**Syngas production in the Power-to-Liquid process - Techno-economic assessment of the operating conditions**

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**Highlights**

* Power-to-Liquid (PtL) process model (Simulation in Aspen Plus®)
* PtL process efficiency for varying process conditions in the syngas unit
* Economic assessment
* Optimum operating conditions of the syngas unit

**1. Introduction**

In order to decarbonize the transport sector several possible routes and measurements are currently investigated. For the air transport sector, a decarbonization seems not likely in the near future as this is one of the “difficult-to-electrify” sectors. However, a promising approach to incorporate renewable sources in this sector (defossilization) is the production of synthetic fuels from CO2 and water by using renewable power sources for hydrogen production in an electrolyzer. In this Power-to-Liquid process (see Fig. 1) the CO2 is activated at high temperature (750-950 °C) and elevated pressure (1-25 bar) via reverse water-gas shift reaction (RWGS). The produced syngas is then converted to hydrocarbons via Fischer-Tropsch synthesis (FTS). Besides the technical challenges to establish an efficient Power-to-Liquid process, the production costs and ways to reduce these costs are of major importance.



**Figure 1.** Principle scheme of the PtL process.

**2. Methods**

The process is modelled in Aspen Plus® (see Fig. 2) and the PtL-efficiency is calculated according to:

$$η\_{PtL}= \frac{\dot{m}\_{Product }∙ LHV\_{Product}}{P\_{electrical}}$$

Different parameters are varied e.g. temperature and pressure in the RWGS reactor. The evaluation of the optimum process conditions is not trivial. On the one hand, increasing the temperature and decreasing the pressure leads to a higher CO2 conversion and less CH4 formation. On the other hand decreasing the pressure leads to an increase in power consumption due to additional compression work, while higher temperatures require additional high temperature heat. The effect of this variation is assessed and discussed. Further the production costs are calculated using the Inhouse Tool TEPET (Techno-Economic Process Evaluation Tool) [1].



**Figure 2.** Simplified process scheme of the PtL process.

**3. Results and discussion**

The assumptions for the process model will be presented. The influence of the parameter variation on the PtL-efficiency will be discussed. Additionally the production costs and the impact of different operating conditions on these costs will be determined.

**4. Conclusions**

The optimum process conditions regarding the efficiencies and production costs will be presented. Major impacts will be outlined and quantified.

**References**

1. F. G. Albrecht, D. H. König, N. Bauck, R.-U. Dietrich, Fuel 194 (2017) 511-526.