Carbon2Chem®

The Carbon2Chem® Communities

PRE-PROCESSING Simulation | ENGINEERING Process Design | POST-PROCESSING GWI Analysis | POST-PROCESSING Cost Estimation | Regulatory Framework

Cost Estimation Community
Estimating Levelized Cost of Production

Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT | Siemens Energy Global

Challenge

The Cost Estimation Community contributes techno-economic evaluation of the process concepts developed in the Process Design and Simulation Communities. Investment and operating costs for the Carbon2Chem® process concepts are estimated based on literature data and various scenarios considering external boundary conditions. Levelized costs of methanol and urea are calculated and compared to market prices.

Objective and methodology
Process design to levelized costs

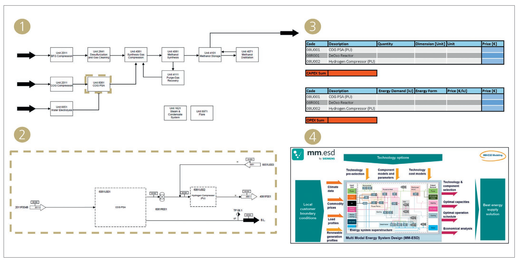
Levelized costs of methanol and urea production in different process concepts were estimated. A modular cost approach was chosen to determine the investment and operating costs (CAPEX & OPEX) of individual process units. Costs of units were estimated based on technical data provided by the process design community using established estimation methods. The modular approach allows for continuous changes to plant configuration as well as the transfer and scaling of individual units to different process concepts thus enabling techno-economic evaluations of comparable systems. For example, such based on the use of process gases from the cement industry or waste incineration plants.

For the synthesis of methanol from blast furnace gas (BFG) multi-modal energy system simulations (MM-ESD) were carried out introducing additional gas storages and timeseries for feed gases. Investigations of various scenarios regarding main cost contributors (e. g. electricity and hydrogen costs) deliver an overview of levelized costs of methanol.

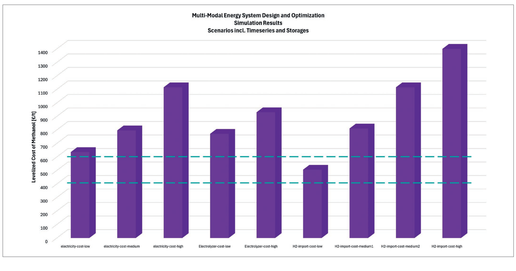
Transferability
Levelized cost of methanol from BFG

Analyses of the production of methanol from BFG show a wide range of levelized costs of methanol depending on external boundary conditions. Static cost estimations yield a range of 350-1560 €/t while MM-ESD simulations yield a range of 470-1370 €/t. Water electrolysis is the largest cost factor for both CAPEX and OPEX. In fact, under most scenarios electrolysis makes up for over 50 % of levelized costs. The process is particularly sensitive to electricity prices, mainly driven by demand for electrolysis. At high electricity prices up to 80 % of levelized costs can be attributed to water electrolysis.

Subsequently, MM-ESD simulations show that lowest levelized cost can be achieved when hydrogen is not produced on site but rather imported at low prices. Levelized cost in this scenario are competitive with recent market prices of grey methanol, whereas the other scenarios yield costs surpassing recent price corridors of grey methanol. With low electricity prices yielding levelized cost slightly surpassing recent market prices.



Four-step cost estimation approach: 1: BFD for overall concept, 2: PFD for individual units, 3: cost estimation of units, 4: MM-ESD.



Levelized cost of methanol in different scenarios. Dashed lines represent minimum and maximum price of grey methanol between 2022-2023.

A KEY BUILDING BLOCK
FOR THE CLIMATE PROTECTION

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