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Coach	**Supervisors**	**Funding**
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A conceptual process analysis of methane superdry reforming as an emerging technology for reusing CO_2

Aim

This thesis aims to develop a process design methodology for comparing alternative technologies for reusing CO_2 either in combination with methane or hydrogen.

Justification

CO_2 chemical conversion to other molecules requires high amounts of energy, as it has the least free energy value, which makes CO_2 being very stable as a molecule. Capturing CO_2 from the atmosphere, and convert it to useful chemicals as methanol can lead to designing technologies with negative emissions. Methane Superdry reforming is a new technology which requires lower heat of reaction because of the synergistic factors associated with chemical looping. Converting CO_2 to CO unlocks the potential to produce fuels or methanol and the latter has a large number of applications. Nevertheless, there are also alternatives routes for synthesizing methanol from hydrogen and CO_2. However, the latter technology employs hydrogen which is a very valuable molecule.

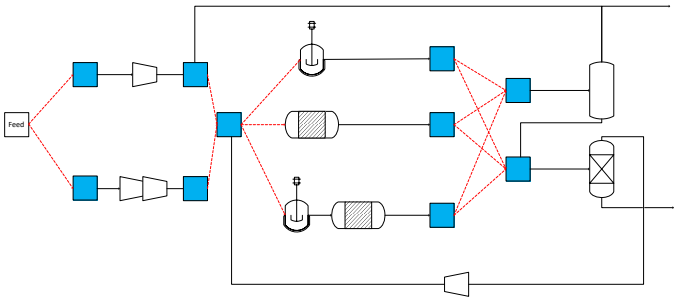

Figure 1. A visualization of a process synthesis of different structures to produce a chemical product (adapted from H. Yeomas, I. E. Grossmann, Computers & Chemical Engineering, 1999)

The program objective is to synthesize a process design that takes into consideration the integration of individual process units. Different process structures will be analyzed so that the impact of those on separations, and energy usage can be optimized. The feasibility of the concepts will be assessed by conducting a pinch analysis of the process. Energy optimization will contribute to determining the net environmental impact of the technology. The concluded process flow diagram will be used in process modeling applications such as Aspen Plus® for further capital estimation of the plant, and a techno-economic analysis.

Program

- Literature survey on the process technologies for methanol synthesis from CO, and from H_2 plus CO_2
- Incorporating the in-house methane Superdry reforming reactors model in Aspen Plus®
- Synthesize in Aspen Plus® process models for methane superdry reforming, and methanol synthesis plants (from CO, and from H_2 plus CO_2)
- Conduct pinch analysis to optimize energy use, and determine the net energy input.
- Develop a capital estimate model in Aspen Plus® and conduct a technoeconomic analysis for comparing the two alternative routes.

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