Success Stories of Advanced Biofuels for Transport

THE GOBIGAS PROJECT

Year of plant start-up:	2013
Location:	Sweden, Gothenburg
Technology:	Biomethane production via gasification of biomass
Plant capacity:	20 MW biomethane
Operational experience achieved:	More than 12 000 hours of gasification and 69 GWh of biomethane delivered to the natural gas grid until the plant was conserved in 2018
Total Capital Expenditure:	1561 MSEK (150 MEUR)
Principle feedstocks:	Domestic feedstock was used including: wood pellets, wood chips based on residues from saw mills and logs of low quality, shredded bark, and recovered wood of class A1 (only test period)
Feedstock Capacity:	30-35 MW_{th} based on lower heating value of the dry fuel.
Products/markets:	Vehicle gas (primary market) or biomethane for combustion (secondary market) and co-production of 5 MW district heating as a by-product.
Technology Readiness Level (TRL):	TRL 8

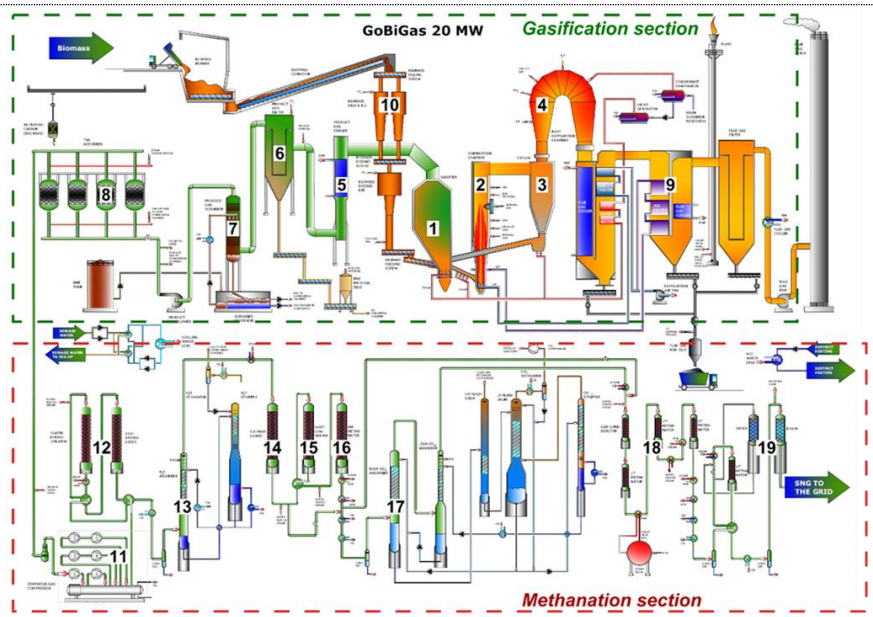
DESCRIPTION

In the GoBiGas project, a first of its kind industrial scale biorefinery was built with the purpose to demonstrate and enable commercial production of biomethane from woody biomass *via* gasification. This report summarizes the experience, lessons learnt and conclusions from the pre-study, construction and operation of the GoBiGas plant with the aim of support development of commercial production plants of advanced biofuels.

The GoBiGas plant, with a production capacity of 20 MW biomethane delivered gas to the natural gas grid in Sweden and is located in Gothenburg, Sweden. The plant was built and operated by Göteborg Energi AB, with financial support of the Swedish Energy Agency. The project was initiated in 2005 as pre-project studies with the goal of having 120 MW bio-methane in production in 2020. The construction of the plant described here was started in 2010 and the commissioning of the plant was initiated in 2013. The purpose was to build a prototype unit to de-risk the scale-up to the full intended capacity. The prototype plant project was therefore focused on how the technology would be commercialized through construction of a similar stand-alone plant with a production capacity of 100 MW or more and was not in itself an economic venture.

In parallel, work was initiated on the full-scale project that received a NER 300 grant support. However, due to market changes and general uncertainties on the development in biofuels in transport, the second project was stopped in 2016, and the motives to operate the costlier prototype plant was reduced such that the plant was decommissioned in 2018 and is now maintained in a conserved state. With more than 12,000 hours of operation the GoBiGas project (of which several uninterrupted operating periods of up to 1900 hours in 2016 to 2018, following a period of extended commissioning and initial operation involving experience build-up, technical and operational improvements) has demonstrated how the quality of the gas produced from a biomass gasifier can be controlled using a range of different feedstock including bark, wood pellets, wood chips and recovered wood of class A1. Results show that a biomass to grid-quality biomethane can be produced with this technology at an efficiency of up to 70% (based on the lower heating value of the dry ash free fuel) is possible and at a reduction factor for greenhouse gas emissions of over 80%. To reach such a high efficiency it is required to dry the feedstock which also benefits the stability of the process. Results also show that the gas quality fulfils the European standard for injection into the natural gas grid, hence showing that large scale production of biomethane delivered by injection to the natural gas grid is possible.

The project has demonstrated that the technology can be applied at a commercial scale with high performance using known technology. Future development should involve improved compatibility between different process steps as well improved economic feasibility of the production. With current process setup and using forest residues as feedstock, the production cost for at plant with 200 MW production capacity, estimated based on the economic data from GoBiGas, corresponds to about 600 SEK/MWh (approx. 60 €/MWh in 2017).



1. Gasifier
2. Combustor
3. Cyclone
4. Post Combustion Chamber
5. Product Gas Cooler
6. Product Gas Filter
7. RME-Scrubber
8. Adsorbent beds
9. Flue Gas Train
10. Lock hoppers
11. Compressor
12. Olefin hydrogenatio
13. H_2S Scrubber
14. Guard bed
15. Water Gas Shift Reactor
16. Pre-Methanation
17. CO_2 Scrubber
18. Methanation
19. Dryers

A Schematic overview of the GoBiGas-plant including a list of the major process steps

Stakeholders involved:	Göteborg Energi AB (local energy company owned by the city of Gothenburg) and the Swedish Energy Agency. Cooperation with the Swedish Gasification Centre, Chalmers University of Technology and Valmet AB (manufacturer of the gasifier) in the evaluation of the technology.
Financing Support:	222 MSEK (20 MEUR) from the Swedish Energy Agency. A NER 300 support of 59 million Euro was obtained for the second phase, which was however not realized
Contribution to Sustainable Development Goals:	SDG 7: Local lignocellulosic resources and wastes can be used to provide renewable biomethane for use in transport or as a fuel. SDG 8: The use of biomass for energy purposes generates job creation along a value chain stretching from urban to rural areas. SDG11: The production of biomethane reduces the carbon footprint of the city of Gothenburg, while the use of renewable CNG in cities reduces diesel tail-pipe emissions. SDG12: Renewable biomethane produced from lignocellulosic biomass or wastes can substitute fossil natural gas in a sustainable way. SDG 13: Greenhouse gas emission reduction factor > 80%. Scale-up and further improvements would make a higher figure possible. SDG 15: Swedish and EU policy safeguards the sustainable use of forest resources for energy purposes.
Contribution to GHG emission reduction in transports:	The project demonstrates that renewable biomethane can be product at above 80 % GHG reduction for use in e.g. transport. Follow-up projects at larger scale and in a variety of locations can contribute to reducing GHG emissions by substituting fossil gas at larger scale.
Employment:	To operate and maintain the plant, incl. management approx. 30 FTE has been required. During the engineering and construction phase, a high number of FTE has gone into the work temporarily.
Replicability and scale-up potential:	The focus of the project was to scale-up to enable commercial production at a capacity of 100 MW or larger in Gothenburg. The replication potential elsewhere is significant.

Success factors: That an off-take market for biomethane exists that provides a premium value for this product relative to fossil natural gas.

Constraints: The investment recovery period for project of this nature is long, 10-15 years. Policy interventions in support of such technologies are typically exceeding 10 years and are also changed within such periods, which in addition to market fluctuations does not give investors sufficient foresight and introduces risks.

Picture of the GoBiGas facility

Info provided by: Anton Larssson, Göteborg Energi AB

More information: https://www.goteborgenergi.se/om-oss/vad-vi-gor/forskning-utveckling/gobigas

https://onlinelibrary.wiley.com/doi/abs/10.1002/ese3.188