From part of the problem to part of the solution

Carbon capture at Norcem Brevik, part of the Norwegian CCS Demonstration project

Tokyo, 19 February 2020

Per Brevik, Dir. Sustainability and Alternative fuels HC NE

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Ambassador-designate Masahiro Tauchi together with representatives from the Japanese business visiting Norcem, Brevik, 5th november, 2019.

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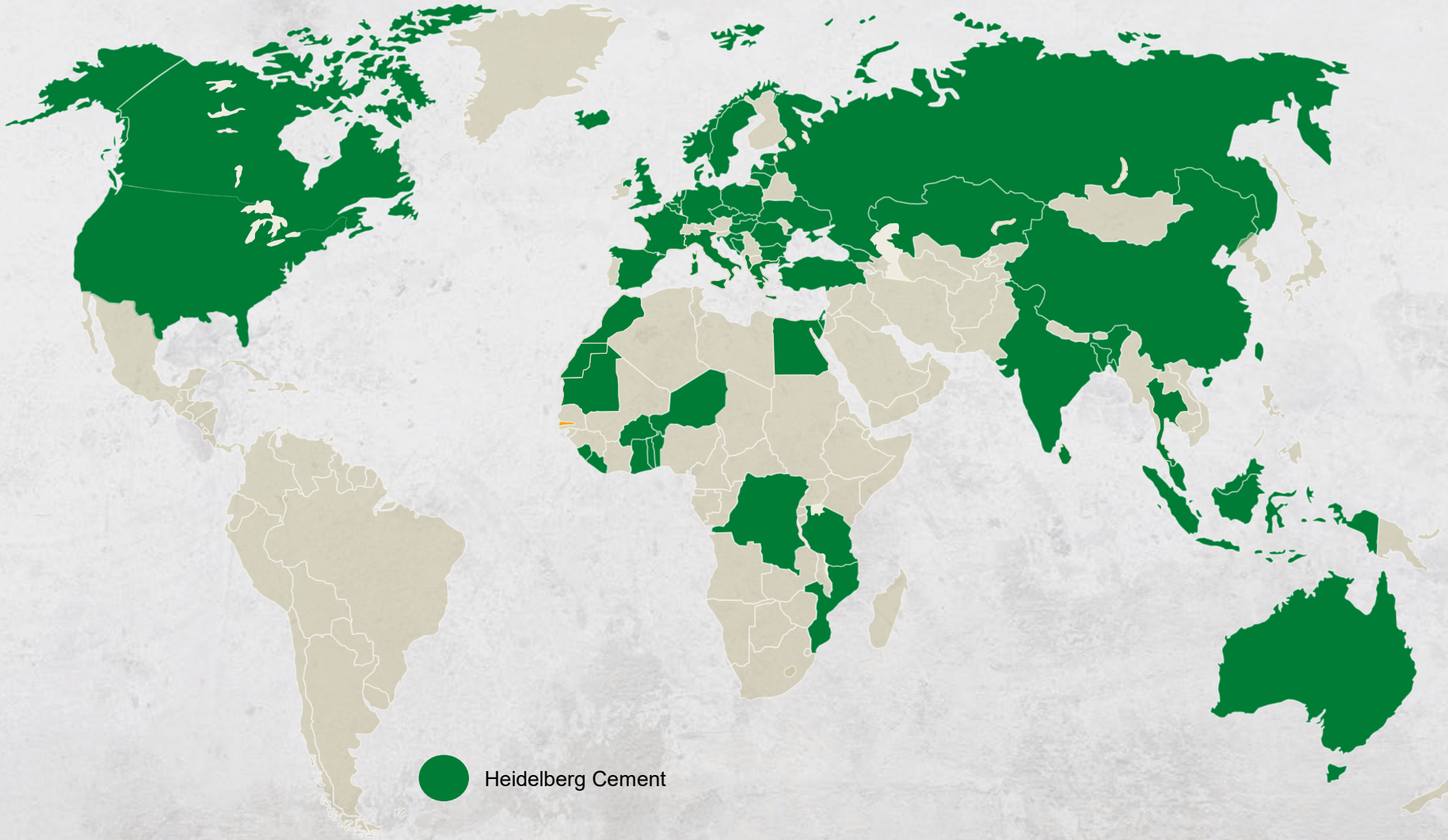
Worldwide

Market position:

01 Aggregates

02 Cement

03 Ready-mix Concrete



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Key figures HeidelbergCement

638 Production facilities with sand,
crushed rock and gravel
163 cement plants (inkl. Møller)
1.786 Ready-mix factories
111 asphalt plants

197
million tons
Cementcapacity

58.000
Employees

20
milioner tons
Aggregates
reserves

3.100
Departments
in 60 countries

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Northern Europe (HCNE)

HCNE is a business unit within HeidelbergCement, and comprises:

- Danmark
- Iceland
- Norway
- Sweden
- Baltikum

The companies within HCNE produces Building materials including:

- Aggregates
- Cement
- Ready-mix Concrete
- Pre-fabricated concrete elements

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Key figures Norcem Brevik

Clinker

1,1
milion tons

3
types

Storage facility
80.000
tons

Cement

1,3
Milion tons

8
types

Storage facility
70.000
tons

NORCEM
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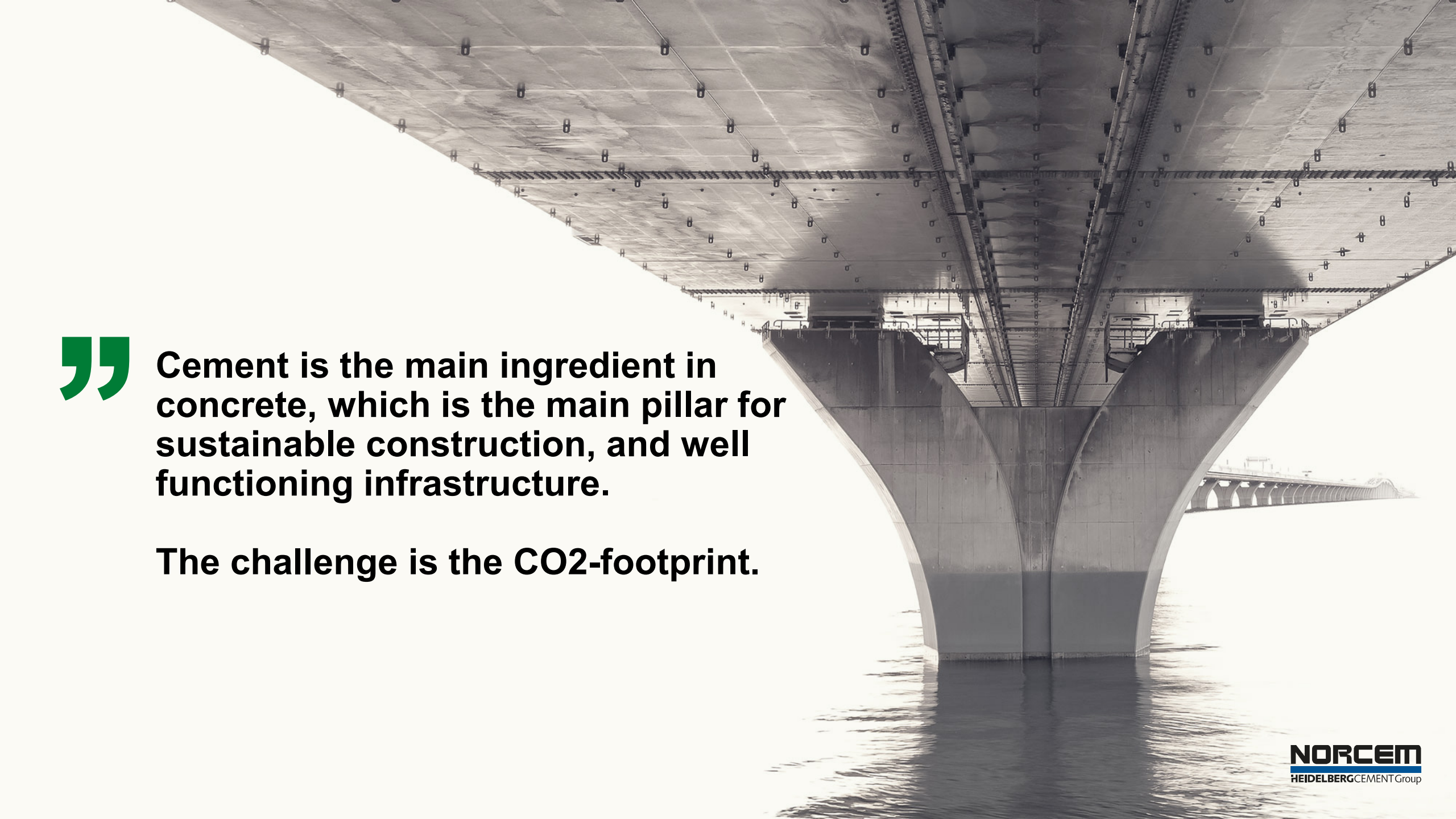

Cement is the main ingredient in concrete, which is the main pillar for sustainable construction, and well functioning infrastructure.

The challenge is the CO2-footprint.

NORCEM
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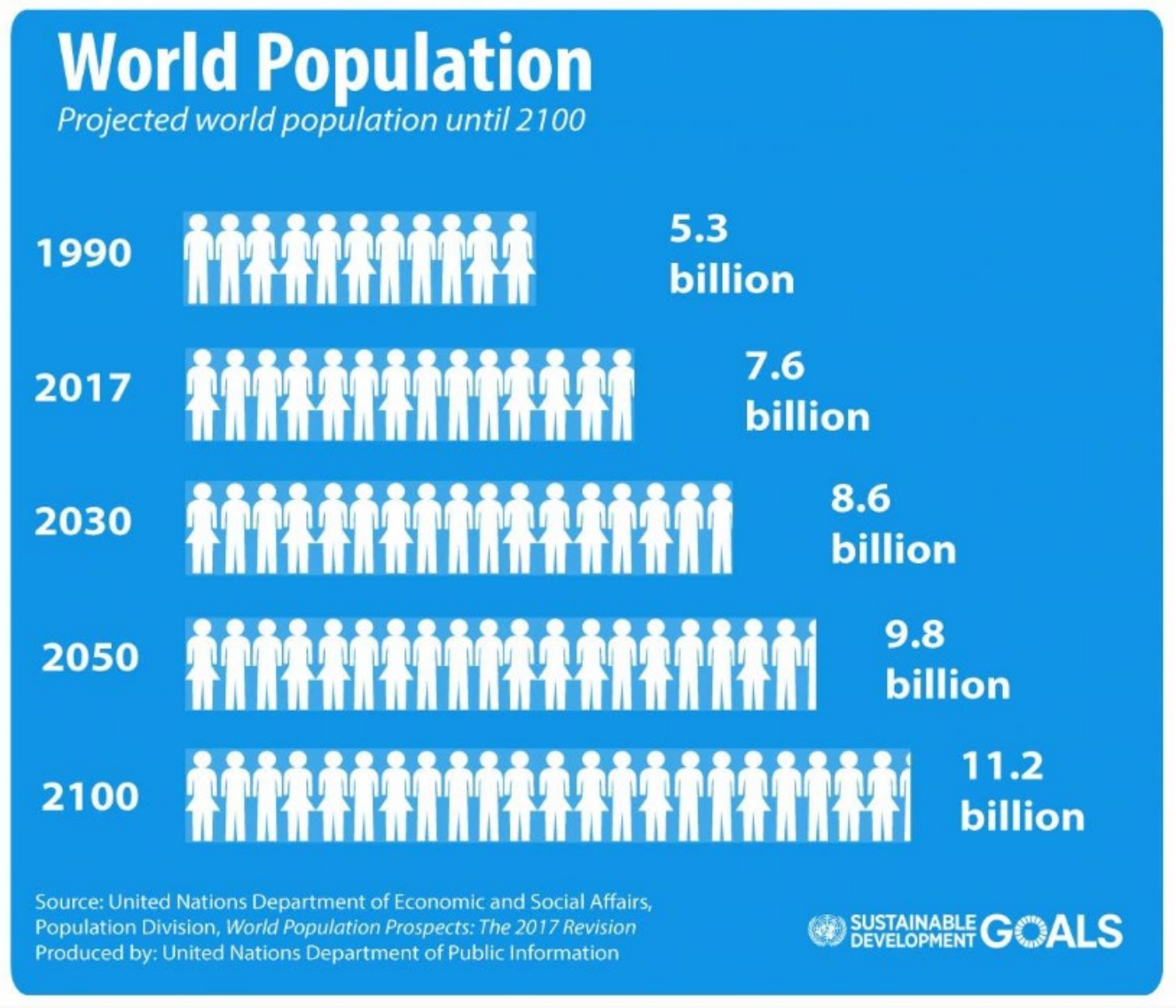
Cement and concrete

- Hard to imagine a future without it
- Lasts for hundreds of years (even thousands)
- The main elements: Limestone, Iron, Aluminium and Silica are the four most dominant elements in the earths crest. Practically unlimited resources

The world population is growing, and..



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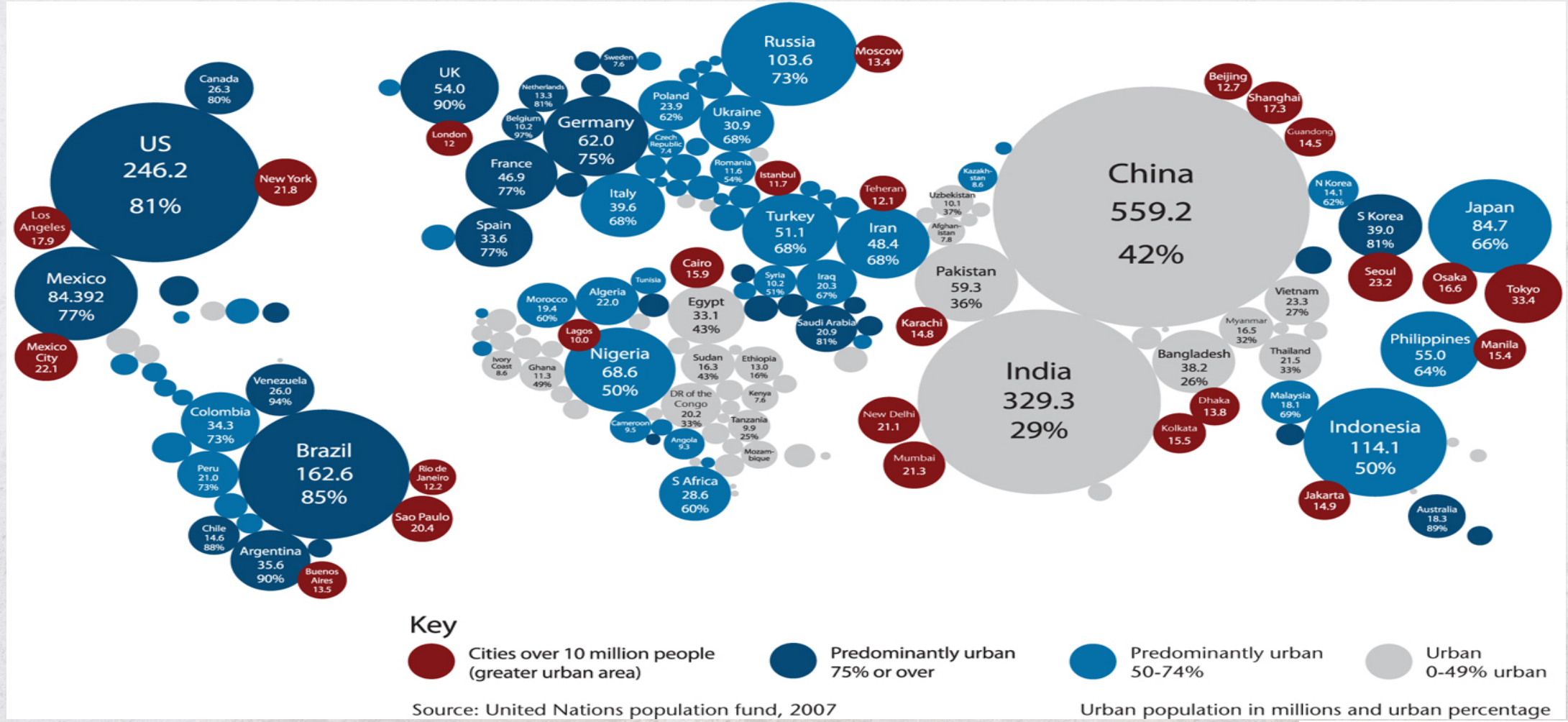
.. urbanisation increases

- 2010: 50% = 3 billion live in urban areas
- 2050: 70% = expecting 6 billion to live in urban areas



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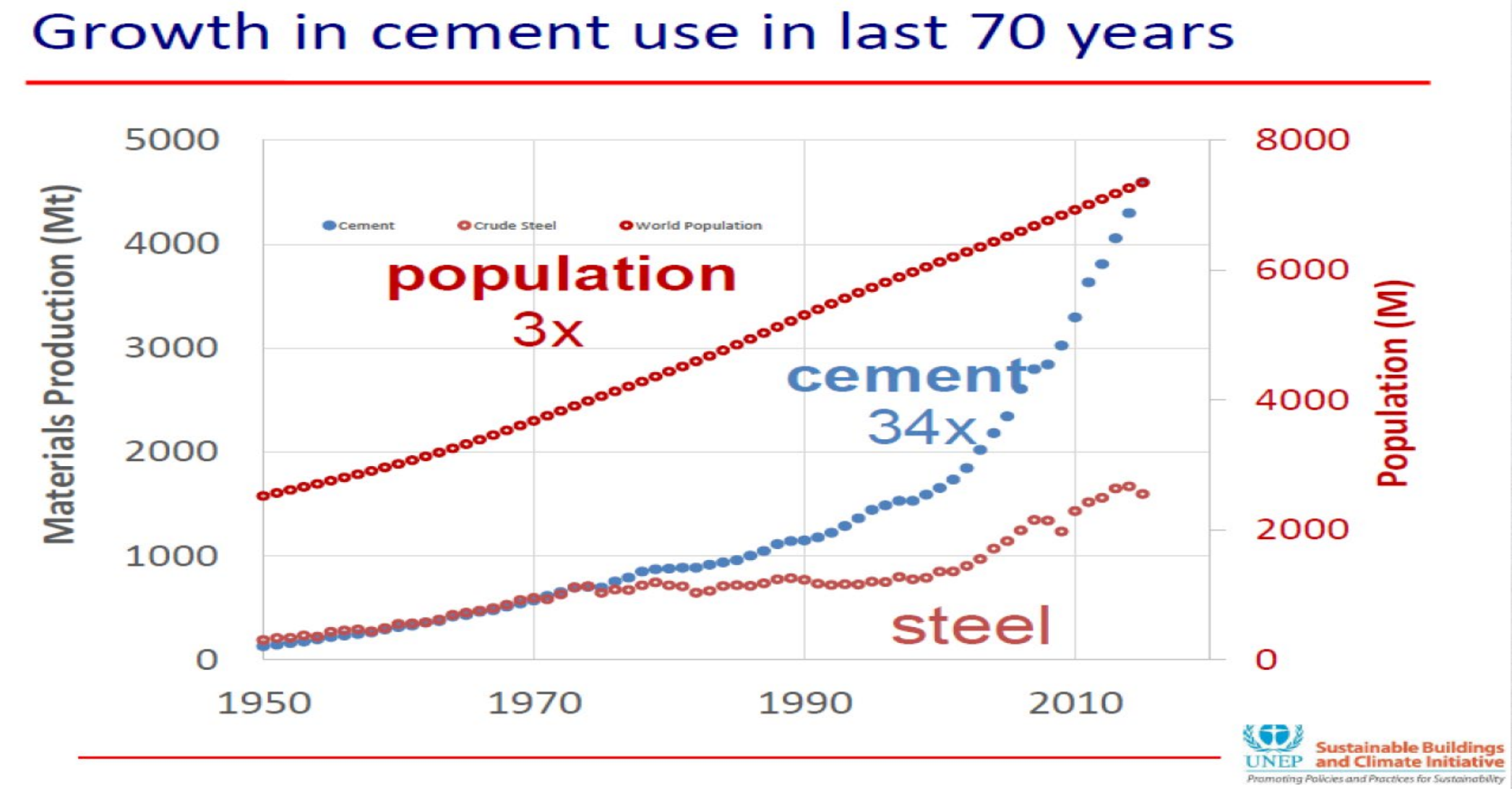
Cement consumption / The industry has a responsibility!



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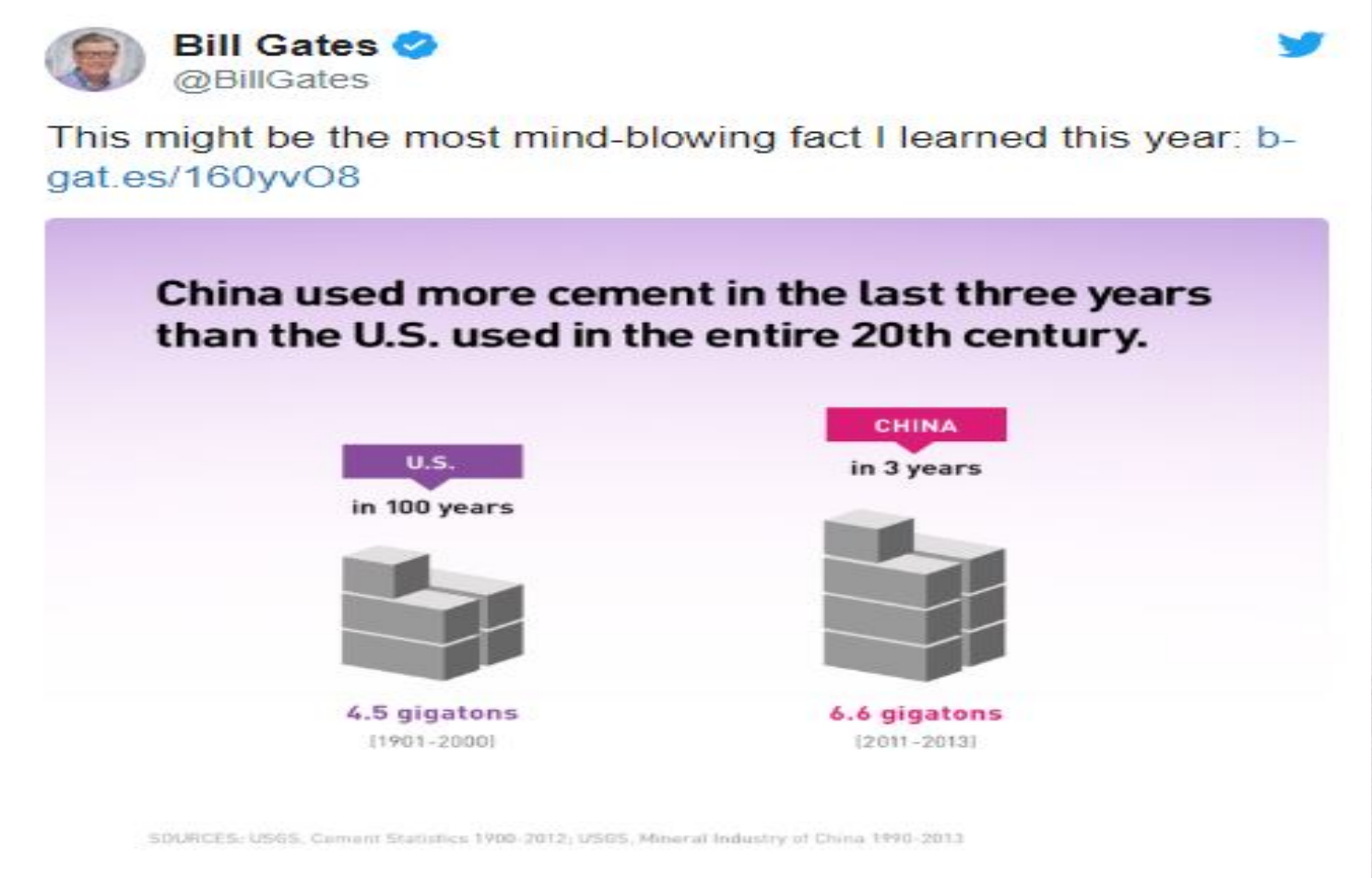
China - the driving force..



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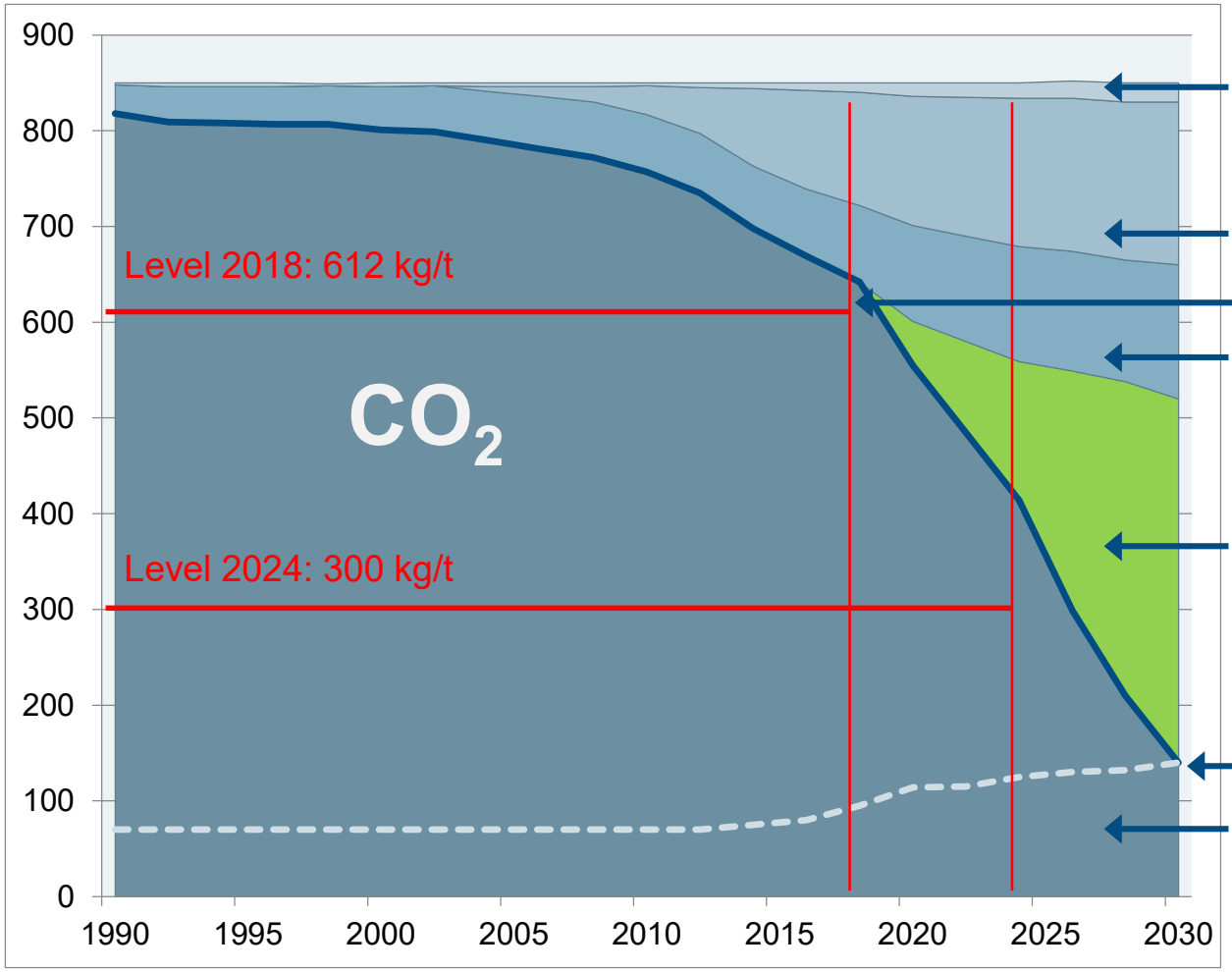
HC NE’s «0-vision»

HC NE's "0-vision"

Calcination:
$CaCO_3 \rightarrow CaO + CO_2$
Represents 64% av the emissions of CO_2. The remaining from energy



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Cement industry well suited for carbon capture

- **Large, stationary units**
  - Typically 500.000 – 2.000.000 tons CO_2 per year
  - Long lifetime (>100 years)
- **Often located close to sea**
- **Process emissions represents 2/3 of the CO_2 emissions**
  - Fuels only 1/3
- **Waste heat often available**
- **High concentration of CO_2 in flue gas** (22-24% CO_2)

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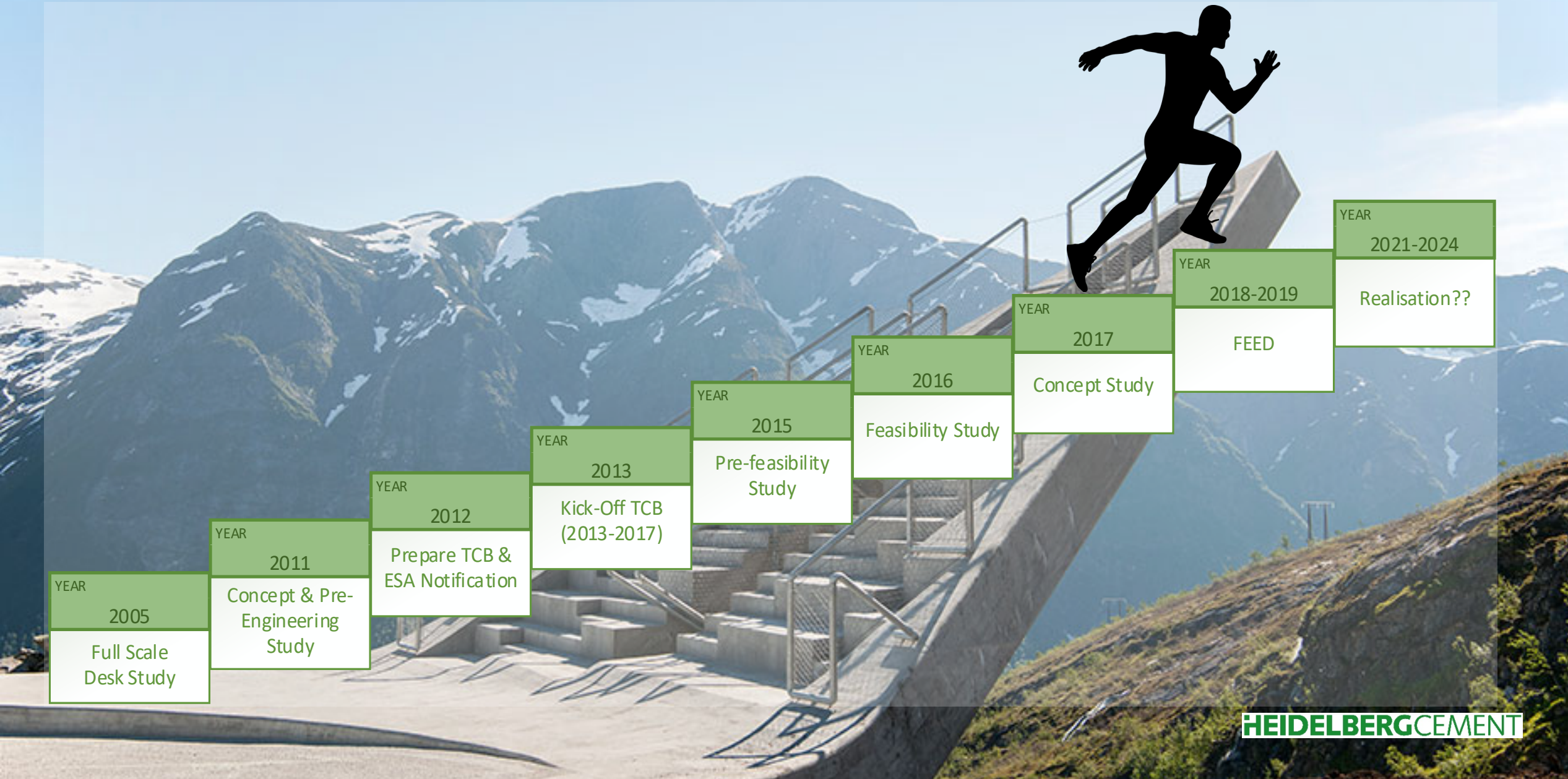
The «road» towards CO2-capture in Brevik



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CLIMIT–project 2013–2017

Aker Solutions amine technology – TRL 9

Air Products/ NTNU membrane technology – TRL 5

RTI solid sorbent technology – TRL 4

Testing on 4 capture technologies on real flue gas

Conclusions

1. Technologies are available
2. Technical feasible, but dependent on economic support
3. In a 2020 perspective, Aker Solutions' amine technology the only one ready for a full scale project

Alstom Power Calcium Looping – TRL 3

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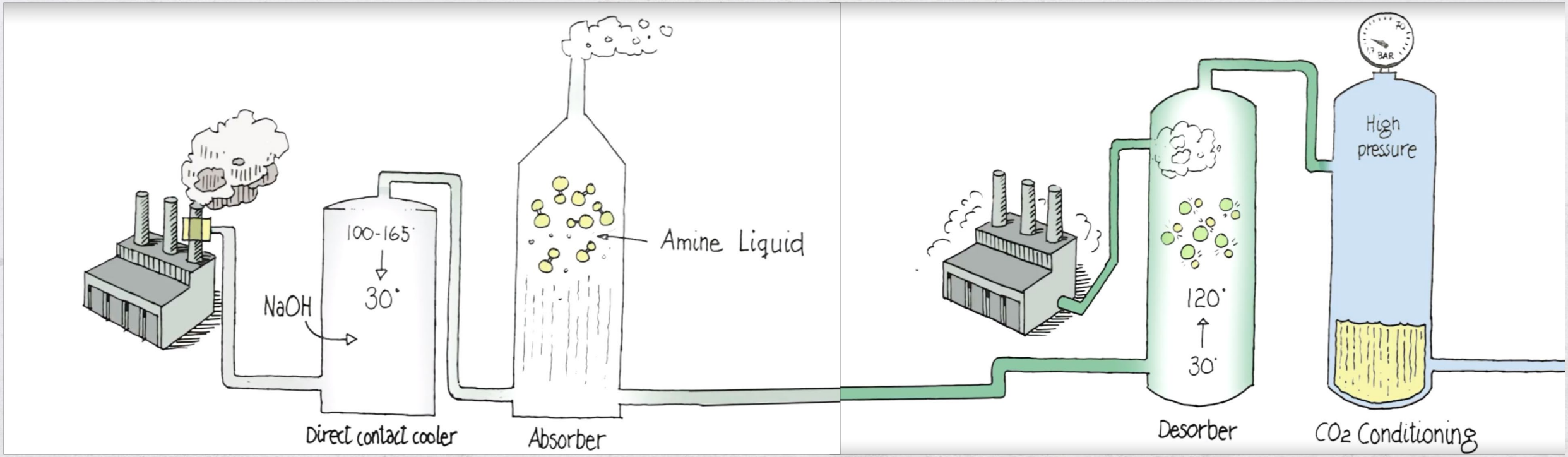
Amine based Carbon capture process



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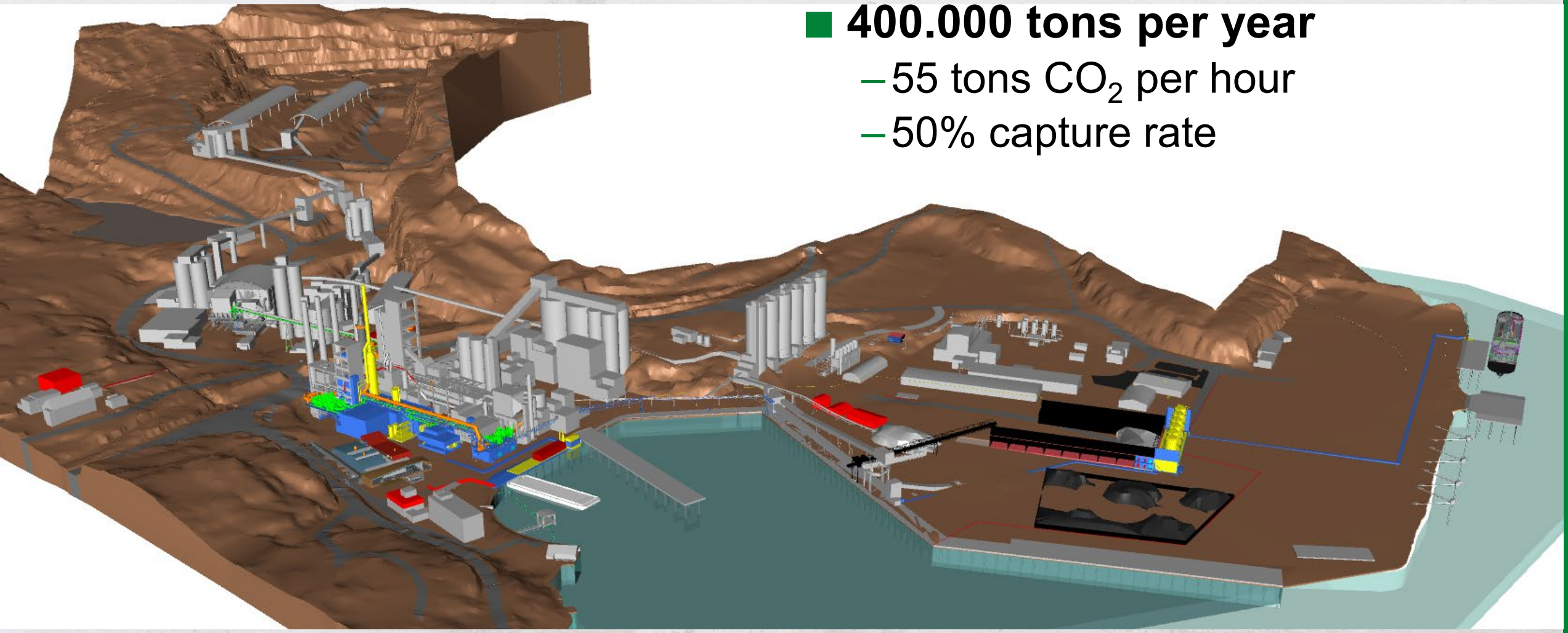
CO_2 capture Brevik.

Demonstration plant

- **400.000 tons per year**
  - 55 tons CO_2 per hour
  - 50% capture rate



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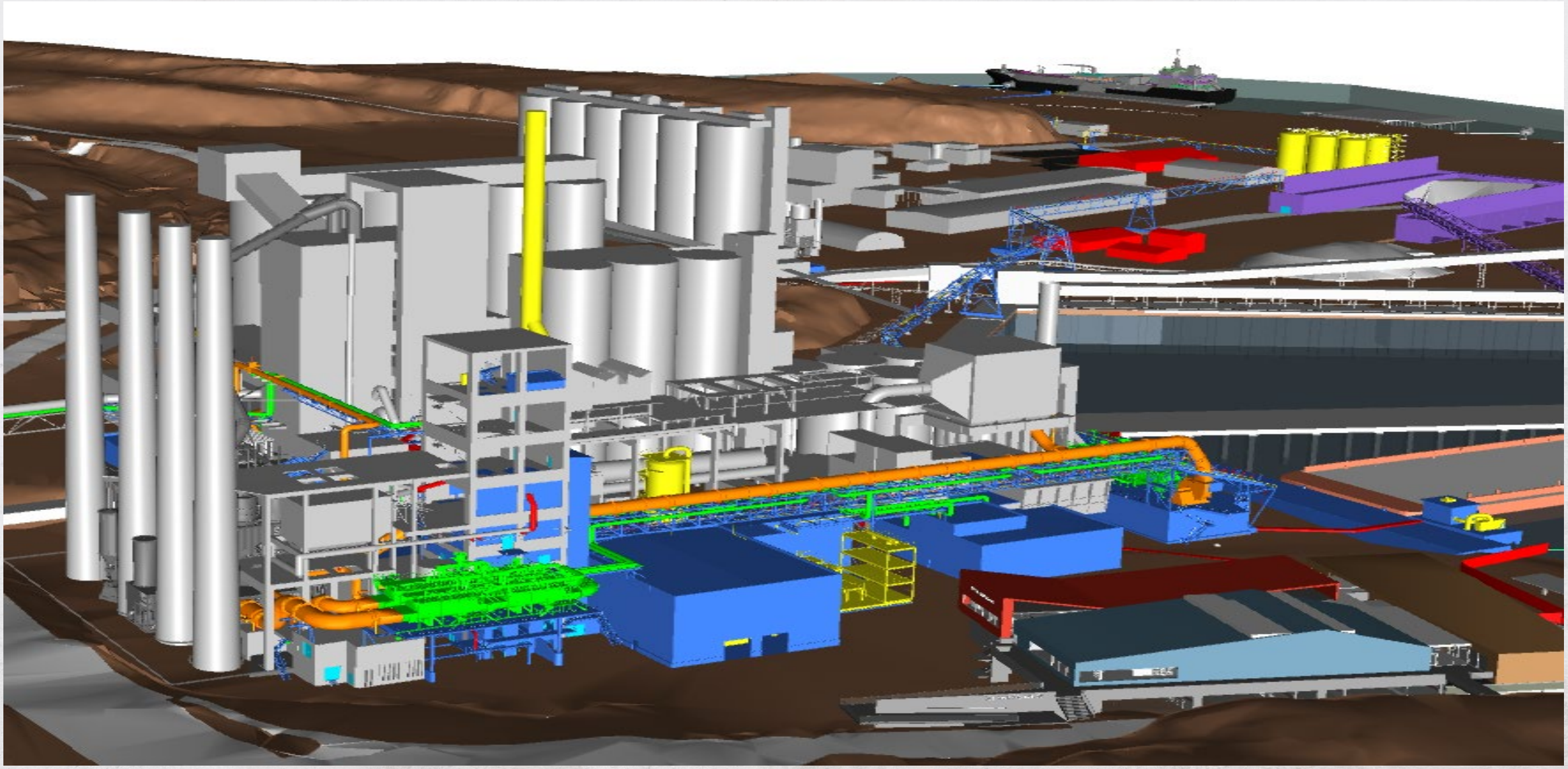
Main challenge: Integrating a new plant into an operating cement plant!



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Status end-of-January 2020

- **The FEED report submitted to Gassnova/Ministry end-of-October 2019**
- **Interim period**

1. **Further work for further reduction of uncertainties**
   a. Negotiations with suppliers
   b. Focus on specific technical solutions (improvements)
   c. Public funding issues
   d. Permitting processes (environment and safety)
2. **Quality assurance and verification by third party**

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CCS and CCU / Competition or co-operation?

- **CO2-level must be reduced to reach the Paris goals**
- **Carbon capture; a prerequisite for both CCS and CCU**
- **CCU related to Climate change**
  - Between «close to storage» and «catch and release»

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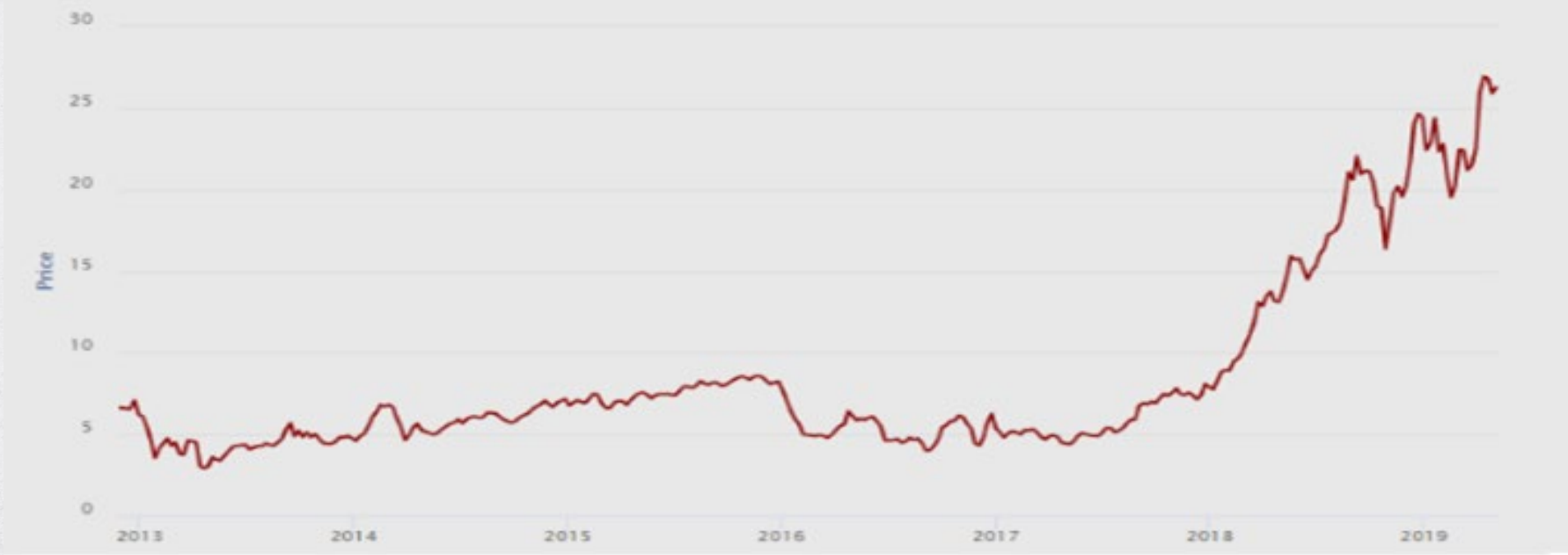
CO2 price development / Future cost of emitting CO2



Spot price of CO2 emissions (€/EUA)*

EUA: european emissions allowance (tradable emission permit of one tonne of CO2)

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The industry's responsibility

- Part of the challenge; but also the solution!
- Commitment UN's Sustainability Development Goals
- «The front runners» are crucial; showing the way forward
- «Lessons learnt» and «Benefit realization» => We don't need to replicate earlier mistakes!
- Realizing a full-scale project will be an basis for new R&D projects

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Next step?

- **A decision regarding realization to be taken in HeidelbergCement and in the Parliament late autumn 2020**
- **The Brevik carbon capture plant will be in operation during summer 2024**
- **Funding of the next generation capture plants**
  - Some EU- and public funding, but the industry's contribution will increase considerably

http://www.thecomicstrips.com/subject/The-Collaboration-Comic-Strips.php

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What if..

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Our footprint
will be further
reduced
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