THE ROLE OF RESEARCH IN REALISING CCS

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One of Europe's largest independent research organisations

2000
Employees

75
Nationalities

4000
Customers

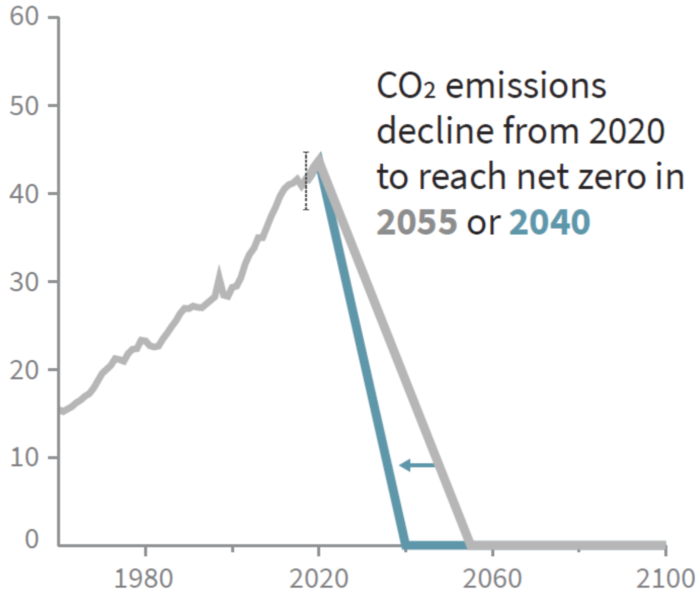
€ 330 million
Revenues

€ 48 million
International sales

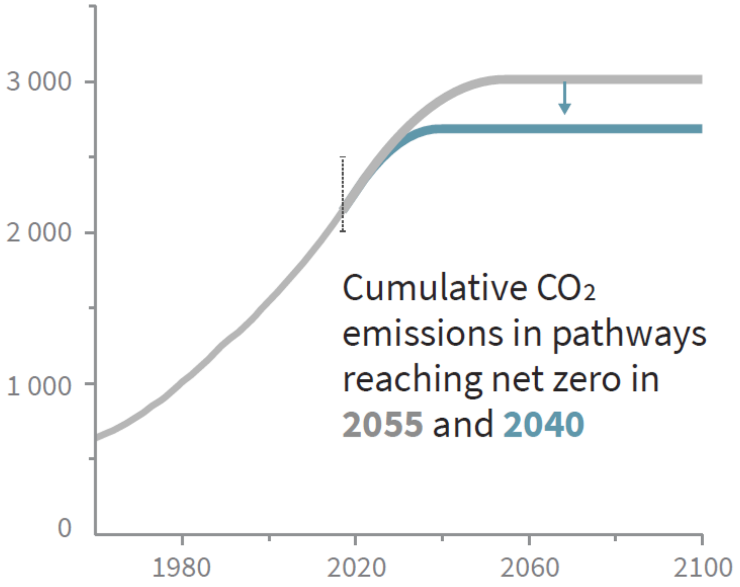

ipcc
Global Warming of 1.5°C
An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

IPCC - SR15- Special report on 1.5 deg warming

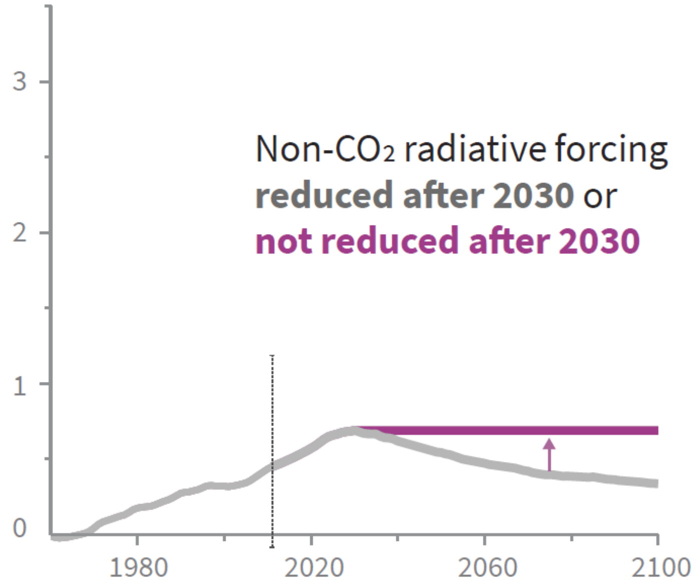
b) Stylized net global CO_2 emission pathways
Billion tonnes CO_2 per year ($GtCO_2$/yr)



c) Cumulative net CO_2 emissions
Billion tonnes CO_2 ($GtCO_2$)



d) Non-CO_2 radiative forcing pathways
Watts per square metre (W/m^2)



Faster immediate CO_2 emission reductions limit cumulative CO_2 emissions shown in panel **(c)**.

Maximum temperature rise is determined by cumulative net CO_2 emissions and net non-CO_2 radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents.

Source: IPCC Special Report on Global Warming of 1.5°C

a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways

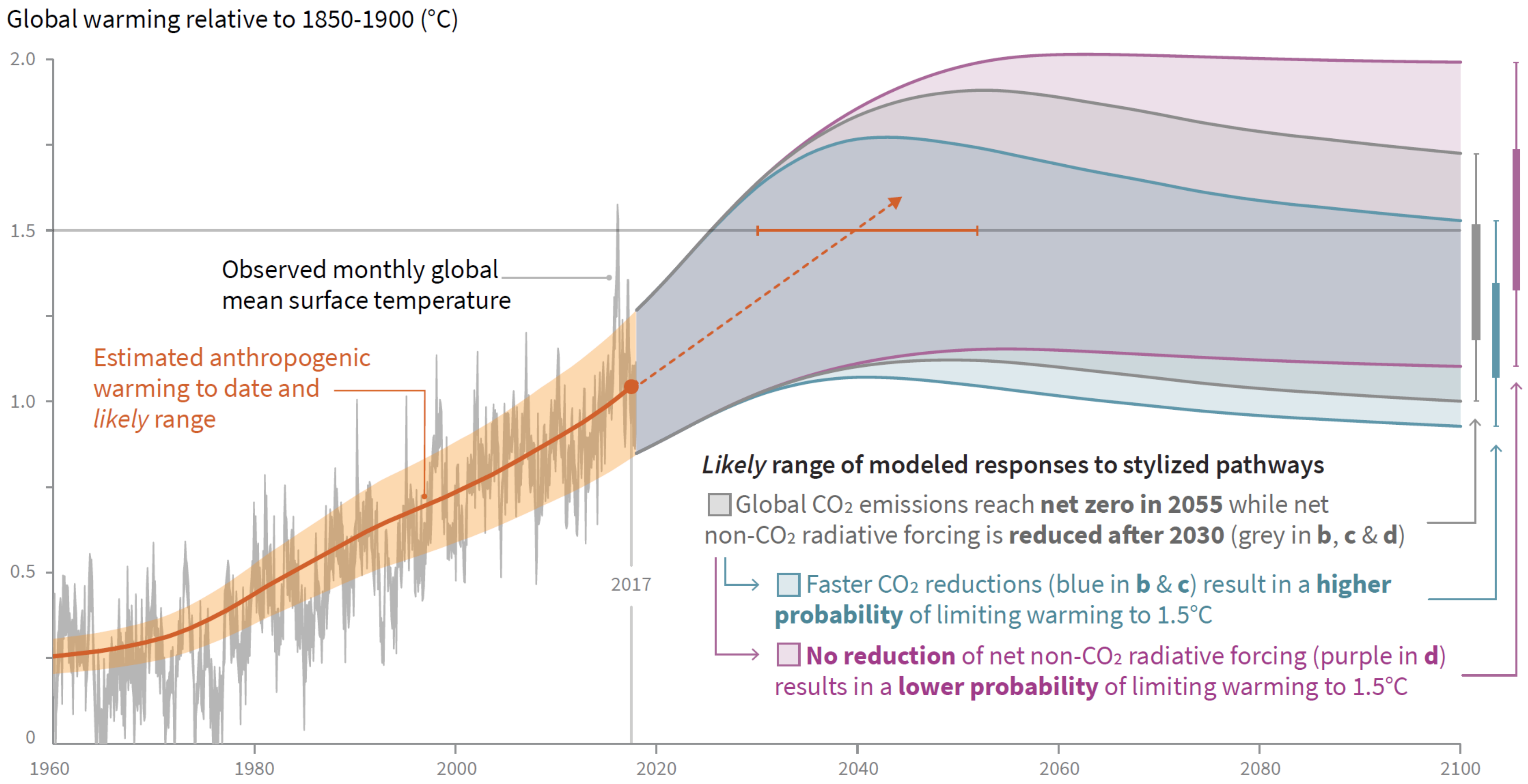
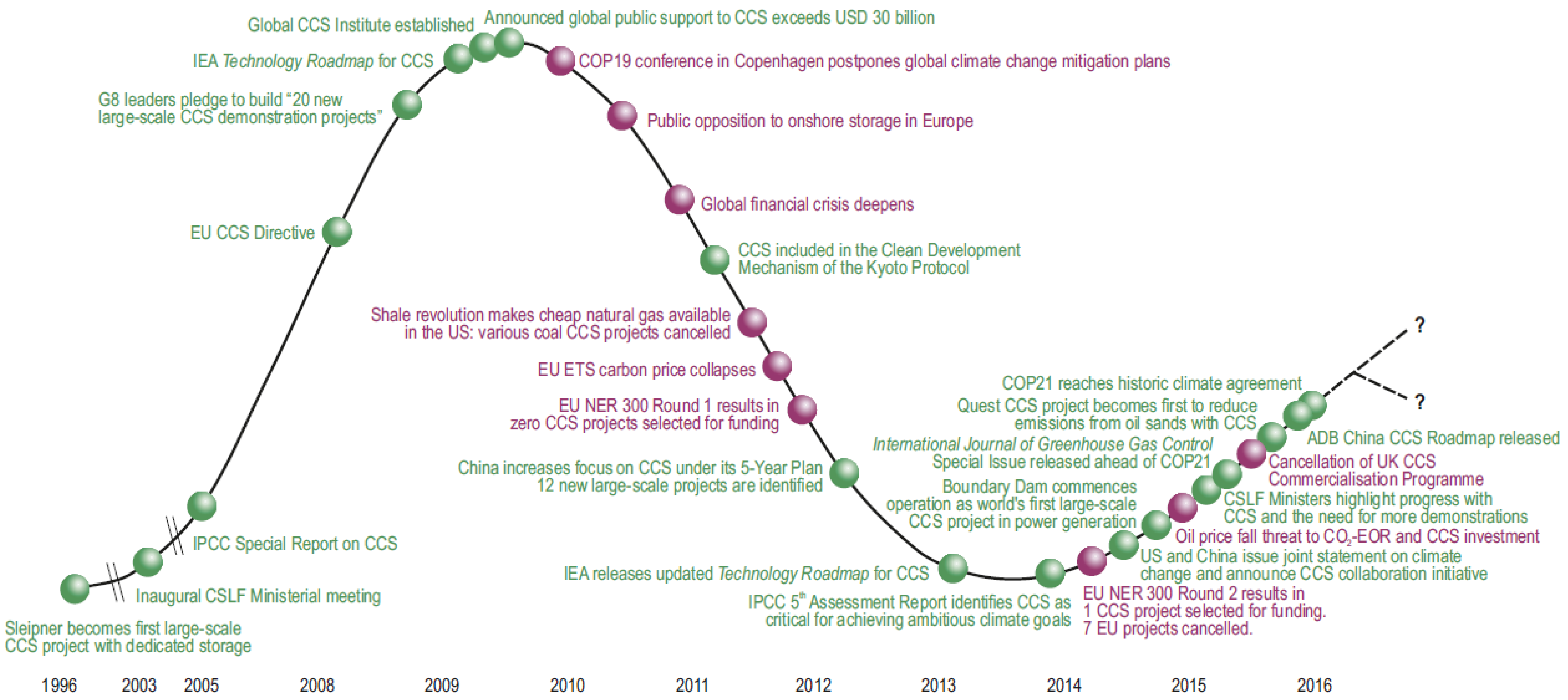


Figure 1.1 • CCS policy and political support over time



Source: Adapted from SBC Energy Institute (2016), Low Carbon Energy Technologies Fact Book Update: *Carbon Capture and Storage at a Crossroads*.

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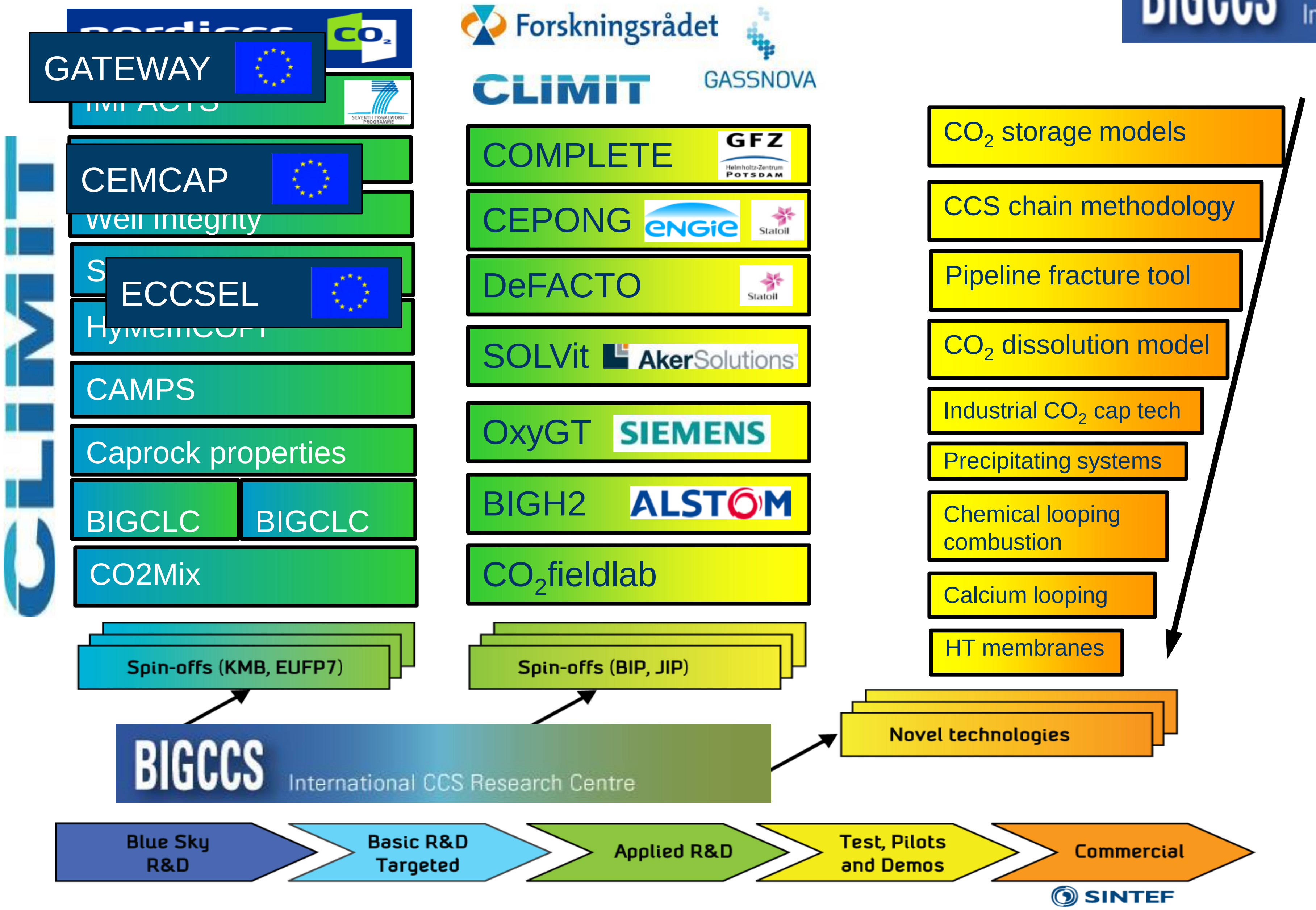
CCS R&D – underpinning CCS deployment

R&D Turnover in CCS > €20 million/yr (SINTEF and NTNU)

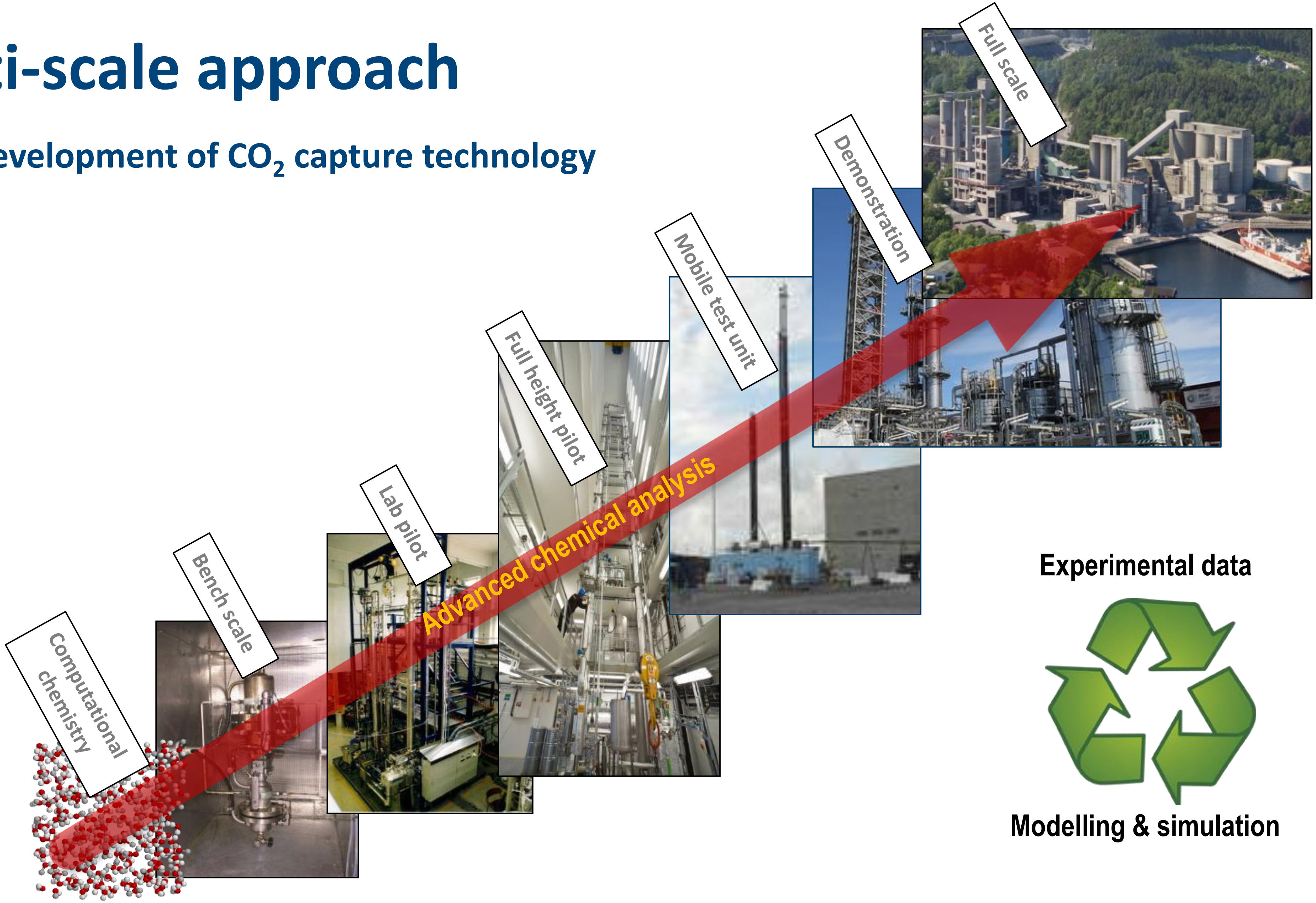
eccsel NCCS BIGCCS International CCS Research Centre nordiccs CO_2

EERA European Energy Research Alliance CCS - Carbon Capture and Storage


GATEWAY
CEMCAP
ECCSEL
CAMPS
Caprock properties
BIGCLC
BIGCLC
CO2Mix
CLIMIT
Forskningsrådet
CLIMIT
GASSNOVA
COMPLETE
GFZ
CEPONG
ENGIE
Statoil
DeFACTO
Statoil
SOLVit
AkerSolutions
OxyGT
SIEMENS
BIGH2
ALSTOM
CO_2fieldlab
CO_2 storage models
CCS chain methodology
Pipeline fracture tool
CO_2 dissolution model
Industrial CO_2 cap tech
Precipitating systems
Chemical looping combustion
Calcium looping
HT membranes
Spin-offs (KMB, EUFP7)
Spin-offs (BIP, JIP)
Novel technologies
BIGCCS
International CCS Research Centre
Blue Sky R&D
Basic R&D Targeted
Applied R&D
Test, Pilots and Demos
Commercial
SINTEF

Multi-scale approach

to the development of CO_2 capture technology



Experimental data

Modelling & simulation

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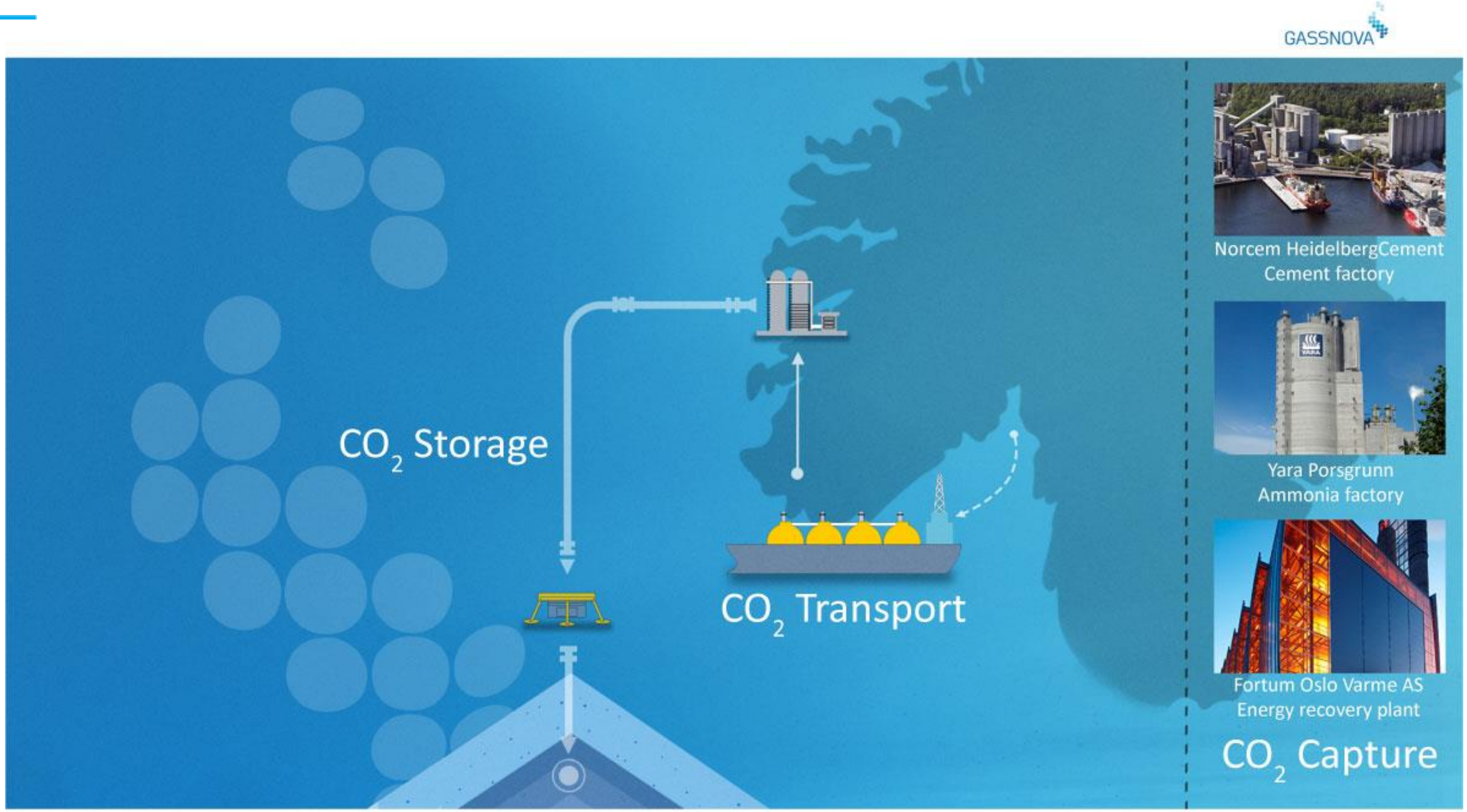
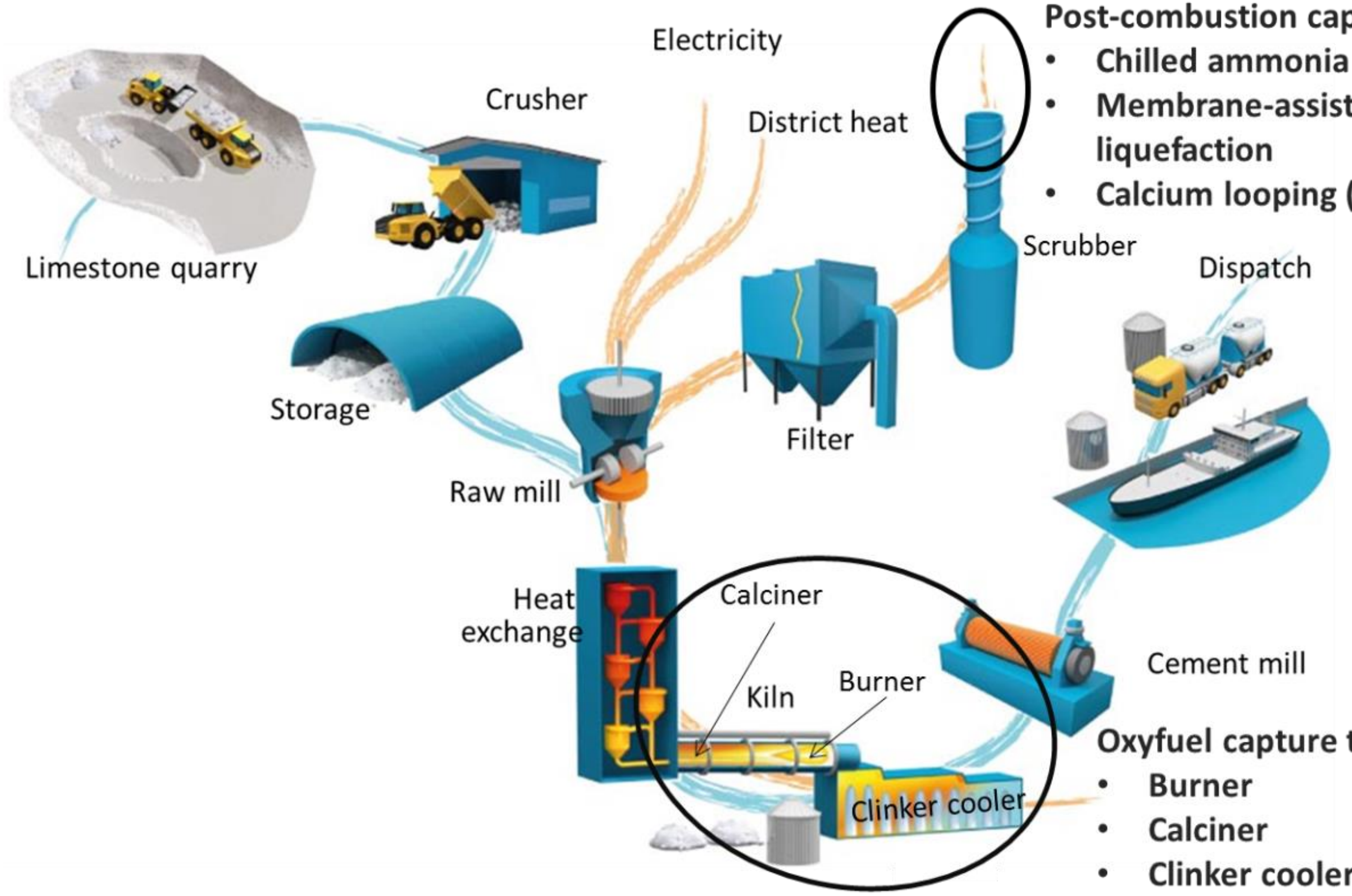
The Norwegian Full-Scale Project



Kilde: Gassnova

Technologies under scrutiny in CEMCAP, reaching TRL6*



Post-combustion capture tests:

- **Chilled ammonia (CAP)**
- **Membrane-assisted CO_2 liquefaction**
- **Calcium looping (CaL)**

Oxyfuel capture tests:

- **Burner**
- **Calciner**
- **Clinker cooler**

*Technology demonstrated in industrially relevant environment

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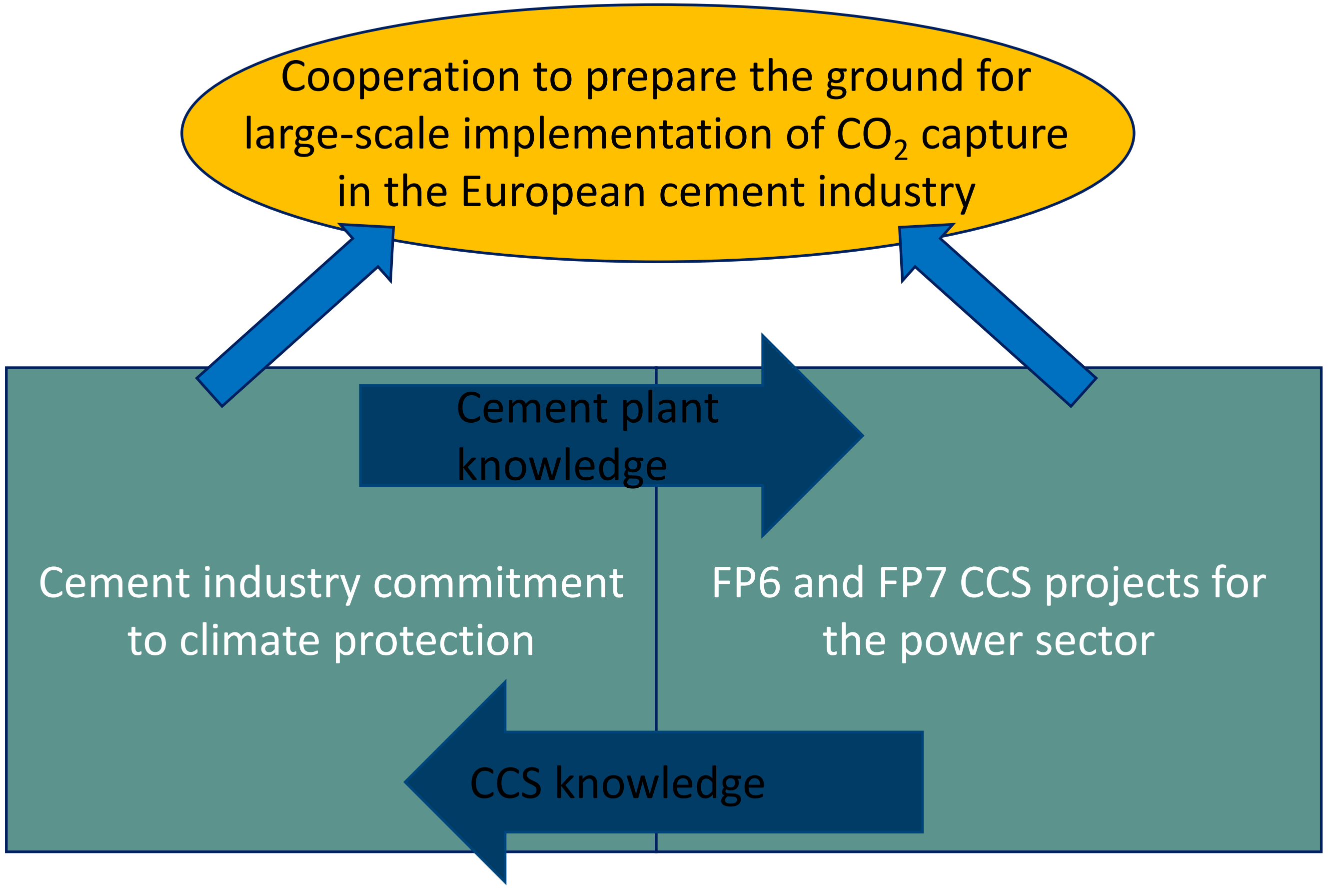
R&D @ work- oxy-fuel solutions for the future

Clinker cooler prototype and recirculation system installation at HeidelbergCement in Hannover

Hot commissioning of the oxyfuel clinker cooler and first oxyfuel clinker samples

In CEMCAP a pool of CCS expertise has been made available to the cement industry



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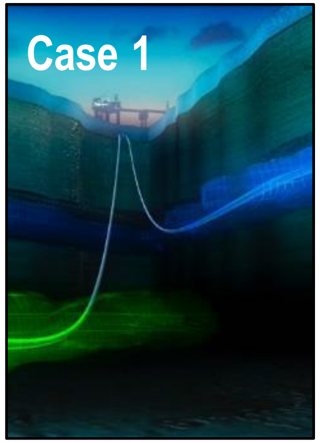
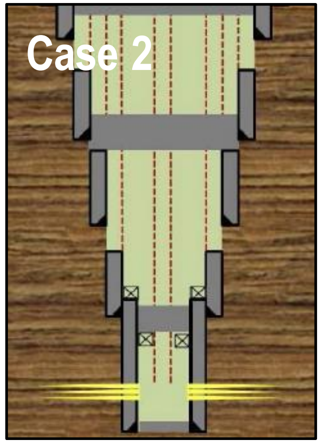
7 cases showing the effect of R&I



Geophysical methods for monitoring subsurface storage of CO_2

Savings: ~€100 million/site



Improved completion of CO_2 wells

Savings: ~ €20 million /completion

Capture and liquifaction of CO_2 for ship transport

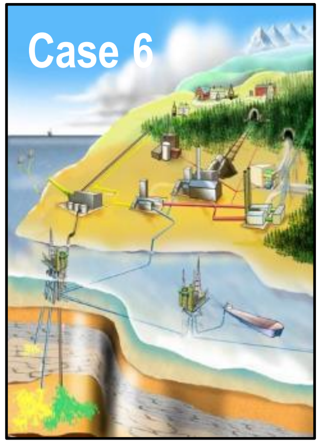
Savings: ~10% cost reduction per ton CO_2 captured

Capturing CO_2 using CLC

Savings: Could cut capture costs by 30-40%

Avoiding running ductile cracks in CO_2 transport

Savings: ~€25 million for a 500km pipeline



Smart design of CO_2 value chains

Savings: ~10-15% of mitigation costs

Efficient capture processes

Savings: Energy- €10 mill/yr (1Mt/yr)

Summary

- R&I key for CCS to happen on the ground- to derisk, optimise and to reduce costs
- Significant knowledge sharing throughout the years- across sectors
- Benefits can be quantified- we need to run more of these post research surveys
- Important to pool resources to achieve scale in R&I- EU, MS/AC, Industry
- Need to speed up CCS in lieu of the IPCC SR15 – BECCS will not happen without CCS
- Important that Horizon Europe cover the whole value chain for CCUS for both industry and power, other sources

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Technology for a better society