The Cement Sustainability Initiative (CSI)

A member-led program of the World Business Council for Sustainable Development (WBCSD)

IEA Global Industry Dialogue
Paris, 19 September 2013
Rob van der Meer, HeidelbergCement

Cement Sustainability Initiative
24 member companies

2002
2006
Now

One third global cement production
Two thirds outside of China

CSI Work Program

<u>Agenda for Action (2002)</u>

Measure, report, verify (+ reduce)

- CO_2 and Energy Management
- Use of fuels and raw materials
- Air emissions
- Safety
- Land use
- Communications
- Biodiversity

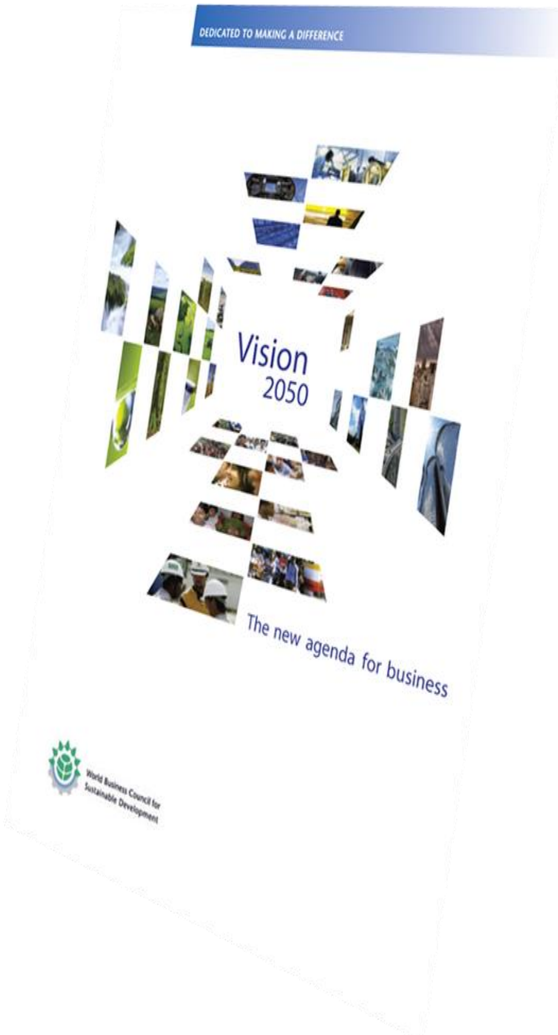
- Sustainable use of concrete

<u>CSI Future review (2010)</u>

- Water
- Co-processing
- Supply chain management

WBCSD Vision 2050 Roadmap

- A long-term vision for ***9 billion people in 2050, all living well within the limits of the planet***.
- Pathways with nine elements that lead to the vision.
- A recognition of the need for radical change to make Vision 2050 a reality.
- Significant opportunities identified for business.



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From Vision 2050 to Action2020

Vision 2050

- Long-term vision
- Pathways for transformation of society
- Qualitative impacts

Action2020

- Medium-term action at scale
- Must-Haves grounded in science
- Business solutions and associated policy requirements
- Quantitative metrics and monitoring process
- 9 Areas

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Key current activities of the CSI

- Cement Technology Roadmap (global, India, Brazil)
- GNR database
- CCS project
- UNFCCC standardized baselines project

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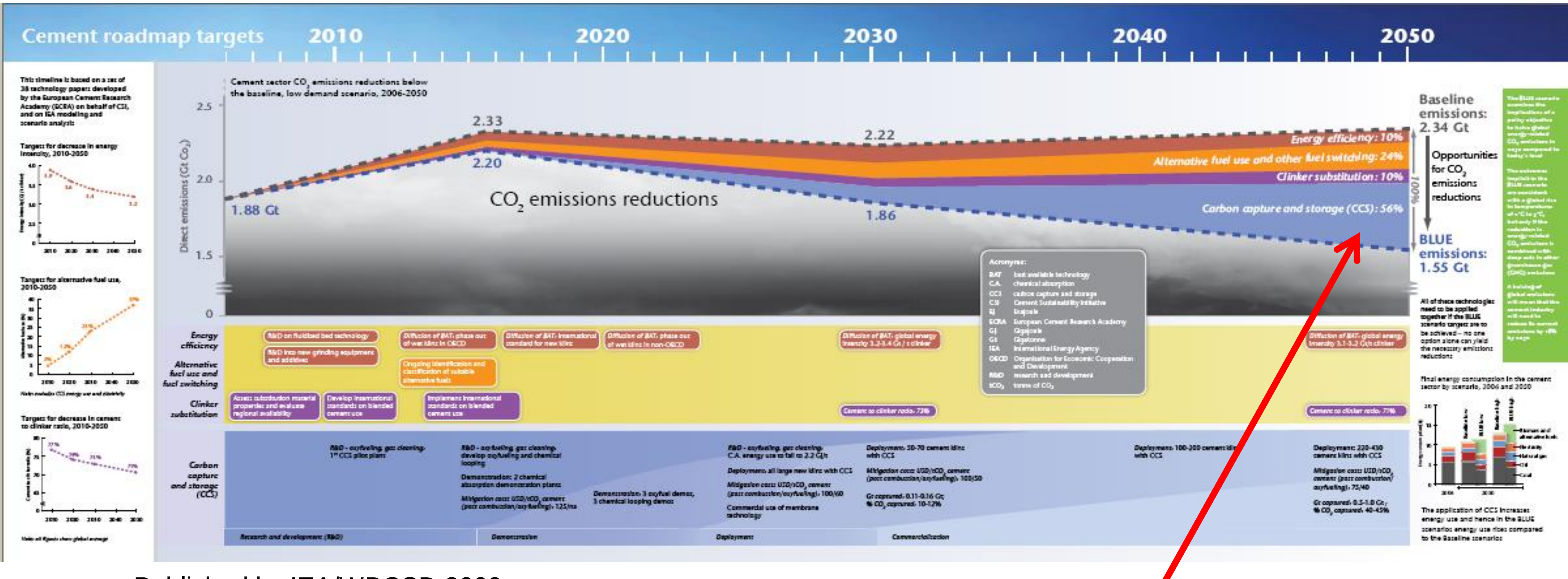
Cement Technology Roadmap



Published by IEA/WBCSD 2009

Emissions reduction levers:

- Energy efficiency
- Alternative fuels
- Clinker substitution
- CCS

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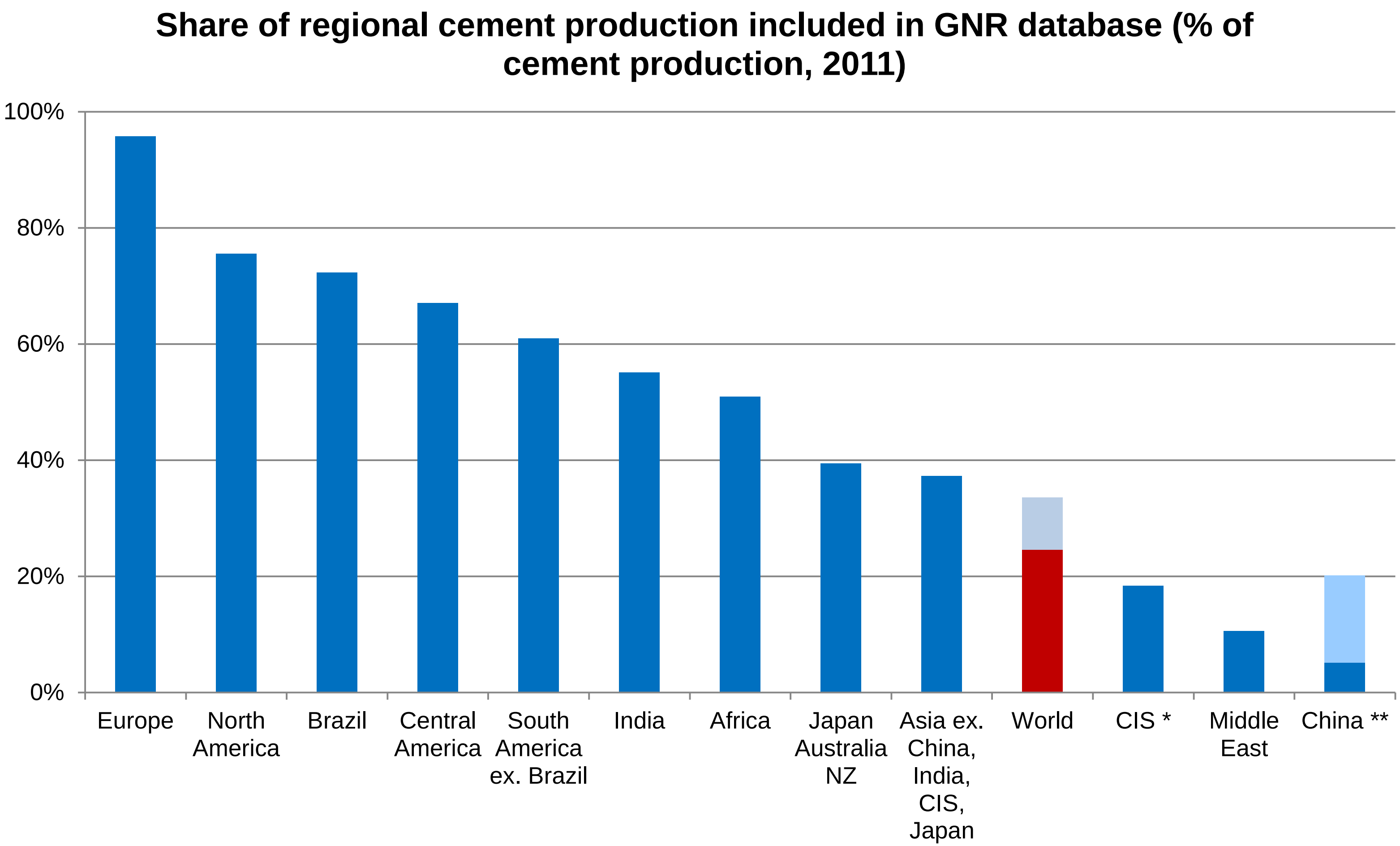
Progress

	GNR*		Roadmap	
	2005	**2011**	**2030 forecast**	**2050 forecast**
Heat consumption, MJ/t clinker	3,690	3,560	3,300-3,400	3,200
% alternative fuel (incl. biomass)	8.0	13.3	23-24	37
Clinker/cement ratio, %	78.8	75.6	73	71
CCS installations	-	-	50-70	200-400
Cement production, mt	746	880		

***GNR coverage (2011, latest data available):**

- 967 facilities
- 880 m tonnes cement (25% of global cement production)
- 95% of data is independently verified by 3rd parties

Global and regional coverage

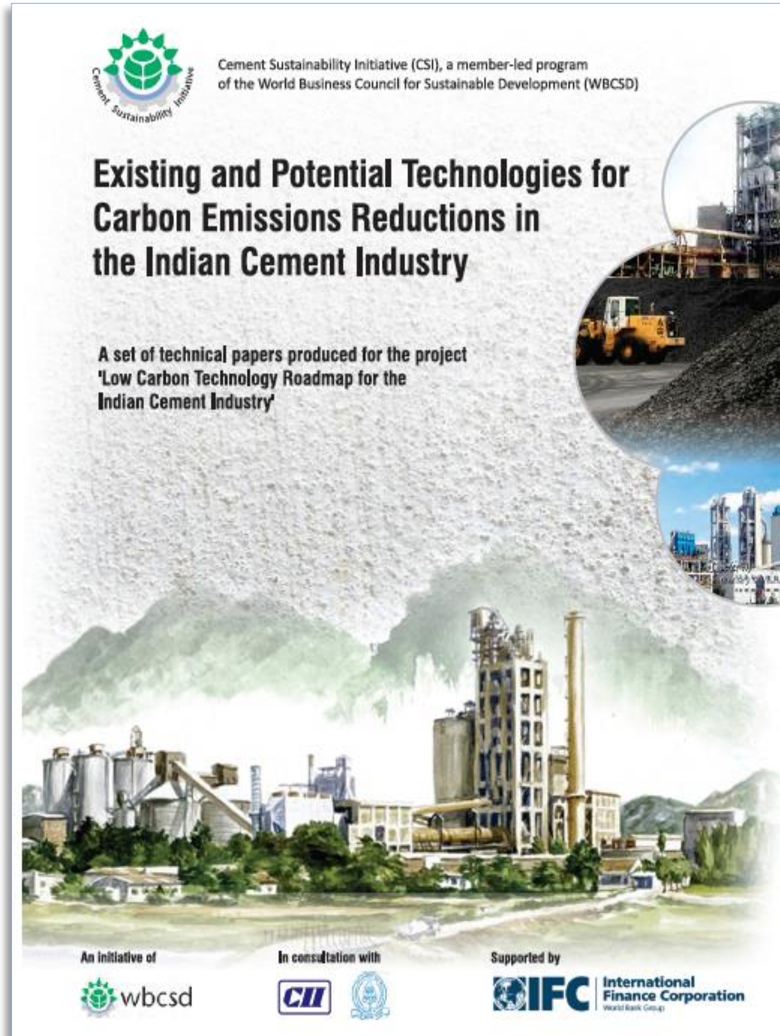


* CIS: Commonwealth of Independent States (former Soviet Union countries)

** China: In light blue, expected coverage in China and worldwide when all Chinese CSI members start reporting to GNR

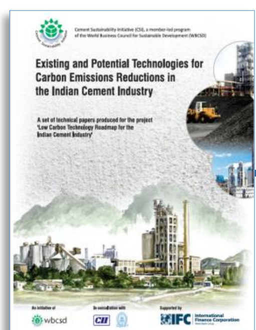
India Technology Roadmap: Technical papers

- 27 papers of existing and potential technologies
- Developed by Confederation of Indian Industry (CII)–Sohrabji Green Business Centre and the National Council for Cement and Building Materials (NCB), in consultation with industry
- 3 expert consultations with industry, technology suppliers, financers, policy-makers and regulators



Data modeling and roadmap drafting

Data collected for 2009-10 by CII		
	CSI members	**Non-CSI members**
Industry represented	67%	
Installed capacity	277.39 mtpa	
Clinker factor	0.721%	0.806%
GHG emissions	644 kg CO_2 / t cement	952 kg CO_2 / t cement
Average GHG emissions	719 kg CO_2 / t cement	



Cement demand data, data modeling and analysis (IEA)

Partner and stakeholder review

Stakeholder outreach

Roadmap structure

- Introduction
- Technology
- Vision for deployment to 2050
- Policy support and milestones
- Financial support and recommendation
- Roadmap action plan for key stakeholders

Foreword

Current trends in energy supply and use are unsustainable – economically, environmentally and socially. Without decisive action, energy-related emissions of carbon dioxide (CO_2) will more than double by 2050 and increased fuel demand will heighten concerns over the security of supplies. We can and must change our current path, but this will take an energy revolution and low-carbon energy technologies will have a crucial role to play. We must also ensure that investment decisions taken in the near term do not saddle us with sub-optimal technologies in the long term. Every major country and sector of the economy must be involved.

Awareness is growing of the urgent need to turn political statements and analytical work into concrete action. To spark this movement, the International Energy Agency (IEA) is leading the development of a series of roadmaps for key industries and some of the most important technologies. By identifying the steps needed to implement radical technology changes, these roadmaps will enable governments, industries and financial partners to make the right choices. This will in turn help countries and societies make the right decisions.

Since 2002, cement-producing companies in the Cement Sustainability Initiative (CSI), a project of the World Business Council for Sustainable Development (WBCSD), have collectively made significant progress on measuring, reporting and mitigating their CO_2 emissions, and sharing their progress with the rest of the cement industry. In 2009, recognising the urgency of identifying technology to reduce the energy use and CO_2 intensity of cement production, CSI member companies around the world (representing about 30% of global cement production) worked with the IEA to develop the first industry roadmap. That roadmap outlines emissions reduction potential from all technologies that can be implemented in the cement industry.

Building on the success of the global roadmap, IEA and CSI, in collaboration with the Confederation of Indian Industry (CII) and the National Council for Cement and Building Materials (NCB), joined together to develop a roadmap specifically for the Indian cement industry. This initiative was supported and part-funded by the International Finance Corporation (IFC).

In 2010, the Indian cement industry's share of the country's total energy and process CO_2 emissions was around 7%. Taking into account the specificities of the Indian context, markets and opportunities, this roadmap outlines a possible transition path for the Indian cement industry to support the global goal of halving CO_2 emissions by 2050. The roadmap estimates that the Indian cement industry would reduce its direct CO_2 emissions intensity to 0.35 tonnes (t) of CO_2/t cement in 2050, about 45% lower than current levels, a saving of between 212 million tonnes of CO_2 ($MtCO_2$) and 367 $MtCO_2$ compared to a business-as-usual scenario. This is nearly as much as the 2009 total energy-related emissions of Thailand (228 $MtCO_2$) or Indonesia (376 $MtCO_2$). Despite this improvement in CO_2 intensity, the total emissions, however, would rise from the current 137 $MtCO_2$ to between 275 $MtCO_2$ and 468 $MtCO_2$ in 2050 due to rapid growth in cement demand, in line with economic growth in India.

The vision is realistic; the targeted reductions ambitious. The changes required must be practical, realistic and achievable. This roadmap is a first step. It is attainable only with a supportive policy framework and appropriate financial resources invested over the long term. The roadmap outlines these policies, estimates financial requirements, and describes technical changes, along with making recommendations to support research and development and future decision making for investment.

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Executive Director, IEA

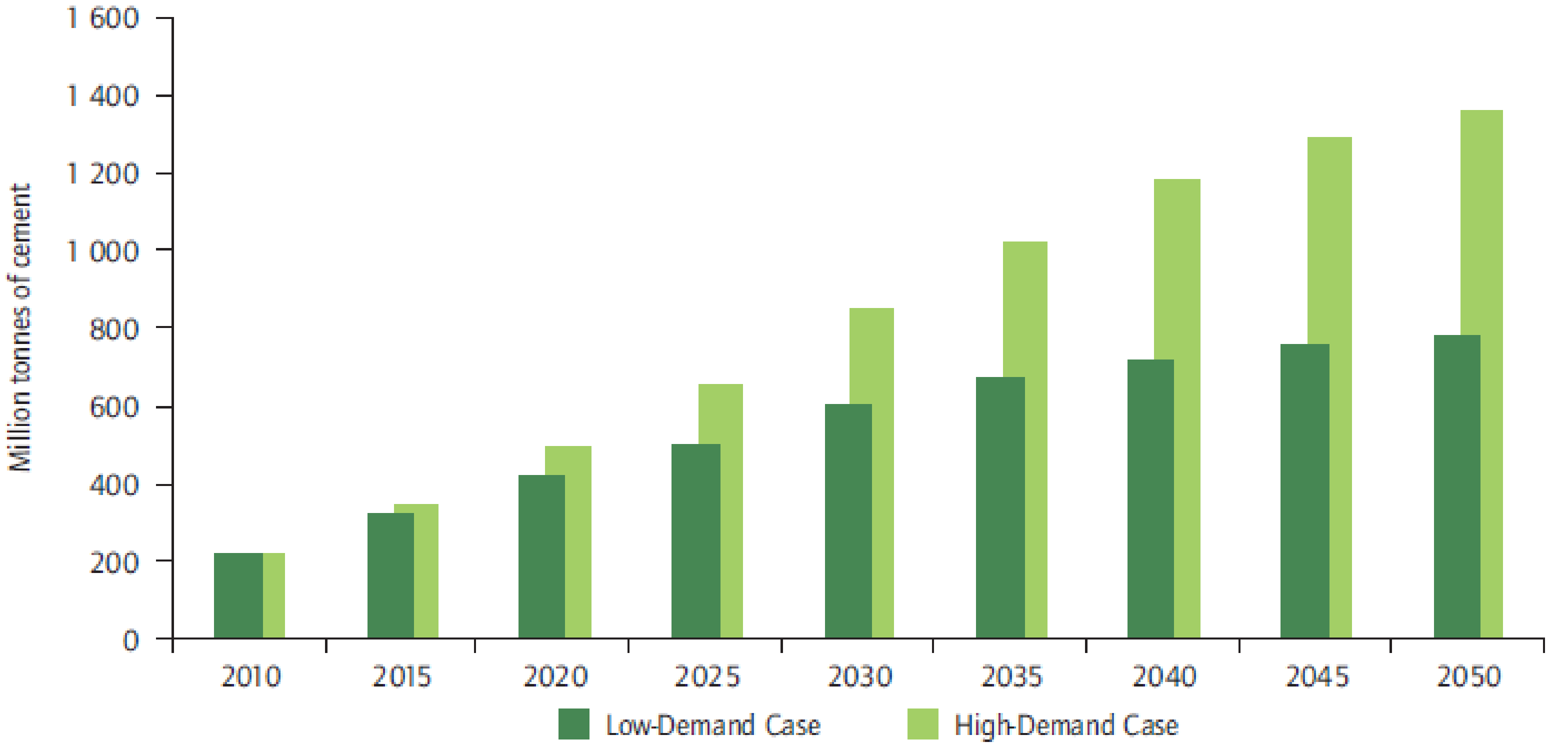
Peter Bakker
President, WBCSD

Kuldip Kaura
CEO and Managing Director
(ACC Ltd., project co-chair)

Ratan K Shah
Group Executive President
and Chief Manufacturing Officer
(UltraTech Cement Ltd., project co-chair)

Mahendra Singhi
Executive Director
(Shree Cement, project co-chair)

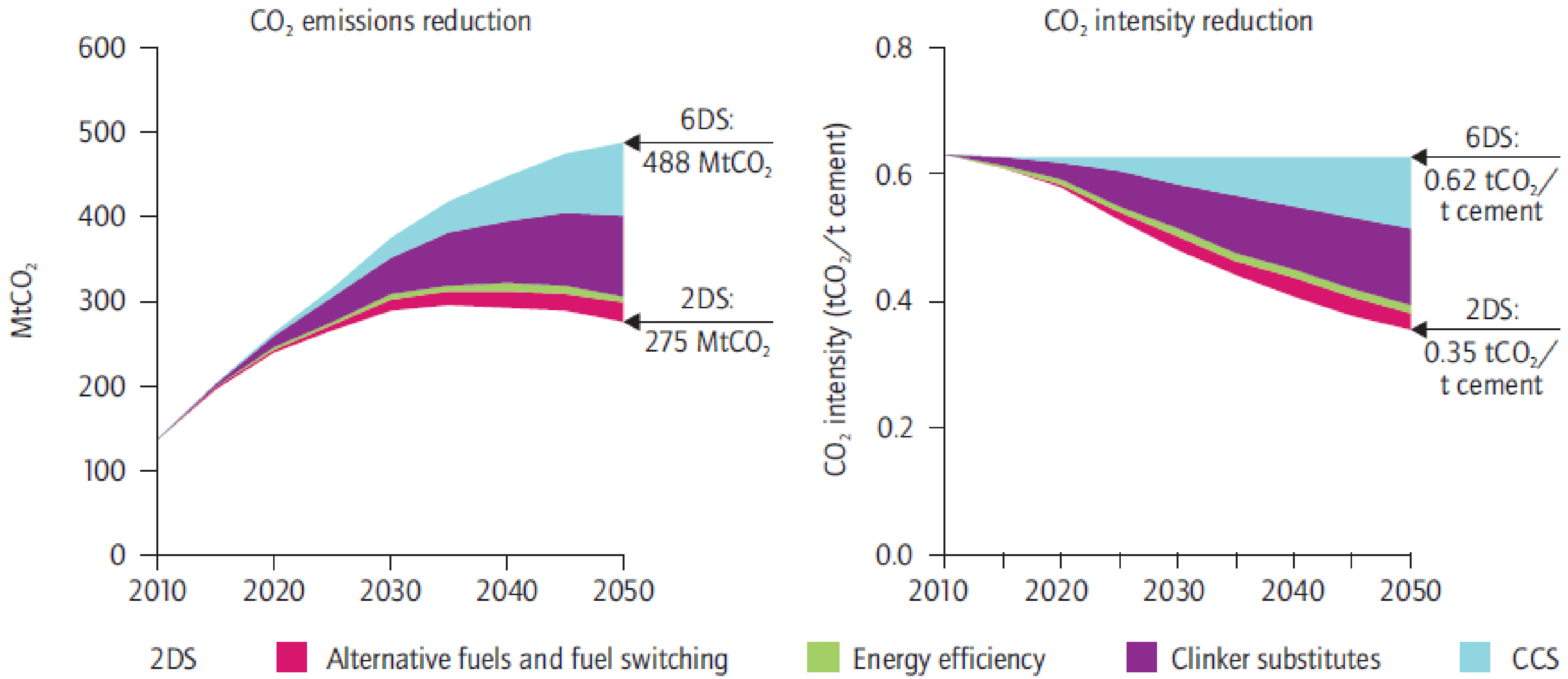
The development of India cement production



KEY POINT: Cement production is projected to increase between 3.6 and 6.3 fold between 2010 and 2050.

Goals

Roadmap findings



Notes: Includes only direct CO_2 emissions from cement manufacturing; indirect emissions from the use of electricity are not taken into account.

KEY POINT: Total savings between the 6DS and 2DS amount to 212 $MtCO_2$.

Milestones

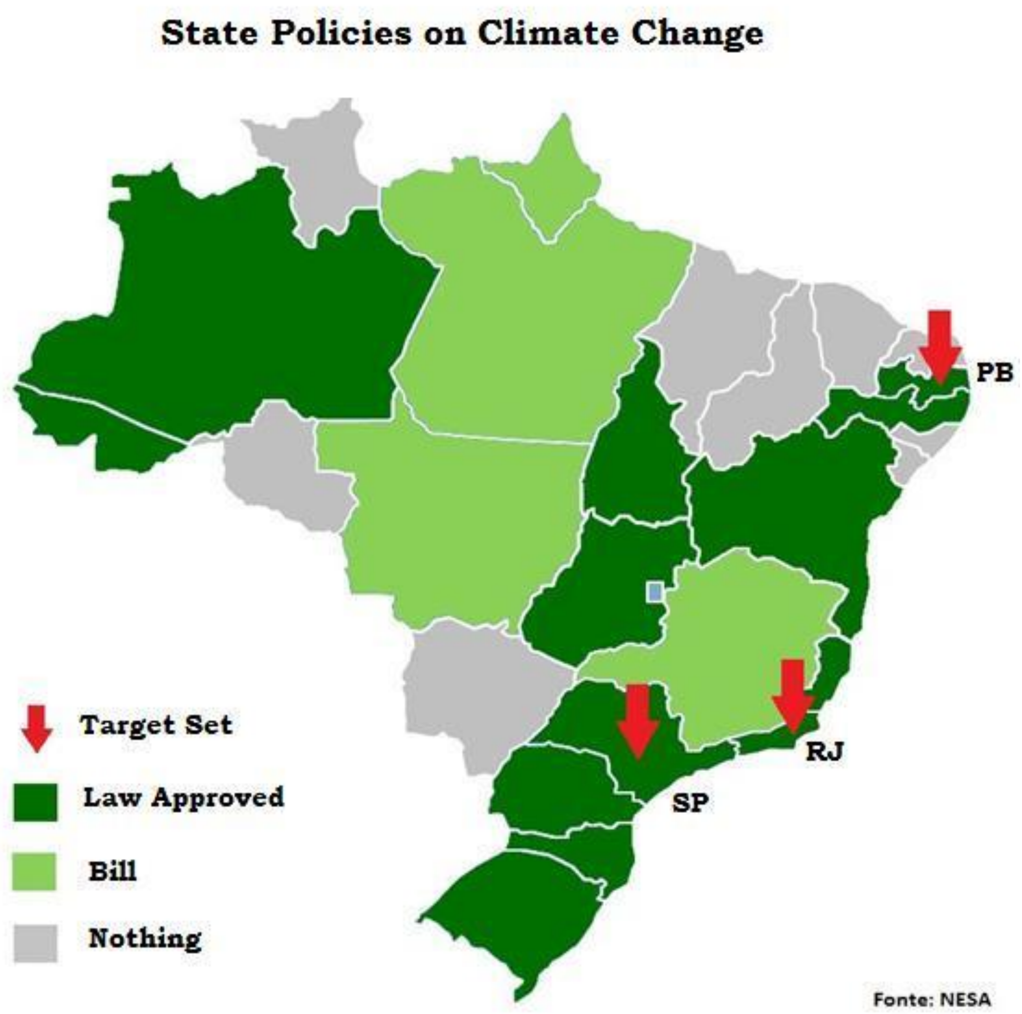
Key indicators for Indian cement industry in the 2DS

		Low-Demand Case			*High-Demand Case*		
	2010	**2020**	**2030**	**2050**	**2020**	**2030**	**2050**
Production (Mt)	217	416	598	780	492	848	1 361
Per-capita consumption (kg/capita)	188	309	400	467	364	565	812
Clinker-to-cement ratio	0.74	0.70	0.64	0.58	0.70	0.64	0.58
Electric intensity of cement production (kWh/t cement)	80	76	73	71	75	72	70
Thermal intensity of clinker production (kcal/kg clinker)	725	709	694	680	703	690	678
Alternative fuel use (as a share of thermal energy consumption) (%)	0.6	5	19	25	5	19	25

Notes: Data for 2010 is for financial year 2009/10 ending 31 March 2010. The electric intensity of cement production does not include the reductions that may come from the use of WHR.

Cement Technology Roadmap Brazil

- Several states in Brazil are establishing state regulation
- Goal: Elaborate an internal mapping, with consensus of the industry, portraying the real potential
- Guide for decision makers
- Cooperation between CSI, SNIC, ABCP, IEA, IFC
- Timeframe: 18 months



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ECRA CCS Project: Research Agenda

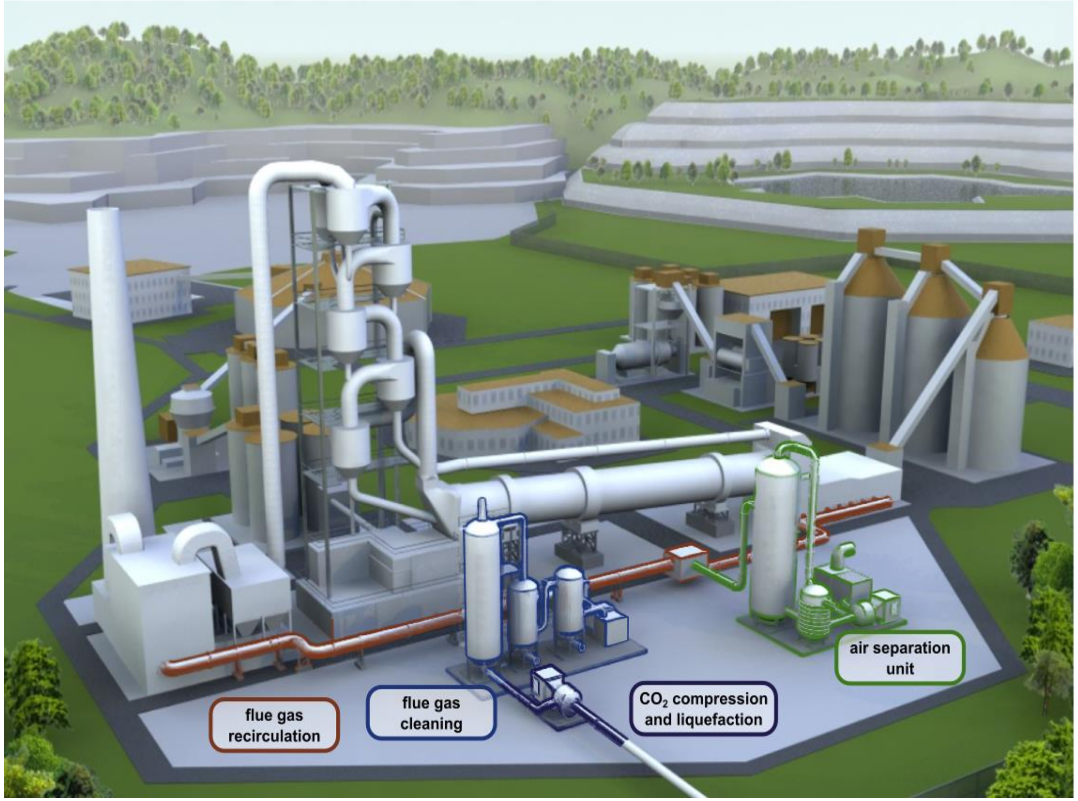
Phase I	Literature study (January - June 2007)	✓
Phase II	Study about technical and financial aspects of CCS projects, concentrating on oxyfuel and post-combustion technology (summer 2007 – summer 2009)	✓
Phase III	Laboratory-scale / small-scale research activities (autumn 2009 – autumn 2011)	✓
Phase 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)	

Oxy-fuel technology

Combustion with pure oxygen instead of ambient air

Flue gas recirculation to regulate temperature level

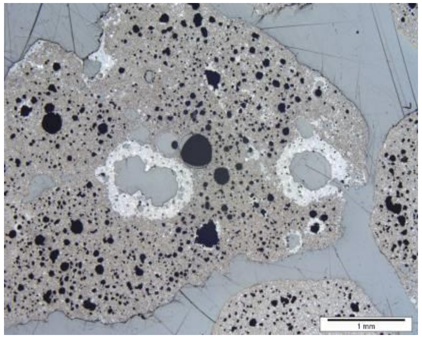
Integrated system

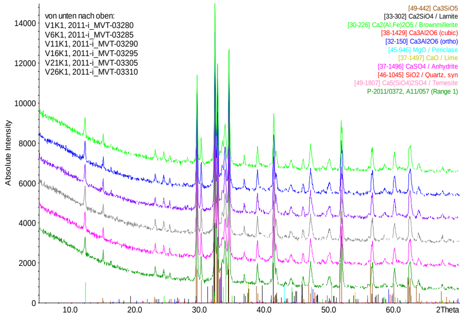


Doubling of the electrical energy demand per tonne of produced cement

Thermal energy demand constant

Limiting factors by quality and durability requirements

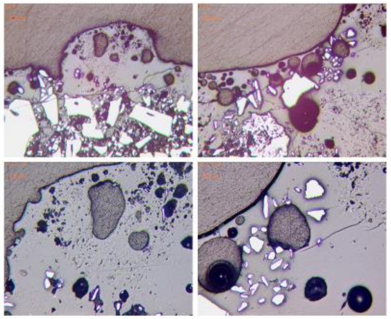




- No serious influence on clinker composition
- Slight differences in cement properties (caused by Fe^{2+}) are in range of assured quality

- No negative influence on basic refractory material detected
- Using non-basic materials an increasing thermo-chemical reaction expected
- Adaption of refractory brickwork necessary
- Long-term test for evaluation advisable

No barriers expected from clinker quality and refractory durability



ecra

Flue gas conditioning decisive issues

Main influencing parameter: degree of false air intrusion

Cost of CO_2 compression and purification ranges

* at power costs of 0.071 €/kWh

- from about € 24 to about € 27/ton* depending on false air intrusion and CO_2 purity

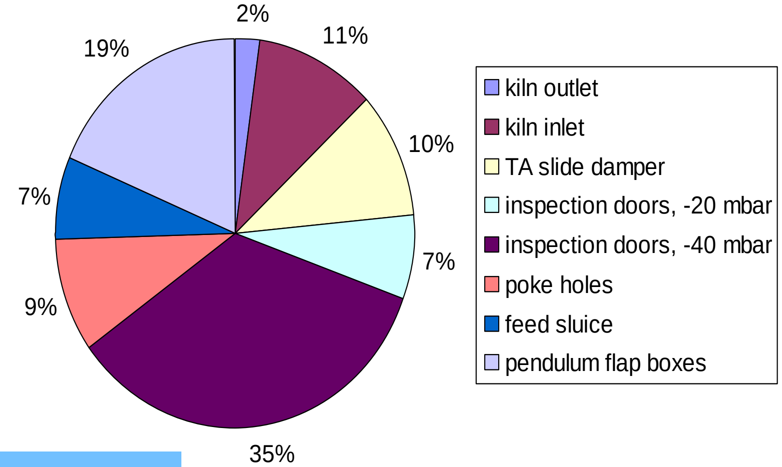
Capture rate of 90% possible.

At higher cost level capture rates of 99% are achievable.

Major intrusion from sealing locations like doors and poke holes

Improved maintenance of these locations (gap reduction of 25%) would reduce intrusion to 6%.

Singular sealing locations at kiln can be equipped with seal gas technology

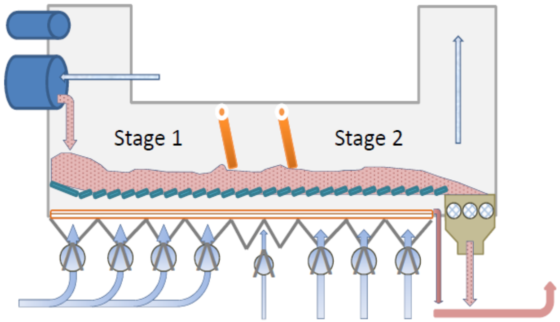


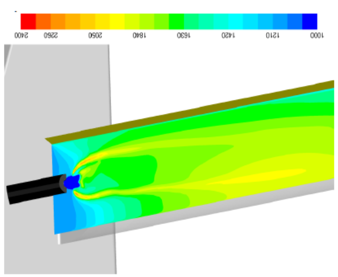
Slight cost increase of CPU by impurities. Decrease of false air by improved maintenance sufficient

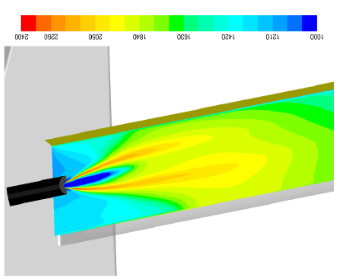
Not only CO2 captured !
SO2, Nox, heavy metals, etc

Retrofitting boundaries

- Important aspect for the application of oxy-fuel in Europe
- Retrofitting an existing burner for oxy-fuel application is unlikely, but replacement by a suitable design is possible
- Designing a gas-tight two-stage cooler is feasible
- False air intrusion could be reduced to the greatest possible extent by overhauling/ replacing inspection doors and similar devices (< 6%)
- New safety and controlling devices necessary
- Space requirements of ASU/CPU
- Conventional behavior in trouble shooting restricted (no opening of doors/flaps in the plant etc.)

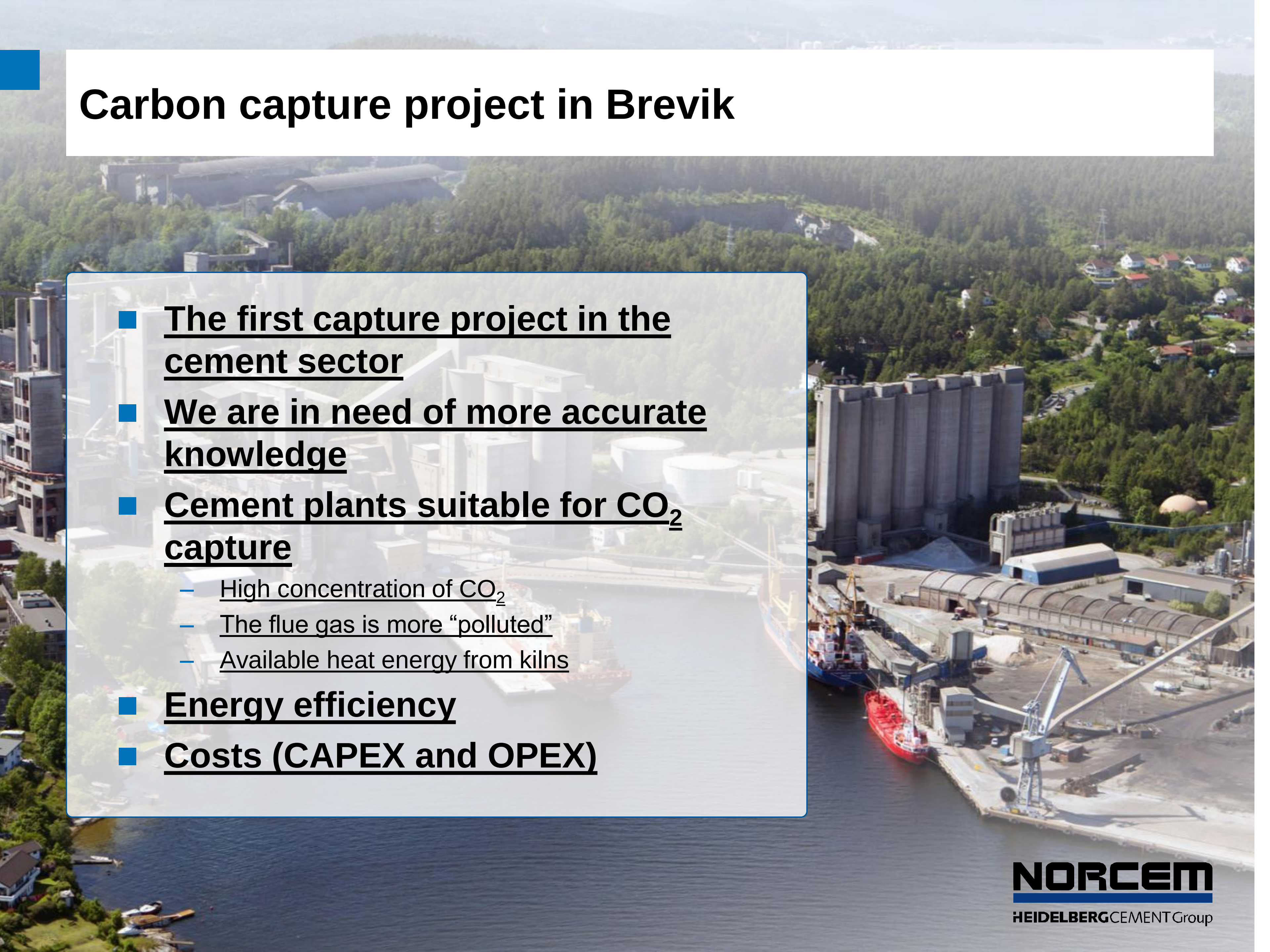






<u>Less limiting factors for retrofitting than expected</u>

Carbon capture project in Brevik



- **The first capture project in the cement sector**
- **We are in need of more accurate knowledge**
- **Cement plants suitable for CO_2 capture**
  - High concentration of CO_2
  - The flue gas is more “polluted”
  - Available heat energy from kilns
- **Energy efficiency**
- **Costs (CAPEX and OPEX)**

NORCEM
HEIDELBERGCEMENT Group

Four capture technologies for testing in Step 1

Technology	Supplier	
Amine technology	Aker Clean Carbon	
Membrane technology	DNV KEMA, NTNU & Yodfat Engineers	
Solid sorbent technology	RTI	
Calcium Cycle (Carbonate Looping, RCC)	Alstom Power	

UNFCCC standardized baselines discussion

- Technologies assessed:
  1. Clinker technology switch (fuel CO_2/ton clinker + power)
  2. Raw material switch clinker production (process CO_2/ton clinker)
  3. Technology switch cement grinding (power CO_2/ton cement)
  4. Raw material switch cement production (clinker / cement factor?)
- Thresholds
  - Baseline threshold at 80% performance of "common practice segment"
  - Crediting threshold to be defined
- Data
  - CO_2 data: CSI proposal to use GNR database
  - Operational costs data collected by DNAs: power, energy, etc.
  - Technology switch data on high level based on external sources with support of CSI

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Proposal model for cement technologies costs

- For the CDM standardized baseline concept information on costs and efficiency of technologies is needed. Due to the differences in regions/countries, global information is not directly applicable.
- A model can be developed on basis on todays/future technologies and already available information on basis of standardized kiln: 5.000 tpd clinker.
- Additional information on historical technologies (still in operation) could be added. But this is more complex due to differences in production capacity.
- Concept: Global model with country/regional specific information

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Country/Regional specific information needed

- Information based on European data / defaults values
- Country/Regional specific information to adapt

Topic	**EU information** (basis model)	**India factors** (example)	**China factors** (example)
Investment	xxx M€	0,50	0,33
Labour intensity	xxx employee/t clinker	4	3
Labour costs	Xxx €/(employee.year)	0,10	0,25
Fossil fuels costs	xxx €/GJ	2	0,8
Power costs	xxx €/MWhr		
Alternative fuels costs	xxx €/GJ	2	1,5
Clinker substitutes costs	xxx €/ton	2	1,5
Clinker quality	1 (standard)	0,85	0,90
Alternative fuels rate	30%	5%	5%
Clinker substitution rate	70%	60%	60%
Cement to concrete ratio	300 kg/m^3	600 kg/m^3	450 kg/m^3

A. Quarry

B. Clinker chemistry

C. Alternative fuels

D. Clinker process

E. Clinker substitution

F. Cement grinding

G. Cement substitution

Scenario's todays/future processes

(basis: 5.000 tpd clinker kiln)

A. Quarry
   1. Default values for common processes (transport, fans, etc.)
   2. 3 Raw materials grinding processes

B. Clinker chemistry factor
   1. Clinker quality factor identifying intensity of clinker process. Three values corresponding to ????

C. Alternative fuels rate
   1. Proposal 5 values: 0%, 10%, 20%, 50%, 80%
   2. Biomass rate for all alternative fuels set at 30%.

D. Clinker process
   1. Default values for common processes (transport, cooler, fans, etc.)
   2. Maximum 20 different clinker production processes

E. Clinker substitution
   1. Proposal 4 values: 60%, 70%, 80%, 90%

F. Cement grinding
   1. Default values for common processes (transport, fans, packaging, dispatch, etc.)
   2. Maximum 3 different grinding processes

G. Cement substitution: cement content in concrete
   1. 3 Values: 300 kg/m^3, 450 kg/m^3, 600 kg/m^3

Number of scenarios
A: 3
B: 3
C: 5
D: 20
E: 4
F: 3
G: 3
Total 32.400

Thank you!

Info: www.wbcsdcement.org; www.csiprogress2012.org
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