

#### GoBiGas a First-of-a-kind-plant Forrest Biomass to Biomethane (SNG)

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#### Short Facts of the GoBiGas Demonstration-Plant

Built, owned and operated by the City of Gothenburg's utility company Göteborg Energi. Vision of the city of Gothenburg: Replace natural gas with gas produced from renewable feedstock

Target for the GoBiGas demonstration-plant:

 Annually operate 8000 h to convert 250 GWh (50 000 dry tons) of woody biomass into 160 GWh biomethane and 50 GWh district heating

Investment cost 225 million C\$ (Whereof 33 million C\$ in governmental support) Associated research program ~30 million C\$



## Project Timeframe

- Project start 2005
- Feasibility studies and planning 2006-10
- Construction and building of pilot gasifier at Chalmers University of Technology 2006-2007
- Investment decision Dec 2010
- Engineering Early 2011
- Construction Mid 2012
- Commissioning Mid 2013
- Start-up 2014-15
- Operation 2015-



The 2-4 MW (10-20 ton dry biomass per day) biomass pilot gasifier at Chalmers University of Technology, with more than 25,000 hours of operation since 2007



# Aims for demonstration

Investigate:

• Feasibility of the process

• Process performance

• Market opportunities





Feasibility of the process

Some short details of the plant

- 5.000 m3 concrete, 800 tons of rebar and 1300 tons of structural steel
- 25 km of piping and 90 km electrical cable
- 130 pumps, compressors, fans, conveyors
- 200 towers and reactors, heat exchangers, tanks and vessels,
- 2 500 instruments
- 650 valves
- Built up of commercially available process elements that are scaled up (gasification) or down (methanation)



#### Feasibility of the process - gasifier

CHALMERS





#### Process Performance

The Gasifiers in the GoBiGas-plant and in the Chalmers pilot are steam reformers for highly volatile ash containing fuels, where the ash from the biomass is used as catalyst





#### Process Performance

# Performance based on experimental data from the gasifier of the GoBiGas-plant using wood pellets normalized to a 100 MW input of dry biomass



Total: 102.5 MW



#### Market Opportunities – Present Market

Syngas (H<sub>2</sub>/CO), Charcoal, BTX (Benzene/Toluene/Xylene), Aromatics (mainly Naphthalene) are more valuable than methane.

However, special local tax regulation in Sweden makes biomethane more valuable than the other products, if it can be sold to the transport sector, thereof the optimization of the GoBiGas plant towards methane.

For an economically sustainable production in the GoBiGas-plant and future plants there is a need to find markets for all primary products including the green carbon dioxide

 Green CO<sub>2</sub> can replace fossil CO<sub>2</sub>-sources in industry, or be used as carbon source in different power to gas/liquid/chemical schemes

# Market Opportunities – Oil, Petro-Chemical Industry

The methanisation is a Fischer-Tropsch process that can be used to produce other hydrocarbons



Picture taken from: Catalysts for Production of Lower Olefins from Synthesis Gas: A Review, Hirsa M. Torres Galvis and Krijn P. de Jong\*, dx.doi.org/10.1021/cs4003436 | ACS Catal. 2013, 3, 2130–2149



# Market Opportunities – Oil, Petro-Chemical Industry

Co-production of hydrogen and SNG is a simpler process than producing pure methane



Hydrogen a key chemical in refineries and chemical industries



### Market Opportunities – Steel Industry



Charcoal and syngas can replace fossil coal in steel manufacturing processes



#### Market opportunities – Forest Industries

The key to meet the challenge to reduce green house gases in Canada, as well as in Sweden, is to integrate the forest industry with the oil refineries, the petro-chemical industries and the steel mills

#### Forest industries

has the logistics and sites to bring in and convert large quantities of virgin biomass

Have steam boiler that can be rebuilt to produce intermediates at a relative low investment cost Intermediates Gas via pipeline SNG, hydrogen, Nitrogen free town gas Carbon Dioxide

Liquids and solids via Truck, Rail, Boat LPG, Naphtha, Charcoal, Carbon Dioxide, Liquefied SNG Oil refineries, petro chemical industries and steel mills

highly optimized chemical processes converting intermediates to established products

need small/no investments to take in the green intermediates



#### Conclusions

- The GoBiGas demonstration plant is online and show an highly efficient pathway to provide green intermediates as renewable feedstock for industries relying on fossil oil, gas and coal
- The technology demonstrated in the GoBiGas plant is especially suited for the conditions in Canada and Sweden, with great potential for renewable electricity production and a large forest industry, as well as a large refinery, petro-chemical and steel industry