

High Pressure Technologies as Key Enabler in the Energy System Transformation

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Since the begin of the industrialization, the atmospheric CO₂ concentration is increasing fast due to the enormous scale fossil resources are utilized for energy generation and as raw material for goods that likewise are converted to CO₂ in the end. To alleviate the associated climate change, it is vital to transform the energy system to sources of renewable energies. The chair Carbon Sources and Conversion targets at providing chemical engineering solutions in this field.

Due to the intrinsic fluctuating nature of renewable primary energy sources it is necessary to establish ways for storage of large amounts of electric energy. Most favorable will be chemical forms of energy storage which supplement physical forms of energy storage. To establish carbon neutral production, it will be necessary to also switch the raw material supply of the chemical industry to sustainable carbon sources.

High pressure technologies and supercritical fluids can play a key role as enabler for this energy system transformation. The poster discusses the use of supercritical fluids in the generation of carbon-based energy storage molecules. Later can be produced in an ecological and sustainable way from wind energy and carbon dioxide and water as feedstock.

Forthcoming Power-to-X processes will be analyzed for the manifold opportunities arising from the use of high-pressure technologies and supercritical fluids. Future process chains based on Power-to-X processes comprise numerous steps. Electrolyzers convert renewable electricity from wind turbine to hydrogen by splitting water. Compensating for fluctuating hydrogen production, hydrogen is stored in nearby storage sites such as salt dome caverns. By Fischer-Tropsch synthesis or related technologies, hydrogen and carbon dioxide are converted to hydrocarbons. The hydrocarbon mixture is then separated and the respective products transported to the consumer.

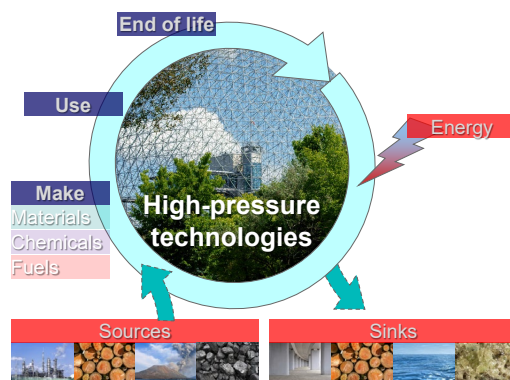


Figure 1: High pressure technologies and supercritical Fluids as key enablers for closing anthropogenic carbon cycles and realizing Power-to-X technologies in the strife for climate-neutral energy storage and as forthcoming raw material supply of the chemical industry

Potential process routes will be outlined on basis of wide-ranging life-cycle-assessments and the impact of high-pressure technologies discussed.