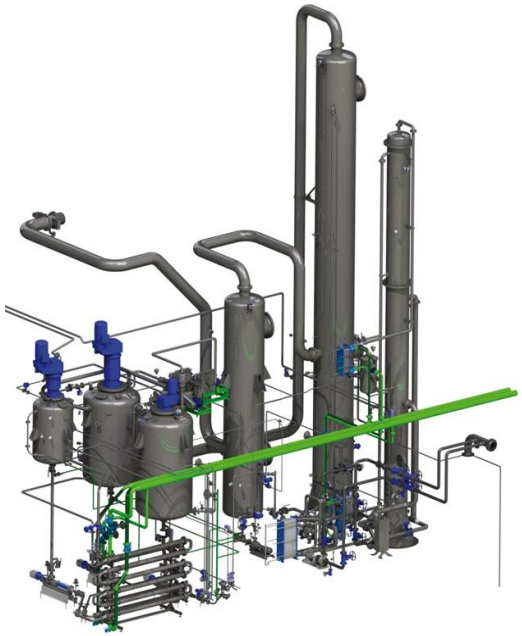
Carbon Capture and Usage @Twence

CATO Meets the Projects

4 December 2018 Utrecht

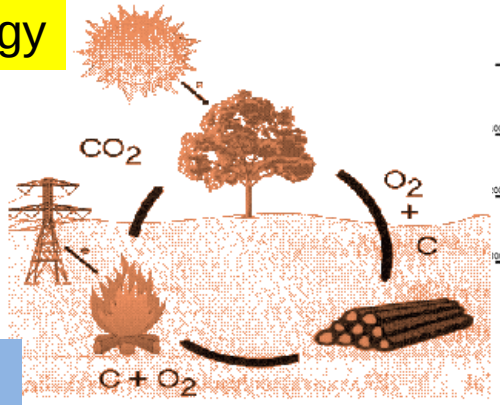
Introduction

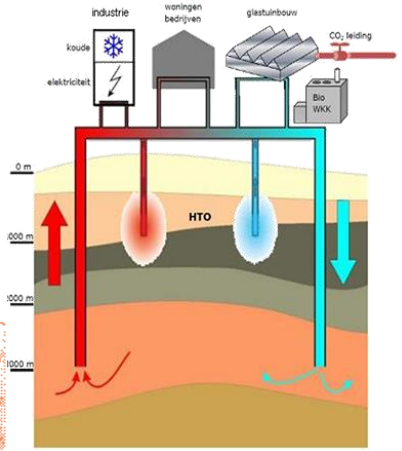


- Vision for CCU
- Carbon Capture and Usage @Twence
- Roadmap from 2008 onwards
- Improved CO_2 Capture (TNO)
- Status of upscaling
- Challenges

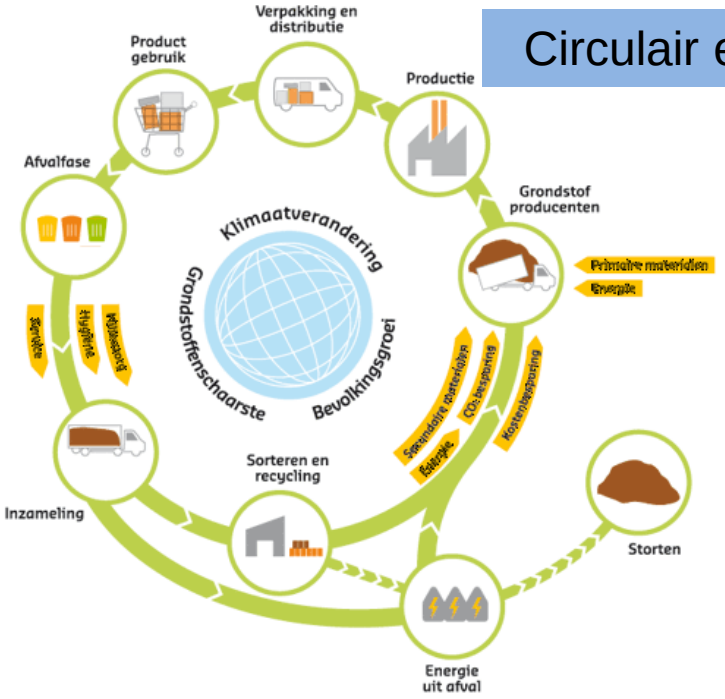
Twence vision for CCU

Renewable energy

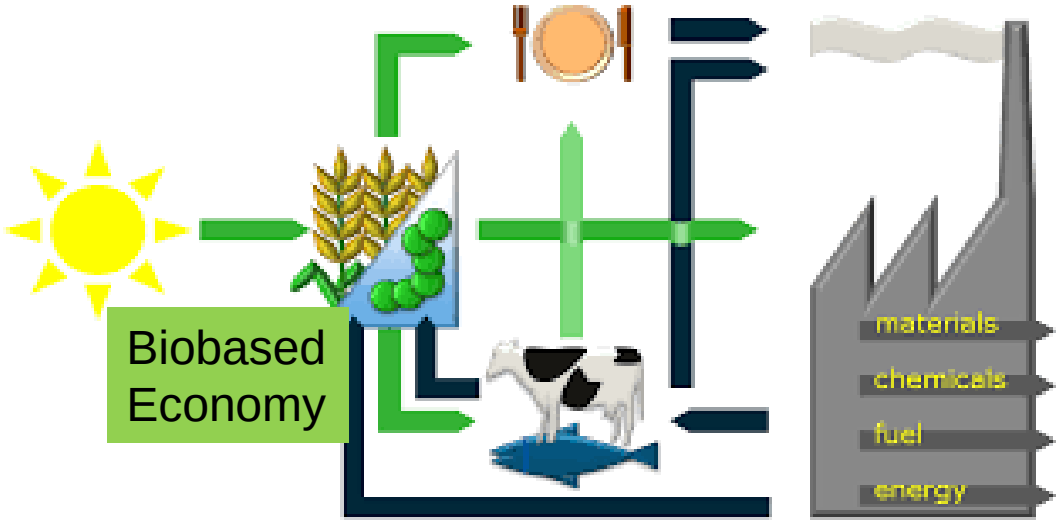




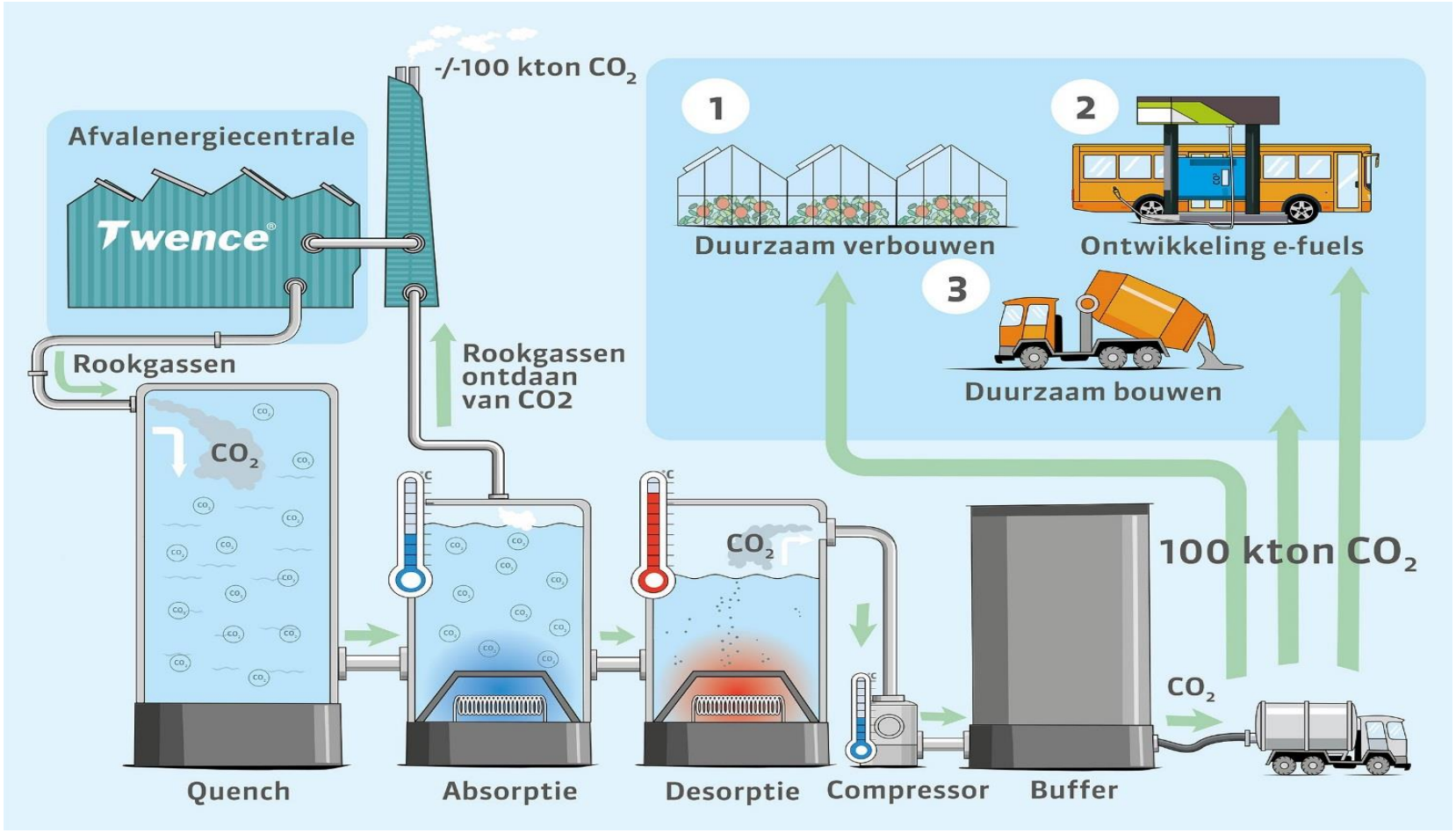
Circulair economy



Biobased Economy



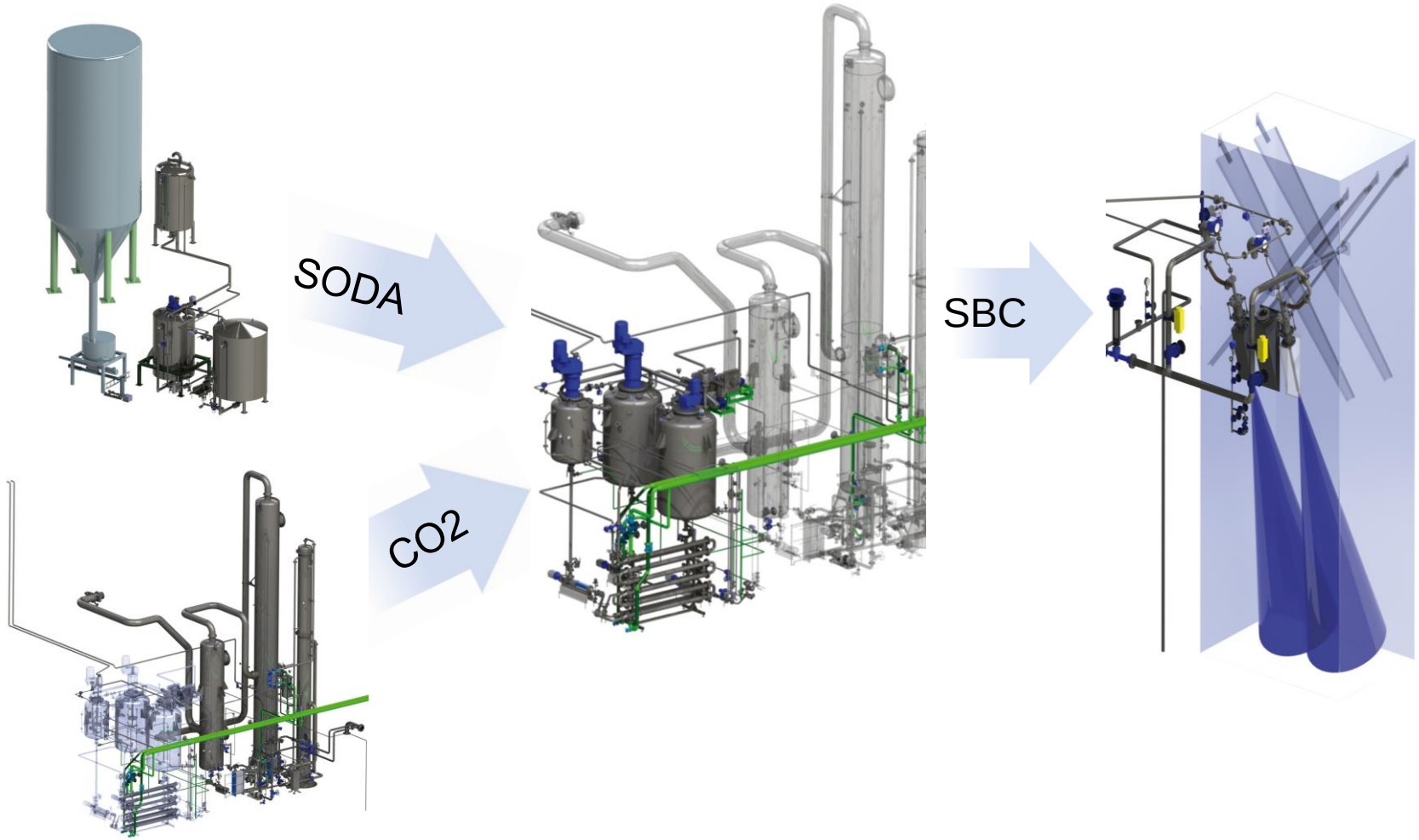
Twence vision for CCU



Carbon Capture and Usage @ Twence

First installation in the world that 'mineralizes' CO_2 for re-use (absorbent) In flue gas scrubbing

Carbon Capture and Usage @Twence



Twence CCU roadmap from 2008 onwards

Rationale for CO_2 valorisation

to produce sodium-bicarbonate (SBC)
to reduce acid gas emissions (Cl, SO2)
towards zero-emission waste treatment

Reaction

$Na_2CO_3 + H_2O + CO_2 \rightarrow 2\ NaHCO_3$

- CO_2 reduction — 3,000 tonnes per year
- SBC production — 8,000 tonnes per year

Roadmap towards demonstration

- First idea demo on CO_2 capture — Autumn 2007
- Start 3 kton/a Demonstration Plant — July 2011
- Commissioning — October 2014
- Demonstration Programme — 2014 onwards and ongoing
- Preparation 100 kton/a Full Scale Plant — 2017 onwards and ongoing
- CEWEP Innovation Award — 20th September 2018 Bilbao

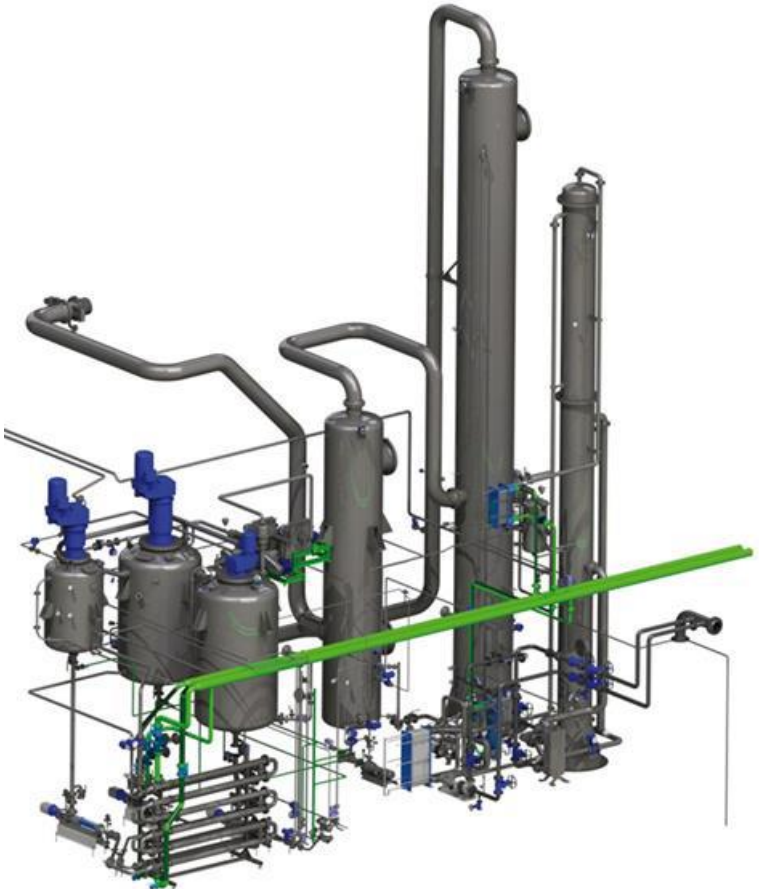
Improved CO2 Capture @ TWENCE

1. Optimization of demo operation

   Goals:
   - enhance availability
   - lower maintenance costs

2. Solvent strategy for full scale CO2 Capture at Twence

   Goals:
   - de-risk the 100 ktonne CCU project
   - facilitate the investment decision
   - support the application for the environmental permit



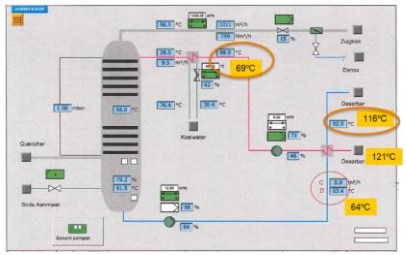
Representation of CO2 capture and utilization plant at Twence

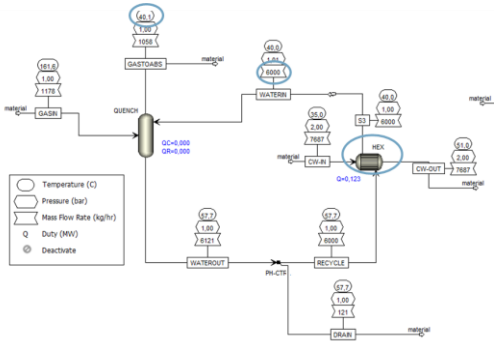
5 Work packages

WP1 Results

WP1 Troubleshooting pilot operation → WP2 Modifications to pilot → WP3 Improved control → WP4 Full scale de-risking → WP5 Management and dissemination

Evaluation of process data → Process simulation → Diagnosis and recommendations





- ✓ Design of plant modifications ready (input data for WP2)
- ✓ Opportunity for 30% energy savings identified

WP 2 Modification to demo plant

- Engineering Q4 2018
- Procurement Q1 2019
- Construction Q2 2019
- Testing MEA Q2/3 2019

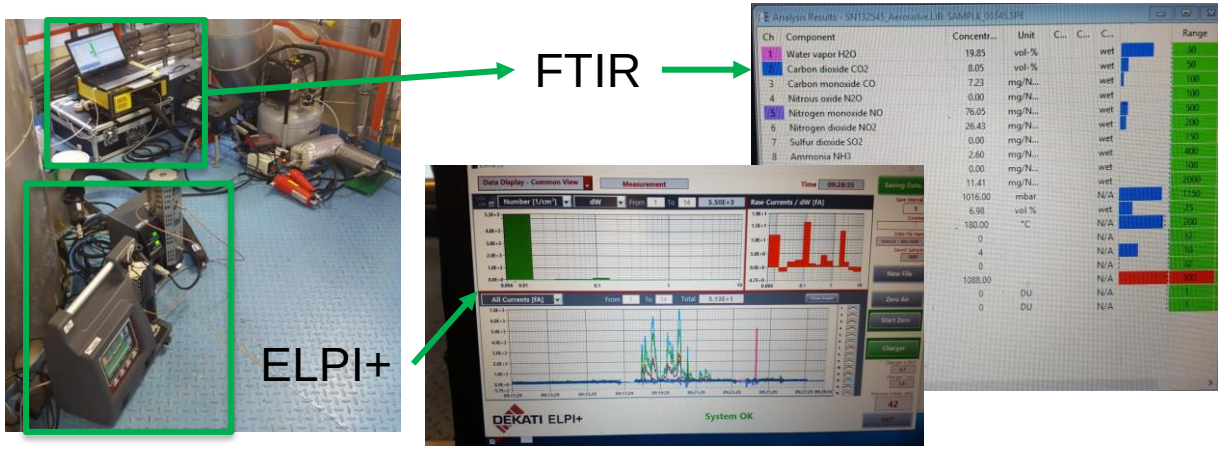
WP3 results

WP1 Troubleshooting pilot operation → WP2 Modifications to pilot → **WP3 Improved control** → WP4 Full scale de-risking → WP5 Management and dissemination

- ✓ TNO's Chemcube installed and operationsl at Twence
- ✓ Online monitoring of solvent and CO_2 compositions
- ✓ Live diagnosis of plant performance

WP4 Results

WP1 Troubleshooting pilot operation → WP2 Modifications to pilot → WP3 Improved control → **WP4 Full scale de-risking** → WP5 Management and dissemination



Initial results:
Gas composition
- Major components
- Minor impurities
- Particulate materials (PM)

Diagnose:
Low content of impurities and PM → expected low emissions

New solvent test in 2019 with the same monitoring equipment

Next steps

- Complete plant modifications
  - Improved water balance, improved CO_2 throughput
  - Increased flexibility: ready to operate with other solvents

- De-risk full scale project (100kton)
  - Monoethanolamine (MEA) campaign
  - Chemcube → Online solvent and CO_2 monitoring
  - FTIR → Online emissions measurement
  - ELPI → Quantify aerosol emissions (if any)

- Dissemination
  - TCCS-10 (Trondheim, June 2019) – planned

Status of Large Scale CCU

Positioning

- WtE line 3
- Dry flue gas cleaning line 3
  - ESP
  - Bag House Filter : activated carbon & sodium bicarbonate injection
  - SCR

Planning

- Start operation Q2 2021

Key Decision Making Hold Points

- Environmental Permit
- Grants for Subsidies
- Financial Closure
- Approval of Supervisory Board
- Contracts for off take and design & construction

Feasibility Captured CO_2 to Green houses

- 100 kton CO_2 Capture installation (Tendering procedure)
- Design package
  - Proces development and interfacing
  - Solvent developments and choices
- Market consultation to identify possible bottle necks
  - Dependency on (new) subsidy regulations
  - Future policy and financial instruments for CCU
- Alternative markets for CO_2

Challenges

- Development time 10 years from initial idea towards upscaling
- Learning curve (process stability) requires development time
- Uncertainties in upscaling to a commercial plant

Risk of delay in project realization whilst acceleration is needed!

THANK YOU FOR YOUR ATTENTION

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