Abstract ICO$_2$CH

Integrated CO_2 capture and hydrogen production, full cSBO with a proposed starting date on 1 January 2022 and a proposed duration of 48 months, with partners VITO, IMEC, VUB and KU Leuven.

In the ICO$_2$CH project, an integrated concept is investigated for the **low-cost capture** from CO_2 point sources with alkaline KOH-based media and **renewable H_2 production**. The innovation is on the level of the water electrolyser, which is fed by a CO_2-rich, post-capture (bi)carbonate solution, that enables isolation of a 80:20 % CO_2/O_2 gas mixture from the anolyte during operation. This eliminates the need for dedicated 'stripping' energy, since CO_2 liberation is a consequence of OH- consumption during O_2 production. Simultaneously, KOH is regenerated in the H_2 evolution reaction, avoiding further capture utility costs. The **high-purity CO_2 stream** can be valorized, in combination with H_2 to produce e.g. synthetic fuels, next to O_2 in (partial) **oxy-fuel combustion**, after a final CO_2/O_2 separation step.

The scientific goals are related to performance targets that enable low electrolyser cost levels (CAPEX ~current density, AWE: 600 - 1200 €/kW) with minimal impact on OPEX (electricity use/efficiency ~cell potential). This will be pursued by the development and stacking of 3D-thin-film components (VITO – Imec), to (1) compensate decreased ionic conductivities compared to typical KOH-based electrolytes and (2) maximize the effectiveness of pH change at the anodic side. Therefore multiphase models are used to link electrochemical reactions and transport phenomena to the bulk chemistry, while process modeling and application testing is involved in the evaluation of CO_2/O_2 separation (VUB) and integration with an oxy-fuel combustion step (KUL). The project is supported by research-directive models and advice (VITO), based on techno-economic principles and benchmark analysis.

The key exploitable results encompass devices and process-based innovations, addressing producers of electrocatalysts, electrodes and membranes, next to process developers, for valorization. The end users of such capture technology are present in the refining, chemical, steel and energy sectors, having unavoidable CO_2 point source emissions and optionally interest in (partial) oxy-fuel combustion. This also involves companies (or clusters) interested in CCU/Power-to-X applications with access to high-purity CO_2 and H_2, as produced in one intensified system.

For substantive questions about this project proposal, please contact MOT3 representative Luc Van Ginneken (lvanginneken@catalisti.be; +32 477 979 947).