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

# Power and Biomass-to-Liquid (PBtL): A promising approach to produce biofuels using electricity

D. H. König, F. G. Albrecht, R.-U. Dietrich
German Aerospace Center, Institute of Engineering Thermodynamics,
Pfaffenwaldring 38-40, 70569 Stuttgart, Germany

## Introduction

Future aviation will continue to depend on energy carriers with a high energy density. Additionally, the emission reduction goals can only be achieved, if crude oil based fuels are replaced by renewable fuels. Currently, the concepts Biomass-to-Liquid (BtL) and Power-to-Liquid (PtL) are under investigation. However, conceptual disadvantages exist in both production pathways such as the low hydrogen concentration in the syngas (BtL) and the need for a cheap and sustainable carbon source (PtL). The Power and Biomass-to-Liquid (PBtL) combines both concepts by an advanced system design to increase overall system efficiency and the fuel yield per biomass used.

## Method

A method was developed to evaluate and compare the technical and economic performance of different X-to-Liquid (BtL, PtL, PBtL) concepts. The method includes the modelling of all three production pathways in flowsheeting software. Additionally, a pinch point analysis was conducted to optimize the processes in terms of carbon conversion, efficiency and fuel production costs. Subsequently, an economic evaluation was performed with emphasis on available excess electricity potentials from renewable energy sources.

## Results

The carbon conversion efficiency of the designed PBtL system is significantly higher compared to the BtL and PtL concepts. The overall process efficiency was found to be highest for the PtL concept (47.5 %) followed by the PBtL (38.8 %) concept. The lowest efficiency was found for the BtL concept (30.1 %). In contrast, the BtL concept is characterized by the lowest fuel production costs followed by the PBtL and PtL concept. The limiting factor for BtL concepts is the availability of biomass. The electricity price was identified as the major cost driver in the PtL and PBtL case. Therefore, the optimization problem biomass vs. power has had to be solved. Expenditures for electricity exceed by far the annual capital costs for the biomass gasifier and electrolyzers as well as the biomass purchase costs. The detailed comparison of the three concepts and conclusions derived from the results will be presented at the conference.