european cement research academy

ECRA CCS Project:
Status of the Pilot Plant Preparation

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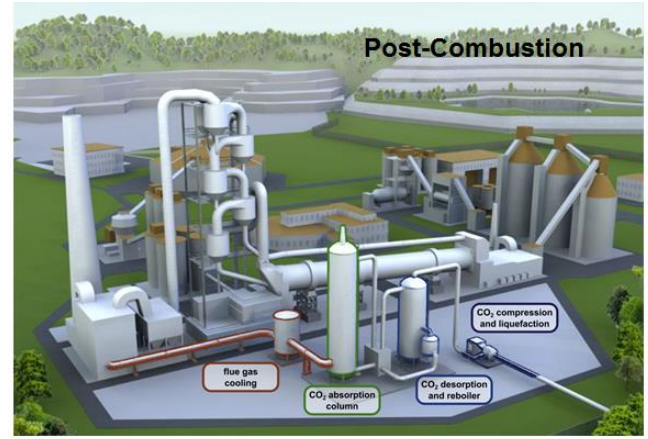
Potential capture solutions for the cement industry

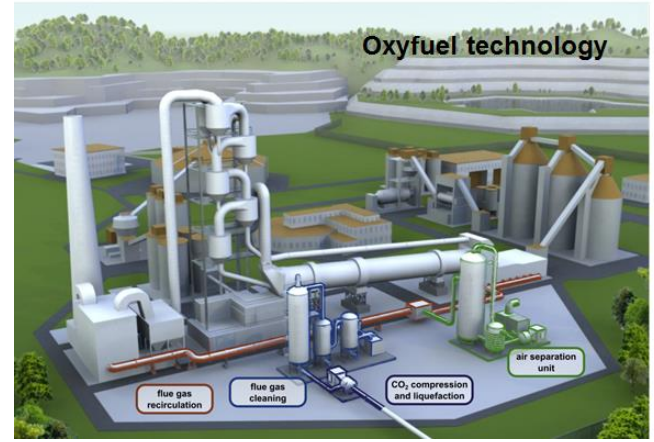
Post-Combustion: Tail-end separation of CO_2 from flue gas by e.g. chemical absorption, adsorption, membranes or Ca-looping.

- 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 CO_2 concentration.

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



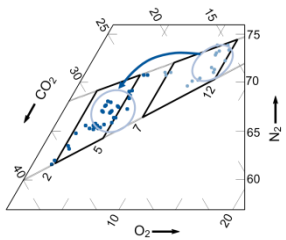


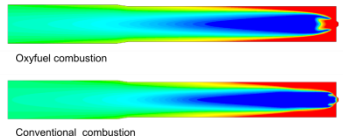
ECRA's CCS project

Phase I	Literature study (January - June 2007)	✓
Phase II	Study about technical and financial aspects of CCS projects, concentrating on oxyfuel and post-combustion technology (summer 2007 – summer 2009)	✓
Phase III	Laboratory-scale / small-scale research activities (autumn 2009 – autumn 2011)	✓
Phase IV	Prepare pilot plant (time-frame: 2 - 3 years)	
Phase V	Build and operate pilot plant (time-frame: 3-5 years)	
Phase VI	Demonstration plant (time-frame: 3-5 years)	

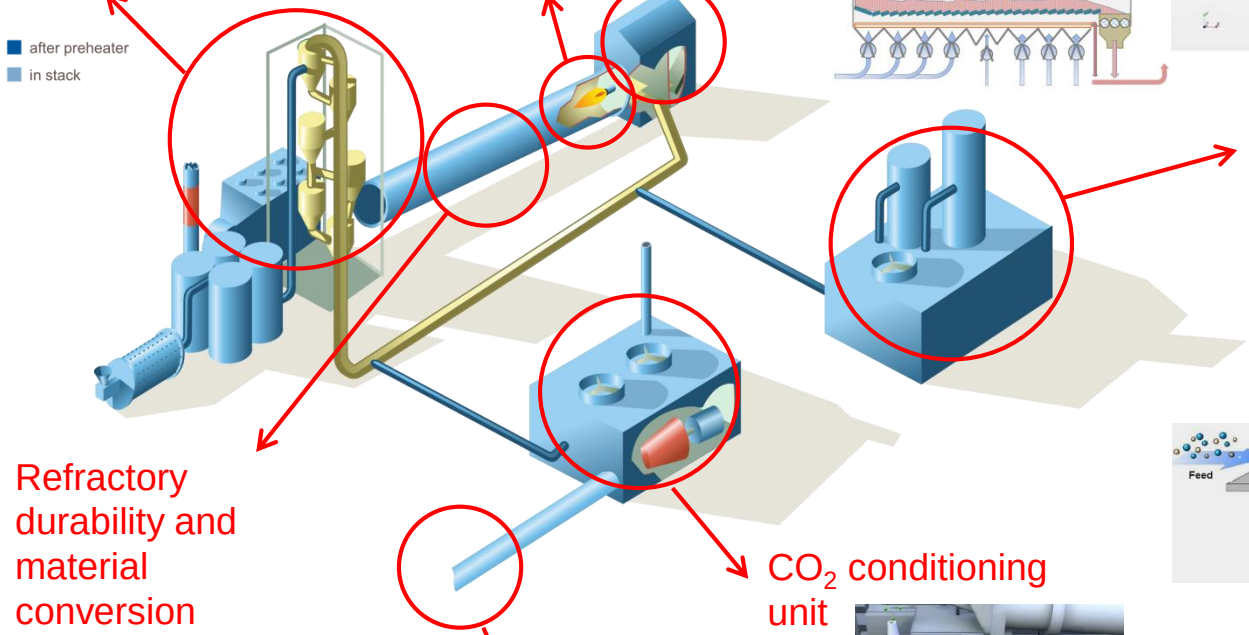
Finalised oxyfuel research packages

Plant operation and false air reduction

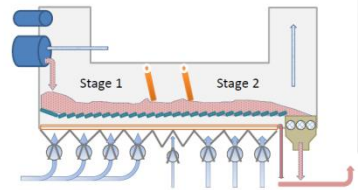


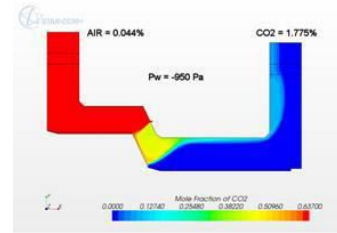


Burner design

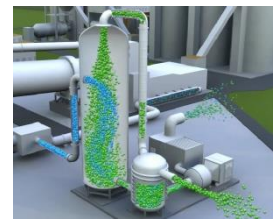


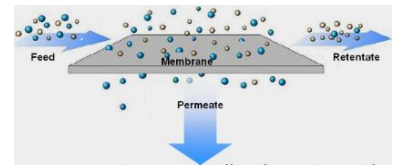
Cooler design





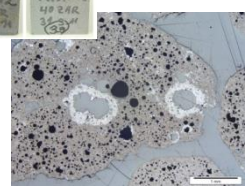
Future oxygen supply systems



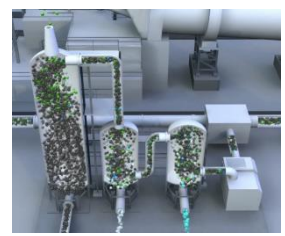


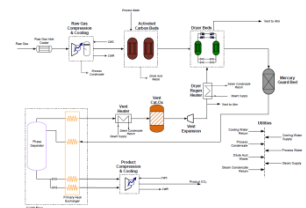
Source: Beilstein J. Org. Chem.

Refractory durability and material conversion



CO_2 conditioning unit





CO_2 reuse

Organisation of the CCS project

Steering Committee

Buzzi Unicem	CEMBUREAU	cemsuisse
Cimpor TEC	CRH	CSI
HeidelbergCement	Italcementi	LafargeHolcim
MPA	Norcem	PCA
SCHWENK Zement	Secil	ThyssenKrupp Ind. Solutions
TITAN	VICAT	VDZ

External project partners

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

Cooperation

University of Mons	CEMCAP
Norcem Project	

Concept of a pilot kiln

Design

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

Production capacity

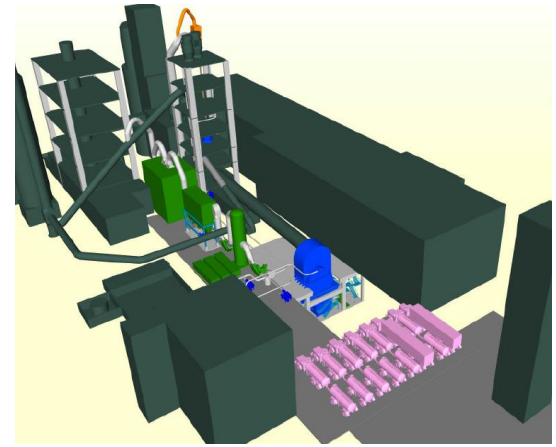
- Pilot scale: 500 - 1000 t/d
- Lab scale: 10 - 100 t/d

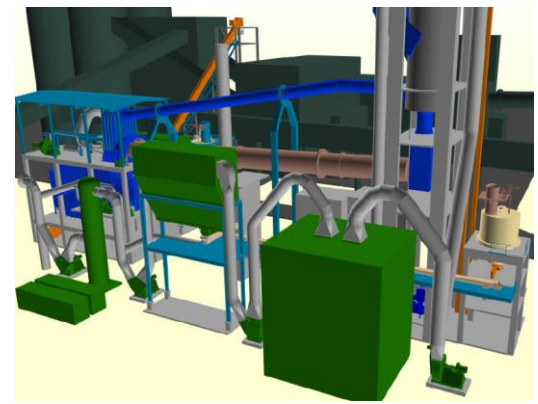
Feasibilty

- Technological risk medium to low

Time schedule

- Engineering and construction: 20 – 24 months
- 1-2 -year project period





source: ThyssenKrupp Industrial Solutions

Business case analysis

After-use	No after-use	Conventional after-use	Research center
Owner	Company (e.g. cement producer)	Comany (z.B. cement producer)	Research consortium
Risk	High funding rates necessary as no economic income is generated	Could become econ. viable Capacity is key factor	Unlikely to cover all running costs
Probability	medium - high	medium - high	low

Plant visits

Plant inspection from raw material supply to clinker handling:

- 3 Blackfield plants
- 1 Brownfield plant

Interviews with plant management:

- Logistics and staff availability
- Permitting procedure
- National funding scheme
- Plant availability/ access/ further use
- Openness/willingness towards the project

Investment Costs and Summary

	Brownfield	Blackfield A	Blackfield B
EPC Price (+/– 20 %)	38.2 Million EUR	28.5 Million EUR	48 Million EUR
Feasibility	VERY GOOD 	GOOD 	GOOD 
Risk	LOW 	MEDIUM 	LOW 
Schedule	24 MONTHS	20 MONTHS	24 MONTHS

Comparison of site options

	Plant A - Sweden	Plant B - Italy
Pilot design principle	Blackfield	Blackfield
After-use option	Conventional after-use	No after-use
Location	Sweden	Italy
Potential CO_2 storage (requiring in any case a CPU)	Possible liquid CO_2 shipping to the North Sea	No storage possibility in the proximity
Status	Running	Production closed in 2014
Capacity	1400 t/d	1000 t/d
Oxygen supply	Air separation onsite required	Tank system and truck supply

Comparison of site options

	Plant A - Sweden	Plant B - Italy
Technical feasibility	Good	Good
Technical risk *	Low - medium	Medium
Time for engineering and construction	24 months (necessary down-time of the plant minimum 6 weeks)	20 months
Testing phase	Limited due to kiln required for production	Unlimited
Staff/infrastructure	Available	No staff on-site Use of clinker unclear

Project costs: Details

Costs	Included	Plant A	Plant B
Investment costs according to TKIS*	Plant: Installed costs (Equipment+ steel work) and EPC (Engineering procurement construction) ASU: turn-key	26 M€ plant 22 M€ ASU	28.5 M€
Total plant costs	EPC costs + Contingency and fees (10% of installed plant costs excl. ASU)	+ 2 M€	+ 2 M€
Variable operational costs*	Consumables like power, fuels, process water, raw materials, oxygen	6.5 M€	6 M€
Fixed operational costs*	Maintenance, operational labour, administration, insurance, local taxes	4.5 M€	4 M€
Scientific evaluation, measurements	Measurement campaigns and new measurement equipment	1 M€	1 M€
Scientific evaluation, coordination	Coordination, evaluation, dissemination	0.5 M€	0.5 M€
Total project costs*		**62.5 M€**	**42 M€**

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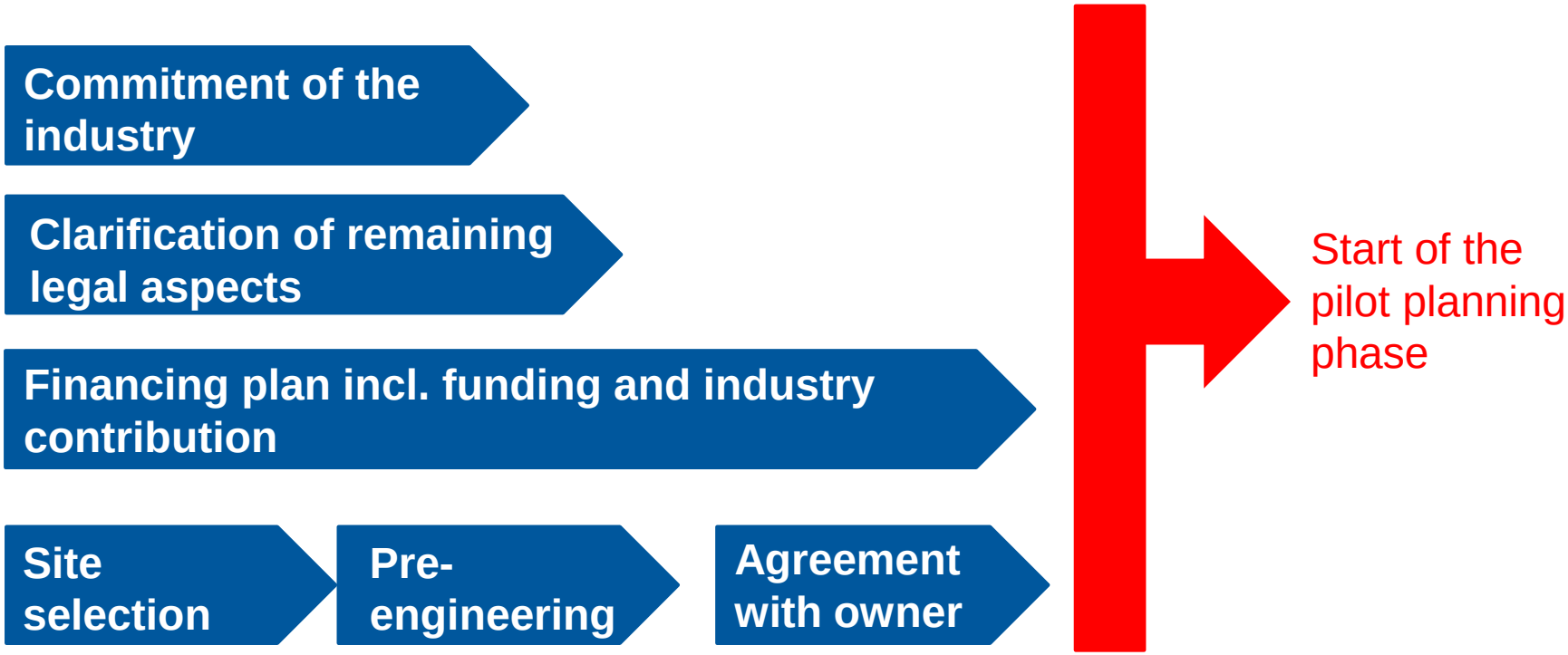
An additional plant still has to be evaluated

Current status and outlook



Funding the project

- ECRA members have committed themselves to around 15 M EUR
- PCA, the Portland Cement Association of North America, has indicated an additional contribution
- For the remaining gap:
  - ECRA will approach the European Commission once the overall project is sufficiently developed
  - ECRA will ask the Commission to set up a funding scheme comprising the different schemes offered by the various DGs

Summary and conclusion

- ECRA's carbon capture project is making good progress
- The site selection process is still ongoing
- The existing short list of plants show different advantages and disadvantages:
  - oxygen-supply: ASU vs. truck supply
  - operating vs. non-operating
  - after-use vs. non-after-use
  - capacity increase of the kiln vs. no change in capacity
- An additional plant still has to be evaluated
- External funding will be crucial

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