VOLTA CHEM
Powered by TNO

ACCELERATING INDUSTRIAL ELECTRIFICATION

ELECTROSYNTHESIS OF CHEMICAL BUILDING BLOCKS USING CO_2 AS FEEDSTOCK

elena.perezgallent@tno.nl / matti.vanschooneveld@tno.nl

CONTEXT & TRL LEVEL

Conversion of CO_2 into added-value chemicals via electrochemical technologies has a high potential for recarbonisation of the chemical industry. Recarbonisation means in this context that many of our carbon based materials (ranging from food to consumer goods to synthetic fuels) could be made using CO_2 as the carbon source. Using renewable electricity to drive electrochemical conversion would at the same time decarbonize production (avoiding emission of greenhouse gasses) and help to mitigate climate-related environmental problems.

Competitive advantages of electrochemical CO_2 conversion are the mild conditions needed for the reactions and the possibility of a precise control of the product yield. Although in the last decade CO_2 electrolysis has been widely studied, and its feasibility and potential has been demonstrated, the technology is still in need of further development before it will be implemented in industry. Many of the latest developments in CO_2 electrolysis are focused on scaling up technologies from TRL 3 to TRL 5-6. The aim is to demonstrate the technology at industrially relevant conditions with high productivity, selectivity and stability. Within 5 years from today our aim is to have the first pilot installations integrated at industrial production sites. We will demonstrate the value that can be generated from this technology both economically, as well as in reducing the CO_2 footprint of production processes.

OBJECTIVES

We aim to have at least three TRL6 pilot systems installed at industrial sites for the production of added value chemicals from CO_2. Specifically we aim to integrate CO_2 conversion products as feedstock for fermentation production processes and CO_2 conversion products as building blocks for the production of plastics.

OPPORTUNITIES

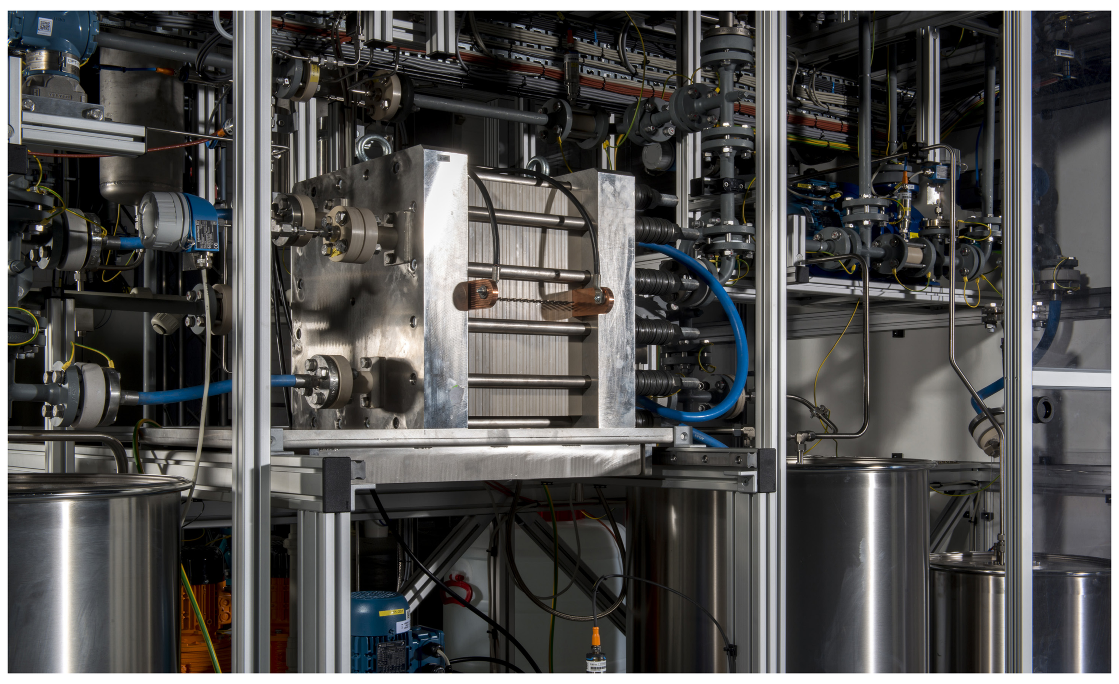
- Integrated CO_2 capture and conversion.
- CO2 electrochemical conversion to formic acid and its further valorisation.
- Development of paired electrolysis for the production of CO and Cl_2 as feedstock for phosgene process.

CHALLENGES

- Development of stable, selective and durable materials (e.g. electrodes, membranes, etc).
- Integration of the CO_2 electrolyser with a CO_2 capture installation and simplification of downstream product recovery from CO_2 electrolysis.
- Scale-up of electrochemical CO_2 conversion stacks and balance of plant, plus process intensification by increasing output per area of footprint, for industrially relevant throughput.

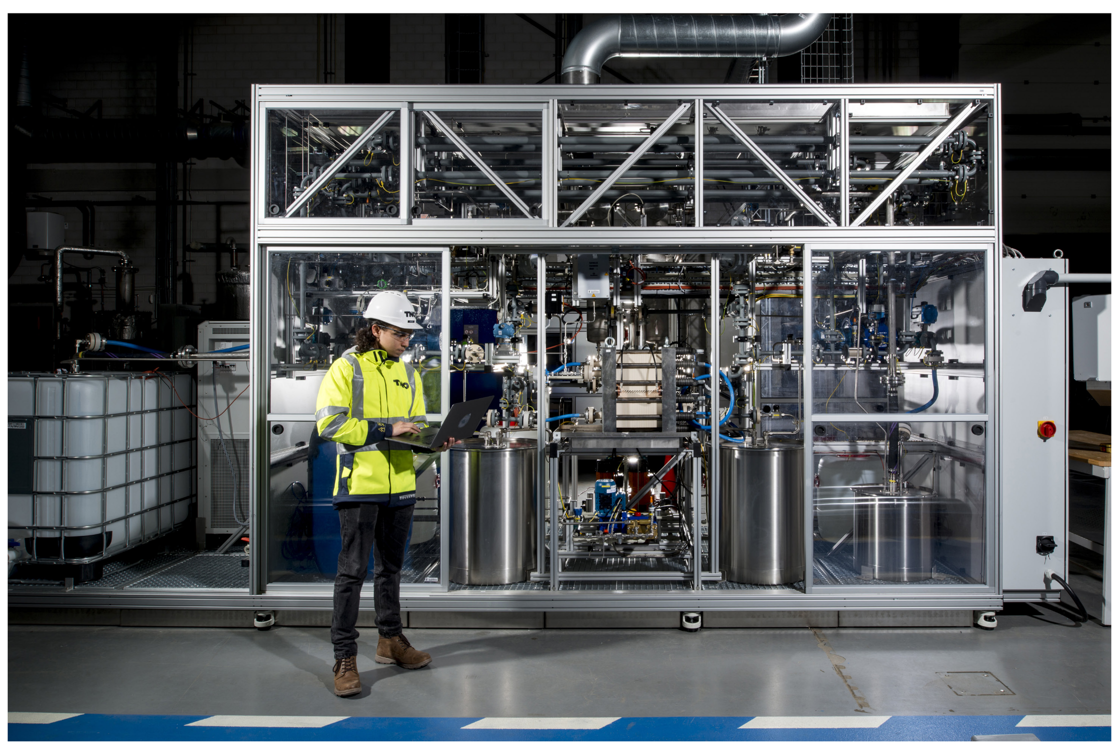
DEVELOPMENT PLAN

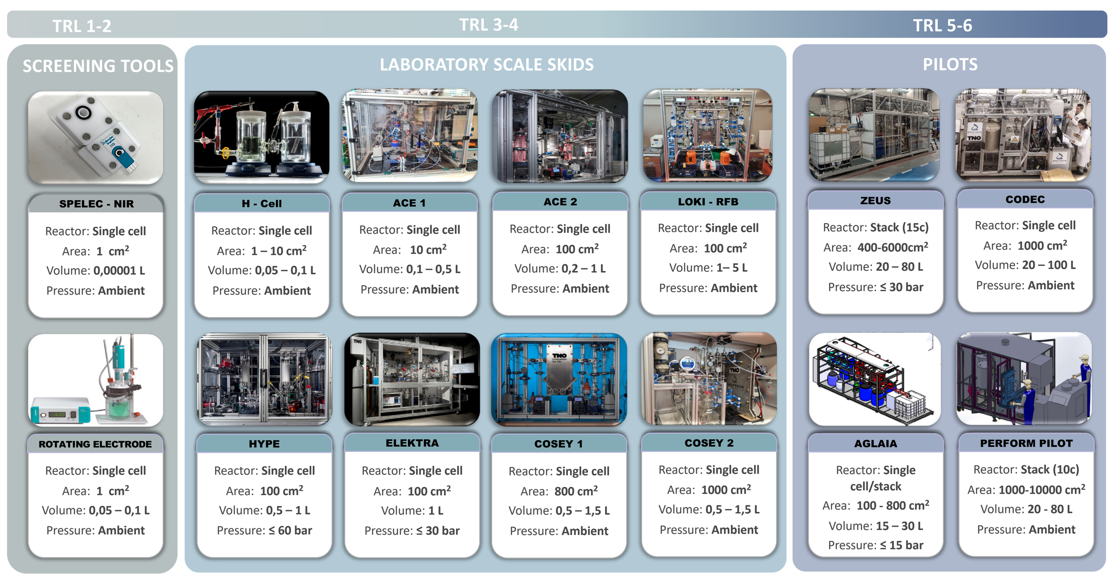
2024: Component optimisation (electrodes, membranes, reactor, etc).
2025: Long term testing.
2027: Testing of different CO_2 sources and sensitivity to impurities.
2028 : Pilot installation integrated at industrial site.
2030: Demonstration of Industrial CO_2 valorisation to chemicals.



INFRASTRUCTURE/PARTNERS

- Infrastructure: the ZEUS pilot installation (TRL 5-6) for the conversion of CO_2 to chemicals such as formic acid and CO is available since march 2023. We are actively looking for partners and invite both component suppliers and electrolysers OEMs to test and validate their products with us on the ZEUS installation and thereby benchmark the performance of their products against standards. We also welcome both CO_2 emitters that aim to valorise their CO_2 waste streams, as well as end-users who aim to have products with a low carbon footprint to collaborate with us.
- We have a unique set of TRL 2-5 infrastructure available allowing to operate at a wide range of conditions, including high pressures, with and without GDE's etc. (see figure below).





RESULTS / PROJECTS

- Interreg E2C 2 Seas: CO_2 electrochemical conversion to formic acid at TRL 5.
- Kansen voor West: Scaling up of CO_2 reduction to formic acid.
- TSE Electrons-to-Fatty acids : Integration of CO_2 conversion to formic acid with utilisation of formic acid in fermentation for the production of fatty acids.

JOIN VOLTACHEM'S COMMUNITY: WWW.VOLTACHEM.COM/COMMUNITY