VOLTA CHEM
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ACCELERATING INDUSTRIAL ELECTRIFICATION

ELECTROSYNTHESIS OF CHEMICAL BUILDING BLOCKS USING BIO-BASED FEEDSTOCKS

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CONTEXT & TRL LEVEL

The developments and innovations in this program target two global trends that are drivers of a major transition within the chemical industry: 1) electrification and 2) a shift towards bio-based feedstocks. Bio-based reactants in general possess already useful functional chemical groups that can be converted into several high value chemicals using electrochemical oxidation or reduction. Control of product mixture of such electrosynthesis is key and allows for flexibility in product selectivity. Combined with the right type(s) of downstream processing technology, chemical purity of the compounds can also be obtained. Such developments are crucial in creating 1) more sustainable chemicals and 2) utilizing local renewable feedstocks relaxing global tensions resulting from scarcity of feedstocks and the associated geo-politics.

For the EU chemicals industry the electrochemical conversion of bio-based feedstocks offers a chance to create valuable chemicals in an energy-efficient manner. Within 5 years from today our aim is to have the first TRL6 pilot installation integrated at an industrial production site. We will demonstrate the value that can be generated from this technology both economically, as well as in reducing the environmental footprint of the production process.

OBJECTIVES FOR 2030

We aim to have at least three TRL6-7 pilot systems installed at industrial sites for the production of added value chemicals from bio-based feedstock by 2023. Specifically we aim to integrate electrochemical conversion and down-stream processing to arrive in a simplified manner to products with high chemical purity to be used in the fine and speciality chemicals industry.

OPPORTUNITIES

- Electrification of industrially relevant processes
- Alleviate dependency from imports of raw materials and specialty chemicals
- Reduction of carbon footprint, abiding to “green chemistry”

CHALLENGES PEM AND SOLID OXIDE ELECTROLYSER

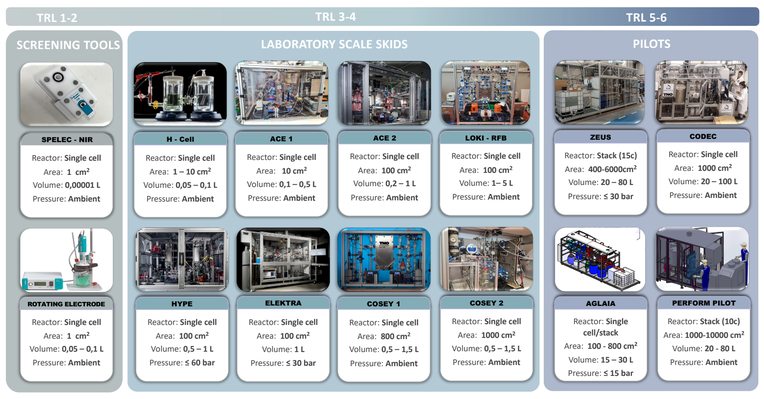
- Scale of production
- High investment cost
- Technology Readiness Level

DEVELOPMENT PLAN

2024:	TRL5-6 pilot demonstrated
2025 – 2030:	TRL6-7 pilot development on industrial site

INFRASTRUCTURE/PARTNERS

Infrastructure: the PERFORM pilot installation and integrated DSP processing units (TRL 5-6) for the conversion of bio-based feedstocks will be available mid 2023, with testing taking place into 2024. This “PowerPlatform” will be Open Access and available for parties interested in the development of organic synthesis routes. TNO is actively looking for partners and we invite component suppliers to test and validate their products with us on the PERFORM installation and thereby benchmark the performance of their products against standards. We also welcome suppliers of bio-based feedstock that aim to valorise their (waste) product streams, as well as end-users who aim to have a need for bio-based products with a low carbon footprint to collaborate with us.
TNO has a unique set of TRL 2-5 electrochemical infrastructure available, allowing to develop new routes on scales from small single cells to 1m^2 surface area stacks, at a wide range of conditions. Including high pressures, various electrodes (e.g. GDE, plate, mesh, structured), aqueous/non aqueous electrolytes, paired and triple cell configurations, etc.



RESULTS

Project showcase: H2020 - PERFORM project : construction of a versatile pilot installation with the ability to be employed in an industrial site (operating at TRL6) for the electrochemical conversion of bio-based feedstocks. Initial show case reactions include furfural to maleic acid and levulinic to valeric acid.

Project showcase: EcoCarb - electrochemical conversion of carbohydrates into building blocks for poly-acrylates.

Contract R&D: Various commercial projects for industrial customers developing new bio-based electro-synthesis routes for their specific business cases.

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