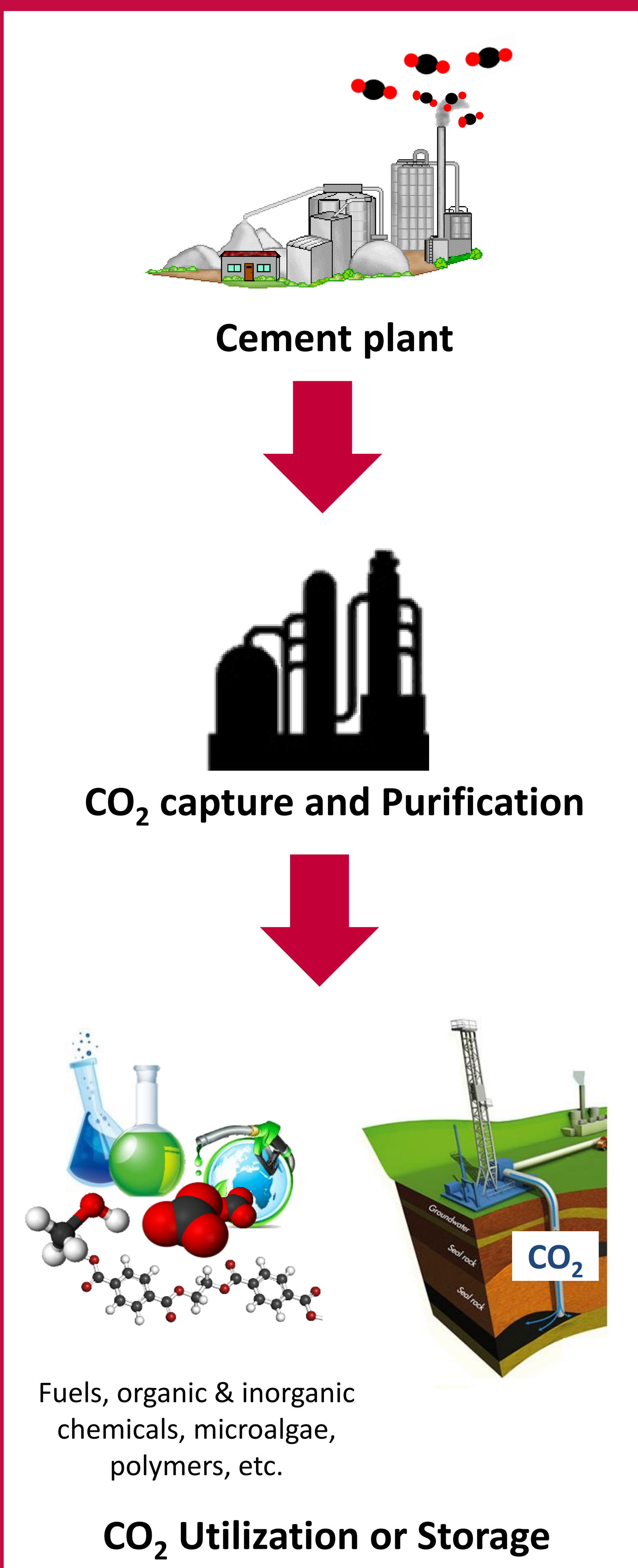
From CO_2 to Energy:

Carbon Capture in Cement Production and its Re-use

The **ECRA (European Cement Research Academy) Academic Chair** was established at UMONS in 2013, focusing on the CO_2 capture and reuse applied to the cement industry.



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KEY CONCLUSIONS

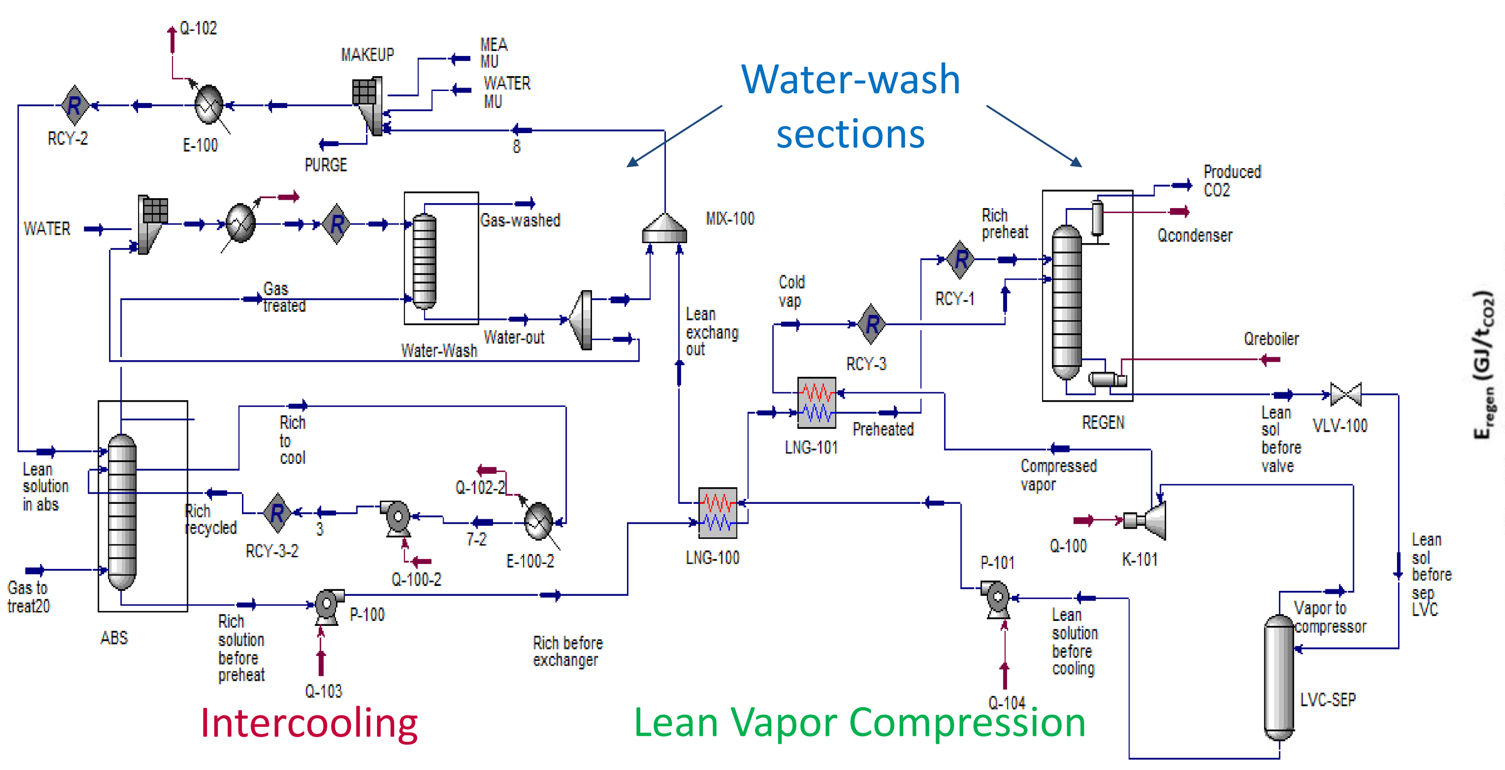
- Processes optimization and integration are required to lower energy and resources consumption
- Economic viability of CCU processes are highly dependent on the assumptions (e.g. price of electricity)
- CO_2 reduction may be possible only if renewable energy use as input
- Mitigation potential of CCU to methanol represents 50% of the original emissions of a reference system without CCU

RESULTS

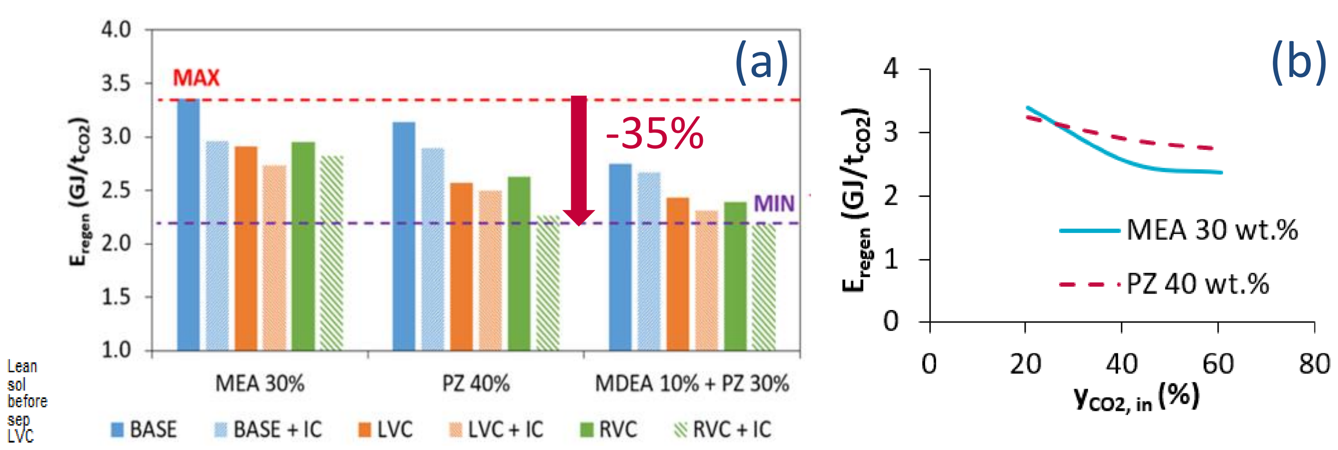
CO_2 Capture

CO_2 Capture: Three ways were highlighted for the decrease (↓) of the energy consumption and the cost of CO_2 capture for the application to cement flue gases:

1. Partial O_2-combustion to increase (↑) flue gas CO_2 content: ↓ by 26% of E_{regen} if y_{CO2} ↑ to 44%
2. Advanced process configurations: ↓ by 35% of E_{regen} with solvent MDEA-PZ + RVC + IC
3. Use of demixing solvents for ↓ the regen. flow rate: ↓ by 40% of E_{regen} (in progress)



Aspen Hysys^{TM} advanced flow sheet

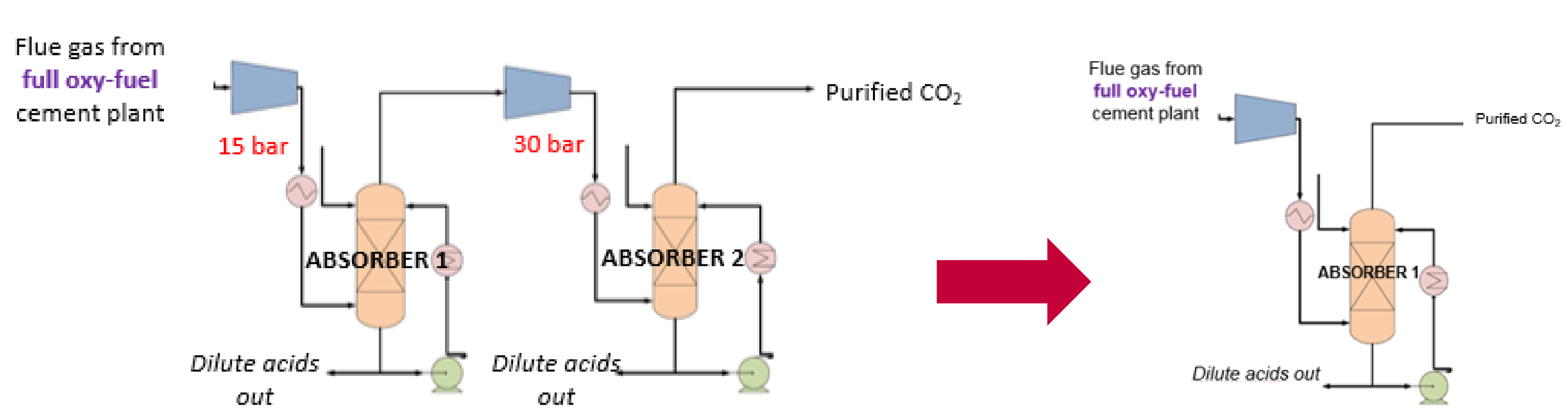


Energy savings thanks to:
(a) Alternative configurations - (b) Partial O_2-combustion

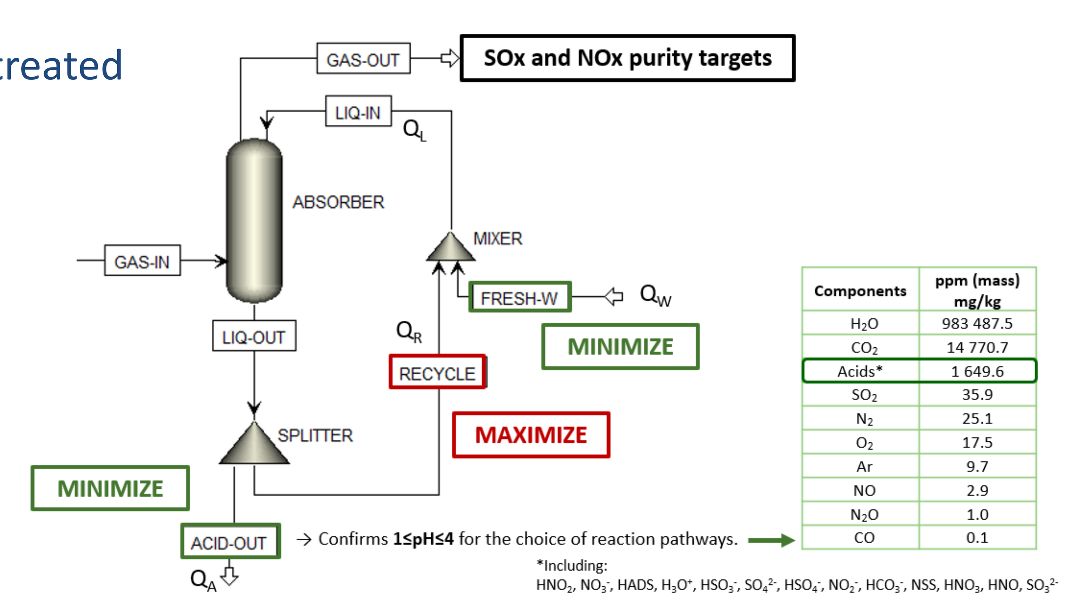
CO_2 Purification

CO_2 Purification: Efficiency of Sour Compression Unit (SCU) De-SOx/De-NOx process Absorption into pressurized water (15-30 bar) → From 2-column to 1-column process

Optimized process → CAPEX: 20-25 M€ & OPEX: 6-8 €/$t_{CO2,\ treated}$



From 2-column process o optimized 1-column process



Operating parameters optimization for ↓ CAPEX & OPEX

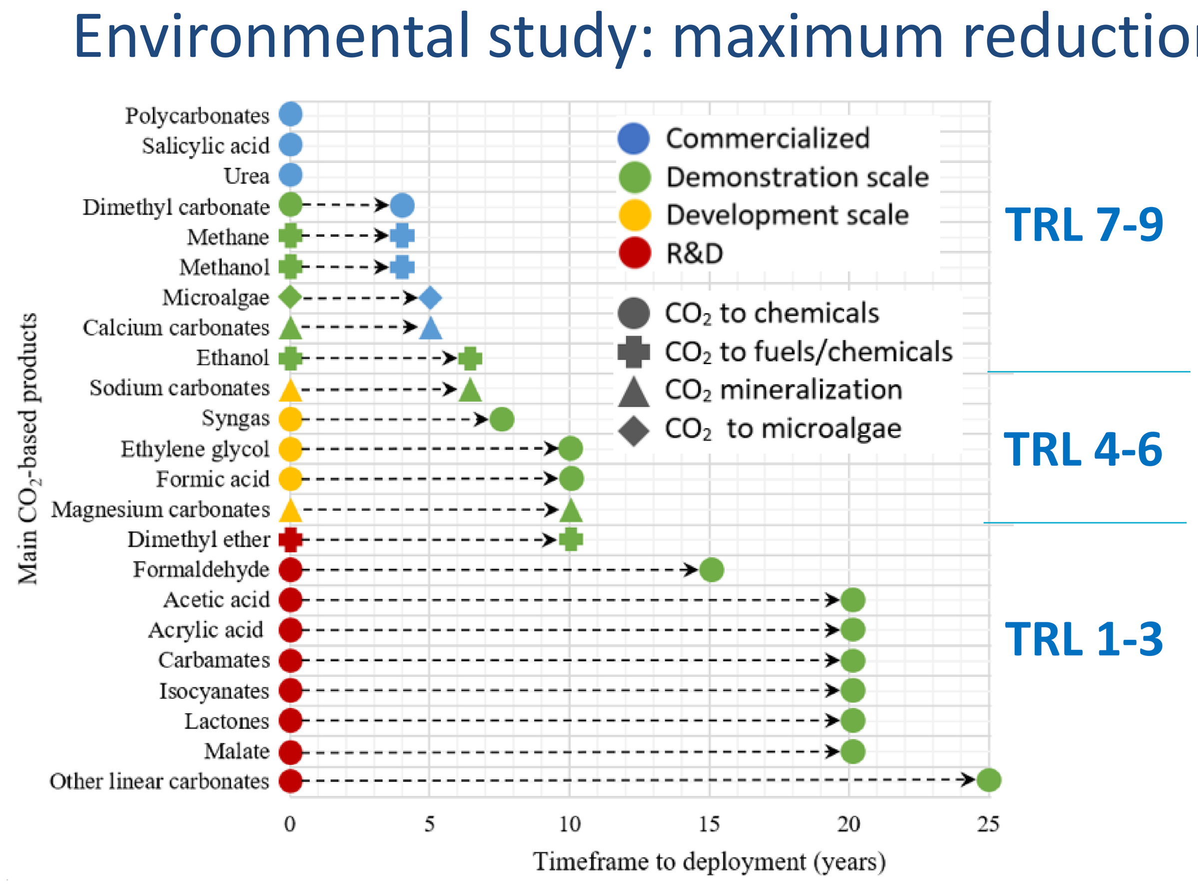
CO_2 Conversion

CO_2 Conversion: Identification of the most interesting CO_2-based conversion pathways

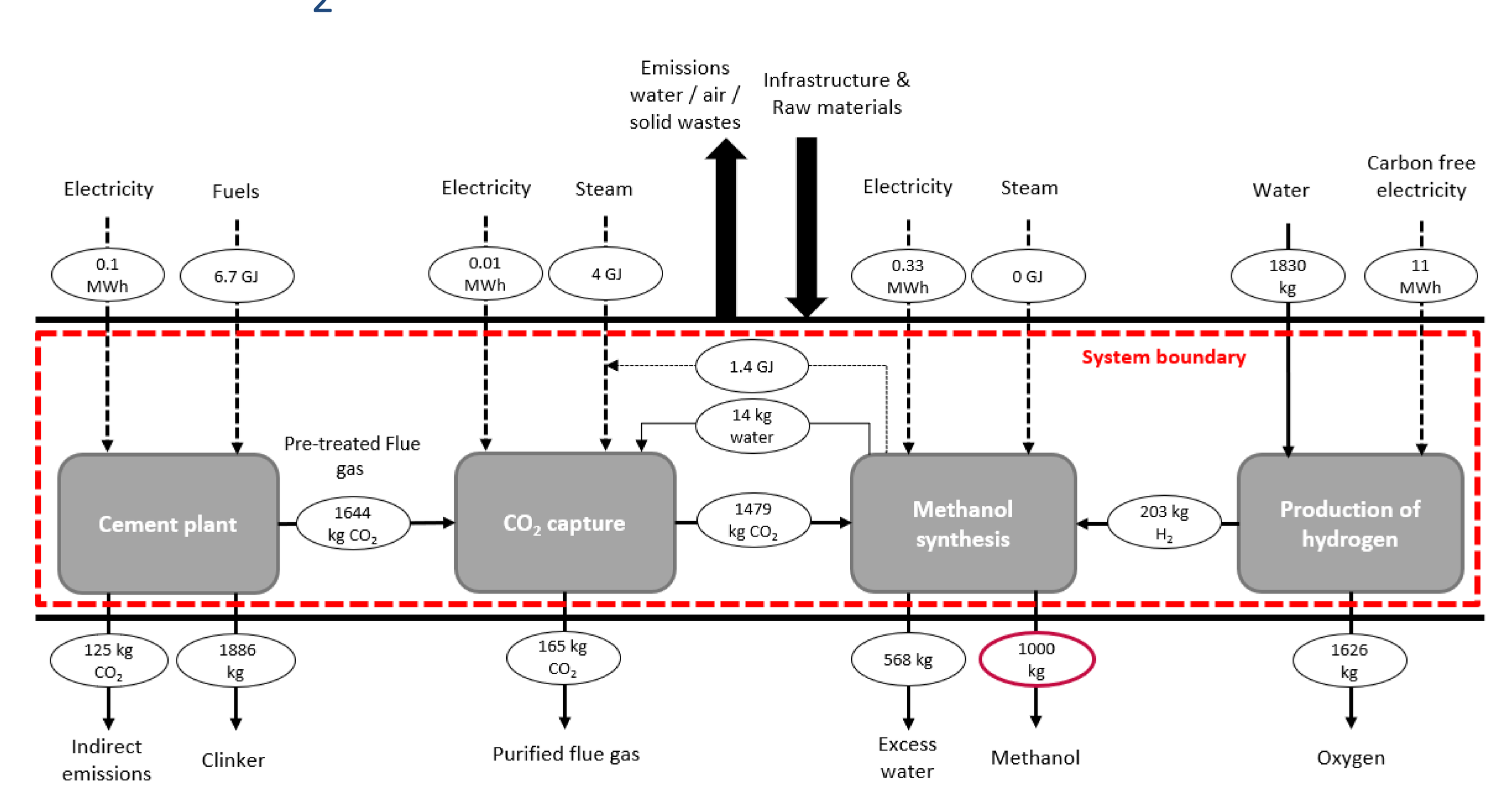
Methanol ; Methane ; Dimethyl carbonates ; Calcium carbonates ; µ-algae

CO_2 conversion into methanol: global chain was simulated and optimized including energy integration with the CO_2 capture → CAPEX: 60 M€ & OPEX: 90 €/t_{CO2}

Environmental study: maximum reduction by 50% of CO_2 emissions



Technology Readiness Level for main CO_2-based products (non-exhaustive)



Technological metrics of the CO_2 capture and conversion units normalized to the production of one-ton methanol