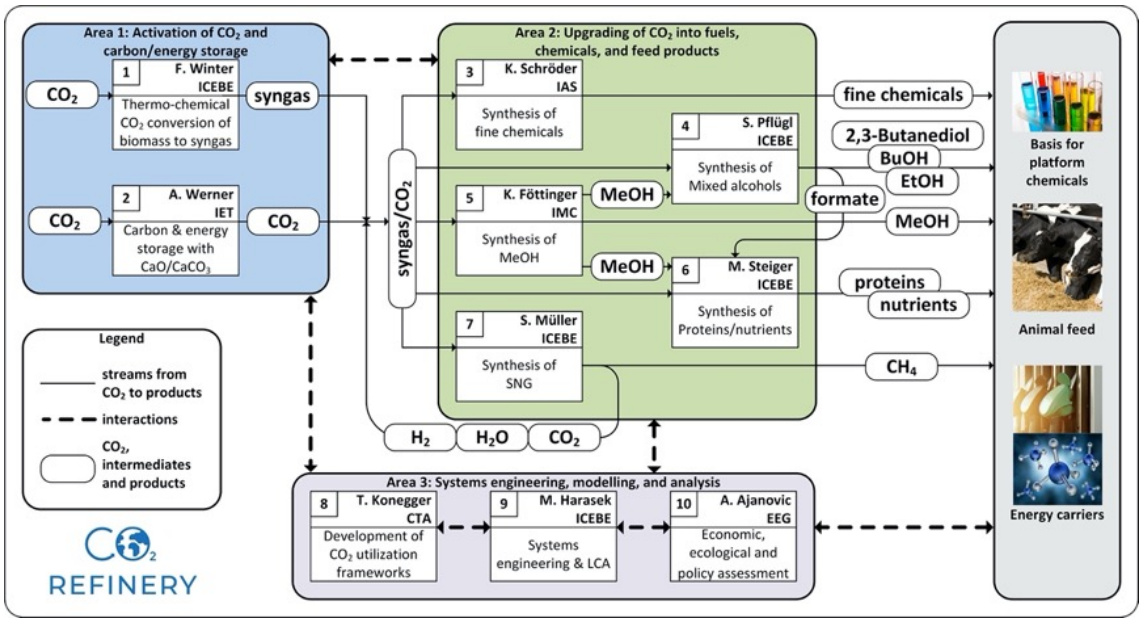
Open Position PhD #3: Continuous production of fine chemicals from CO_2 using supported ionic liquid phase catalysts

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:

Upgrading of CO_2 into fuels, chemicals, and feed products is of key interest in a **CO_2Refinery**. Platform chemicals can be synthesized using chemical or biological catalysts directly from crude gas streams. Using this integrated chemo-biological refining approach, bulk and fine chemicals, fuels, energy carriers and feed will be generated as end-products. **CO_2Refinery** envisions an integrated approach where fundamental research is translated from proof-of-principle to lab scale and further to bench scale. This PhD project will focus on chemical catalysts to allow the synthesis of fine chemicals, methanol, and methane. Heterogeneously catalyzed reactions for the conversion of (sub- or supercritical) CO_2 in a continuous-flow reactor system shall be analyzed with regard to kinetics, selectivity and conversion.

Key goals and tasks:

PhD #3 will develop novel well-defined ionic liquids for CO_2 conversion into value-added fine chemicals, including carbonates and carboxylic acids and their derivatives. The catalytic activity of different base metal catalysts shall be tested with an emphasis on Fe, Co, and Mn PNP pincer complexes in combination with functionalized ionic liquids. Extensive experimental testing will provide a basic and fundamental understanding of CO_2 activation by means of cooperative catalysis. Promising catalytically active ionic liquids will be immobilized using the continuous catalysis mode based on the SILP technology (Supported Ionic Liquid Phases) on highly structured materials to maximize the catalyst/reactant interface in close cooperation with PhD #8.

Experience and skills:

- Master level degree in technical chemistry, chemical engineering or related discipline.
- Good experience and interest in synthetic chemistry, experiments in chemistry, and chemical kinetics.
- Excellent written and verbal communication skills, and a safe command of English
- Personal skills: independence, creative thinking, systematic and structured work approach, hands-on mentality, team player
- Willingness to participate in teaching and supervision of students
- Interest in international outgoing stays

Supervisors:

Katharina Schröder / Franz Winter / Michael Harasek