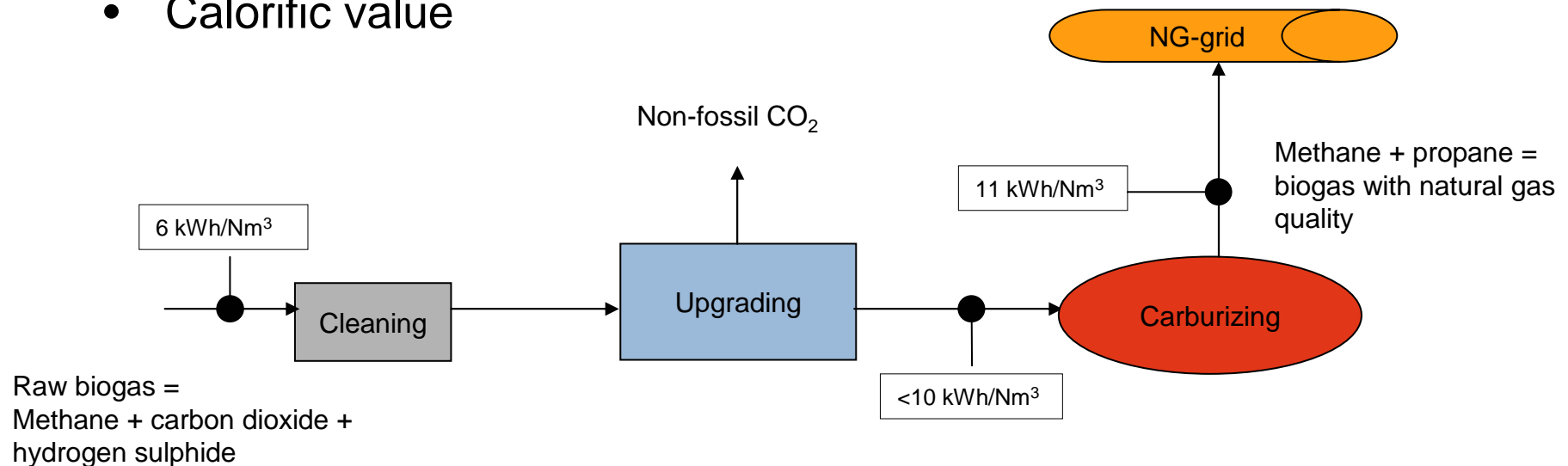
- Swedish standard SS 155438 - "Biogas as a fuel in vehicle engines, Biogas Typ A" - regulates the gas quality
- Gas standard EGN01- regulates the pressure of the upgraded gas
- Gas standard G260 - regulates the calorific value and Wobbe index

Continuous measuring

Continuous measuring of:

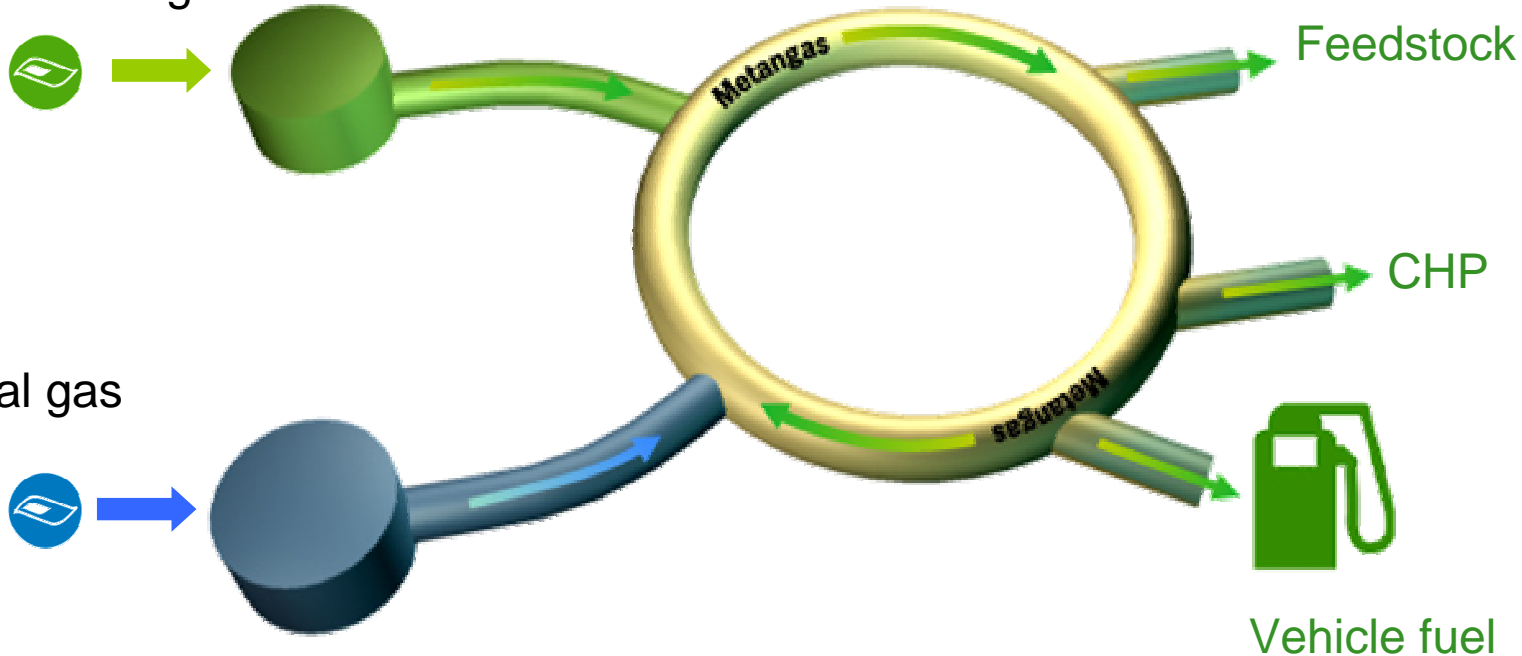
- Methane content
- H₂S-content
- Dew point
- Wobbe index
- Calorific value

No biogas is delivered out on the natural gas grid if the gas doesn't fulfill the quality demands, the biogas is then recirculated in the plant.



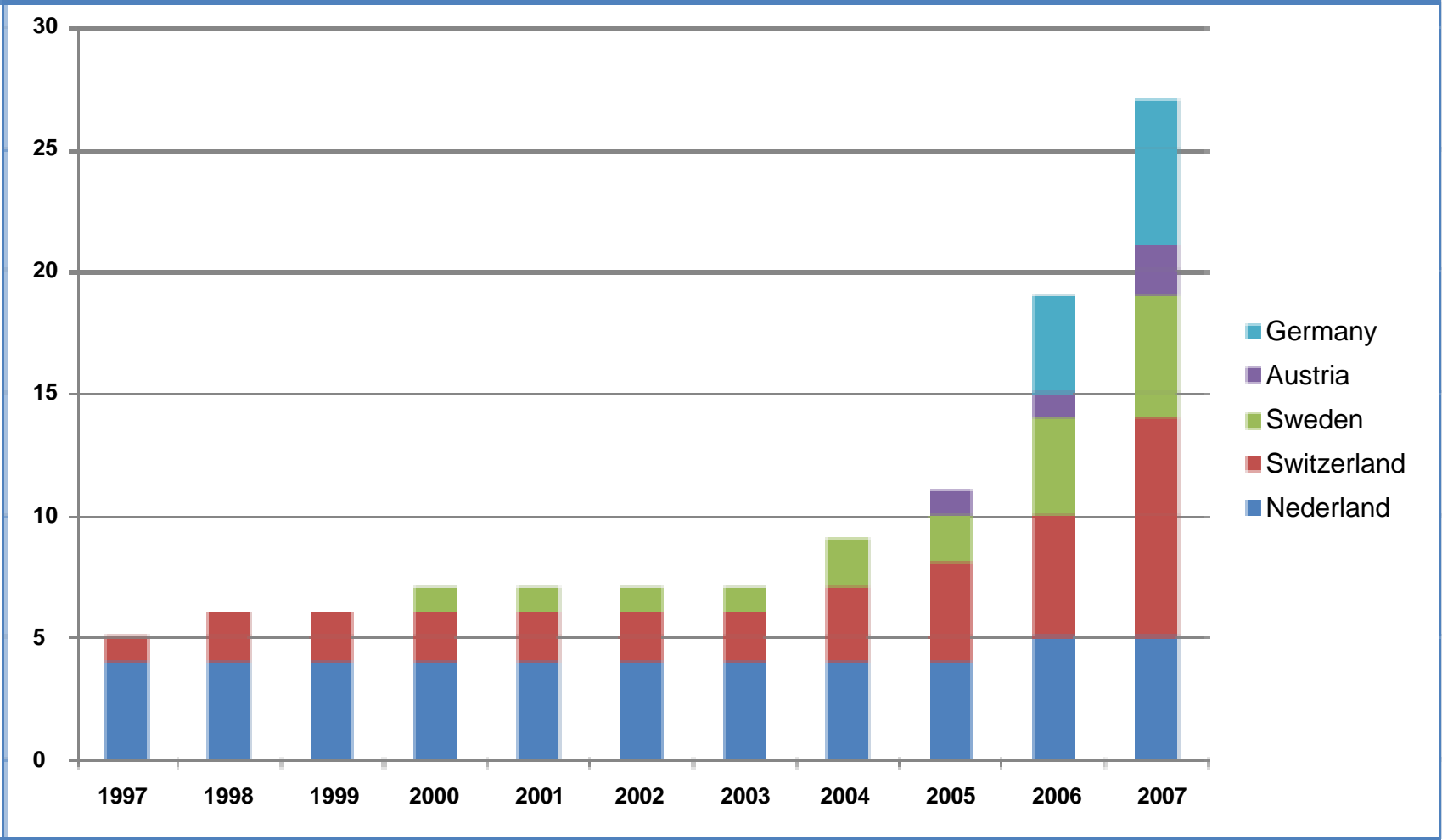
“Green gas concept”

Upgraded biogas



The green gas concept enables biogas to be offered at all connected filling stations for vehicles

Connected biogas plants to the gas grid

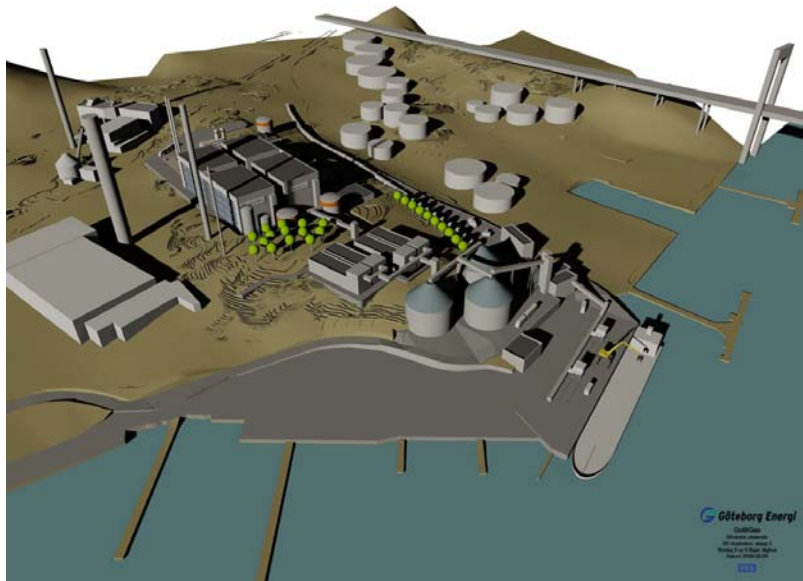


Picture from Anneli Petersson, SGC



GoBiGas

Gothenburg Biomass Gasification Project



- Thermal Gasification of biomass for production of synthetic natural gas (SNG) - biomethane
- Commercial scale (100 MW)
- Methanization of synthetic gas for distribution in the natural gas grid
- Synthetic gas to Rya CHP is also investigated
- A first step - 20 MW, planned to be commissioned 2012

The BiG project - Biogas in Göteborg



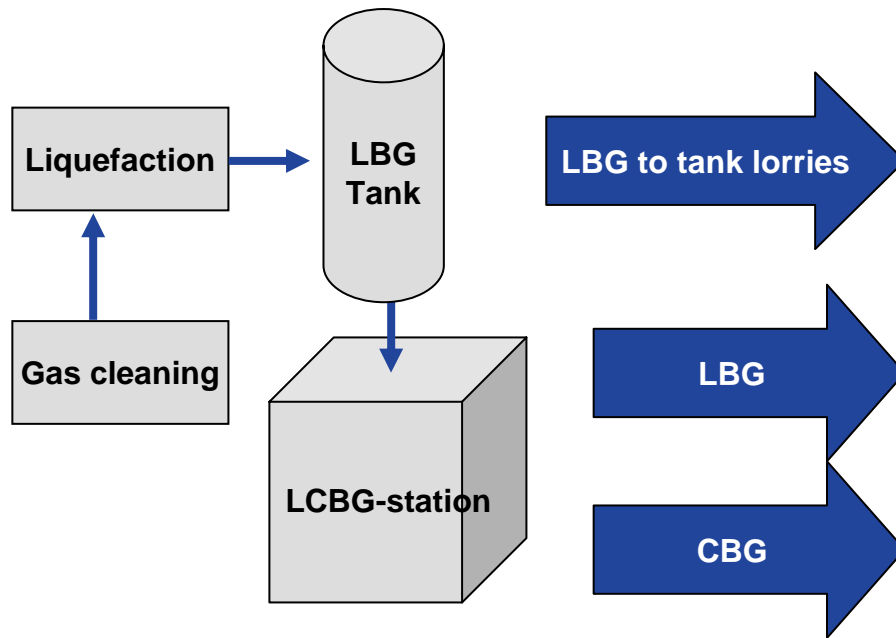
- Cooperation with Renova (waste treatment company in Göteborg)
- A plant for digestion and upgrading of biogas
- The biogas will be produced from household waste and biological industrial waste
- Capacity ca 25 GWh/y
- Planned to be commissioned 2011
- Supported by KLIMP

Falköping – the beginning of a new concept



- Biogas produced using sewage sludge and household waste
- Upgraded at new plant to vehicle quality and piped to local filling station
- Raw gas pipes laid next to clean gas pipes
- Upgrading raw gas from manure and other agri-waste in the near future
- Supported by Swedish KLIMP-program and BiogasMax

Liquid bio methane in Lidköping



- Utilizing waste from ethanol production and other food production
- Producing 60 GWh/a of upgraded, liquefied biogas
- Investment: €7 million
- In cooperation with the Municipality of Lidköping and Swedish Biogas International
- In operation 2010



We're paving the way for the energy of the future!

