Karlsruhe Institute of Technology

Division I – Biology, Chemistry, and Process Engineering

Institute for Technical Chemistry (ITC)
Engler-Bunte Institute (EBI ceb)
Institute of Catalysis Research and Technology (IKFT)

CarbonCycleLab

Hydrogen in the Circular Economy

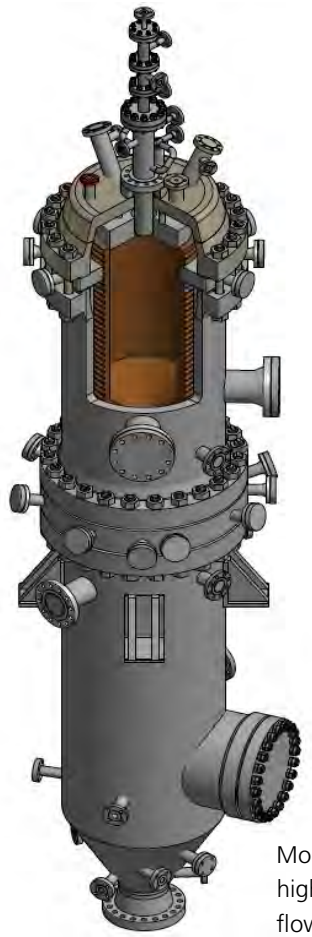
With the Green Deal, the European Union aims to accomplish the transition to a resource-efficient, climate-neutral and competitive economy. The Green Deal combines the challenges of the energy transition with a circular economy. The basis for the future energy and economic system is green electricity from renewable sources, and raw materials from residual and waste materials.

The raw materials for the circular economy may come from industry and commerce, from households, from forestry and agriculture. For their reuse, these very heterogeneous material flows must be returned to the carbon cycle. Hydrogen and renewable energy are needed to power this cycle. The CarbonCycleLab at KIT provides important insights into how this can work on an industrial scale.

The Carbon Cycle – Basic Research Reaching into Industrial Application

The CarbonCycleLab covers a complete process chain of the carbon cycle of the future: From residual and waste materials to the basic chemical substances obtained from them for reuse in the chemical industry as a substitute for fossil raw materials.

In the first step of the process chain, these feedstocks are thermochemically pretreated in material-specific pyrolysis processes for plastic waste or residual biomass. Liquid and solid intermediate products, pyrolysis oil and pyrolysis coke, are produced. In a high-pressure entrained-flow gasifier, these are then converted into the basic chemical building blocks hydrogen and carbon monoxide, which together form the synthesis gas. In downstream synthesis processes, this is used to produce important chemical feedstocks for industrial production, for example methanol.



Model of the high-pressure entrained-flow gasifier at KIT

The fundamental understanding of the process technology of the process steps is a prerequisite for the optimization of the individual processes of the CarbonCycleLab and their successful transfer to industrial scale. For this KIT works closely with internal and external partners.

For example, the reaction kinetics of fuel conversion in the entrained-flow gasifier are being researched at KIT's Engler-Bunte Institute, the pyrolysis of mixed plastic waste and the atomization of pyrolysis oils for gasification are being studied at the Institute for Technical Chemistry (ITC), and biomass pyrolysis and synthesis routes to important chemical feedstocks are being developed at the Institute of Catalysis Research and Technology (IKFT). The use of synthesis gas in novel synthesis steps to produce chemical feedstocks is an important research and development area at CCLab. Other research partners include the KIT Institute for Automation and Applied Informatics (IAI), the Institute of Energy Process Engineering and Fuel Technology (IEVB) at TU Clausthal, and Forschungszentrum Jülich (FZJ). In addition, there are partners from industry.

For the individual processes, KIT's research at ITC and IKFT covers the complete range from basic research for individual process steps to pilot scale applications and the operation of large complex demonstration plants.

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CC-Lab

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