



ecra

european cement research academy

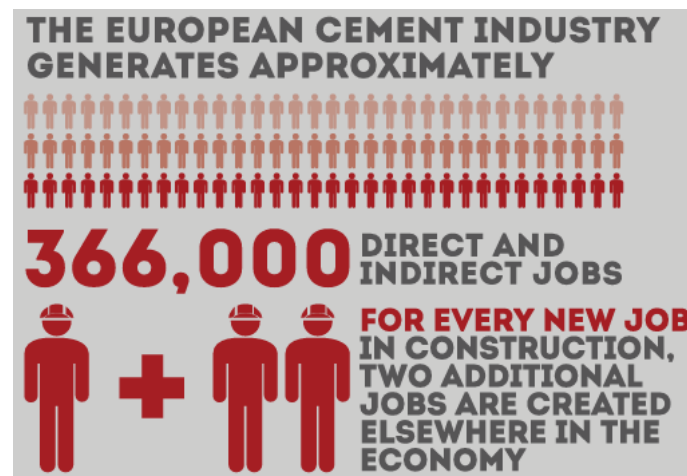
The cement industry's approach to carbon capture

Martin Schneider

AGENDA

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| 1 | Who is ECRA? |
| 2 | Potential capture solutions for the cement industry |
| 3 | ECRA's approach towards an industrial implementation of carbon capture |
| 4 | Envisaged next steps towards an industrial-scale oxyfuel cement kiln |

The European Cement industry



©CEMBUREAU: The role of cement in the 2050 low carbon economy
More information: www.cembureau.eu



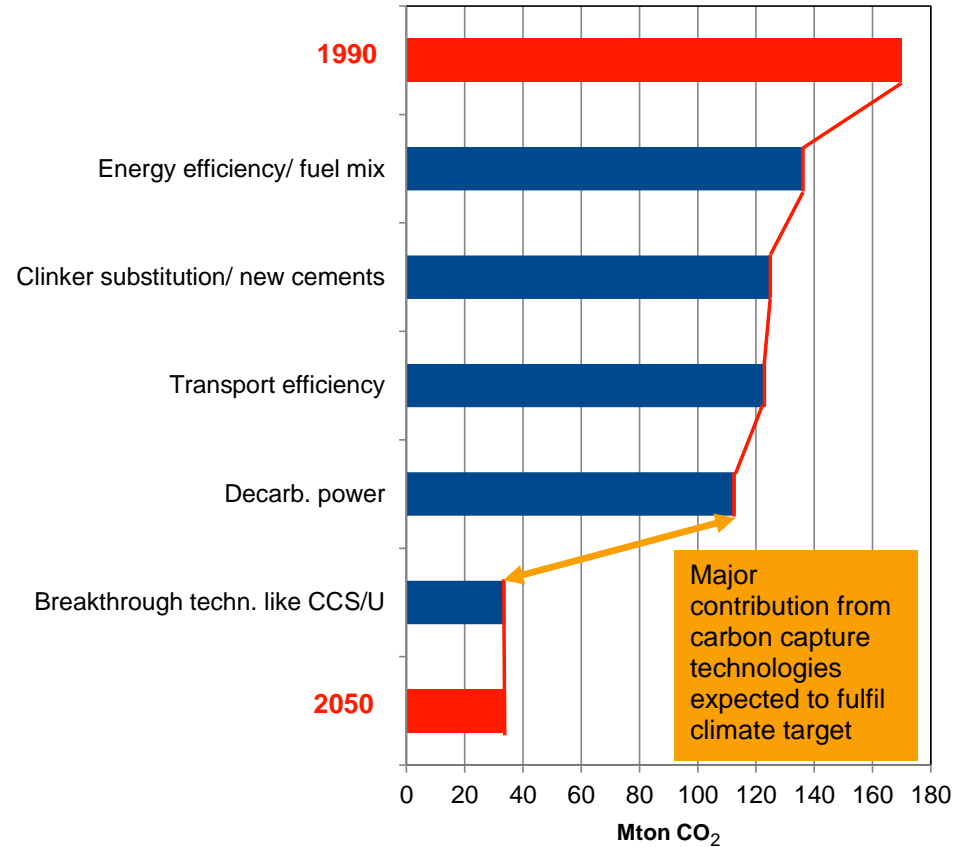
European Cement Research Academy

- The cement industry in Europe: a highly innovative sector, underlined by the establishment of ECRA in 2003.
- Members of ECRA: 47 cement manufacturers, associations and technology providers from mainly European but also non-European countries.
- Internationally recognised European research body in cement and concrete technology.
- Collaboration in R&D of technology providers and cement manufacturers to bring innovative products and improved manufacture processes to the market.
- Interrelations with associations to communicate the cement industry's activities.



Why carbon capture in the cement industry?

- All low-carbon roadmaps require a significant reduction of CO₂, also in the cement sector.
- Correspondingly and according to CEMBUREAU approx. 60% of cement plants in the EU should be equipped with CCS technology by 2050.
- Based on the need to develop this breakthrough technology, ECRA is investigating its technical and economic feasibility in its CCS research project.



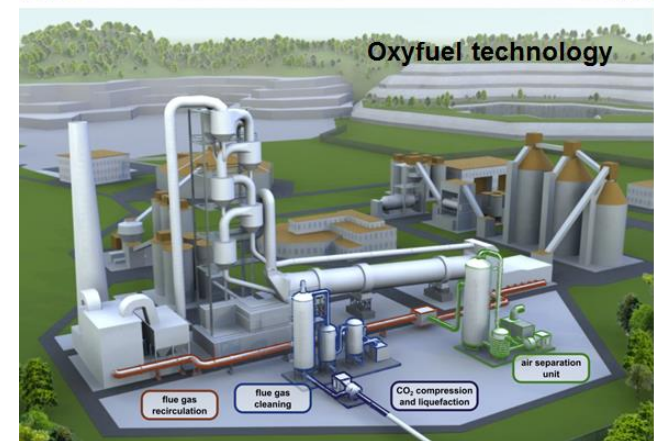
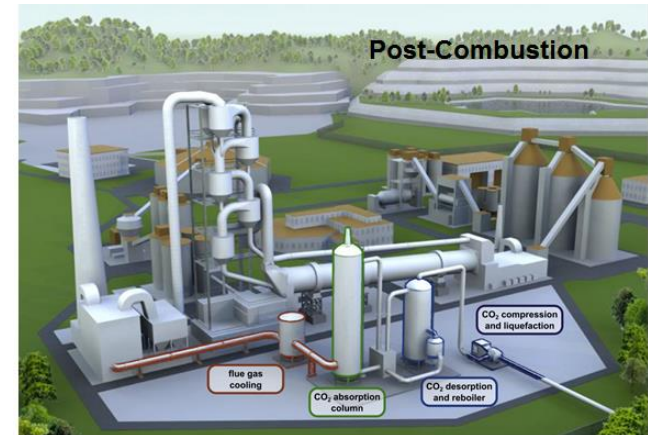
Potential capture solution for the cement industry

Post-Combustion: Tail-end separation of CO₂ from flue gas by e.g. chemical absorption, adsorption, membranes or Ca-looping.

- A very energy-intensive technology.
- Important projects: Norcem's Brevik project (pilot testing), CEMCAP (prototype testing).

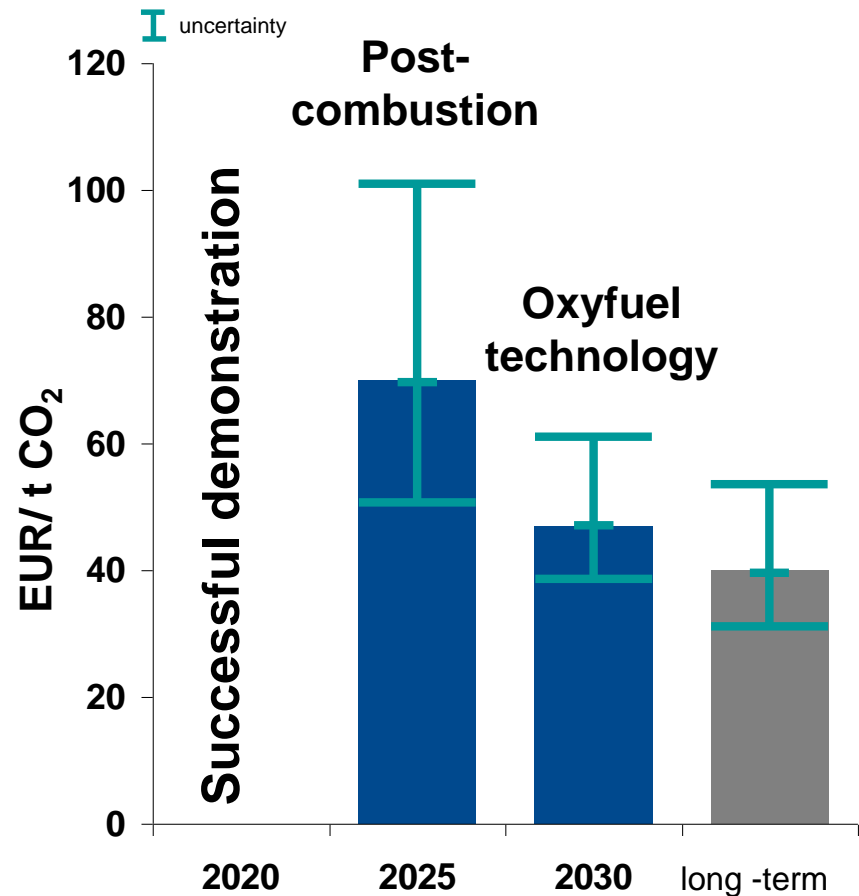
Oxyfuel Technology: Combustion with pure oxygen instead of air in combination with flue gas recirculation to increase the CO₂ concentration.

- Requires process and design adaptations.
- Important projects: ECRA (complete oxyfuel), LafargeHolcim/ AirLiquide/ FLSmidth (pilot testing of partial oxyfuel), CEMCAP (prototype testing).



Challenges of carbon capture

- Significant increase of production costs
- Currently, the legal and economic conditions of these technologies would impair the competitiveness of cement production.
- CO₂ 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

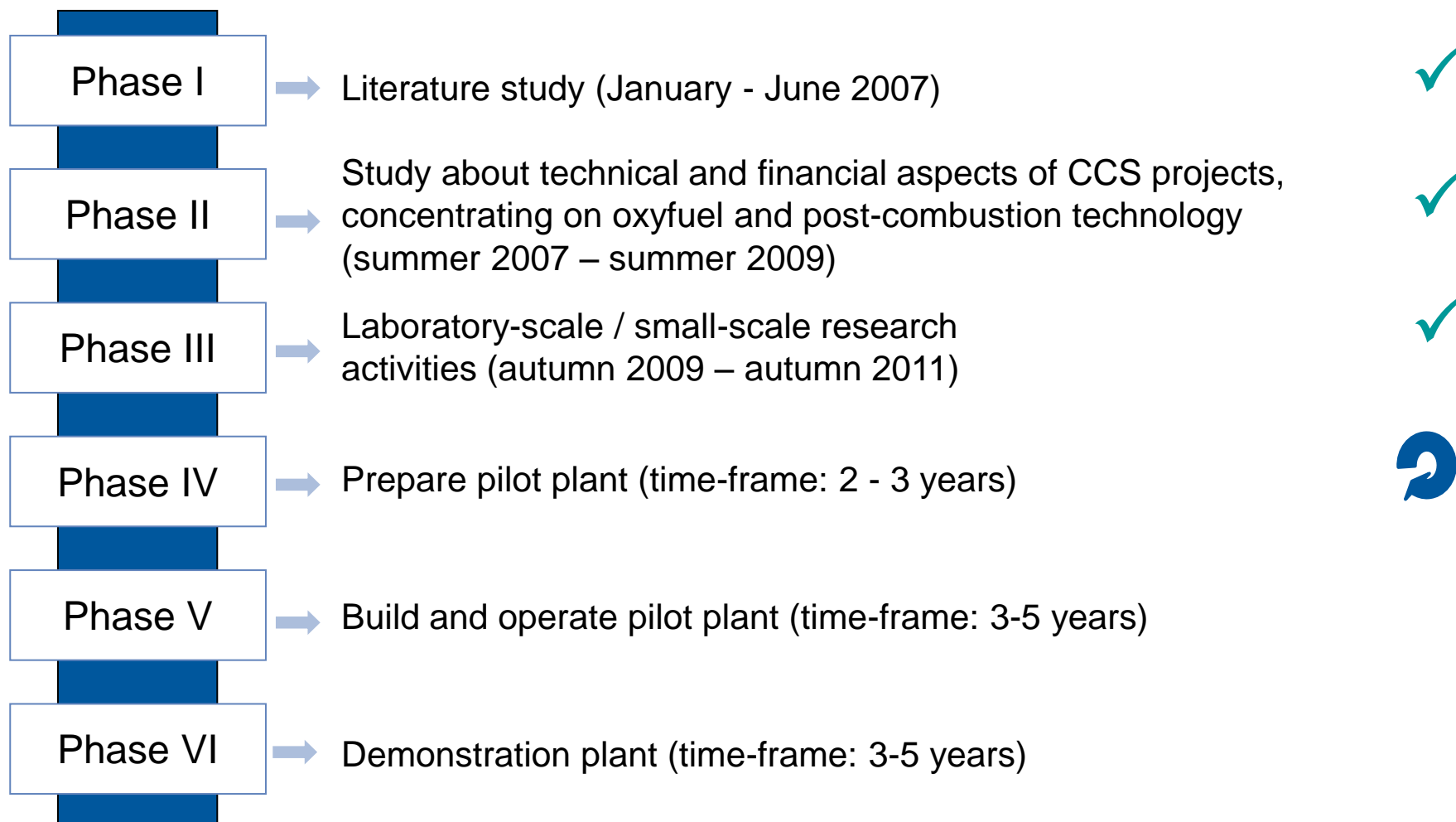


Post-Combustion: The Norcem Project

- Testing of Post-Combustion technologies in industrial surrounding:
 - Solid sorbents
 - Amine
 - Membrane
 - Calcium Looping
- Period: 2013 - 2016
- Evaluation concerning:
 - Suitability
 - Energy demand
 - CAPEX/OPEX
 - Capture rates
- Perspective: 40 – 50% capture rate based on waste heat utilization



ECRA's approach towards carbon capture



Organisation of the CCS project

Steering Committee

Buzzi Unicem	CEMBUREAU	cemsuisse
Cimpor TEC	CRH	CSI
HeidelbergCement	Italcementi	LafargeHolcim
MPA	Norcem	PCA
Schwenk	Secil	ThyssenKrupp Industrial Solutions
Titan	Vicat	VDZ

External project partner

Aixergee	Cinar
Danish Technical University	Fives FCB
IKN	IrishCement
Praxair	Refratechnik Cement

Cooperations

Université de Mons	Norcem Projekt	CEMCAP
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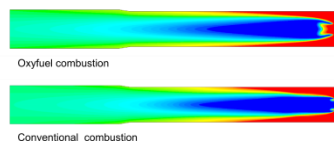
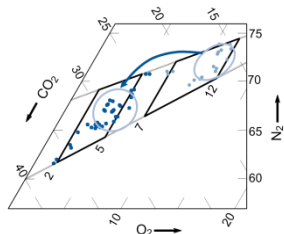


Quelle: Springerprofessional

Finalized oxyfuel research packages

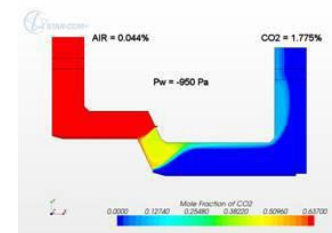
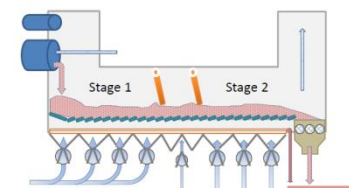


Plant operation and false air reduction

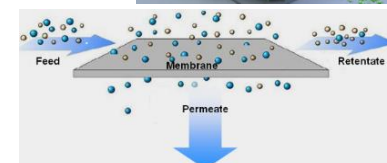
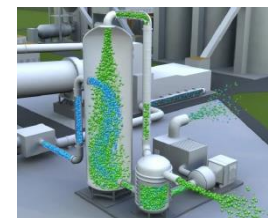


Burner design

Cooler design

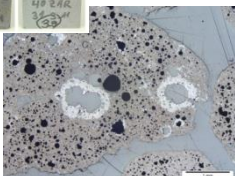


Future oxygen supply systems

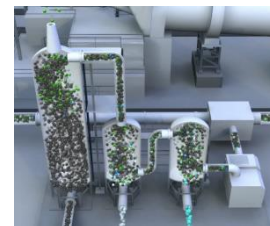


Source: Beilstein J. Org. Chem.

Refractory durability and material conversion



CO₂ conditioning unit



CO₂ reuse



Concept of an oxyfuel pilot kiln

Design

- Brownfield: New construction of a pilot plant using the infrastructure of an existing plant
- Blackfield: Retrofitting an old existing plant

Production capacity

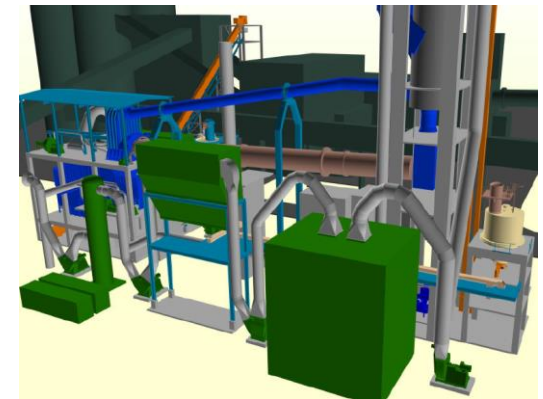
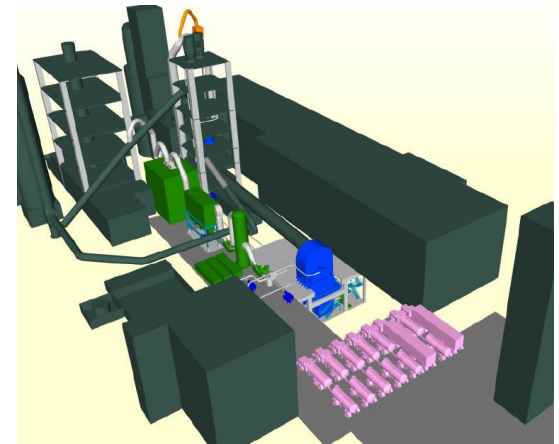
- Pilot scale: 500 - 1000 tato
- Lab scale: 10 - 100 tato

Feasibility

- Technological risk medium to low
- „New“ units (e.g. condenser) can be adapted from other industries

Time schedule

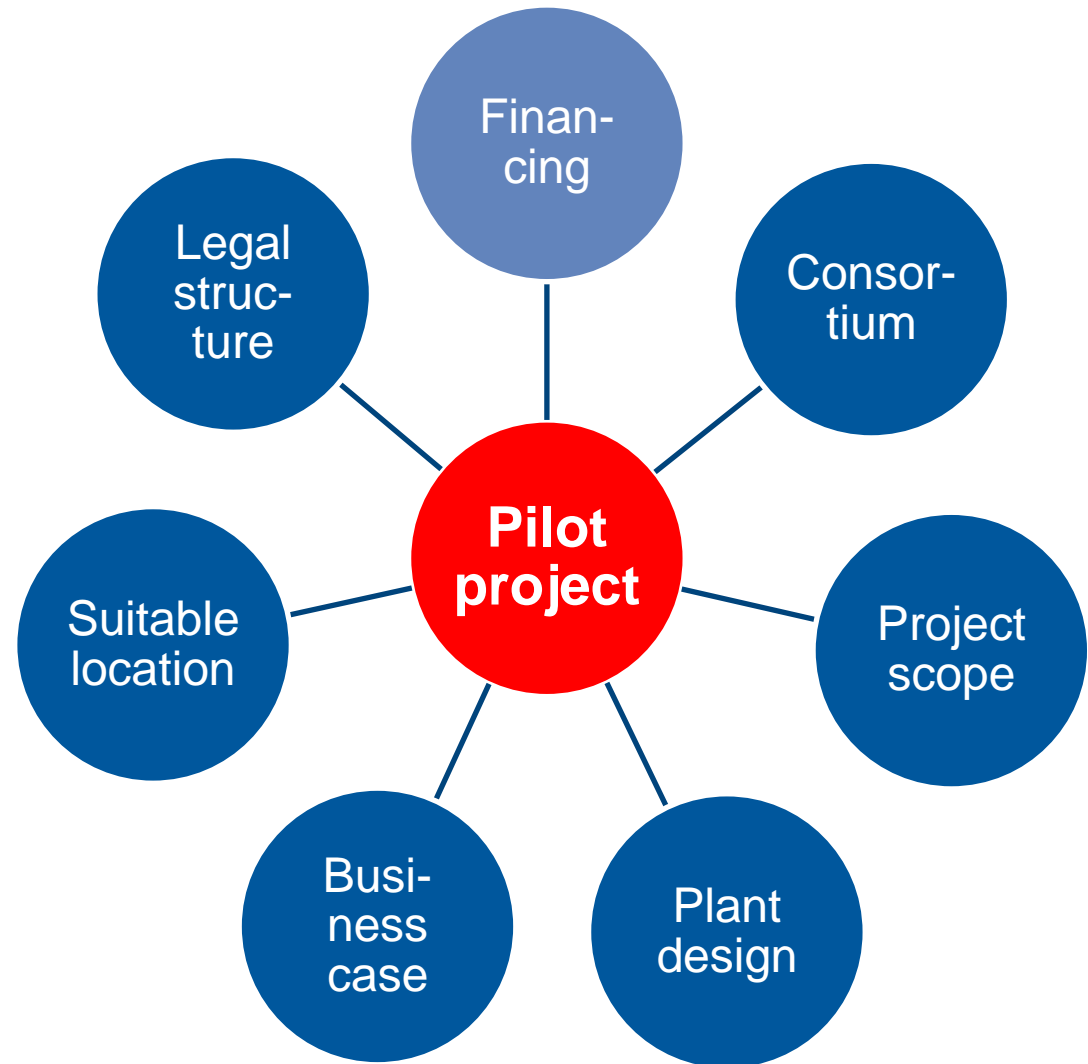
- Engineering and construction: 20 – 24 month
- 1-2 years project period



source: ThyssenKrupp Industrial Solutions

Organisation of a pilot plant

- Projects costs estimated at up to 90 M €.
- Project includes engineering/construction, training and operation/scientific evaluation.
- Project requires significant funding.
- Time horizon: Starting the project in 2017, the plant could be operated in 2019/2020.



Site selection process for an oxyfuel pilot plant

Plants selected for opportunity study:

Buzzi Unicem - Travesio plant, Italy

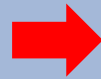
Holcim - Beli Izvor plant, Bulgaria

Opportunity
study
completed



Pre-selection 2015:

Buzzi Unicem - Travesio plant, Italy



No after use of the pre-selected plant
Re-opening the selection process for
plants with commercial after-use

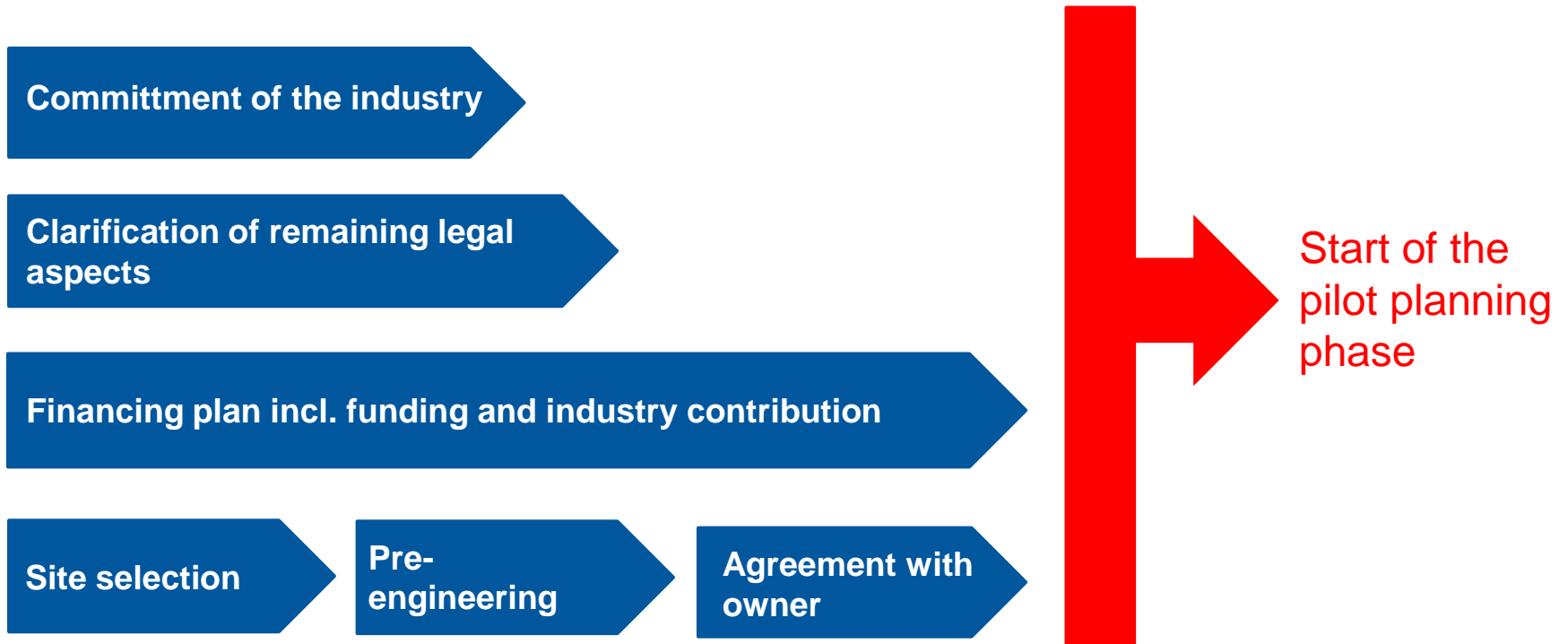


Re-opening 2016:

Heidelberg Cement - Slite plant, Sweden

Opportunity
study
ongoing

Current status and outlook





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