

## Hydrogen Production from Biomass over Steam Gasification

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### Abstract

Renewable hydrogen is one option for a clean energy carrier in the future. There were several research programs in the past, to produce hydrogen on a renewable basis by electrolysis, direct conversion of water or by gasification of biomass. None of these options were developed to a stage, that they could be used on a commercial basis.

At the moment almost all hydrogen is produced from fossil fuels and one main consumer of hydrogen are refineries. So a good option to demonstrate the production of renewable hydrogen and bring it later into the market is over refineries.

The most economic option to produce renewable hydrogen at the moment is over gasification of biomass. In Austria an indirect gasification system was developed and is demonstrated in Güssing, Austria. The biomass CHP Güssing uses the allothermal steam dual fluidised bed gasifier and produces a high grade product gas, which is used at the moment for the CHP in a gas engine. As there is no nitrogen in the product gas and high hydrogen content, this gas can be also used as synthesis gas or for production of hydrogen. The main aim of this paper is to present the experimental and simulation work to convert biomass into renewable hydrogen.

The product gas of the indirect gasification system is mainly hydrogen, carbon monoxide, carbon dioxide and methane. Within the ERA-Net project "OptiBtLGas" the reforming of methane and the CO-shift reaction was investigated to convert all hydrocarbons and carbon monoxide to hydrogen.

On basis of the experimental results the mass-and energy balances of a commercial 100MW fuel input plant was done. Here 3 different cases of complexity of the overall plant were simulated. The first case was without reforming and CO-shift, only by hydrogen separation. The second case was by including CO-shift and afterwards separation of hydrogen. The third case includes hydrocarbon reforming, CO-shift and hydrogen separation. In all cases the offgases (CO, CO<sub>2</sub> and methane) were used in gas engines to produce electricity and heat. The efficiencies for these cases range from 25%, if no gas treatment is done, 40% by including a CO-shift and 60% for the case, where steam reforming and CO-shift is included.

Based on the simulation results an economic analysis of the overall system was done. The main result of the economic evaluation is that hydrogen can be produced at costs between 20-30 Eurocents per Nm<sup>3</sup>, which is 2.5-3.0 €/kg or 6-10 Eurocents per kW.