CCUS: HeidelbergCement's innovative approaches

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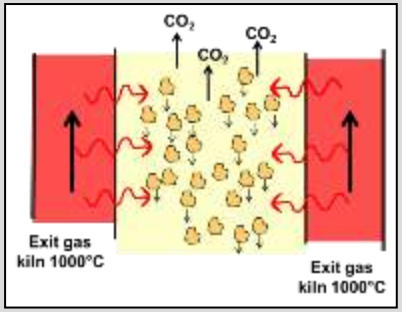
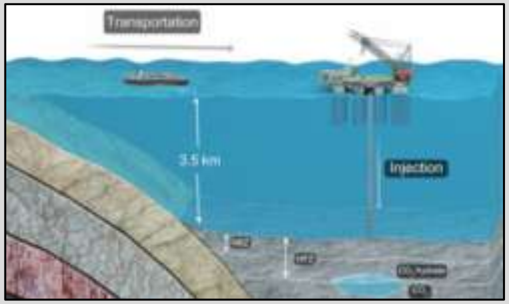
Director Alternative Resources GES

Trondheim, 18th June 2019





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https://www.heidelbergcement.com/en/pr-21-03-2019

HeidelbergCement successfu...

COMPANY INVESTOR RELATIONS MEDIA CARE

Dr. Bernd Scheifele, Chairman of the Managing Board

Sustainability and innovation

Sustainable business is an integral part of HeidelbergCement's business strategy. In 2018, the focus was on the key topics of the Sustainability Commitments 2030. The company decreased the accident

fuels and reduced specific net CO_2 emissions. In addition to the modernisation of its plants, the company further develops technologies to capture and recycle CO_2 (CCS/CCU) and, in doing so, holds a leading position in the industry. Innovations at product and technology level play an important role in achieving this. In 2018, CDP (formerly the Carbon Disclosure Project) named HeidelbergCement the best company in its sector on account of its transparency and pioneering role. HeidelbergCement's vision is to offer a CO_2-neutral concrete by 2050.

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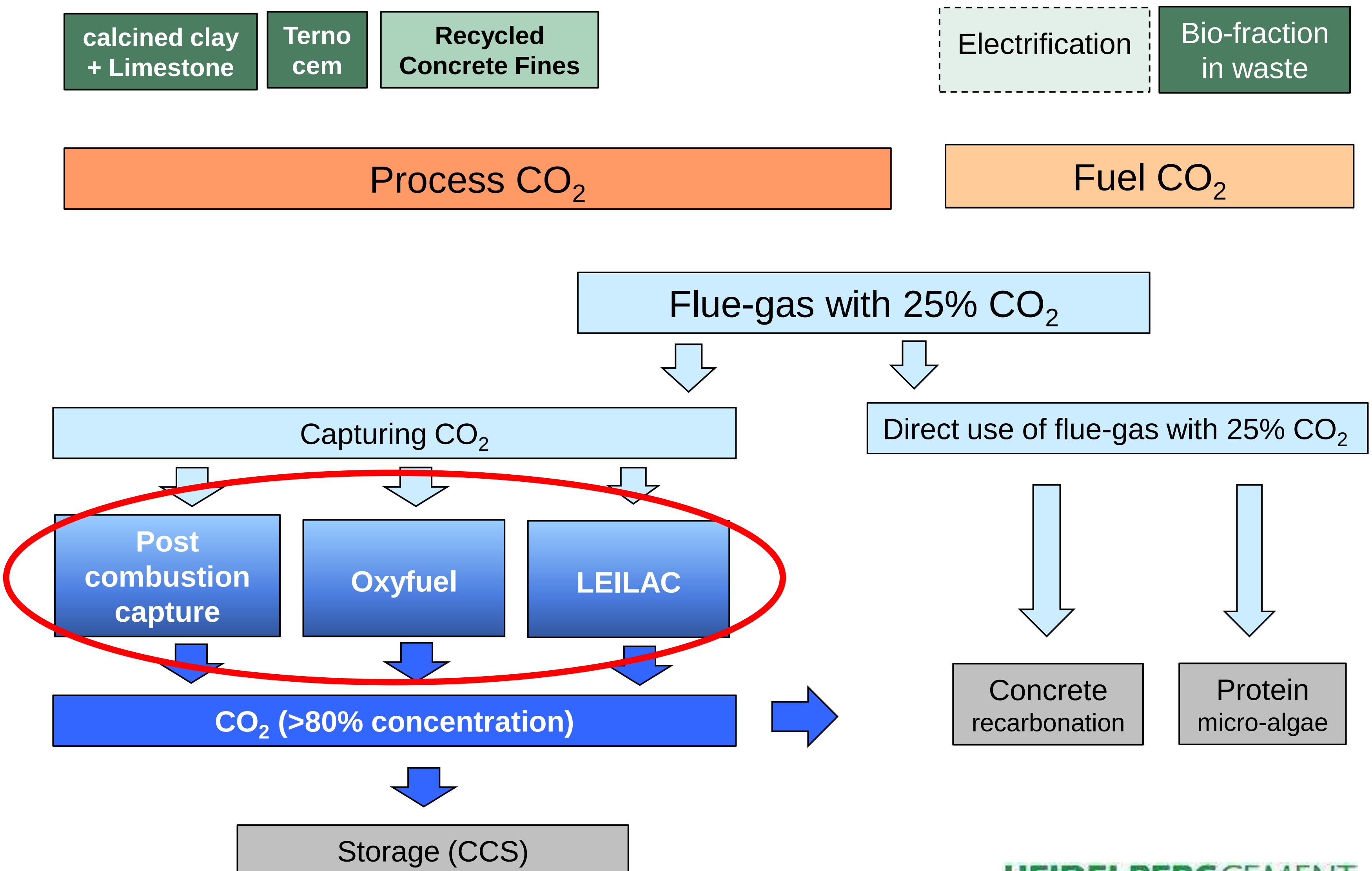
Decarbonization clinker



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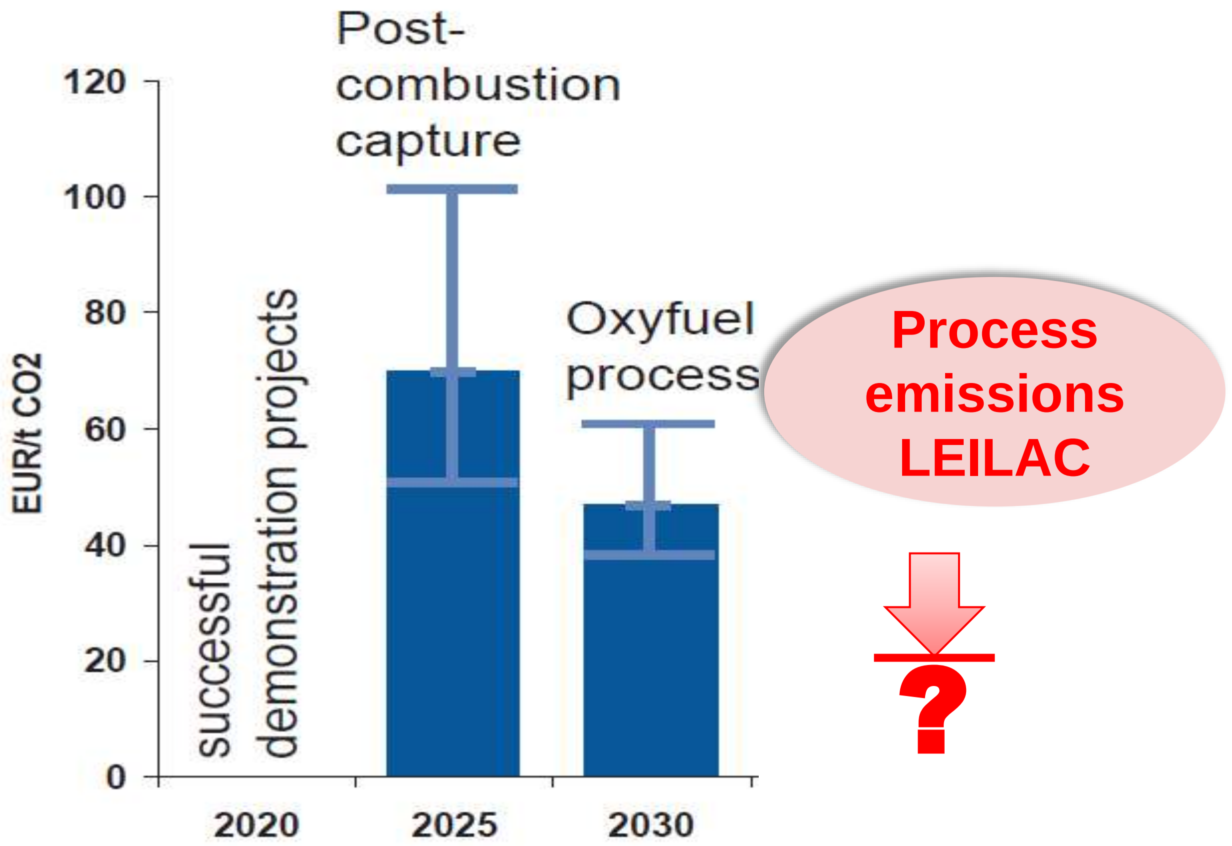
Carbon Capture: reducing costs and risk mitigation



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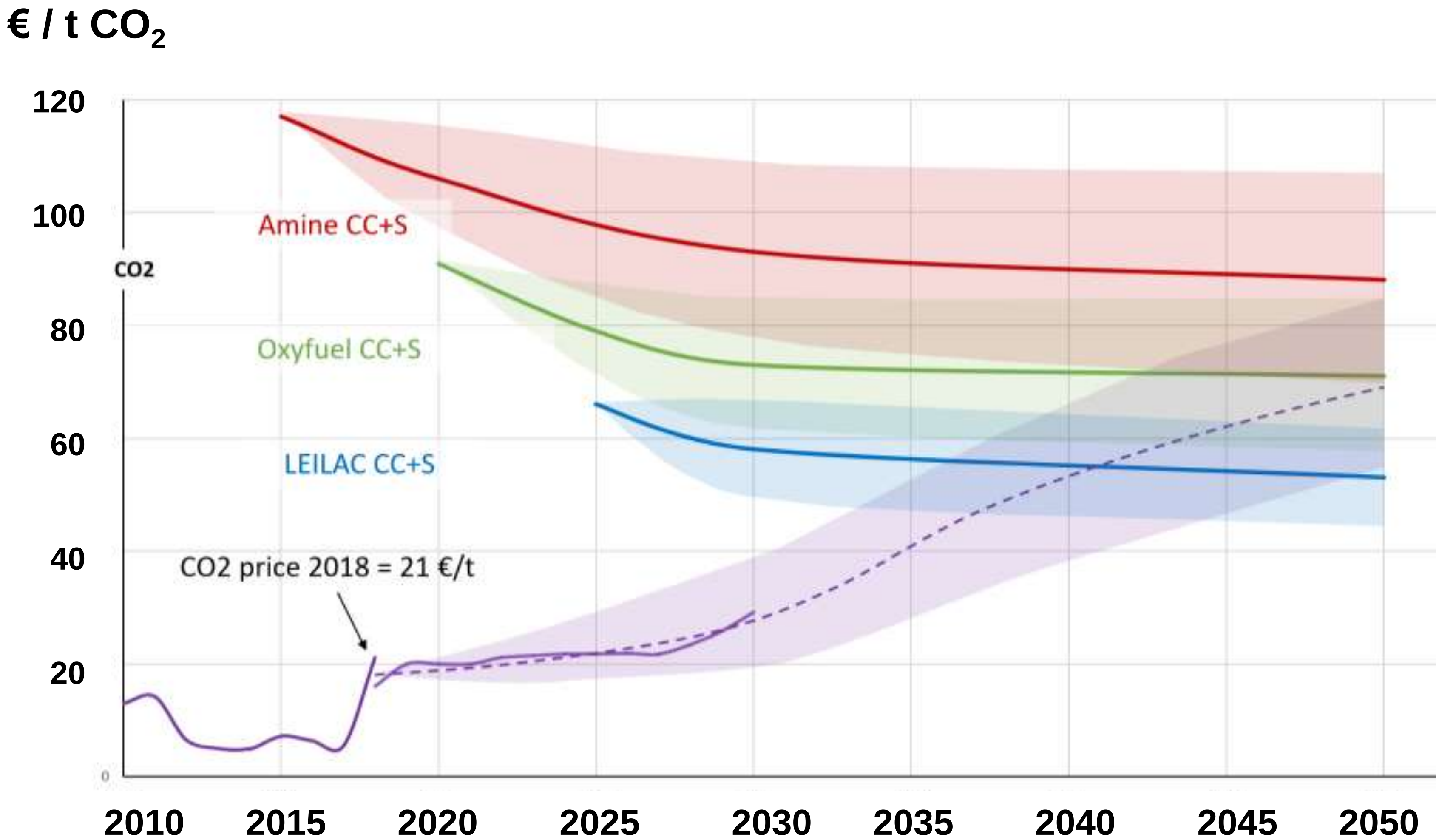
Closing the financial gap



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Portfolio of CC projects within cement industry

Amine

2015	2018	2021	2023	2024
2 kt/y	50 kt/y	70 kt/y	400 kt/y	800 kt/y
Brevik	Conch	HC	HC	HC
Norway	China	Germany	Norway	Canada

Oxyfuel

2007-2017	2016	2023
Studies	CEMCAP	HC+..
ECRA	Pilot's	120 kton/y

LEILAC

2016-20	2022
HC+CEMEX	HC ?
25 kton/y	120 kton/y
demo	permanent

Portfolio of CC projects within cement industry

Amine

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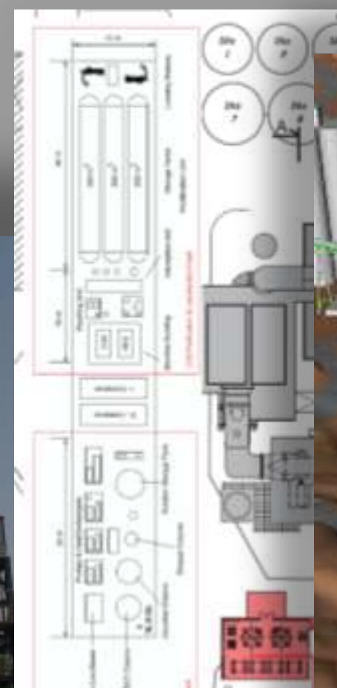
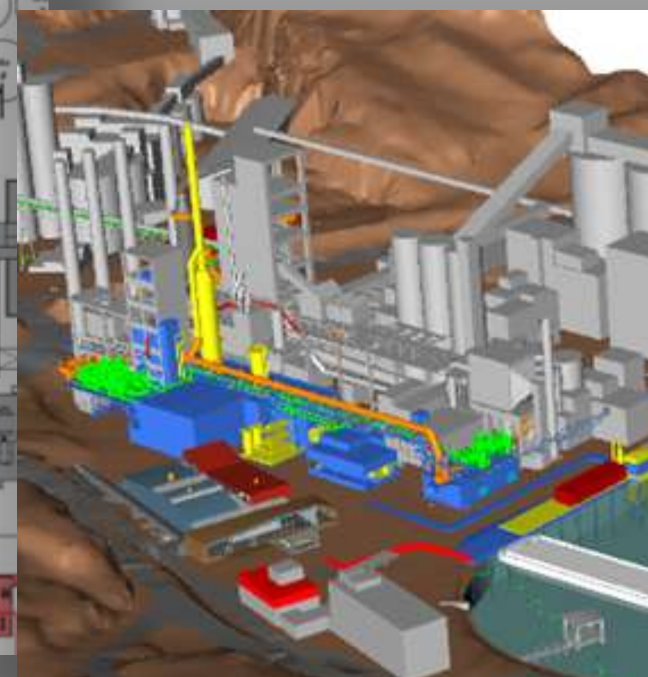
2 kt/y Brevik Norway	50 kt/y Conch China	70 kt/y HC Germany	400 kt/y HC Norway	800 kt/y HC Canada





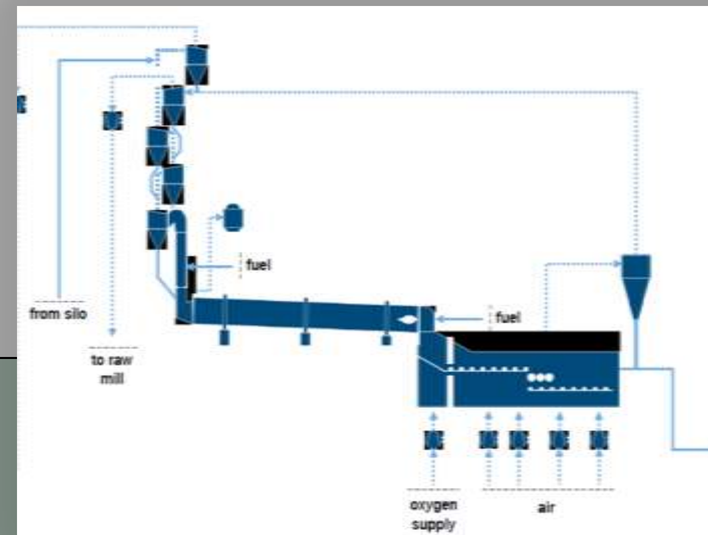
Portfolio of CC projects within cement industry

Oxyfuel

2007-2017

Studies
ECRA

2016



120 kton/y

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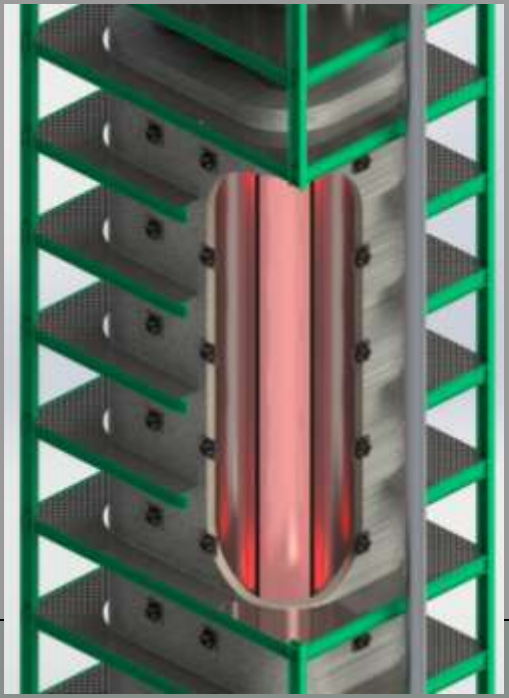
Portfolio of CC projects within cement industry



LEILAC

2016-20

HC+CEMEX
25 kton/y
demo

2022

HC ?
120 kton/y
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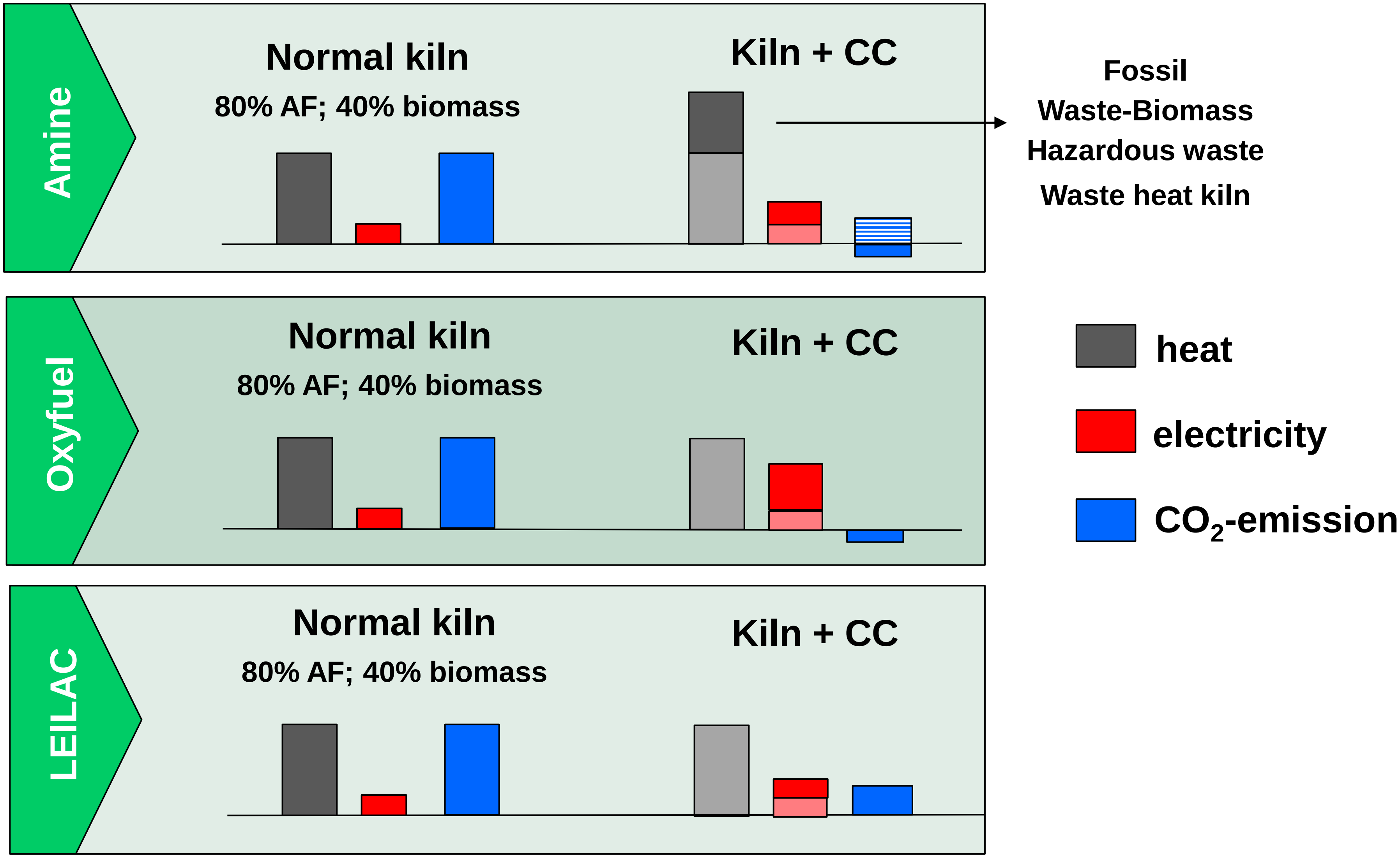
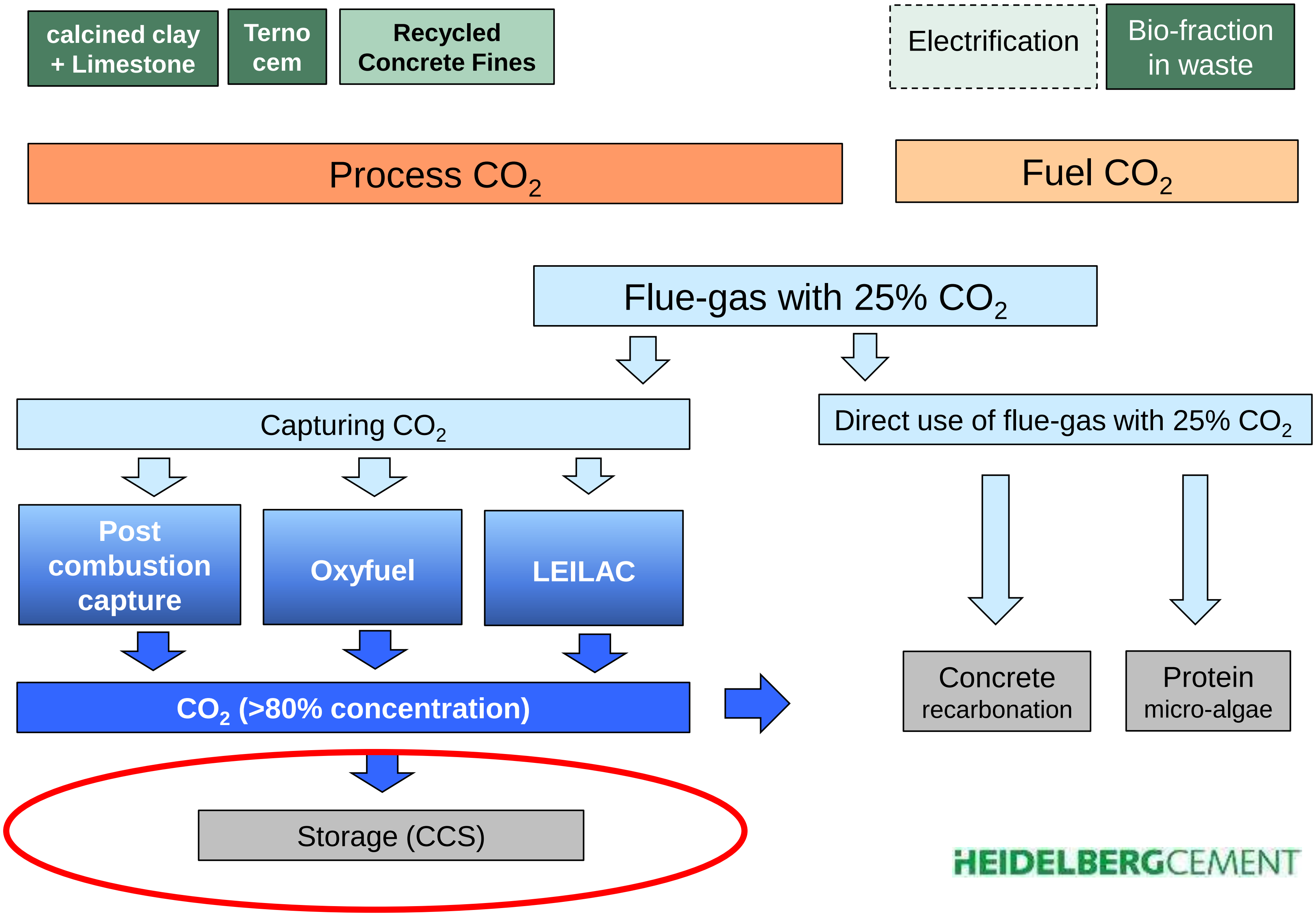
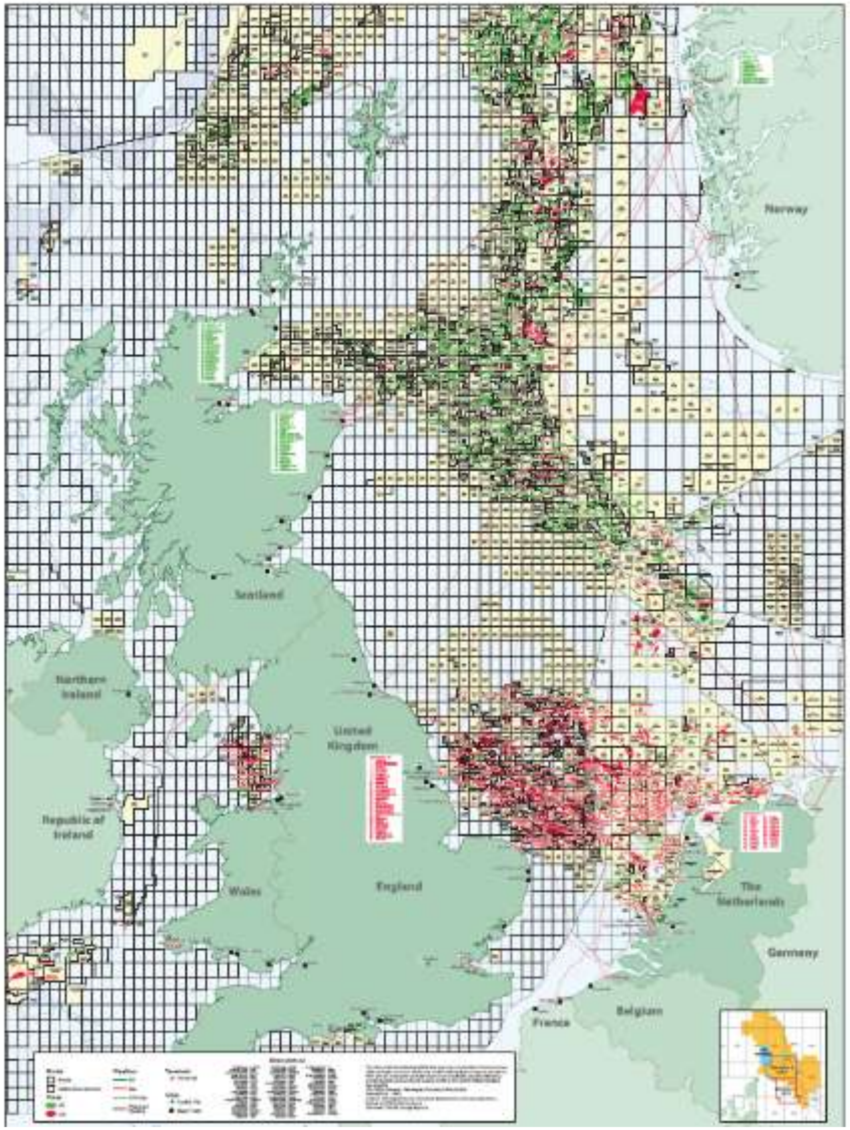
Comparison on energy-need and CO2-reduction



Decarbonization clinker



Where to store ?



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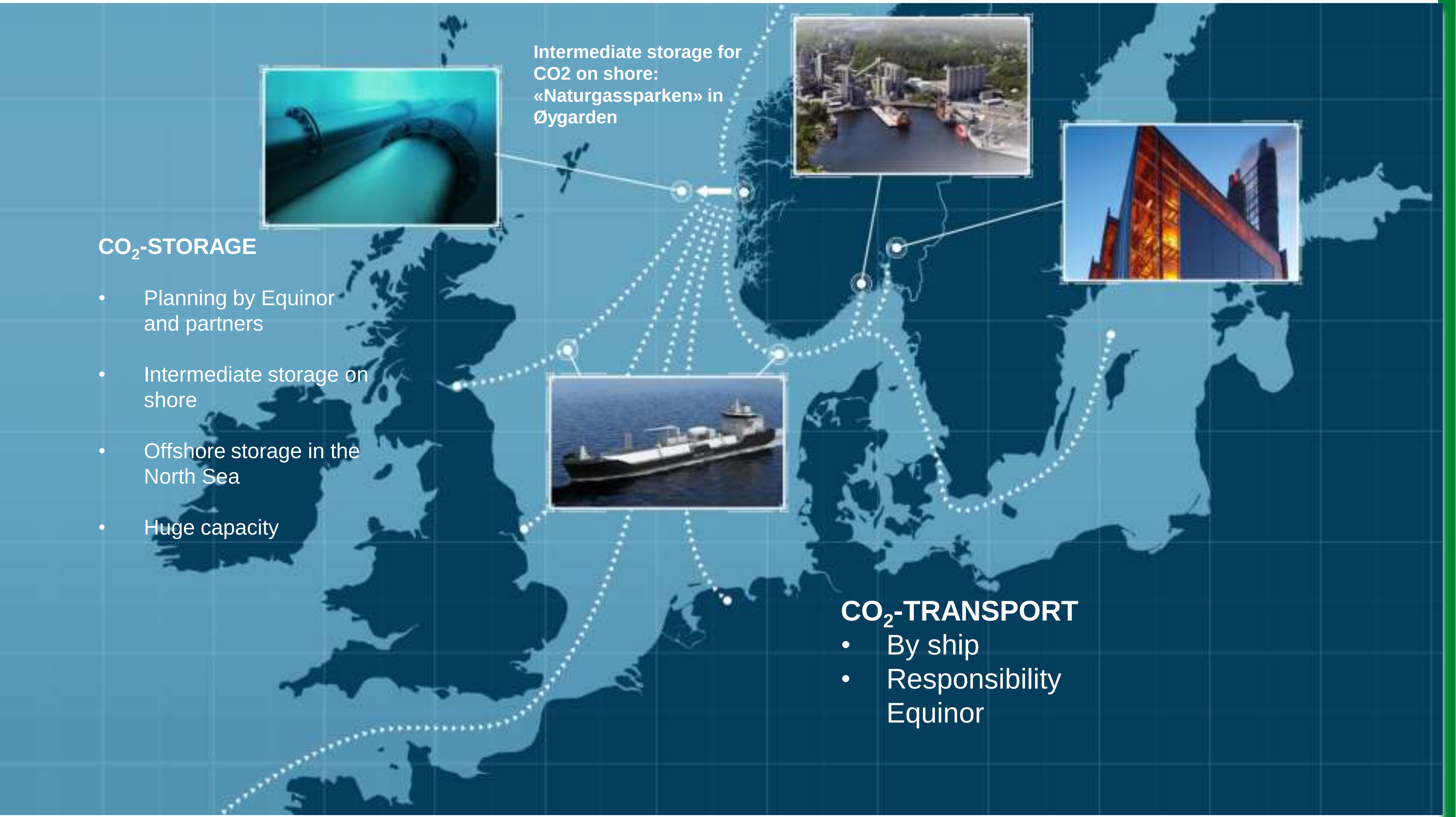
Part of the Norwegian full scale CCS demonstration project



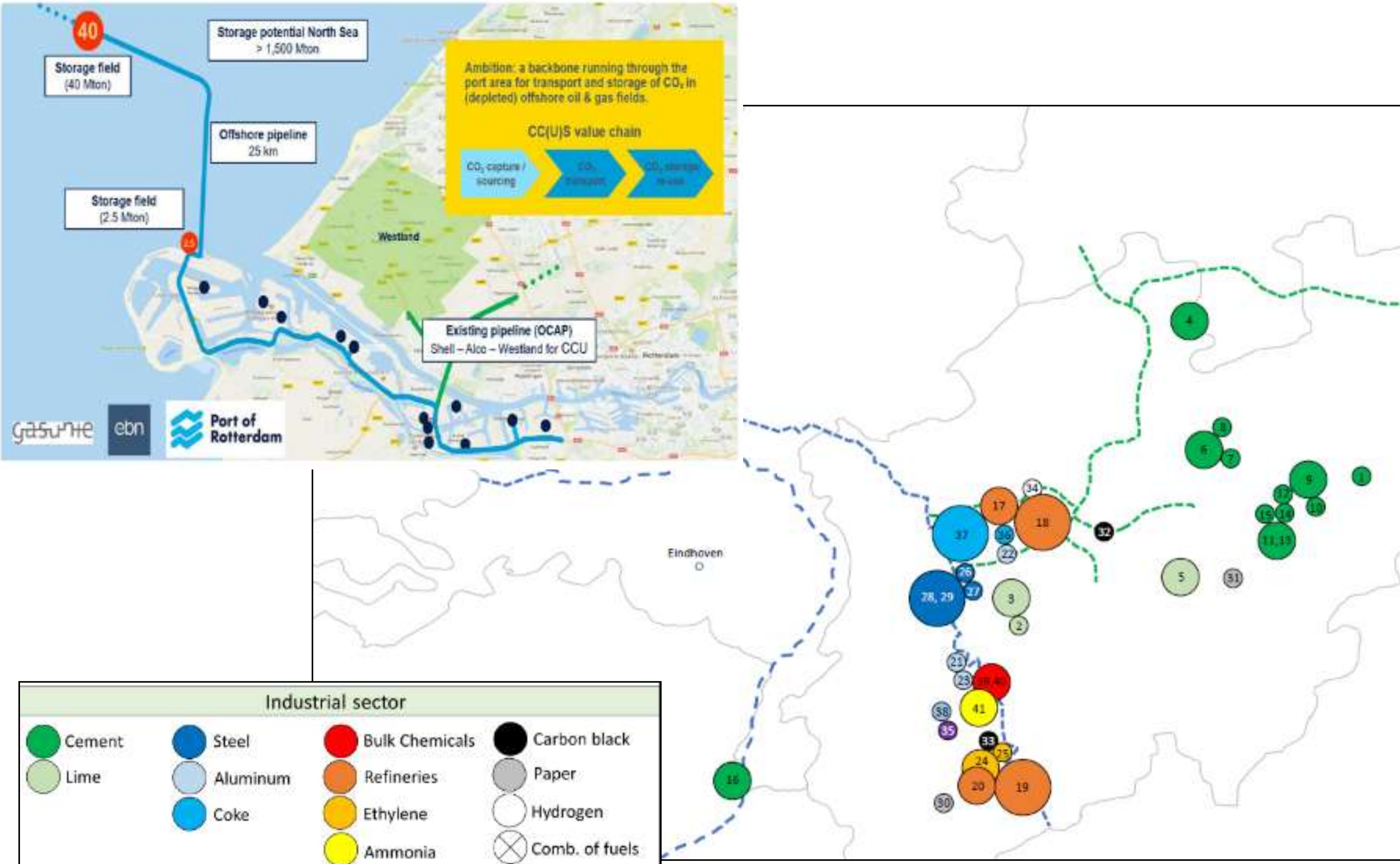
CO_2-STORAGE

- Planning by Equinor and partners
- Intermediate storage on shore
- Offshore storage in the North Sea
- Huge capacity

CO_2-TRANSPORT

- By ship
- Responsibility Equinor

CCS in Netherlands = opportunity for NRW and Cement



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Logistics is key !

Slite
From Slite to Norway ≈ 1500 Km

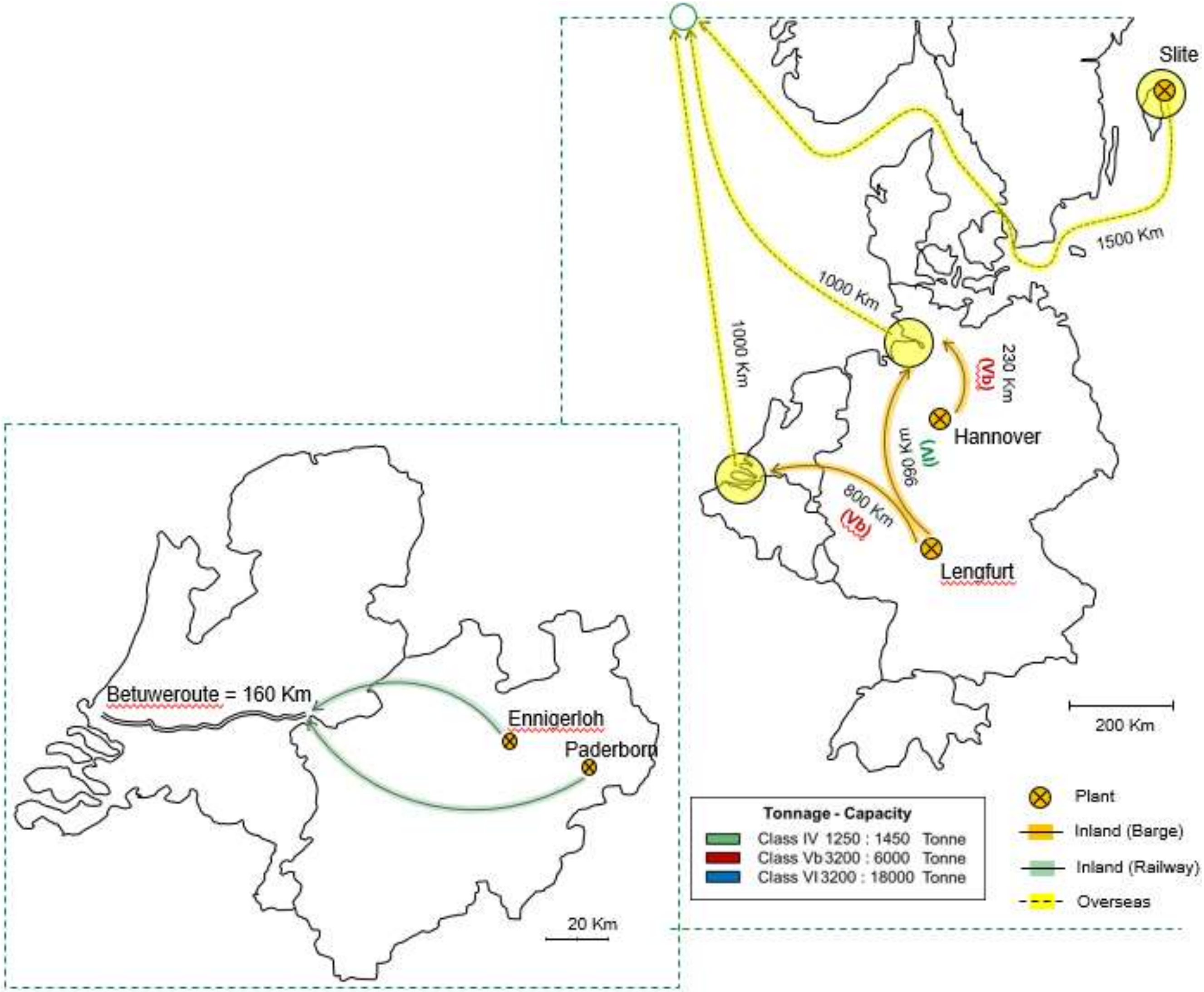
Hannover
Hannover – Hamburg = 230 Km
Hamburg - Norway ≈ 1000 Km

Lengfurt
Option 1:
Lengfurt to Hamburg = 990 Km
Hamburg to Norway ≈ 1000 Km

Option 2:
Lengfurt to Rotterdam ≈ 800 Km
Rotterdam to Norway ≈ 1000 Km

Ennigerloh
Ennigerloh – R'dam (train) ≈ 400 Km
Rotterdam to Norway ≈ 1000 Km

Paderborn
Paderborn – R'dam (train) ≈ 450 Km
Rotterdam - Norway ≈ 1000 Km



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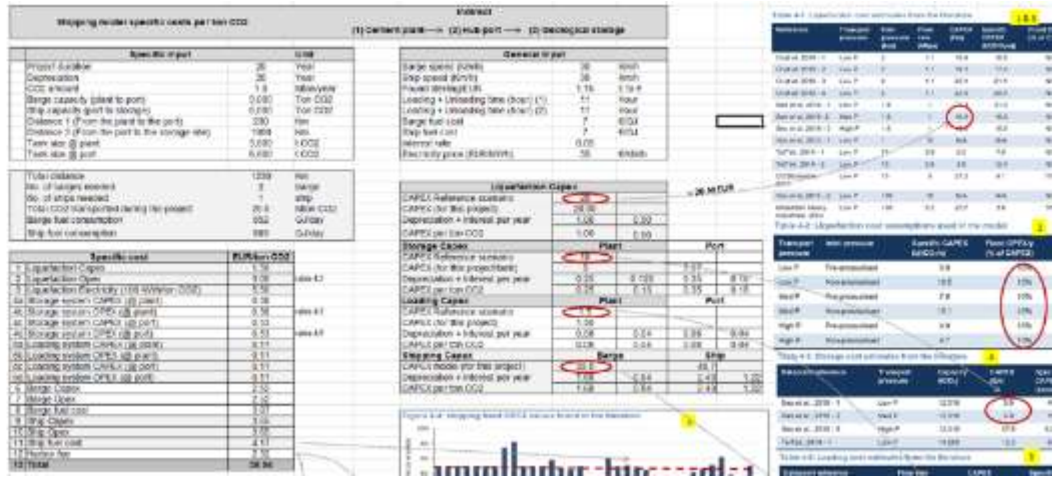
Cost assessment in development

- **Transport by ship/train:**
  - Liquefaction
  - Storage
  - Loading
  - Ship / train transport
  - Unloading + Storage
  - Loading
  - Ship



- **Purity of captured CO_2 versus costs of storage**
  - O_2-content
  - N_2-content
  - SO_2

Table 3: Storage capacity of pure CO_2 versus CO_2 fraction of mixtures at various depths in various storage compartments. The fi source of the CO_2 considered (see Table 2 for the corresponding mixtures); the second row gives the storage reservoir (saline f field)

CO_2 source: Capture technology	Coal-fired pp Amine-based absorption	Coal-fired pp Ammonia-based abs.	Coal-fired pp Selexol-based abs.	Coal-fired pp Oxy-fuel	Natural gas proc. Amine-based absorption	Synthesis gas proc. Rectisol-based abs.	Cement industry
Storage type	Oil field	Saline formation	Oil field	Saline formation	Oil field	Oil field	Oil field
wt % impurities	0.24	0.05	0.21	1.28	0.93	0.41	4.99
800 m	-2.8	-0.5	-5.3	-16.0	-15.1	-9.7	-53.0
900 m	-2.0	-0.3	-4.1	-11.4	-11.0	-7.4	-41.3
2000 m	-0.7	-0.2	-1.7	-4.4	-4.2	-3.1	-12.2
3400 m	-0.7	-0.2	-1.2	-3.2	-3.1	-2.2	-7.5

% reduction in storage capacity of a field compared to pure CO2

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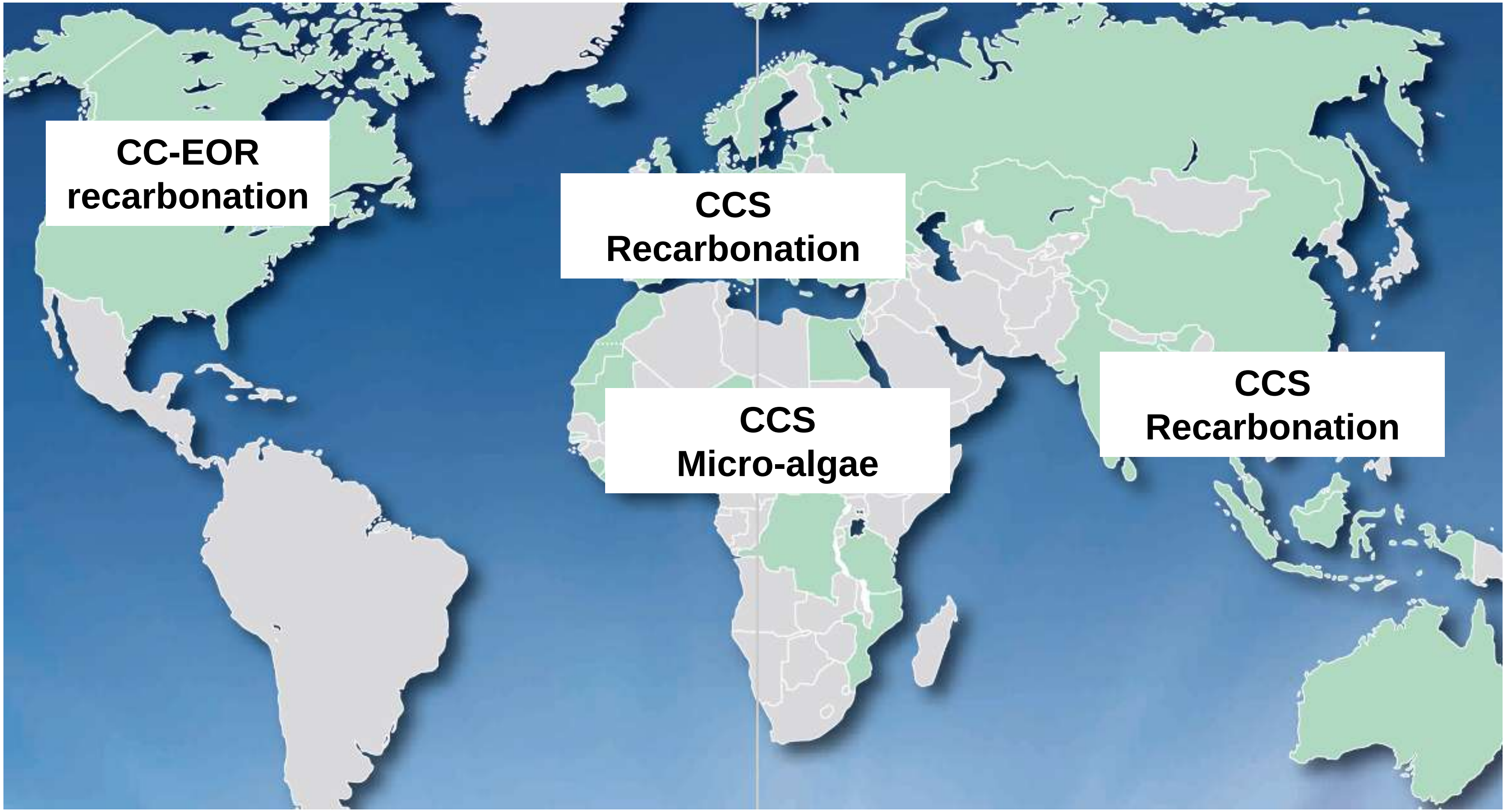
CCS, CC-EOR, recarbonation + other CCU will make HeidelbergCement's based concrete carbon neutral



CO_2 a challenge and an opportunity…..

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