SUMMARY

9-10 of October 2008 Swedish Gas Centre (SGC) arranged an international seminar on gasification in Malmö, Sweden. In total 20 international and national experts were invited to give presentations. The seminar was chaired by Staffan Karlsson, SGC.
The seminar was divided into three parts

- . Production technologies
- Applications
    - Gas turbines and gas engines
    - Biomethane as vehicle fuel
    - Syngas in industrial processes
- Strategy, policy and vision

BACKGROUND
Production of synthetic fuels through gasification of biomass is expected to develop rapidly due to political ambitions related to the strong fossil fuel dependency, especially within the transportation sector, security of supply issues and the growing environmental concern.

Techniques that offer a possibility to produce high quality fuels in an efficient and sustainable way are of great importance. In this context gasification is expected to play a central part.

TECHNOLOGY STATUS - PRODUCTION
Gasification of biomass has been successfully demonstrated in different projects during the years and several activities are on-going. Below are some R&D activities and related plants concerning biomass gasification described.

Indirect gasification:
The indirect gasification concept has been further developed in recent years and there are now pilot and demonstration plants as well as commercial plants in operation.
The R&D activities at the semi-industrial plant in Güssing, Austria have resulted in the first commercial plant, in Oberwart. The design data is 8.5 MW_{th} and 2.7 MW_e which gives an electric efficiency of 32 % and the possibility to produce biomethane. In this scale conventional CHP production based on combustion of solid biomass and the steam cycle would result in a poor electric efficiency.

Metso Power has complemented the 12 MW_{th} CFB-boiler at Chalmers University of Technology, Gothenburg, Sweden with a 2 MW_{th} indirect gasifier. The gasifier is financed by Gothenburg Energy and built for R&D purposes.

Gothenburg Energy in collaboration with E.ON Sweden will in a first stage build a 20 MW plant for biomethane production (as vehicle fuel and for grid injection) in Gothenburg based on the indirect gasification technology. The plant is expected to be in operation in 2012. The next stage involves an 80 MW plant with a planned start of operation in 2015.

Indirect gasification of biomass results in a product gas free of nitrogen and hence suitable for production of biomethane. The concept has been proven at the Güssing plant using a slip-stream but still we are awaiting the first commercial plant that produce biomethane suitable as vehicle fuel or for grid injection.

Air-blown gasification
Several demonstration projects are related to air-blown gasification and CHP production. The two-stage Viking gasifier developed at Technical University of Denmark produces a gas with low tar content (<5 mg/Nm^3) suitable for combined heat and power production where a gas engine is used for the electricity production. The 70 kW_{th} pilot plant has an electric efficiency of 25 %. With a scale-up to 0.2-2 MW_e and improved internal heat recovery an electric efficiency of >37 % is expected.

In Skive, Denmark, biomass gasification in a 20 MW_{th} gasifier based on technology developed at GTI, USA and commercialized by Carbona, Finland is demonstrated. The total investment cost is 30 million Euro. Expected pay-back time is approx. 10 years. The project is delayed and the official opening is planned to April 2009. The delay reflects the inherent uncertainty related to large-scale demonstration of new technology.

There are several other demonstrations related to biomass gasification and gas cleaning on their way and the field of gasification seems to experience a renaissance.

TECHNOLOGY STATUS - APPLICATIONS
Gasfied biomass has been demonstrated in many applications and some of them are now well proven and commercially available.

CHP production - Gas engines
Gas engines utilizing gasified biomass are commercially available. GE Jenbacher has installed gas engines in many biomass gasification plants in Europe (e.g. Harboore and Skive in Denmark, Güssing, Austria, Spiez, Switzerland and Kokemäki, Finland). The accumulated hours of operation for the gas engines well exceed 100,000 hours. The plants with installed gas engines span over different gasification technologies (e.g. fixed bed – updraft, fixed bed – down draft and indirect gasification) and different gas compositions with lower heating values ranging from 5.4 MJ/Nm^3 to 10.5 MJ/Nm^3. High CO content in the gas results in high CO emissions from the gas engine which calls for exhaust gas after-treatment. To avoid problems related to tars, particles, corrosive substances, water etcetera gas cleaning is crucial and a key technology.

CHP production - Gas turbines
Gas turbines are associated with low maintenance, high availability and reliability, low emissions (compared to gas engines) and high power density. On the downside gas turbines in single cycle have a low electric efficiency compared to gas engines and unfavourable part-load characteristic (single-shaft turbines).

The applicability of standard gas turbines covers high heating value gases such as natural gas, up-graded biogas (anaerobic digestion) and biomethane through gasification and methanation. For gases with lower heating value, typically landfill gas, non-upgraded biogas or producer gas from air-blown gasifiers the turbines normally have to be adjusted.

Biomethane as vehicle fuel
Vehicles powered by compressed or liquefied methane (natural gas and biogas) increase rapidly and in the world there are now more than 9 million vehicles powered with methane. In Iran, where there in principal were no vehicles powered by methane 5 years ago, gas powered vehicles now constitute 75 % of the total number of cars, trucks and buses. In Sweden upgraded biogas (approx. 97 % methane) has surpassed natural gas as vehicle fuel. The potential to produce biomethane through gasification and methanation of biomass is huge especially in countries with vast forest resources.
The high conversion efficiency of 60-70 % (from wood chips to biomethane) makes gasification and methanation a promising route towards the production of a renewable vehicle fuel.

Gasified biomass in industrial processes
Hydrocarbons are the main constituent in many products, e.g. paint, plastic products, coatings, cable insulation, flooring etcetera. The petrochemical industry heavily relies on fossil resources such as oil and natural gas but renewable options are of great interest. This can be achieved in different ways. One way is to produce biomethane with a quality suitable for grid injection. In this way renewable biomethane enters together with natural gas into the petrochemical processes. Another way is to place a biomass gasification plant at the petrochemical site and produce syngas (CO and H_2) which is used as raw material in petrochemical processes. The gas cleaning is of vital importance in order to avoid catalyst poisoning and deactivation further downstream.

In metallurgical processes the use of gases is widely spread. Much of the gas comes from internal processes (e.g. coke oven gas and blast furnace gas). It may be possible to partly replace the use of coke, coal and oil with gas. The use of gas from external supply is influenced by the local situation and requirements (i.e. heat value and impurities) for the actual application.

During the seminar different productions technologies related to biomass gasification and applications as well as strategy and policy issues were presented by international and national experts.

The presentations give an excellent overview of the current status and what to be expected in terms of development, industrial needs and fuel requirements in different applications.

NOMENCLATURE
CFB Circulating Fluidised Bed
CHP Combined Heat and Power
RME Raps Methyl Ester
R&D Research and Development

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