*SUBJECT 3: 3.2 Pyrolysis and other biomass liquefaction technologies*

# Techno-economic assessment of the Power and Biomass-to-Liquid (PBtL) concept

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## Introduction

The use of first generation biofuels like biodiesel or ethanol is discussed critically due to the available biomass potential and the competition for farmland. As a consequence, biofuels of the second generation are developed, which are made from residues and/or waste. The concept is well-known under the acronym Biomass-to-Liquid (BtL). However, the low hydrogen concentration in the syngas derived from biomass is a conceptual disadvantage of this concept. The Power and Biomass-to-Liquid (PBtL) concept, where the hydrogen concentration is increased by the supply of additional hydrogen from electrolysis, may be an option to increase the fuel yield per biomass feed.

## Method

A detailed technical and economic evaluation of the PBtL concept was carried out. The concept was modelled in flowsheeting software and the system was optimized in terms of carbon conversion. Secondly, the energy consumption was analyzed by pinch point analysis and afterwards minimized. Third, an exergy analysis was conducted to identify and quantify energy losses. Finally, the economics were evaluated by cost estimation.

## Results and Conclusion

Flowsheet modelling allows the optimal integration of waste heat and side streams to maximize the system efficiency and minimize production costs. An overall efficiency, which relates the energy content of biomass and electricity to the energy content of the liquid fuel, was determined to be 38.8 %. The carbon conversion is 73.2 %. The biomass gasification section and the electrolyzer account for the highest energy losses within the process. Fuel production costs between 2.00 €/l and 3.50 €/l were calculated. Sensitivity analyses indicate that production costs depend for the most part on electricity price, the capital cost of the biomass gasification and the electrolyzer. Increasing efficiency in biomass gasification and electrolysis as well as lower costs for this equipment are necessary to reach market competiveness. If renewable electricity is available as excess energy at low prices, biofuel production at the market price level of crude oil fuels may be possible.