Greenhouse and acid gas conversion by electrothermal catalysis

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COORDINATOR: UGENT | 9 PARTNERS 6 COUNTRIES | 01/09/2022 to 28/02/2026 | € 7.6M | https://www.e-coduct.eu/

CONTEXT

CO_2 conversion currently faces two technological **challenges**:
1/ the composition of streams containing other acid gases (e.g. H_2S);
2/ the inefficiency of reactors, both economically and environmentally.

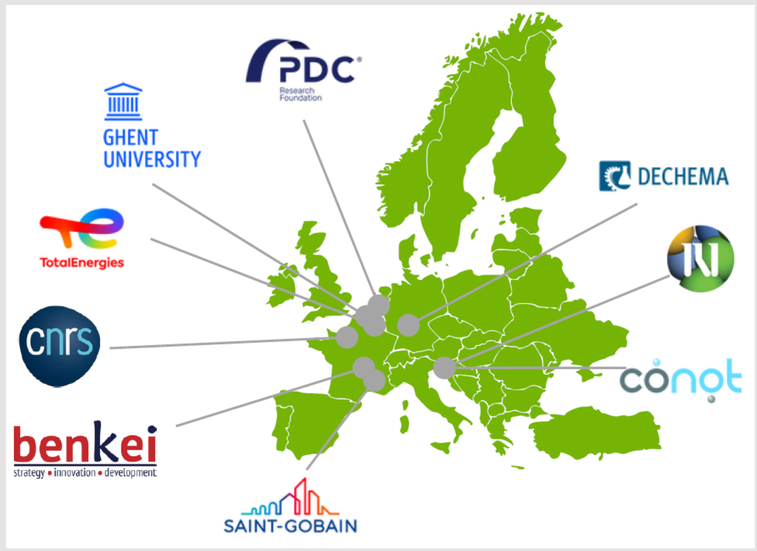
e-CODUCT aims at:
- **reactor electrification**
- a **breakthrough technology**
- **simultaneous reduction of CO_2 and H_2S**
- **production of marketable green end products** in the form of fuels and useful chemicals (CO, S_x and CH_3OH).

OBJECTIVES

- Development of stable and sulphur-resistant **catalysts**
- Construction of a **pilot-scale reactor** for conversion of COS into CO and S.
- Validation of the **reaction products'** quality and conversion of CO into methanol.
- Construction of **reactor and process models** with **integrated microkinetics** for process optimization and scale-up.
- Demonstration of techno-economic and environmental performance of e-CODUCT reactors and models via **techno-economic assessment** and LCA modelling.

CONSORTIUM

e-CODUCT is an European Horizon project with several partners from across Europe:



PROCESS

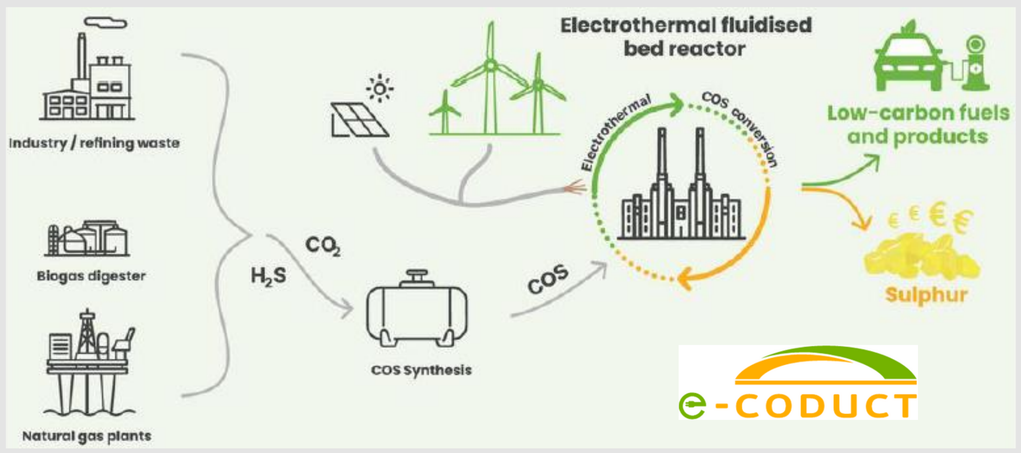


Figure: the e-CODUCT process concept.

APPROACH

- Process electrification
- Simultaneous chemical conversion of acid gas components (CO_2 and H_2S) into platform molecule CO and marketable S.
- Two-step conversion process:
  1/ reduction of CO_2 and H_2S to carbonyl sulphide (COS)
  2/ decomposiiton of COS into CO and S_x.
- Optimization of reactor materials and catalysts.
- Reducing the reactor size by 50% compared to current day technology.
- Upscaling to TRL6 to produce 16 ton CO per year.
- Predict the techno-economic and environmental performance, including sustainable production.
- Extend the technology to other applications such as fluid catalytic cracking, steam cracking and dehydrogenation.

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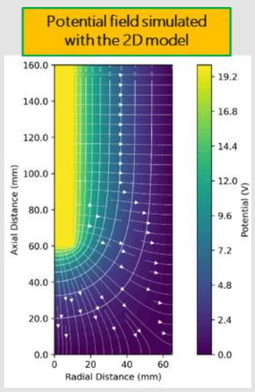
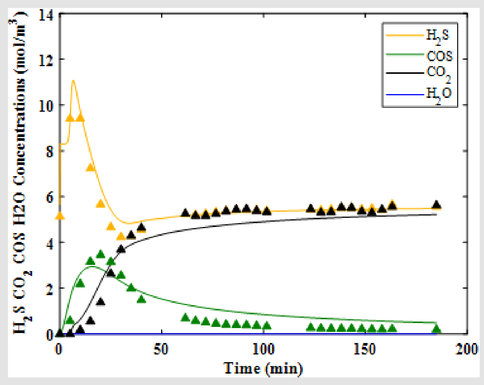
RESULTS

Catalysts for COS formation from from CO_2 + H_2S identified, ready for scale-up.



Reactor model development for ETFB:
from 2D ideal to real.
Final reactor model to be connected to microkinetic reaction models …



Microkinetic models for CO_2 conversion to COS and for COS conversion to CO and S. To be integrated with reactor model …

ETFB reactor for electrothermal fluidised bed conversion of COS into CO designed and built at test site of the Institute Jožef Stefan (IJS), Slovenia.

Techno-economic analysis and life cycle assessment:
- 1st TEA model to predict performance.
- LCA study compared to Claus process.
- Planning tool for energy-efficient process operation.