CCS and the cement industry

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COP24, December 6th , 2018

HeidelbergCement has committed to reduce its carbon footprint

2030 Sustainability Commitments

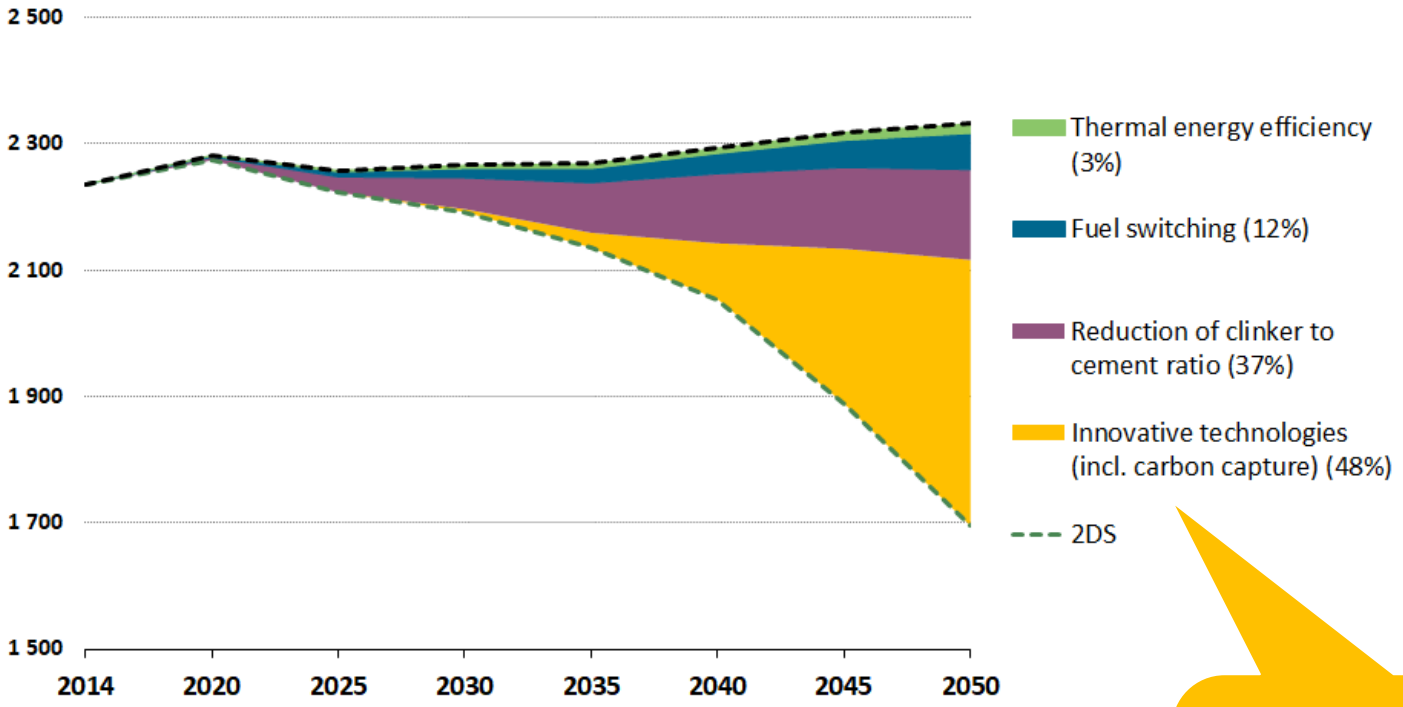
- We are committed to fulfilling our share of the global responsibility to keep temperature rise below 2°C”

R&D budget

- 80% of R&D budget is related to CO_2-reduction research

The cement industry Roadmap 2050: we share responsibilities

Direct CO_2 emissions from global cement production (Mt/yr)



Source: IEA-CSI Technology Roadmap, 2018

CCS/ CCU (share of generated CO_2 captured in 2050)
- **25% in IEA Roadmap**
- **46% in European Roadmap**

- Concrete is the world 2nd most used commodity
- Cement production is responsible for 5-7% of manmade CO_2-emissions
- CO_2-roadmaps are defined at worldwide and on EU-level
- HeidelbergCement is co-founder and frontrunner in all these initiatives

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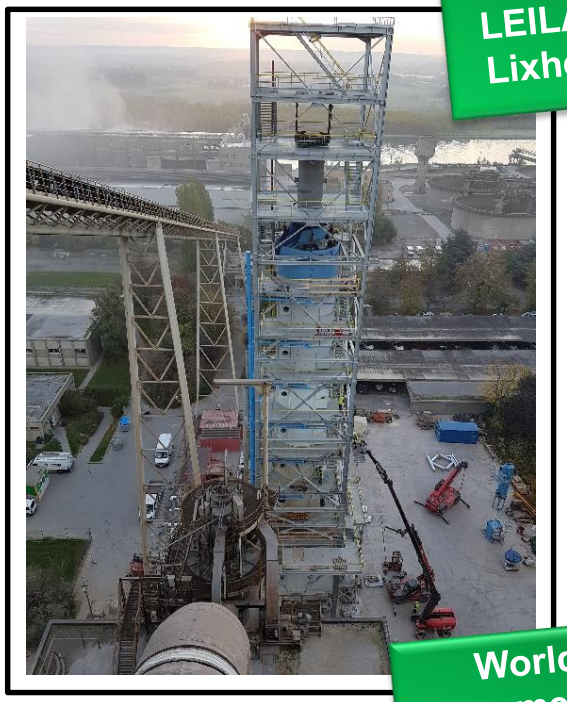
Proud to be frontrunners in CCUS

World's first CCS for Cement pilot Brevik –Norway

World's first LEILAC reactor Lixhe- Belgium



World's first Oxyfuel clinker Hannover-Germany

World's most commercial algae farm Safi- Morocco

- **Post combustion CC** in HeidelbergCement Norway tested in 2016; in preparation for full scale 300 m€
- **Oxyfuel** reduces the cost of CC; demo for 80 m€
- LEILAC: innovative calciner to separate CO_2 without energy-penalty: EU-funded 12 m€
- CCU: using CO_2 to grow algae for sustainable protein for animal nutrition (own investment 2 m€)

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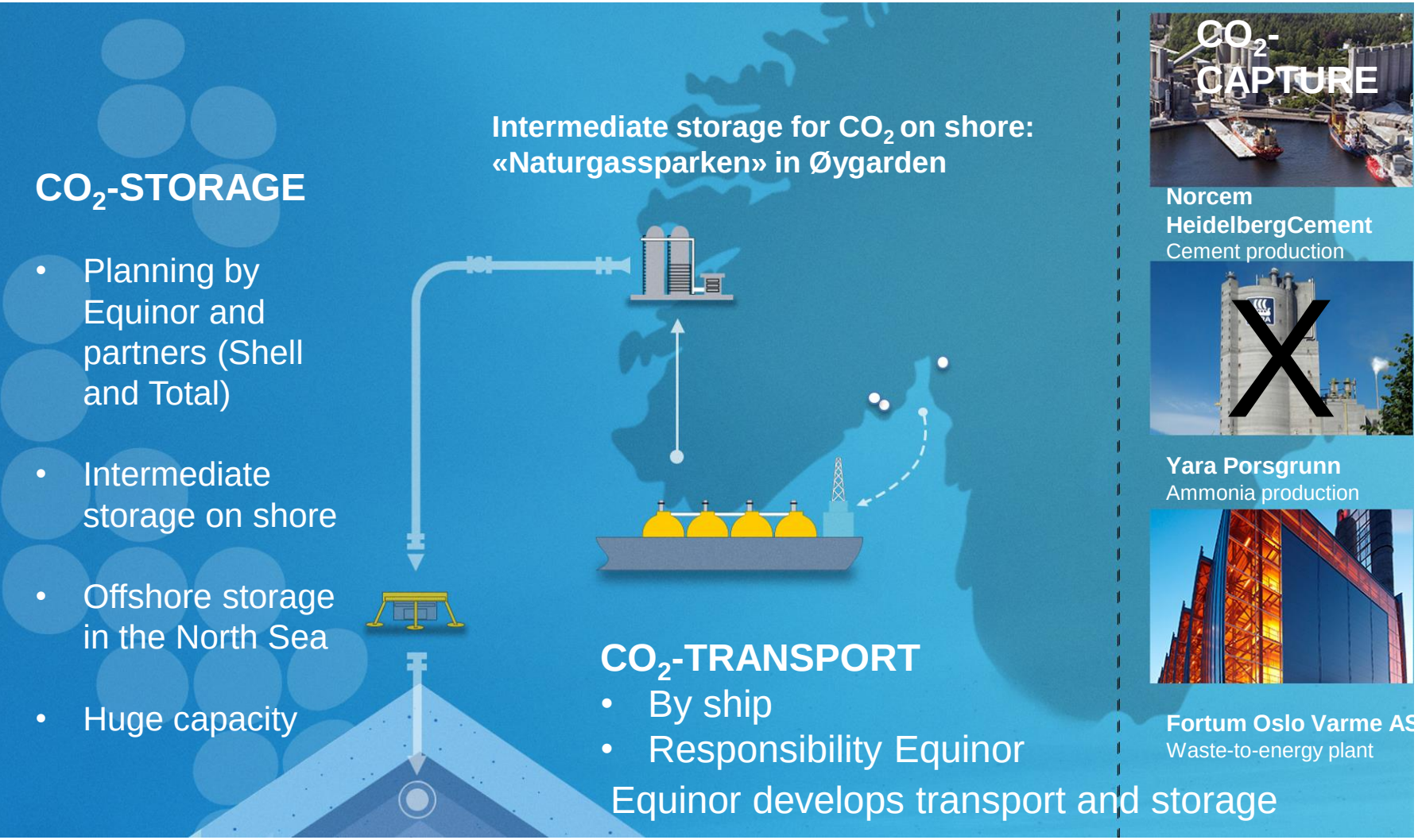
The Norwegian full scale demonstration CCS project



- First full-chain industrial CCS project in Europe
- Project 75% funded by Norwegian government
- Co-funded with 3 m€ by Norcem-HC
- After successful tests (2014-2016), project is now set for real scale
- Investment decision **for full-chain demonstration in 2020/2021** (0.4 mio ton/year CO_2). **Costs: 300m€**
- In operation late 2023 (or 2024)

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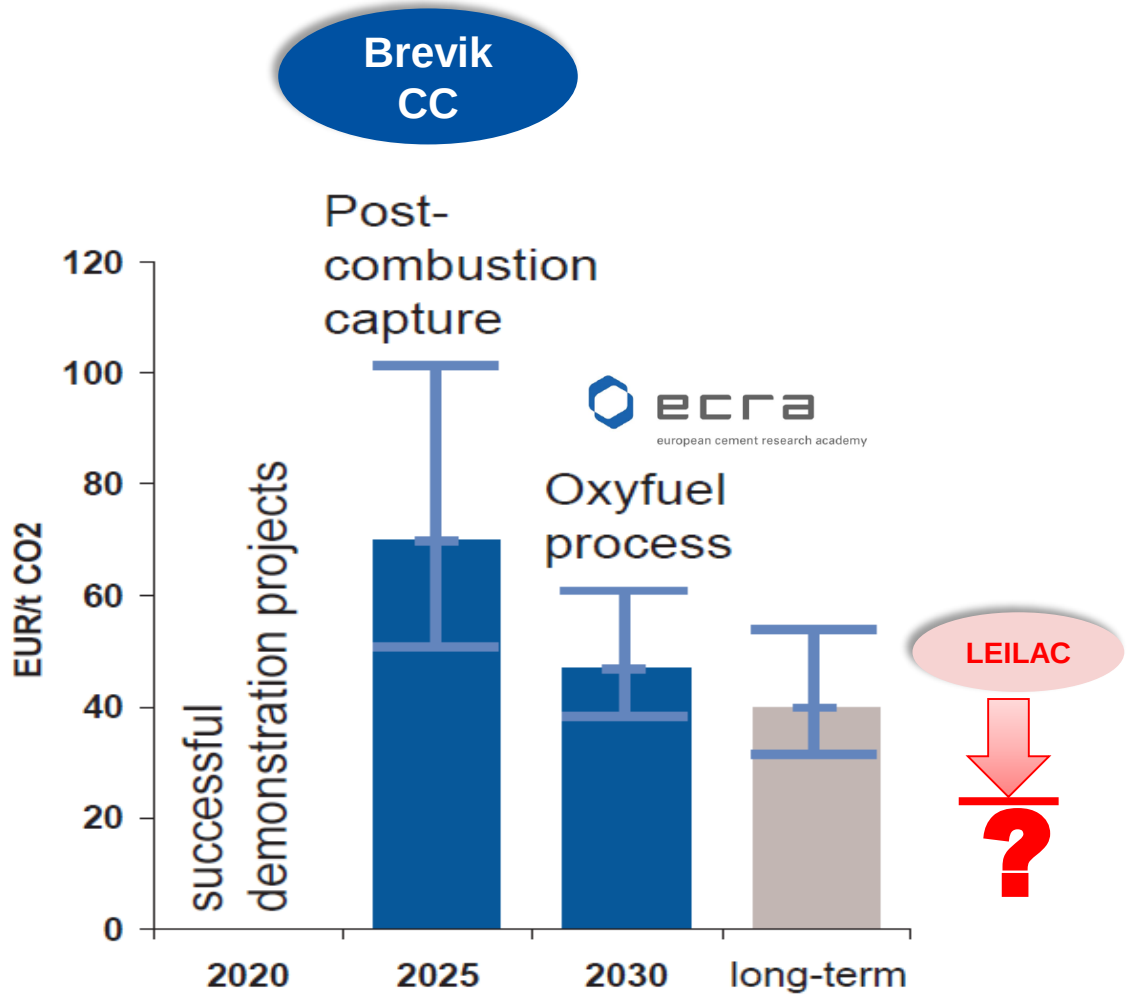
Carbon Capture: the challenges



Significant increase in production costs:

- Currently, the legal and economic conditions of these technologies would impair the competiveness of cement production
- CO_2 storage or reuse strategy and infrastructure
- Oxyfuel still requires R&D
- Post-combustion requires further development of high-performance capture materials to reduce energy demand

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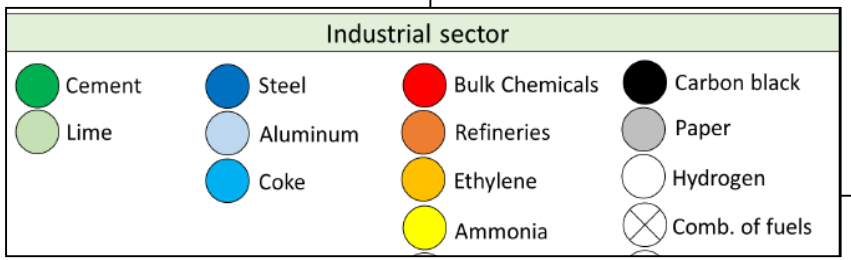
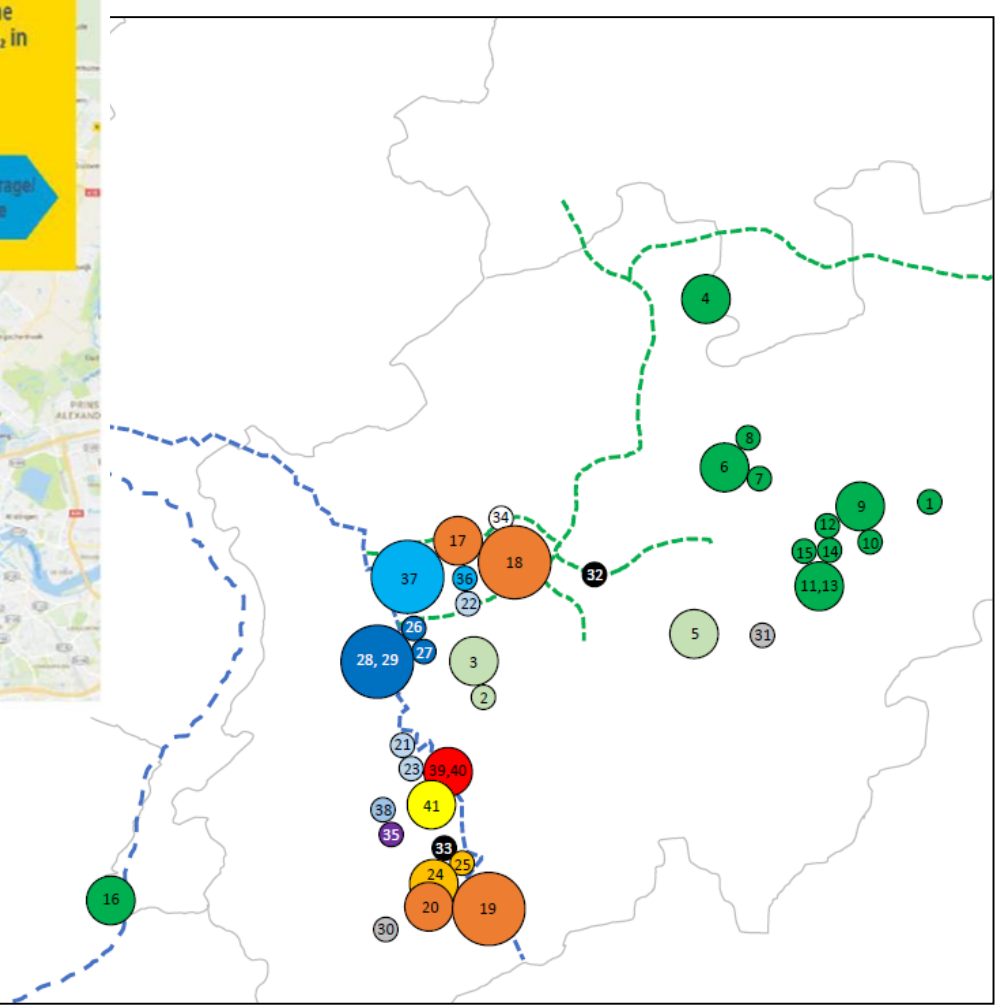
Looking beyond cement plants





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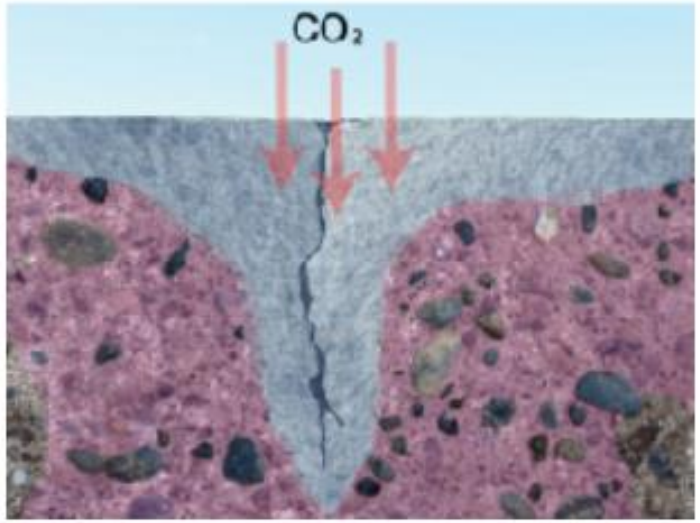
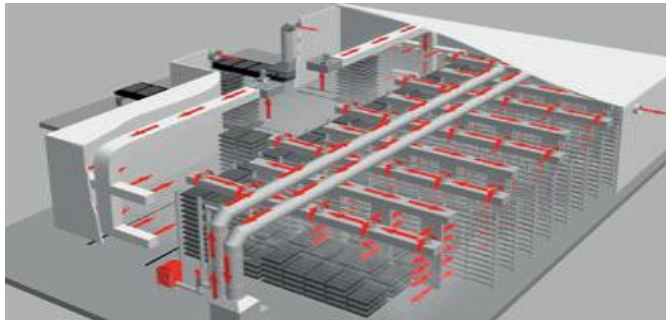
And beyond emissions: recarbonation (CO_2-uptake)



- Ambient CO_2 reacts with Ca(OH) in concrete to $CaCO_3$
- Alkalinity drops (PH < 10): rebar's surface passivation dissolves
- Corrosion reinforcing steel accelerates



- Curing of pre-cast concrete with CO_2

- CO_2 sequestration during lifetime of construction

- Recycled concrete fines recarbonate with CO_2

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Concluding remarks

- HC commits to fulfill its share in the Paris 2° target
- HC is engaging pro-actively with politics and society to find most effective way in decarbonizing the industry, while maintaining a competitive position
- In its operations worldwide HC is testing and developing Carbon Capture and when possible the (commercial) Use of CO_2 from stacks applying various technologies
- HC estimates maximum 10-20% of CO_2 emissions can be used by CCU, thus CCS is unavoidable

Thank you

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