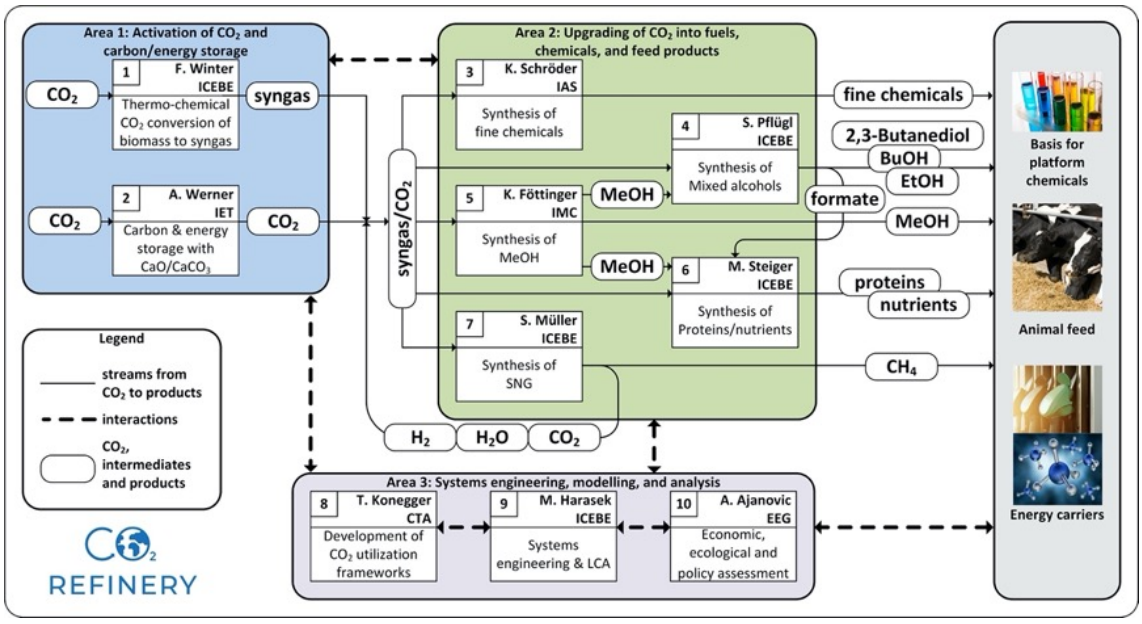
Open Position PhD #1: Thermo-chemical CO_2 conversion of biomass to syngas

General

The TU Wien doctoral school **CO_2Refinery** covers a wide range of methods and will integrate multiple disciplines required to implement a fully functional facility for refining and upgrading CO_2 on a technical center scale. With its integrated research and training program, the doctoral school targets to train "**one carbon engineers**" will work together on the development of technologies to efficiently utilize CO_2 as a carbon source to make a broad variety of products using chemical and biological catalysts. In addition to synthesis of products from CO_2, **CO_2Refinery** will focus on the activation of CO_2 for utilization as a carbon source in synthesis processes. Moreover, using renewable resources such as biomass and energy, and energy storage with CO_2 as the scaffold will be investigated. The strategy of **CO_2Refinery** is complemented by research on systems engineering, modelling, and analysis to provide the framework of the individual unit operations. Additionally, life cycle analysis will be used as a powerful tool to evaluate performance of the refinery on an economic scale. The research topics are structured into three research areas as shown below.



Within the proposed research framework, the members of the TU Wien doctoral school will be trained interdisciplinary to obtain a unique skillset. Graduates are envisioned to work at the forefront of groundbreaking research, but also to implement the concepts and ideas of a CO_2 refinery in industry. **CO_2Refinery** offers excellent scientific research, combined with a multi- and interdisciplinary curriculum (lectures and lab rotation) and a dedicated supervision and mentoring program. The PhD students are in the center of attention and their training and scientific advancement is the key to a successful implementation of this program. Research training will be obtained through work embedded into high-quality scientific research environments provided by supervisors that are internationally recognized experts in their fields and the close support through junior faculty members.

Project description:

This PhD project focuses on the thermo-chemical conversion of CO_2 to syngas, which is a mixture of CO, CO_2, H_2, small amounts of higher hydrocarbons and H_2O. The CO_2 is fed together with steam or in pure form into a fluidized bed gasifier, where biomass is converted to a high-value syngas. In this process, the end product CO_2 is converted to CO which is the carbon source for further synthesis routes. This syngas is further used for the production of biofuels, synthetic natural gas, fine chemicals, proteins or nutrients in the other PhDs theses of this doctoral college. Therefore, it is import to have knowledge about the downstream processes of syngas utilization and its optimal composition as well. In close interaction with PIs and PhD students within this doctoral college, suitable syngas compositions will be evaluated, and the CO_2 biomass gasification process integrated in the CO_2 Refinery. The aim of this PhD project is to optimize the operation parameters during CO_2 gasification to increase the CO_2 conversion and carbon utilization efficiency.

Key goals and tasks:

The primary aim of this PhD thesis is the experimental investigation of the conversion and reaction mechanism of CO_2 within the biomass gasification process. Thereby, the focus lies in the field of CO_2 utilization and reduction, circular economy and climate-friendly energy supply. Detailed conduction of reaction kinetics measurements and experimental test campaigns within a team of researchers are the basis of this PhD project. Additionally, experimental data has to be evaluated and validated with different software tools (e.g.: IPSEpro, MATLAB, AutoCAD, programming skills). With the aid of simulation tools and digital twins, the overall process is optimized. Based on the results scientific and technical reports and publications are created. Research findings are published in scientific journals and conferences.

Experience and skills:

- Completed master studies in chemical engineering, technical chemistry, mechanical engineering or similar
- Knowledge on fluidized bed technology, catalysis, material sciences, thermodynamics in the field of synthesis reactions, process simulation is advantageous
- Interest in working with experimental setups, their development and adaptation
- Enthusiasm for experimental investigations
- Affinity for computer integrated modelling of process chains and validation of measurement data
- Willingness to travel to project meetings and scientific conferences
- Good German or English language skills in scientific field
- Personal skills: Independence, ability to work in a team, communication, problem-solving skills

Supervisors:

Franz Winter / Stefan Müller / Anna Mauerhofer