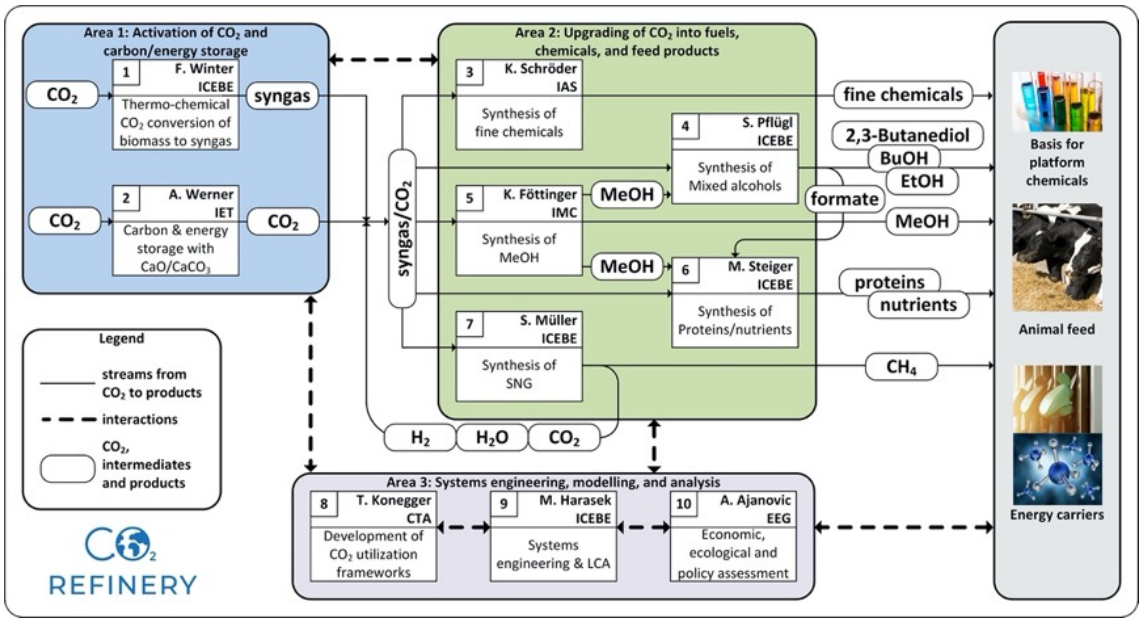
Open Position PhD #2: Energy storage using CO_2

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 thesis concerns energy storage in combination with sCO_2-power cycles. In a first step thermochemical energy storage concepts, based on decarbonization / carbonization of metal oxides shall be analyzed. Additionally, even other thermochemical storage materials for Power2Heat2Power(P2H2P)-concepts have to be taken into consideration. An important measure is their applicability for the combination with sCO_2-cycles. After selecting the most interesting cycles these one will be modelled and simulated by using a stationary process simulation software, e.g. IpsePro or Ebsilon. The different cycles have to be evaluated according to technical and economic aspects.

Key goals and tasks:

The primary aim of this PhD-thesis is the development of new thermochemical energy storage concepts in combination with sCO_2-power cycles. The starting point are the concepts described in literature and the knowledge base at IET – based on its expertise due to research on energy storage and sCO_2-cycles. By modeling and simulation of different cycles, including different thermal energy storage concepts (Carnot-battery) a general overview and comparison of different concepts shall be given. The comparison shall give detailed information about strengths and weaknesses of the different concepts like investment costs, operating costs, storage capacity, max. power during storage and release, cycle stability of thermochemical materials, implementation to modern power grids and more. Dependent on use case even dynamic simulation of selected cycles or partial systems of them can be necessary.

As a result of the thesis a profound knowledge base about sCO_2-power cycles and storage concepts is available. The results will be published in peer reviewed journals.

Experience and skills:

- Master study in mechanical or process engineering, or related
- Interest in thermodynamic modelling of power- and energy storage cycles
- Modeling skills concerning process simulation software like Ebsilon, IpsePro, AspenPlus
- Willingness to participate in teaching and supervision of students
- Scientific experience: Presentation, scientific writing, publications, conferences
- Personal skills: independence, creative thinking, team working ability, communication, problem-solving skills

Supervisors:

Andreas Werner/ Michael Harasek / Franz Winter