

LOGIC - Liquid-In Gas-Out Concept

The new LOGIC project scales-up the Liquid-In Gas-Out Concept (LOGIC) reactor for methanol synthesis from carbon dioxide and sustainable hydrogen.



Project number SI-50-09

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Partners DMT Environmental Technology, Shell, University of Twente (UT)

Budget 648 k€

Duration 2020-2023

Incentive

Because of the rising amount of intermittently available sustainable energy the storage of this energy for longer periods becomes increasingly important. Furthermore, there is a rising demand for sustainable carbon feedstocks in the chemical industry.

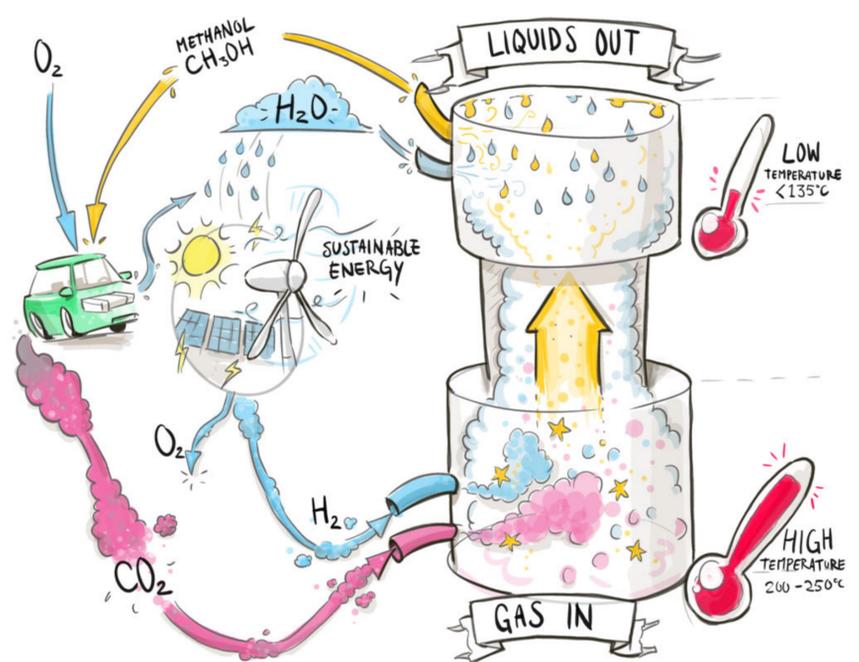
The LOGIC technology aims to combine these two factors by providing a process for producing methanol from CO₂ and H₂ at mild temperatures and pressures with a carbon yield of nearly 100%. This is realized by using an innovative reactor design with an internal gas recycle.

Objective

- To scale-up the LOGIC reactor, in which the complete conversion of CO₂ and H₂ to methanol takes place autothermally, from the previously built proof-of-principle reactor to a 15 kg/day pilot unit. Build, test and optimize the scaled-up reactor.
- Investigate the natural convection phenomena in the system in combination with autothermal operation of the reactor.
- Make a design for a large-scale unit.

Approach

- CO₂ and H₂ are fed into the reactor in a molar ratio of 1:3 and mixed with the recycle gas stream.
- A heat exchanger heats up the fresh gas using heat from the catalyst outlet stream.
- The exothermic reaction takes place inside the catalyst bed, heating up the gas.
- Heat from the catalyst outlet is exchanged with the catalyst feed stream.
- Water and methanol are condensed by locally lowering the temperature and are removed from the reactor.
- The unconverted gases are recycled.



Results

- The Proof of Concept reactor (approx. 15 kg/day) has been designed based on extensive modelling work. Documentation like Base of Design (BOD), Piping & Instrumentation Diagrams (P&ID) have been drafted;
- Fundamental knowledge and a better understanding of the underlying elements has been achieved;

Next steps

- Build the proof-of-concept reactor in first half of 2021 and after completion start first test campaigns;
- Draft a detailed design for a (demonstration) unit on the scale of an industrial biogas-based installation (100-500 kg/h), including engineering package and cost estimate (CapEx);
- Increase further understanding and fundamental knowledge on the natural convection phenomena in the system in combination with autothermal operation of the reactor.

