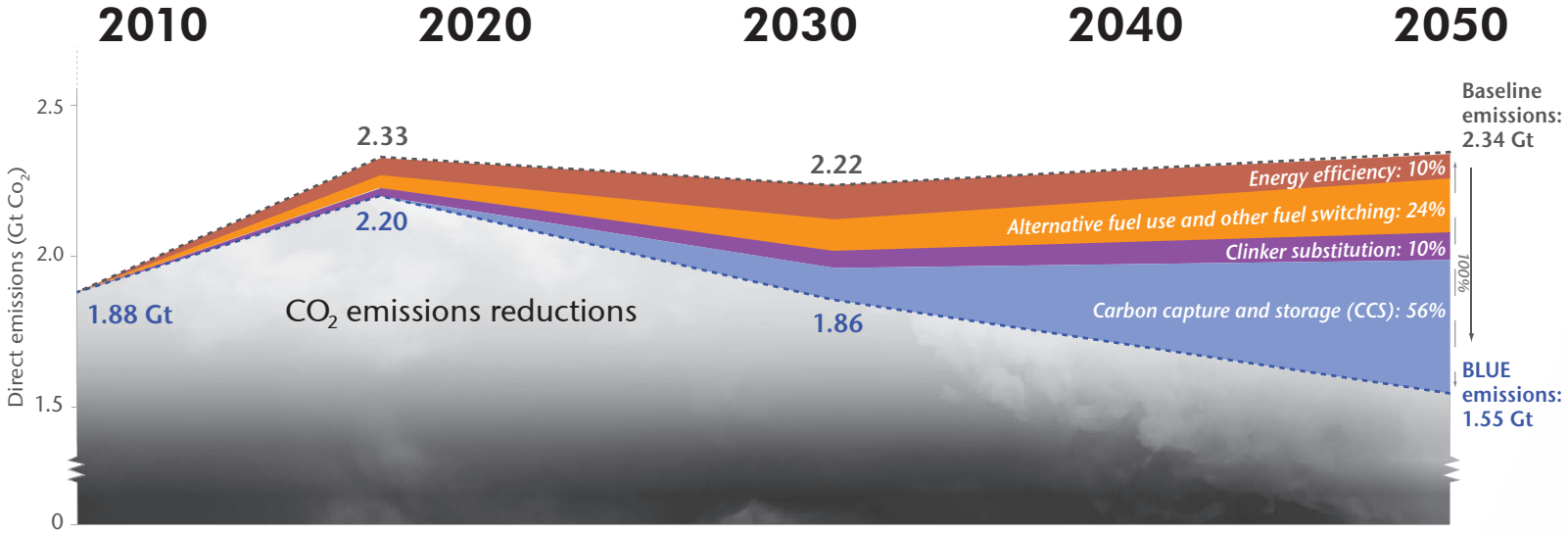
CEMENT ROADMAP

International Energy Agency

World Business Council for Sustainable Development

Cement sector CO_2 emissions reductions below the baseline, low demand scenario, 2010-2050



All of these technologies need to be applied together if the BLUE scenario targets are to be achieved – no one option alone can yield the necessary emissions reductions

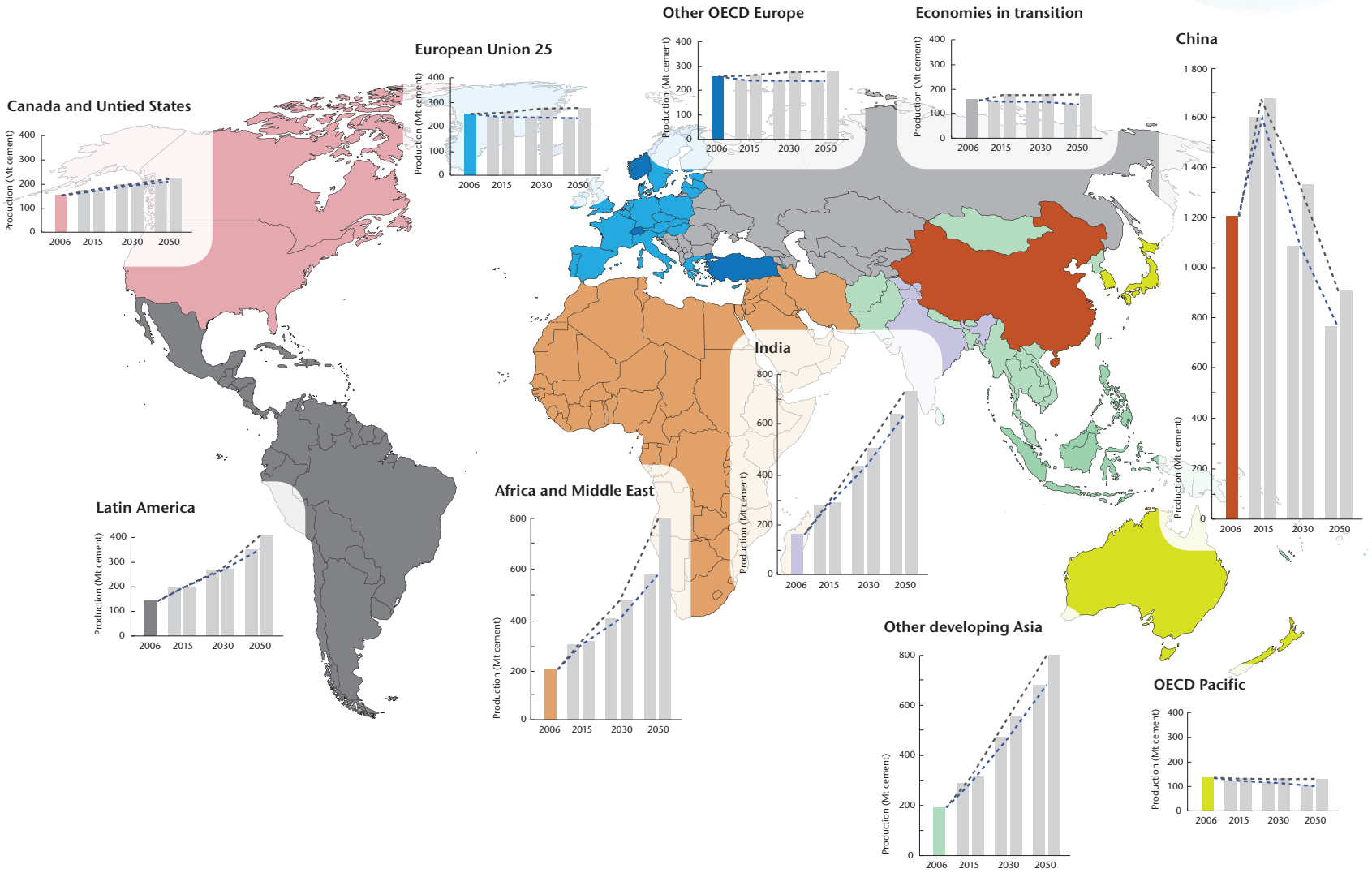
Key findings

Four distinct "reduction levers" are available to the cement sector to reduce CO_2 emissions:

1. **Thermal and electric efficiency:** deployment of existing state-of-the-art technologies in new cement plants, and retrofit of energy efficiency equipment where economically viable.
2. **Alternative fuels:** use of less carbon-intensive fossil fuels and more alternative (fossil) fuels and biomass fuels in the cement production process.
3. **Clinker substitution:** substituting carbon-intensive clinker, an intermediate in cement manufacture, with other, lower-carbon materials with cementitious properties.
4. **Carbon capture and storage (CCS):** capturing and storing CO_2 emissions from cement production.

- Cement is a key material for building society's infrastructure. Demand reduction and/or substitution are not realistic options given growth in developing countries, increasing urbanisation and climate change adaptation needs.
- Existing options to reduce emissions in the sector, while helpful, are not sufficient to counteract growth in demand. New products and technologies are needed, including CCS and new cement types.
- These new technologies will require a step change in RD&D efforts; the roadmap provides a vision for what is needed between today and 2050.
- CCS is a particularly important technology for the cement sector, required to deliver up to half of the emissions reductions needed by 2050. This will require advancement of demonstration projects in the cement sector over the next decade, to learn in parallel with other sectors how to best apply CCS technology at the necessary scale.
- The high cost of reducing CO_2 emissions in the sector will require markets with long-term stability and resultant confidence in the pricing of CO_2 by those markets.
- International collaboration and public-private partnerships must be encouraged to help speed up research, design, development and deployment of necessary new technologies.

Regional cement production: 2006, 2015, 2030 and 2050



This map and figures show estimated cement production for the years 2006, 2015, 2030 and 2050, and regional breakdown of forecast production under BLUE high and low demand scenarios.

Between 2006 and 2050, cement production is projected to grow by 0.8-1.2% per year, reaching between 3 700 megatonnes (Mt) and 4 400 Mt in 2050. This represents a 43-72% increase compared to production in 2006.

Cement consumption in China, which currently accounts for just under half of total production, is expected to peak between 2015 and 2030, as per capita cement consumption declines towards more developed country levels.

Post-2030 global cement production will be fuelled by strong demand growth in India and other developing Asian countries, and in Africa and the Middle East.

Key regional milestones

This roadmap aims to propose tangible policy recommendations for governments around the world and so is written with a broad, global view.

However, it acknowledges the wide differences between regions for many aspects of cement industry technology development and implementation. There are differences, for example, in alternative fuel availability, and in building standards enabling or preventing higher clinker substitution.

It is key that nationally appropriate policies should be developed to reinforce this roadmap's broad recommendations.

Canada and United States	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	12.4	11.4	12.3	12.2	11.3	14.2
Share of alternative fuel use	8%	21%	37%	9%	22%	38%
Clinker to cement ratio	0.90	0.85	0.81	0.90	0.84	0.81
CO_2 captured (Mt)	0	4.9	21.5	0	9.3	43.0

European Union 25	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	15.5	13.3	13.7	16.5	15.7	19.0
Share of alternative fuel use	17%	28%	39%	18%	30%	40%
Clinker to cement ratio	0.76	0.73	0.69	0.76	0.72	0.71
CO_2 captured (Mt)	0	4.3	20.7	0	9.4	69.8

Other OECD Europe	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	2.7	3.3	3.9	2.9	3.9	5.4
Share of alternative fuel use	19%	30%	39%	21%	30%	40%
Clinker to cement ratio	0.82	0.80	0.80	0.78	0.72	0.73
CO_2 captured (Mt)	0	1.7	5.5	0	4.6	3.7

OECD Pacific	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	9.7	8.2	7.5	10.3	9.5	10.7
Share of alternative fuel use	12%	23%	35%	13%	24%	35%
Clinker to cement ratio	0.83	0.77	0.72	0.82	0.76	0.72
CO_2 captured (Mt)	0	4.0	15.8	0	7.2	38.2

China	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	118.2	66.1	53.3	118.8	85.6	76.9
Share of alternative fuel use	8%	20%	36%	8%	14%	34%
Clinker to cement ratio	0.72	0.69	0.68	0.71	0.69	0.70
CO_2 captured (Mt)	0	25.0	82.0	0	40.3	236.8

India	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	19.4	29.9	47.4	19.6	33.6	60.1
Share of alternative fuel use	13%	23%	33%	15%	27%	35%
Clinker to cement ratio	0.77	0.73	0.71	0.77	0.72	0.72
CO_2 captured (Mt)	0	23.7	99.8	0	28.8	173.1

Other developing Asia	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	24.7	35.1	51.2	26.3	39.4	64.5
Share of alternative fuel use	11%	21%	34%	15%	28%	35%
Clinker to cement ratio	0.78	0.72	0.70	0.78	0.72	0.73
CO_2 captured (Mt)	0	21.4	100.2	0	21.0	150.6

Economies in transition	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	14.7	12.7	10.8	17.9	15.2	16.2
Share of alternative fuel use	14%	22%	35%	7%	16%	37%
Clinker to cement ratio	0.77	0.74	0.72	0.77	0.74	0.72
CO_2 captured (Mt)	0	1.5	12.9	0	4.1	19.0

Latin America	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	14.5	18.4	26.4	14.4	18.5	32.7
Share of alternative fuel use	16%	25%	39%	16%	25%	40%
Clinker to cement ratio	0.73	0.71	0.70	0.73	0.71	0.72
CO_2 captured (Mt)	0	9.7	49.7	0	11.8	73.3

Africa and Middle East	BLUE low demand			BLUE high demand		
Technologies	2015	2030	2050	2015	2030	2050
Energy use (Mtoe)	25.5	30.5	47.0	26.4	35.3	68.0
Share of alternative fuel use	11%	22%	33%	14%	25%	35%
Clinker to cement ratio	0.82	0.77	0.74	0.81	0.76	0.76
CO_2 captured (Mt)	0	8.4	97.1	0	21.5	158.7

Alternative fuel shares presented exclude the additional energy requirement for CCS. The CO_2 storage figures presented here are based on capture potentials. Additional analysis is needed to verify the storage potential in different regions.

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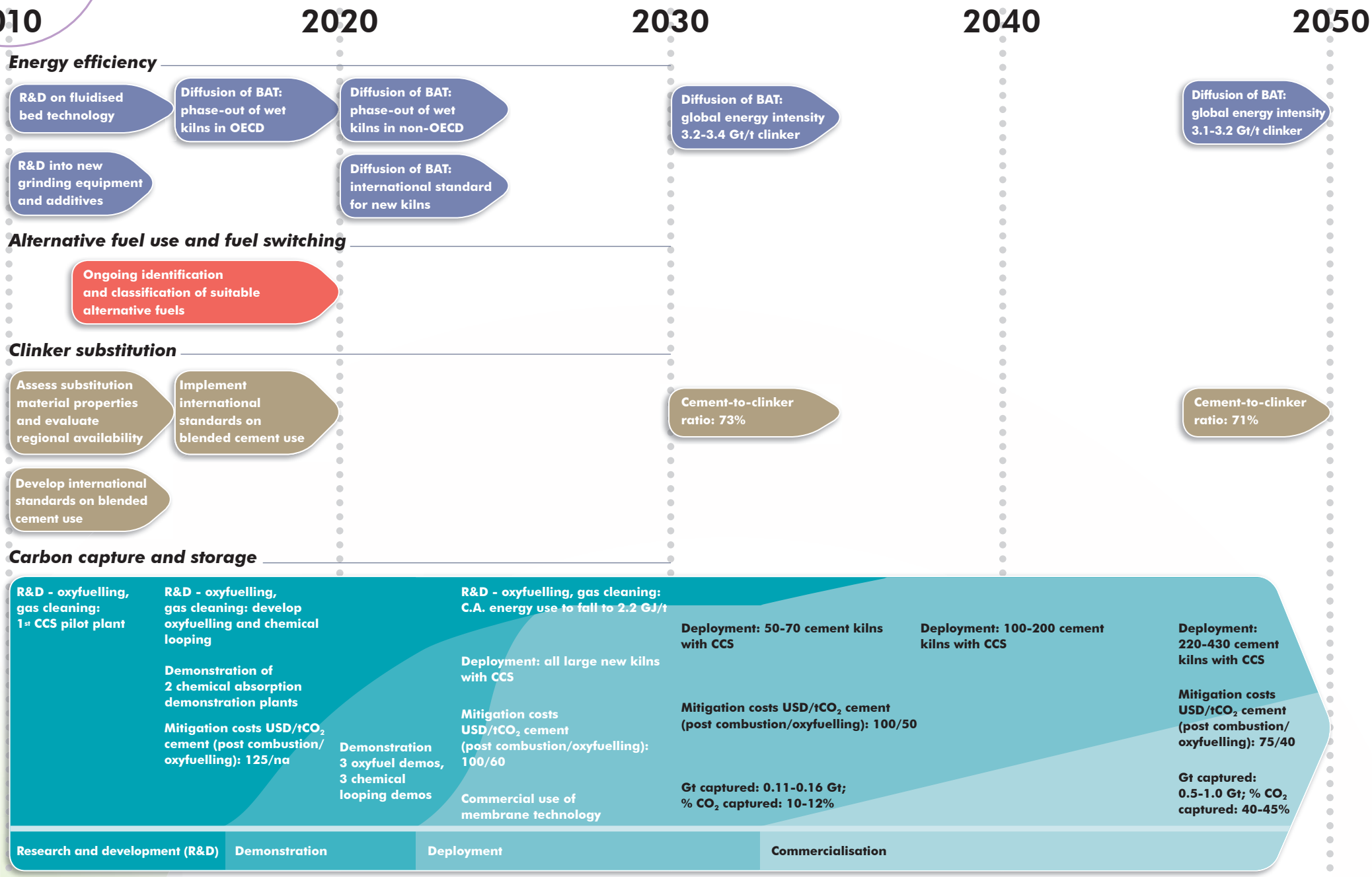
Cement roadmap milestones



BAT: best available technology; C.A.: chemical absorption