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Coach	**Supervisor(s)**	**Funding**
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Techno economic analysis of CH4 and MeOH synthesis from syngas produced by SOEC by modelling and basic experimental validation

Aim

The primary objective of this master thesis is to conduct a comprehensive techno-economic analysis of methane (CH4) and methanol (MeOH) synthesis from syngas produced by Solid Oxide Electrolysis Cells (SOEC), utilizing a combination of modeling and basic experimental validation. This research aims to explore the potential of solid oxide for syngas production through co-electrolysis, emphasizing its importance as a crucial intermediate for the innovative concept of power to molecules. The thesis will specifically compare the production efficiencies of methane and methanol, employing various feedstocks such as biogas (CH4 + CO2) or pure CO2 + water. The ultimate goal is to perform a detailed techno-economic analysis that identifies the optimal production pathway for each molecule under different feedstock scenarios.

Justification

This research is grounded in the unique properties of solid oxide, a ceramic material conducting oxygen anions at elevated temperatures. The SOEC technology, distinguished by its lack of expensive catalysts, is exceptionally suited for co-electrolysis, efficiently converting H2O into H2 and CO2 into CO. The synthesis of electrical syngas, a vital intermediate in the power-to-molecules process, will be explored. Additionally, leveraging steam or waste heat in the process offers potential cost savings, making it an economically viable option. The use of CO2 as a feedstock further aligns with sustainability goals, reducing emission costs. Collaboration with VIRECA, a Gent-based startup building solid oxide electrolysers, ensures real-world applicability and practical insights.

Program

The research program will involve the following key steps:

1. **Model Development:** Build a comprehensive model in Aspen that encompasses two stages. Stage one will focus on solid oxide co-electrolysis and syngas production, while stage two will delve into the subsequent production of methane or methanol.

2. **Experimental Validation:** Verify the findings of the model through experimentation on a solid oxide electrolysis setup. This step ensures the alignment of theoretical predictions with practical observations.

3. **Techno-economic Analysis:** Conduct a detailed techno-economic analysis to compare the production of methane and methanol under different feedstock scenarios. Assess the economic viability and sustainability of each pathway, considering factors such as production costs and environmental impact.

By choosing this thesis topic, students will engage in cutting-edge research at the intersection of electrochemistry, sustainable energy, and chemical synthesis, contributing to the development of innovative solutions for the evolving landscape of energy and molecules.