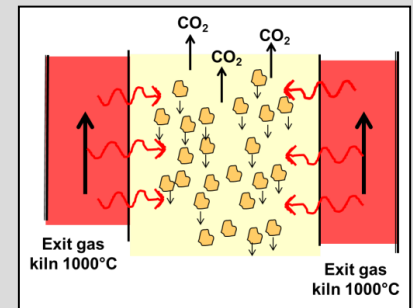


# HeidelbergCement's activities regarding Carbon Capture & Reuse

**Daniel Gauthier**

**HeidelbergCement, Technical Advisory Board ECRA (Belgium)**

ECRA-Mons Chair Event 9<sup>th</sup> November 2016



# HeidelbergCement in the world

- Turnover 2015: 14 bn €
- 63.000 employees
- 3.000 locations
- 60 countries

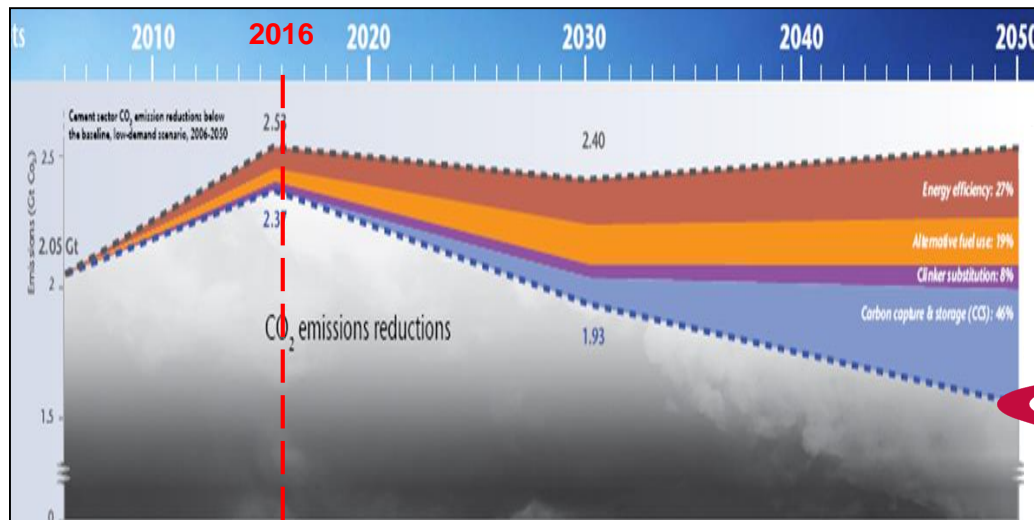


## Capacity 2016:

- Cement: 197 mio t (2)
- Aggregates: 19 bio t reserves (1)

**HEIDELBERGCEMENT**

# Mandatory to deploy CCS/CCU to reach our goals!



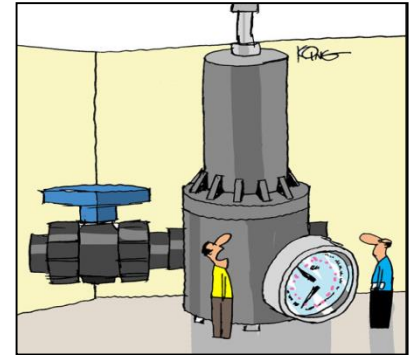
## 4 levers to reduce CO<sub>2</sub>

Energy efficiency	27%
Alternative fuels	19%
Clinker substitution	9%
<b>Carbon Capture &amp; S/U</b>	<b>46%</b>



# HeidelbergCement beliefs & strategy (I)

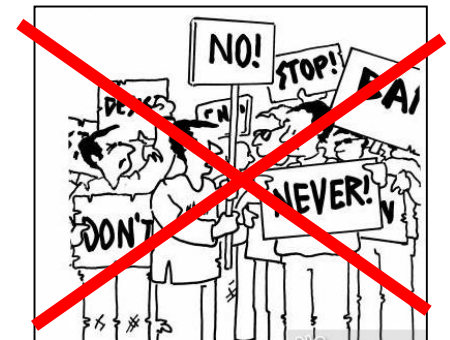
- Carbon Capture and Storage (CCS) is required for a full de-carbonization of cement industry
- CCS needs financial supporting mechanisms to be feasible (no carbon leakage)
- CCS lacking public acceptance in mainland EU, sufficiently accepted in Scandinavia and Canada
- Carbon Capture & Utilization (CCU) commercial today for small high-value-end-products
- CCU potential to significant contribute to CCS/U targets for cement industry → in focus



*Reliable technology*



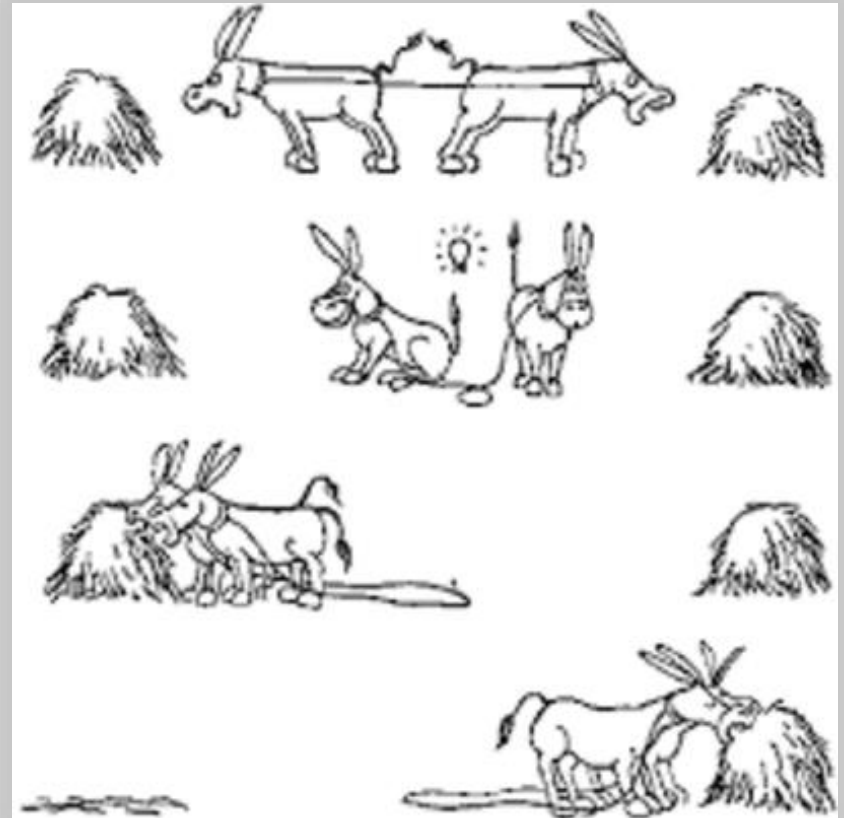
*Financially sound*



*Public acceptance*

## HeidelbergCement beliefs & strategy (II)

- **CCS and CCU are mainly in pre-competitive phase**
- **HeidelbergCement encourages and initiates collective approaches**
  - within the cement industry
    - WBCSD-CSI
    - ECRA
  - and beyond
    - Lime-industry
    - Automotive industry
    - Start-ups
    - Universities
    - Research/Business Institutes
  - **CCU association**
    - Regulation barriers
    - Common voice
    - Non commercial contacts





# Carbon Capture



# Carbon Capture tests in cement industry Norway



- **Test program 12 m€ final end 2016**
  - 75% funding government
  - Amine scrubbing most reliable technology
- **Feasibility study done**
  - 40% CO<sub>2</sub> capture using waste heat Brevik
  - Investment > 200 m€
  - OPEX: > 40 €/t clinker
  - CO<sub>2</sub> from fertilizer industry + refinery will be combined for shared storage
- **Next steps**
  - Evaluate to which extend Government of Norway can finance CAPEX and OPEX to avoid competitive out ruling of Norcem
  - Evaluate how much HC can “bare” to remain competitive
  - 1½-2 years to finalize this phase

# LEILAC: CO<sub>2</sub> separation@calcining (12 m€ EU-Horizon 2020)

## ■ Consortium

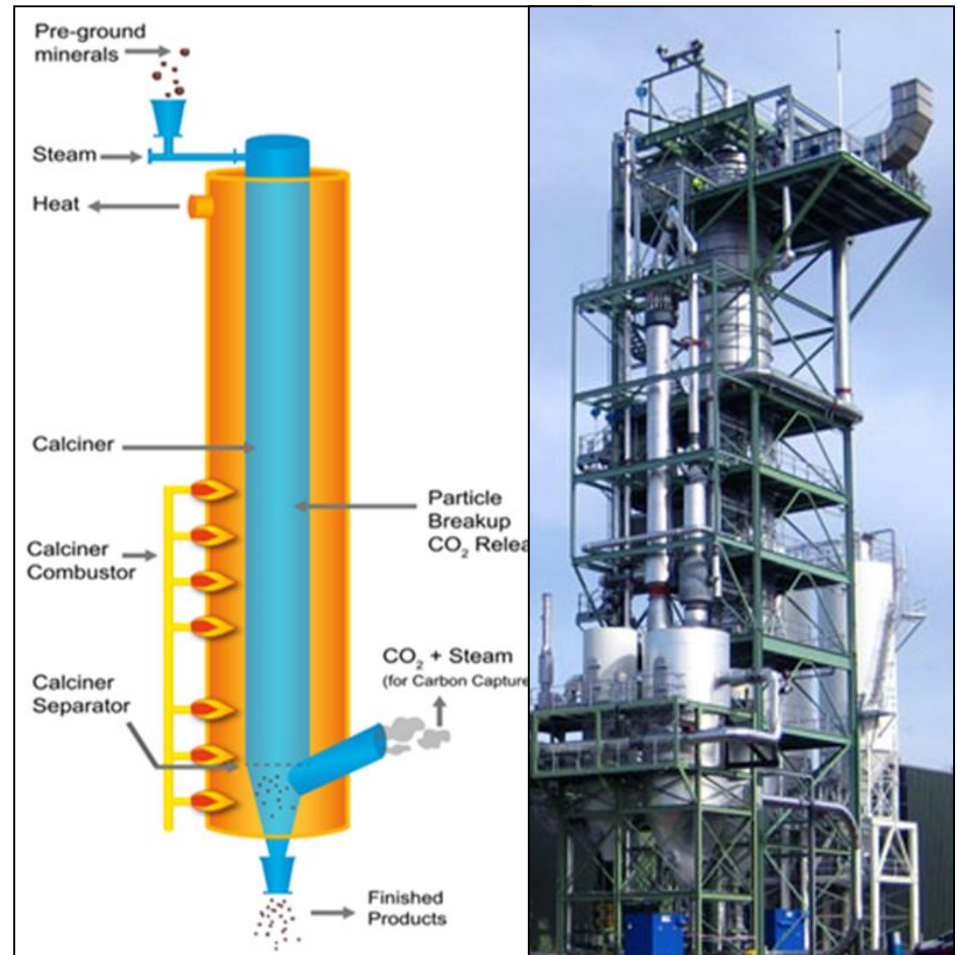


## ■ Indirect heating raw meal:

- Separate process CO<sub>2</sub>
- Calix MgO proven process

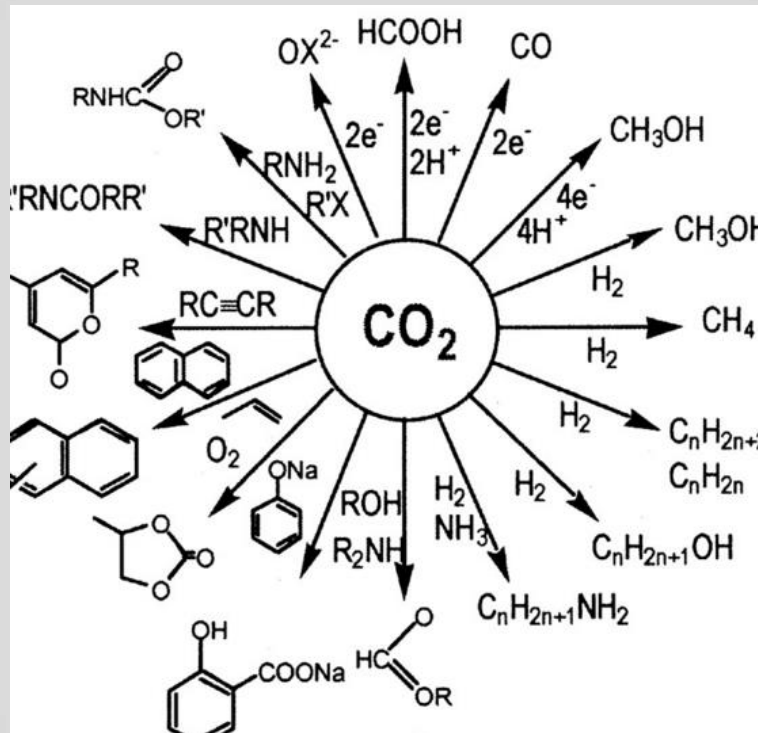
## ■ 10 tph demonstration plant, Lixhe-Belgium

- Cement & Lime applications
- [www.leilac.org.uk](http://www.leilac.org.uk)



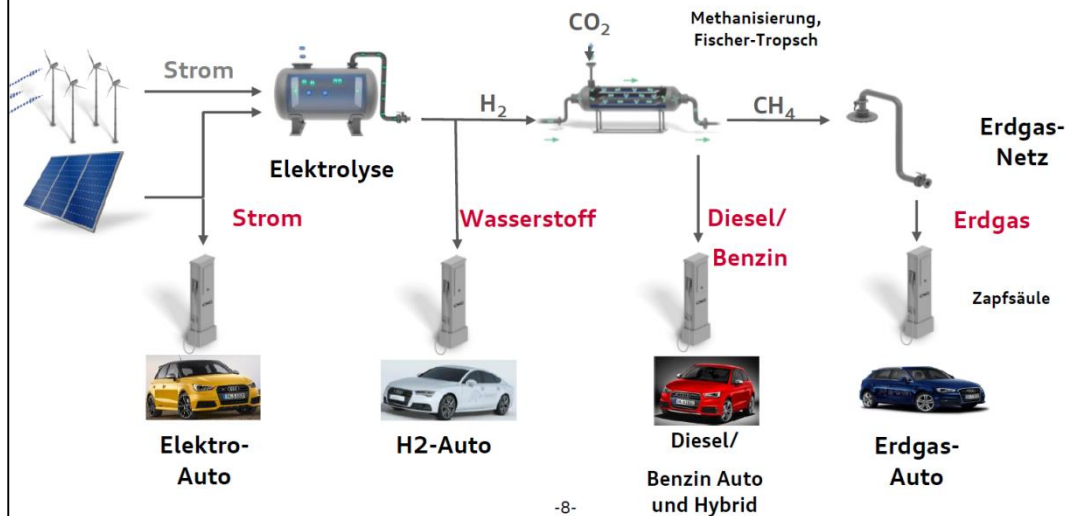


# Carbon Capture and Utilization



# Energie-wende + CO<sub>2</sub> issue, ingredients for Power-to-X

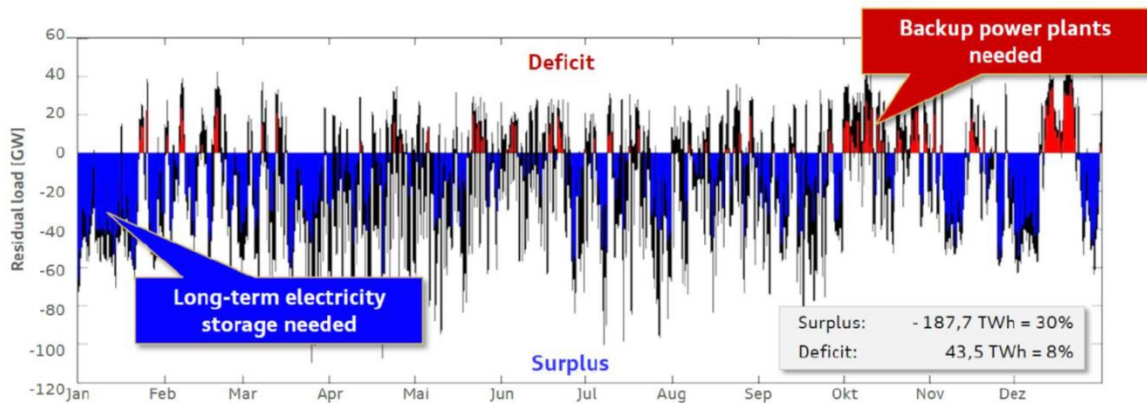
**Strom-zu-Kraftstoff (Power-to-X, PtX): aus erneuerbarem Strom, Wasser und CO<sub>2</sub> wird Kraftstoff erzeugt**



-8-

**Electricity sector: what would happen if a lot 80% renewable sun&wind energy?**

Residual load simulation for 78% renewable electricity in Germany, no exports/imports, copper plate, weather data 2007

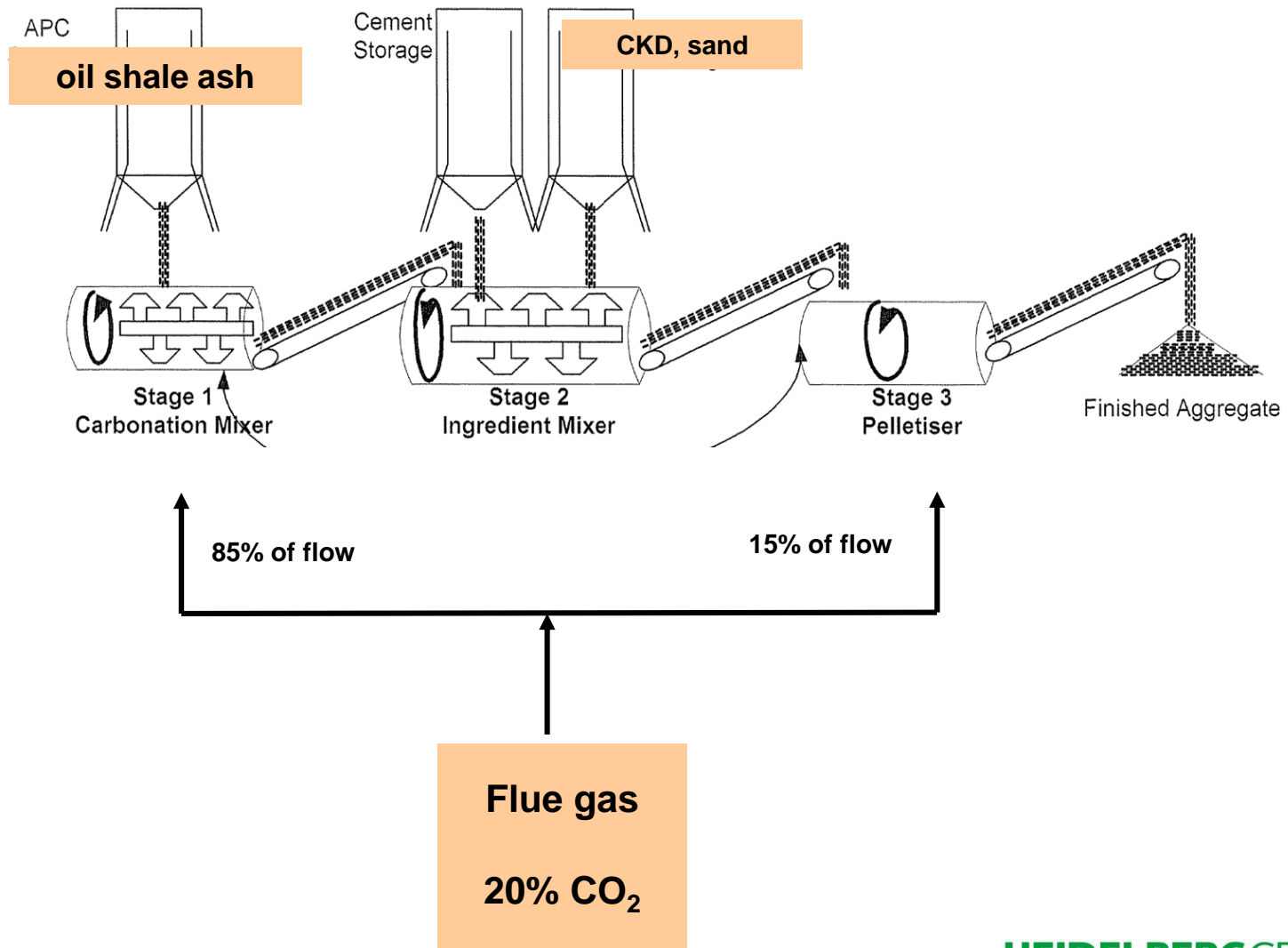


# Why is HC attractive to co-develop Power-to-X ?

- HC shows consistent development of CCSU
- Cement plant exempted from “Energiewende-aufschlag”
- We have proven the concept of CO<sub>2</sub>-purification at Brevik
- Sites all over Germany available with CO<sub>2</sub> and industrial sites for Power-to-X plants
- We are good in:
  - Project development
  - Acquiring permits
  - Attracting funding / support from local government



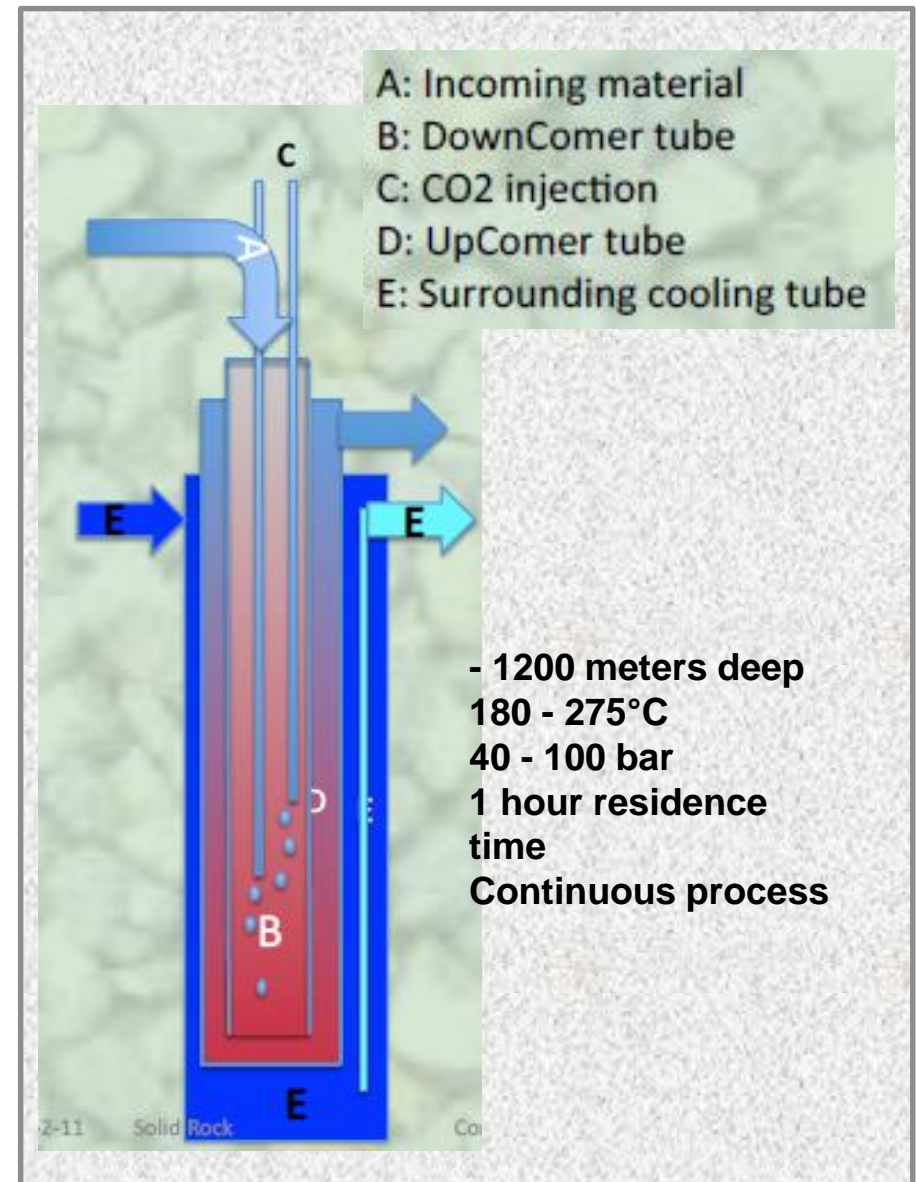
## Carbon8: carbonating CaO rich ashes to light weight aggregates





# Natural mineral carbonation

- **CO<sub>2</sub>-uptake by mineral products like basalt, olivine and steelslag**
- **Generated products (high in blaines):**
  - amorphous silica
  - crystalline magnesium-carbonate
- **R&D program will start in 2017**
  - Funding might come from BMBF
  - Therefore German based partners from RWTH Aachen and IASS Potsdam



# R&D Sweden micro-algae growing on CO<sub>2</sub> from flue-gas

## RESULTS

- Microalgae react positive to flue-gas of cement kilns
- Algal biomass meets criteria for healthy fishfeed

**algoland**   
**CEMENTA**  
HEIDELBERGCEMENT Group

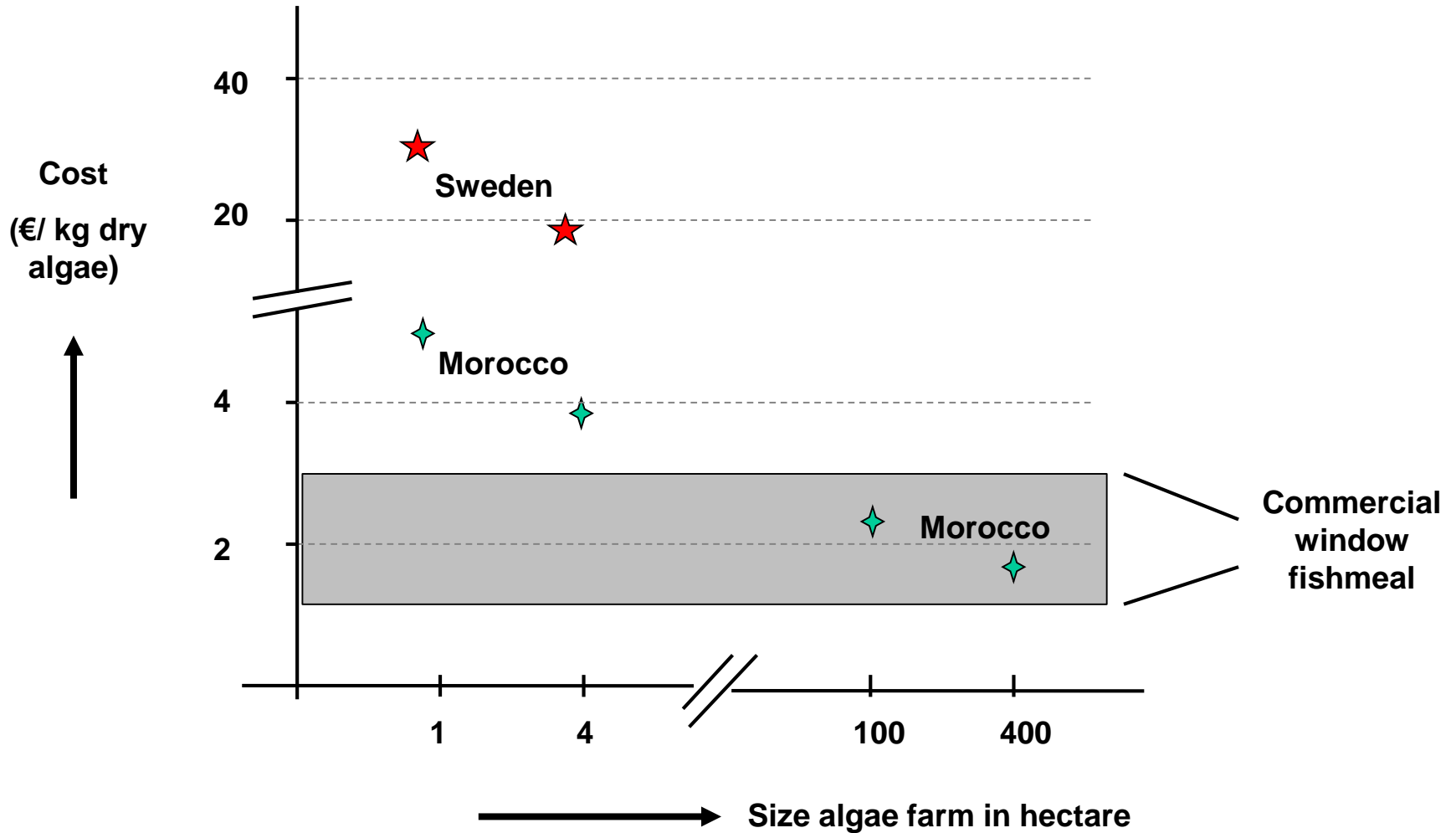


## Mid to large volume markets relevant for cement-industry

Algae products	Value	World market	Volume		CO2 uptake
	€/kg	€/ton	min mton/yr	max mton/yr	max mton/yr
Neutraceuticals	10 -100	60-100 million	0,0006	0,01	0,02
Fish and feed	0,5 -5	3-4 billion	0,6	8	16
Bulk materials	0,5 -1,2	10-50 billion	8	100	200
Transport fuels	< 0,5	giga			

**Growing relevance for  
cement industry**

# Cost price related to scale and location (climate, wages)





## Concluding remarks

- The cement industry set ambitious targets on CO<sub>2</sub> reduction in the CSI-Roadmap 2050
- Carbon Capture requires intensive cooperation in our industry and HeidelbergCement is demonstrating leadership in this domain
- In its operations worldwide HC is testing and developing (commercial) use of CO<sub>2</sub> from our stacks applying various technologies



# CO<sub>2</sub> will become a valuable asset.....



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