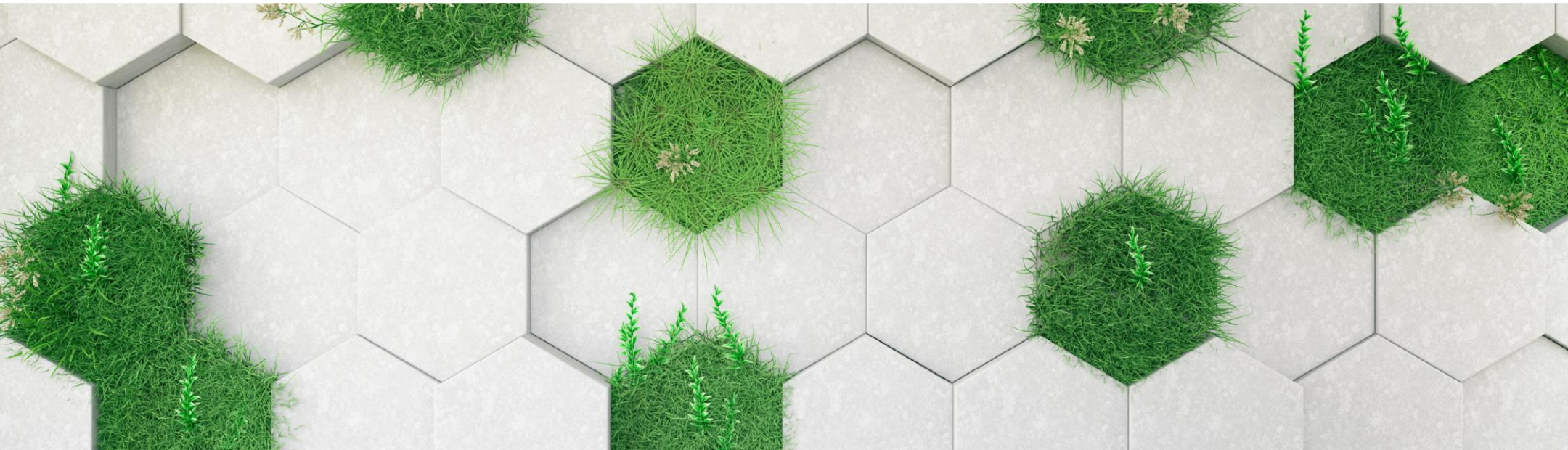
CCUS AS A BUSINESS OPPORTUNITY

Koen Coppenholle/Rob van der Meer



The policy levers to achieve carbon neutrality by 2050

Non-fossil fuel feedstock change
e.g. use of alternative fuels in cement industry

CCS/CCU
Capture the CO2 emitted and store or use

today's focus

Biomass as fuel or feedstock
Replace feedstock or fuel with sustainably produced biomass to reduce CO2 emissions

Hydrogen as fuel or feedstock
Replace feedstock or fuel with carbon neutral hydrogen

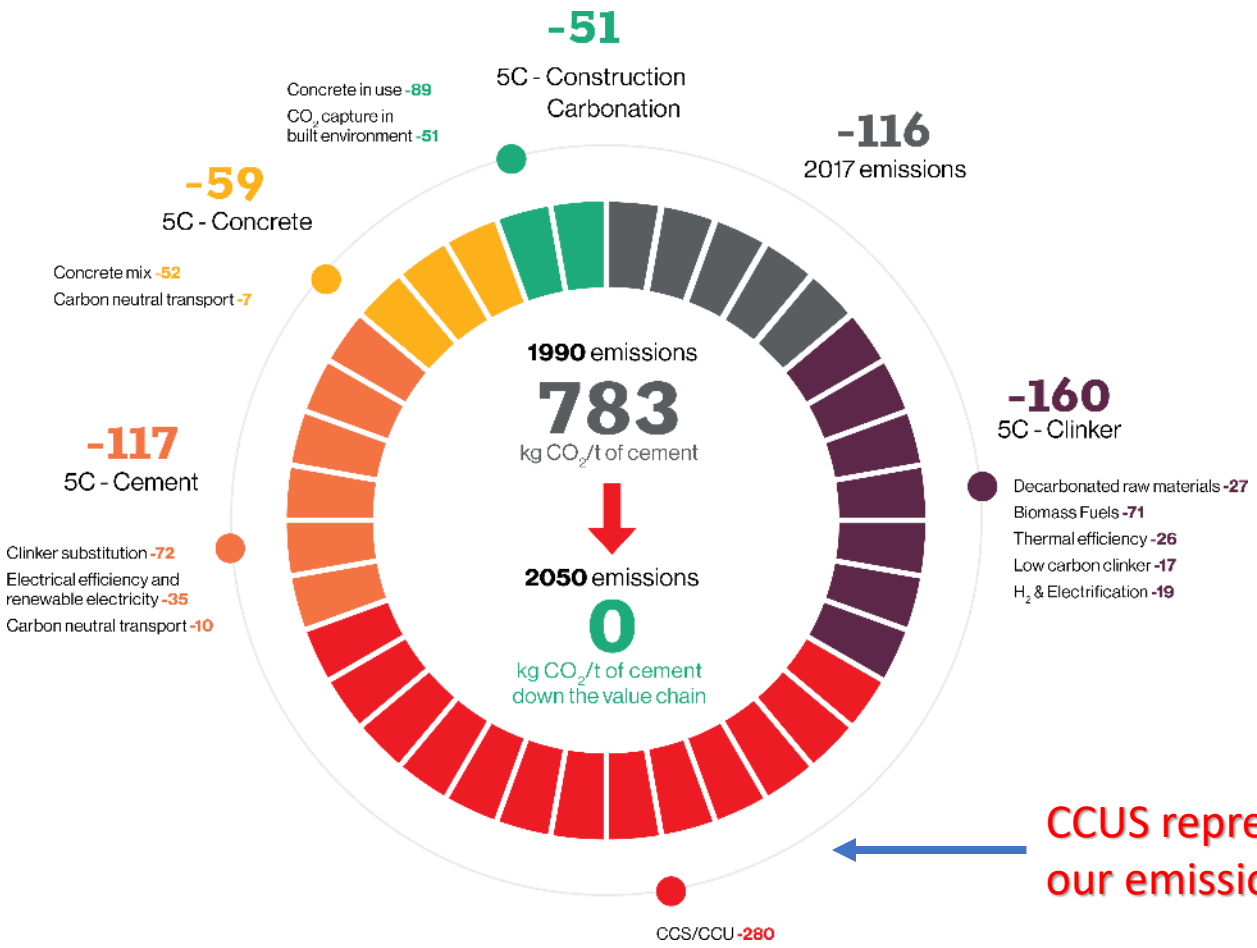
Demand-side measures
Lower demand for primary resources through increased circularity

Energy efficiency
Adapt production equipment to lower energy use per produced volume

Electrification of heat
Replace fossil fuel for heating with renewable electricity

CEMBUREAU 2050 roadmap

CO_2 reduction along the cement value chain (5Cs: clinker, cement, concrete, construction, re-carbonation)



CCUS represents 42% of our emission reduction efforts

CCUS key to reduce process emissions

Limestone from quarries → **Processed into clinker & cement** → **in CEMENT plants**

200 plants spread across Europe / close to quarries

CO2 EMISSIONS

1/3 combustion emissions

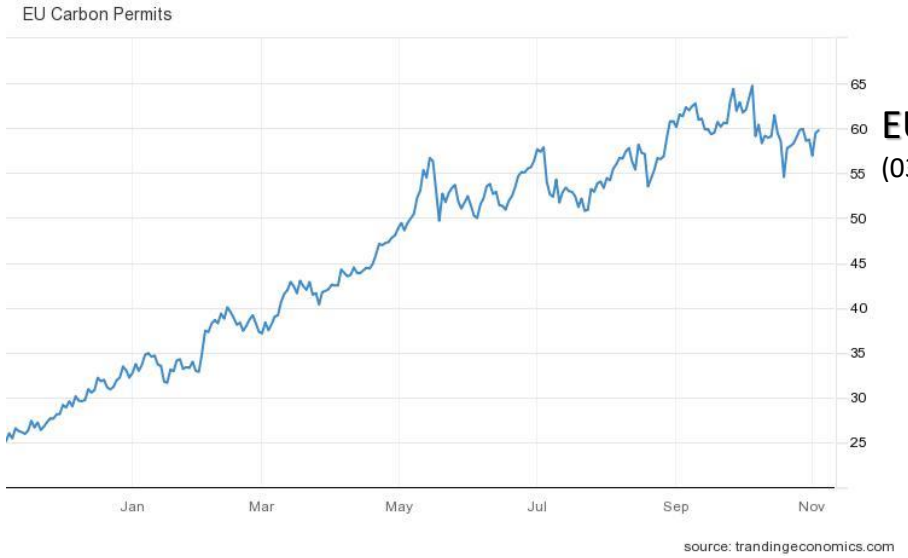
Today: 50% of total fuel needs sourced from alternative fuels waste/biomass waste

2/3 process emissions

Breakthrough technology needed/ carbon capture

→ **Significant CAPEX + OPEX**

The business case for CCUS



EUR 59.75
(03/11/2021)

- ✓ Carbon price increased by 82% since beginning of 2021

- ✓ Maturing technology will drive down costs
- ✓ Public funding opportunities (Innovation Fund, Recovery Plans; Just Transition Fund)
- ✓ Investor pressure
- ✓ Green credentials and responsibility are a duty towards society

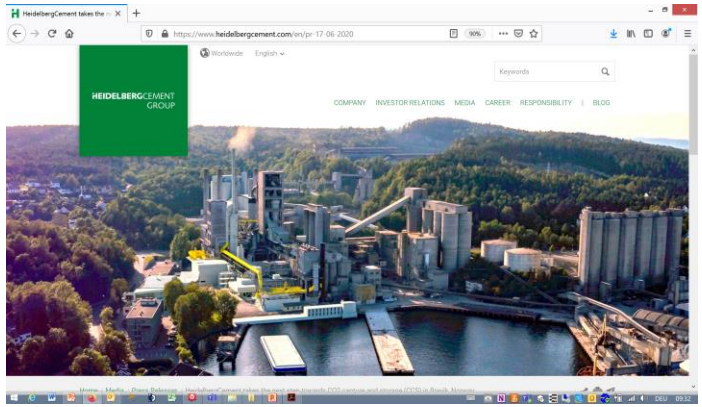
We need to demonstrate our credibility and proactively shape the political agenda

The technologies are under development with increasing amount of pilots and demonstrators

DIRECT SEPARATION

- **LEILAC 1 (H2020) (2016-2020):**
- Direct capture of process-related CO2
- 95% capture rate of pure CO2
- **LEILAC 2 (2020-2024)**
- Scale-up (10 Mt)
- Electrification tested

POST COMBUSTION



- **BREIVIK**
- Capture with amine technology
- Transport through pipeline through gas field
- Off-shore storage

OXYFUEL

WESTKÜSTE 100

HeidelbergCement, Buzzi Unicem-Dyckerhoff, Schwenk Zement and Vicat found Oxyfuel Research Corporation

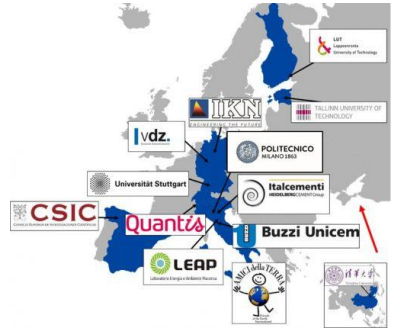
Written by Global Cement staff
12 December 2019

Accelerating CCS Technologies

AC²OCem

Accelerating Carbon Capture using Oxyfuel technology in Cement production

CALCIUM LOOPING (CLEANKER PROJECT)



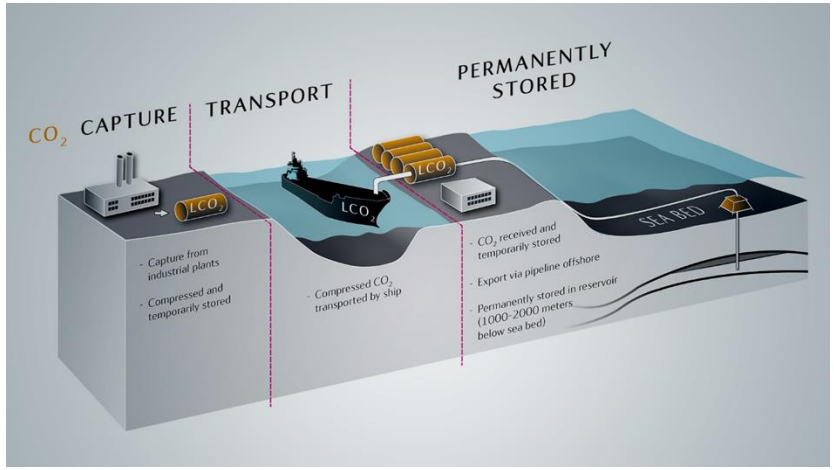
THE CHALLENGES FOR THE BUSINESS CASE

- INFRASTRUCTURE

  ✓ Research projects ongoing to identify storage sites and pipelines

  ✓ Industrial hubs approach

  ✓ Target for public-private partnership approach (IPCEI)

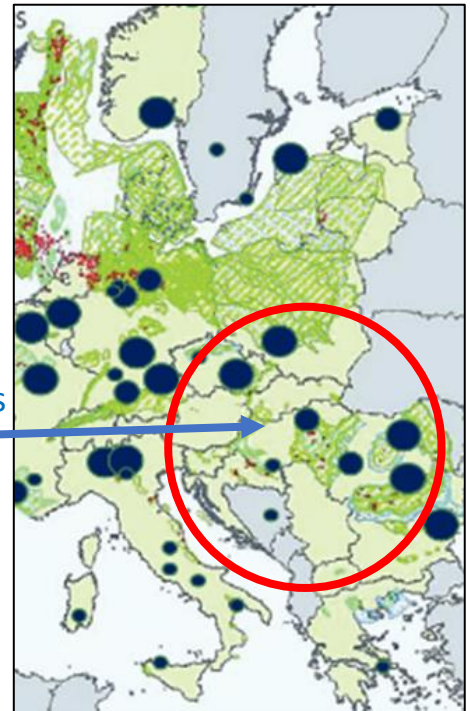


- LARGE PART OF CEMENT PLANTS WILL

✓ either need a single user storage location (strong (geological, legal) expertise required)

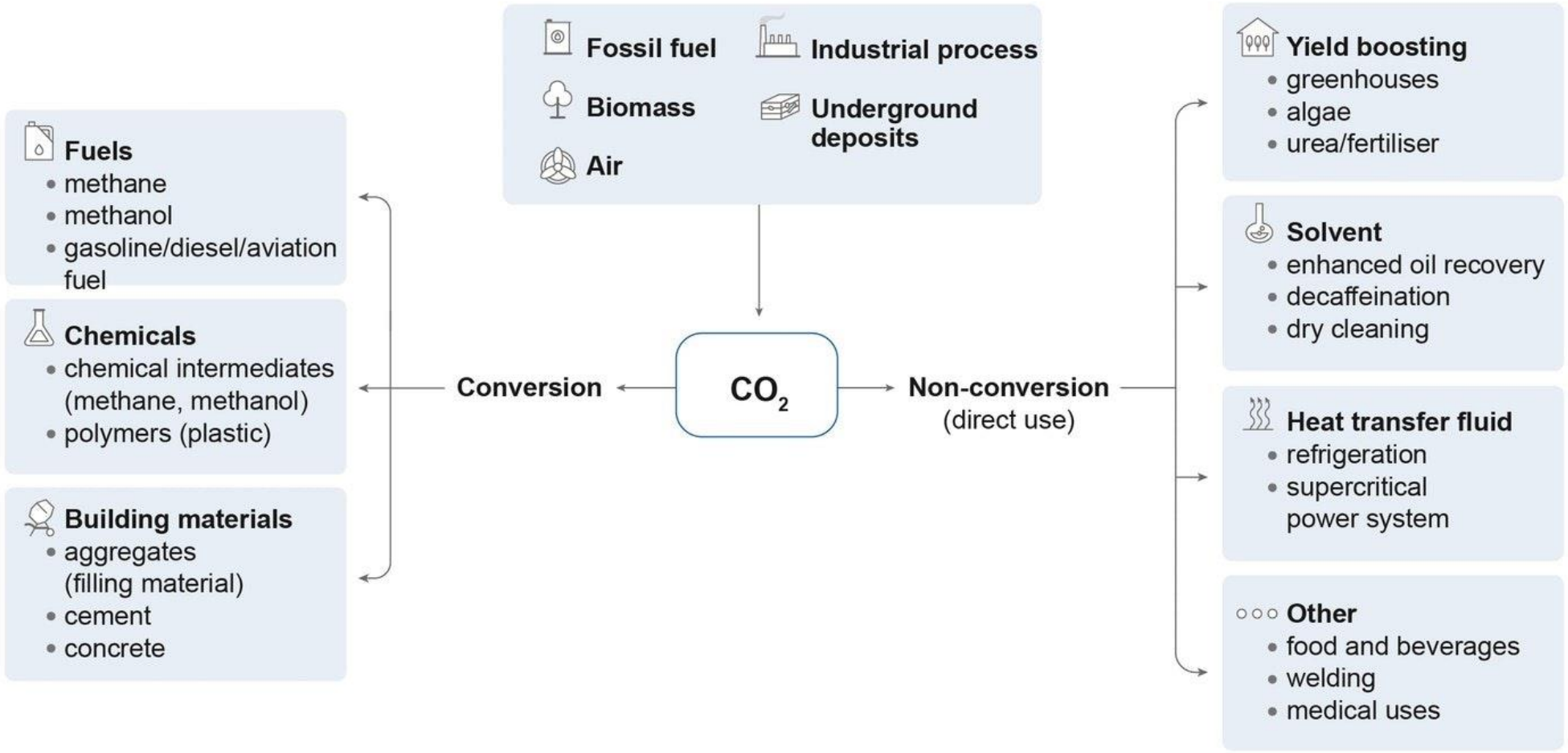
✓ or revert to use applications of captured CO2

especially for landlocked plants

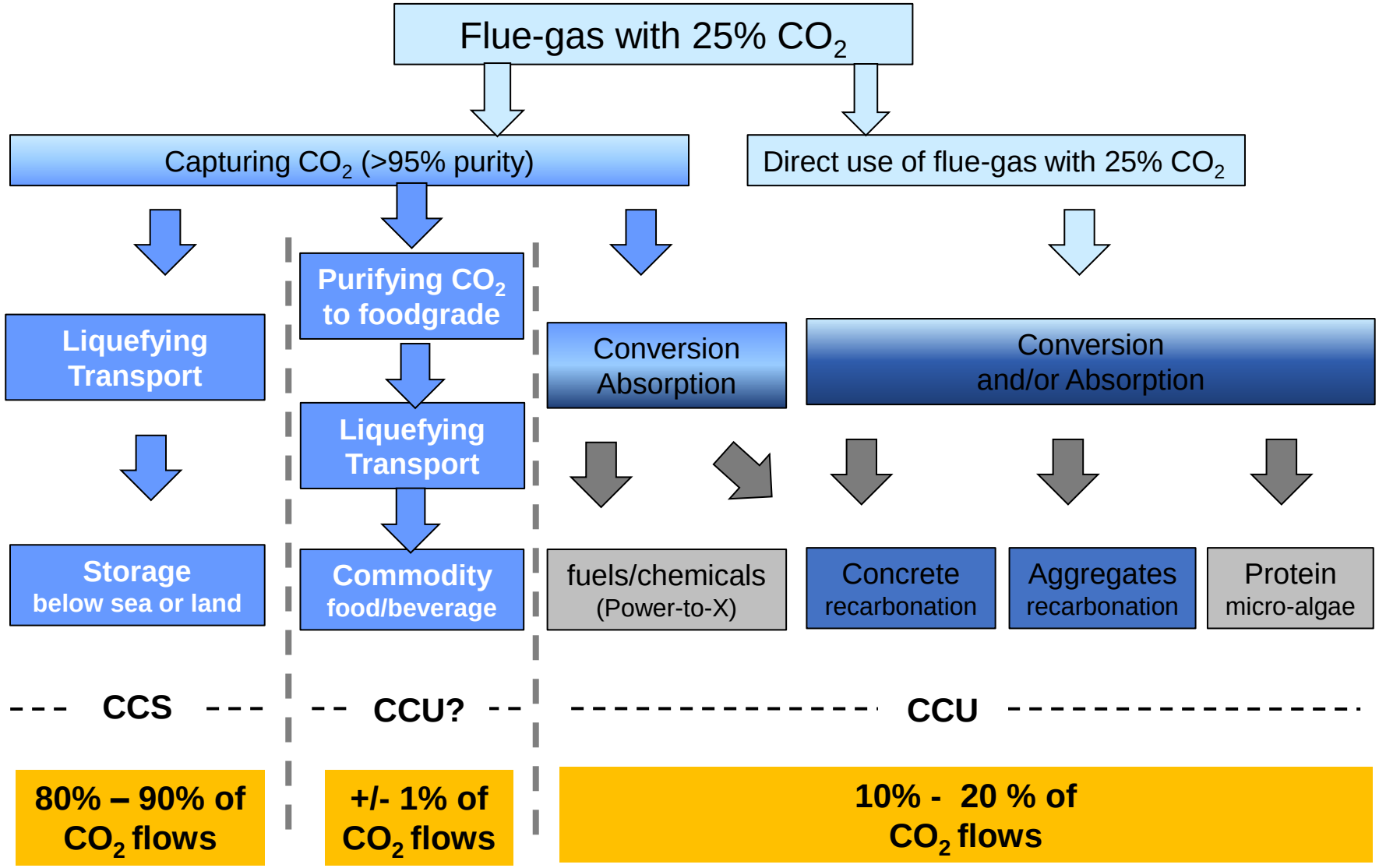


Carbon use as part of the business case

Overview IEA (2021)

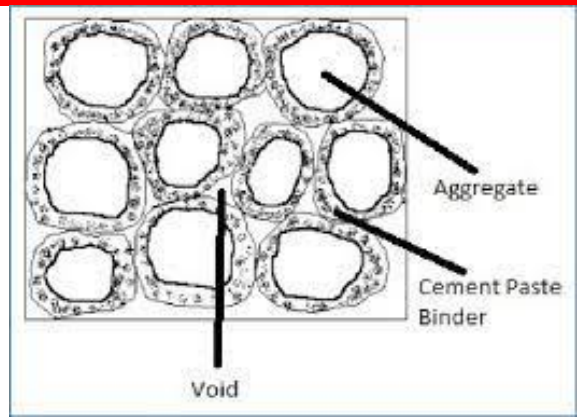


Options for CCU are small compared to CCS but there is potential



Mineralisation and recarbonation with capture installation

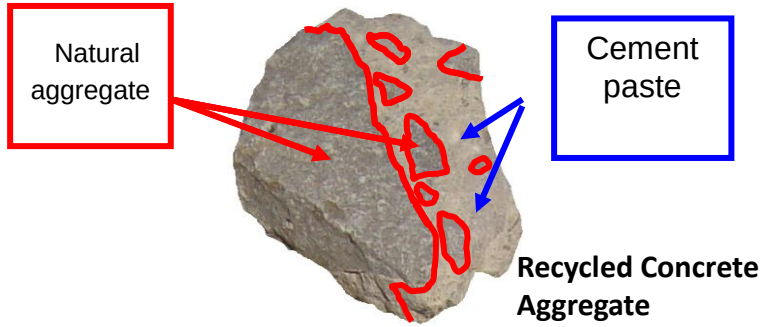
1. Increase concrete recarbonation is possible with higher pressures and / or higher CO_2 concentrations in industrial installations.
   1. Use of captured CO_2 from cement plants.
   2. Use in cement or concrete production.



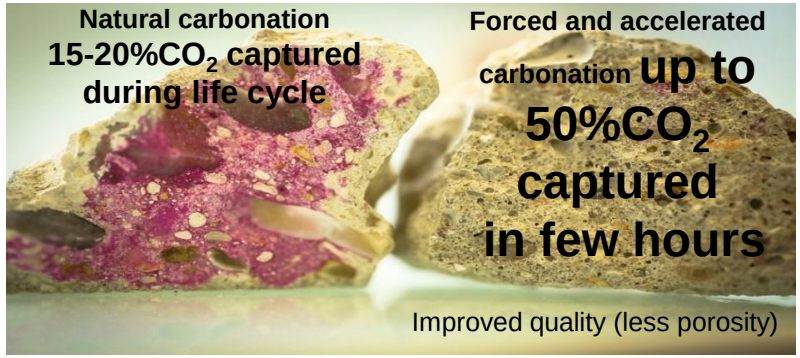
2. Industrial installations can increase absorption of CO_2 in mineralization processes.

An example: building on the mineralisation of concrete to store CO2 – the Fastcarb project

- Fastcarb aims to accelerate a natural phenomenon, the carbonation of concrete:
  - Storing permanently significant quantities of CO2
  - Promoting the use of Recycled Concrete Aggregates by improving their quality
- Industrial Pilots produced several tons of carbonated RCA
  - Using CO_2 directly from cement plants exhaust gas
  - ready to be used in new concretes



Recycled Concrete Aggregate

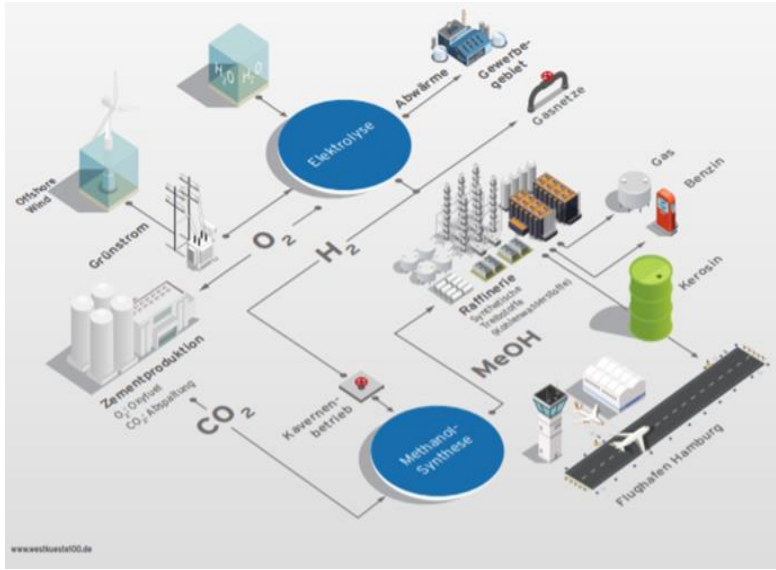


Fastcarb carbonation pilot In Créchy Vicat plant (France)

Use for methanol production

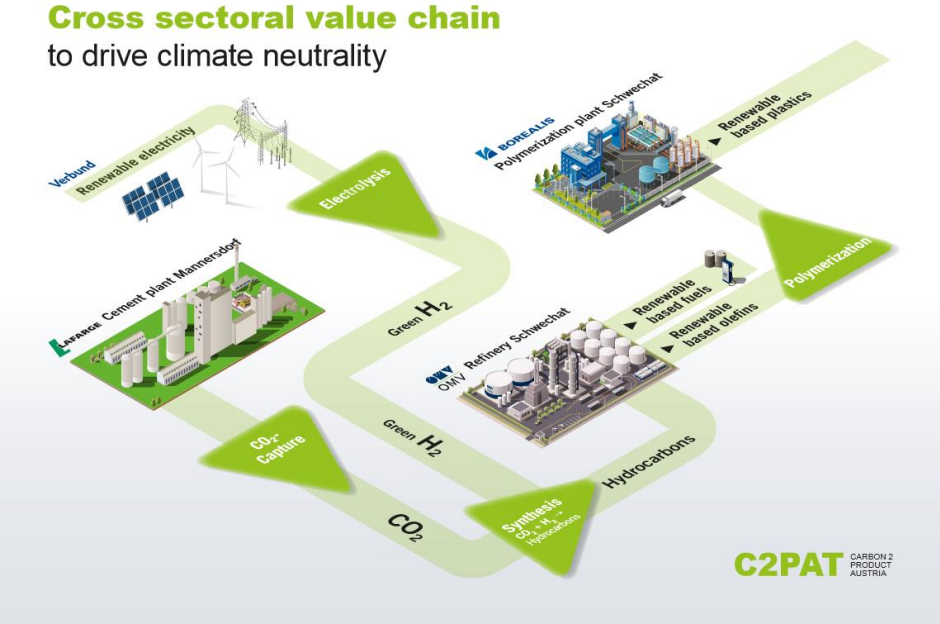
- Complete sector coupling: Green hydrogen and decarbonisation on an industrial scale
- CO_2 capture from cement plant using oxyfuel technology at LH Lägerdorf plant
- Electrolysis to produce green H_2 from surplus offshore wind energy
- Methanol (kerosene,...) produced at a refinery with hydrogen and CO_2 from cement production

WESTKÜSTE 100



Use for synthetic fuel production – the C2PAT project

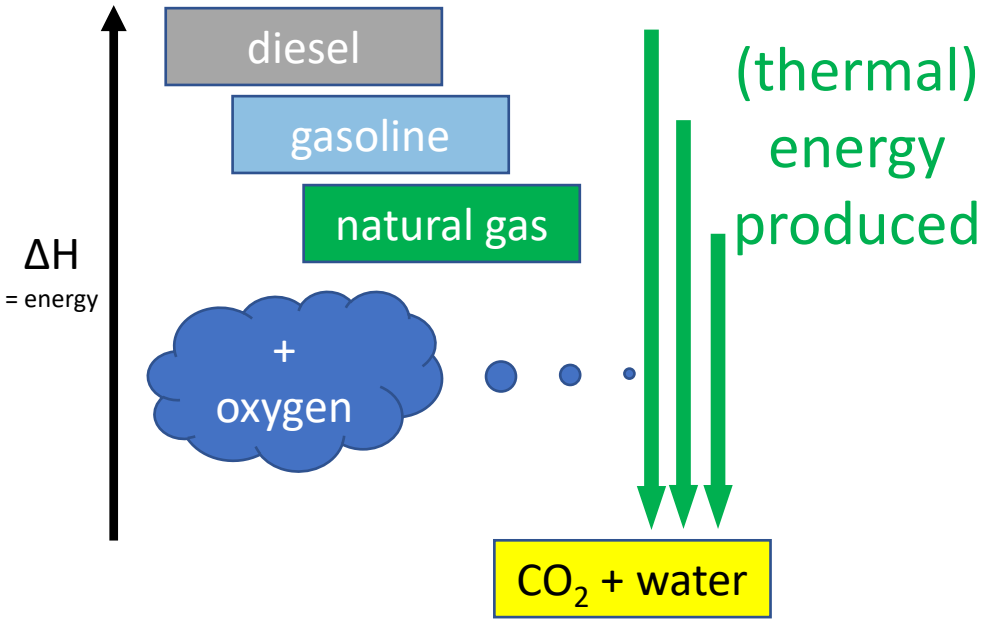
- In 6/2020, a MoU for a large-scale CCU project (C2PAT: Carbon2ProductAustria) has been signed
- Project partners: Lafarge Austria, OMV, Verbund and Borealis
- Phase 1: feasibility studies, phase 2: pilot trials (operational by 2023), phase 3: full-scale plant with the capture and utilisation of 700,000 t CO_2/a by 2030.
- CO_2 capture pilot at Lafarge Mannersdorf cement plant
- Production of synthetic fuels, plastics or other chemicals by the reaction of CO_2 and green hydrogen.



Challenge for the business case: increased electricity demand (and cost)…

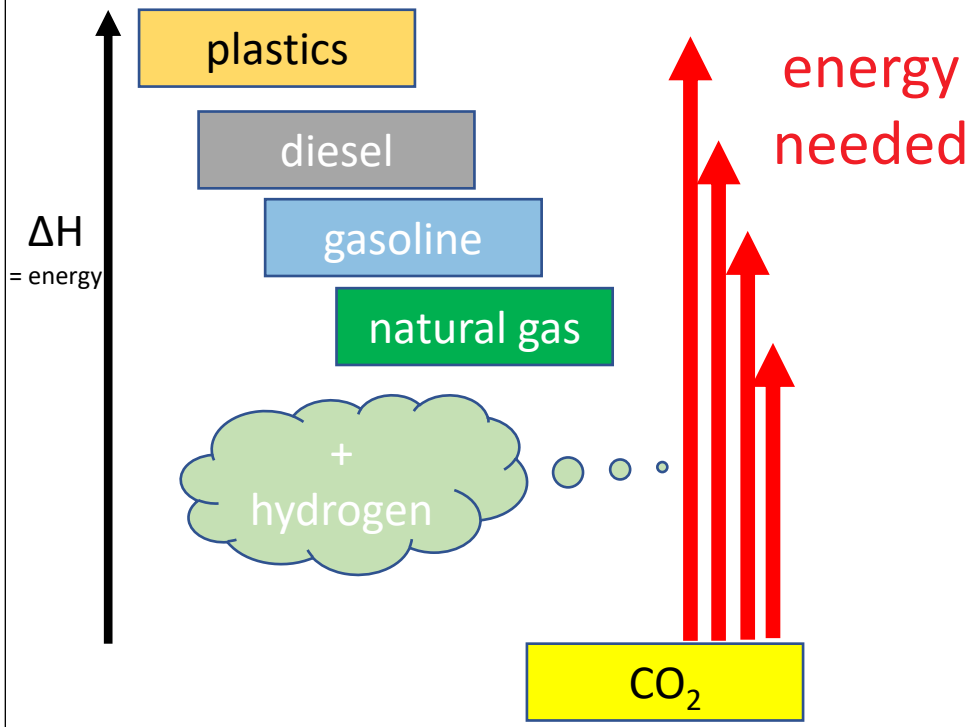
Combustion processes

- Objective: to produce energy
- Practice: combustion of “high” energy material to “low” end product



CCU processes

- Objective: to produce products
- Practice: conversion from CO2



Thermodynamic law
Conversion of CO_2 to something else always costs energy

BUSINESS CASE FURTHER REQUIRES THE RIGHT REGULATORY FRAMEWORK

- ✓ CO2 infrastructure: candidate for a “Project of Common European Interest” (PPPP) to be funded through the Recovery and Resilience Fund/ Bringing together industry and Member States in a joint project ?
- ✓ Clear accounting rules for CO2 captured: incentive to invest in CCU only when CO2 can be deducted from emissions
- ✓ Consistency in application processes and methods for public funding across TRL levels
- ✓ Legal certainty essential for industries with long-term investment cycles
- ✓ Comparable cost basis for EU and 3rd county operators: CBAM to complement ETS free allowances / decarbonization investments require a healthy competitive environment


CEMBUREAU
The European Cement Association