



ecra

european cement research academy

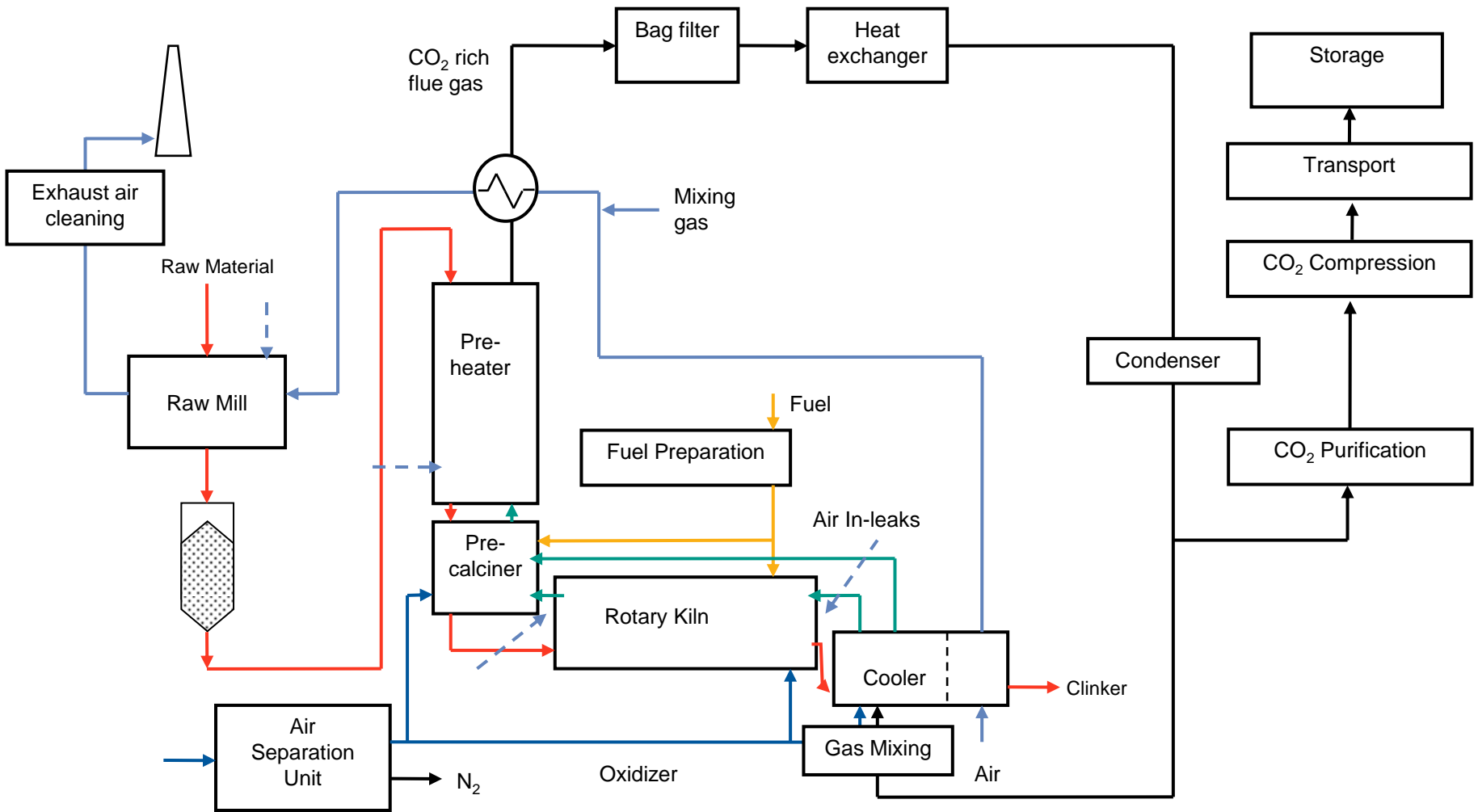
# **Perspective on oxyfuel capture technology application in a cement plant**

Volker Hoenig, Johannes Ruppert

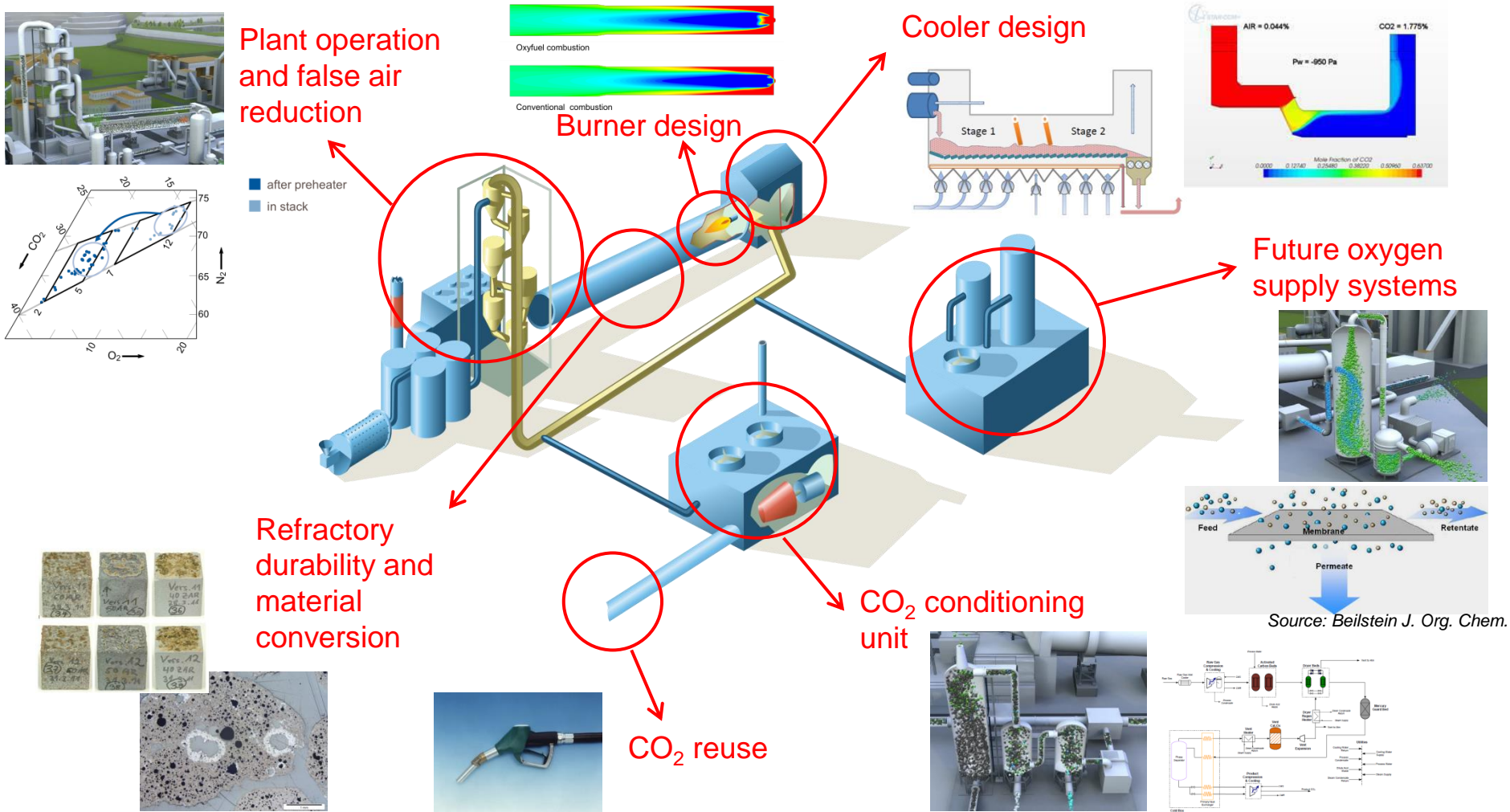
Carbon Capture Technologies in the Cement Industry

Brussels, 17.10.2018

# ECRA's general layout of an oxyfuel cement plant

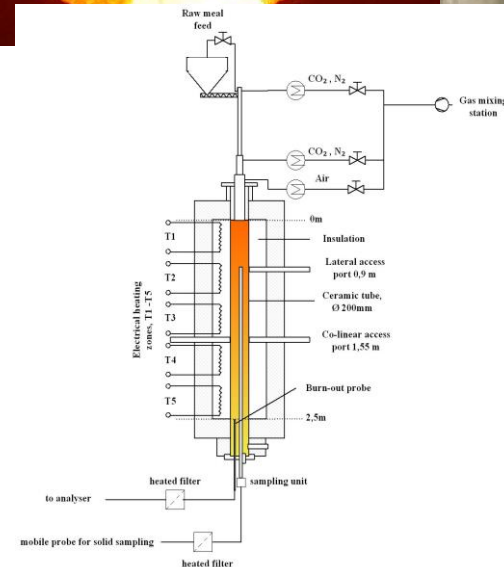
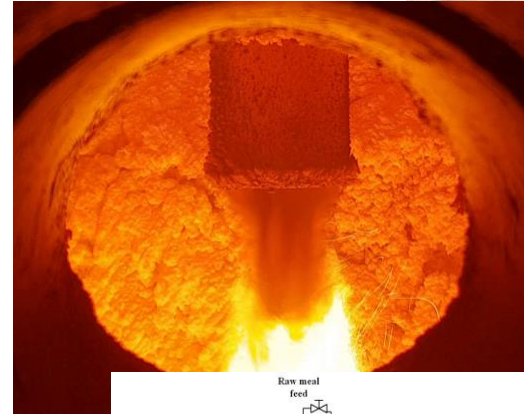


# Oxyfuel technology has been investigated in detail



# Three important questions to be answered in Cemcap

- Impact on clinker quality due to cooling with CO<sub>2</sub> rich gas?
- New burner design needed for Oxyfuel kiln?
- Is full calcination of raw material possible in Oxyfuel calciner?

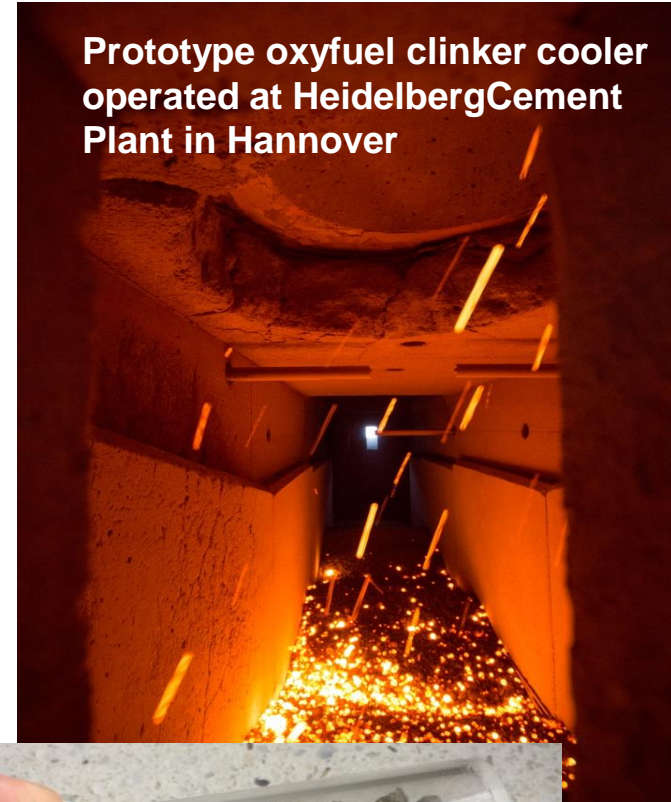


# Successful operation of oxyfuel clinker cooler prototype

## CEMCAP WP 9

- Clinker cooling was successfully demonstrated under oxyfuel conditions in industrial environment
- No negative impact on cement strength development due to cooling with CO<sub>2</sub> rich gas
- Sealing the cooler outlet against false air ingress will demand special attention in industrial scale projects
- Moisture and dust content in re-circulated gases to be minimized for a trouble-free operation of the cooler

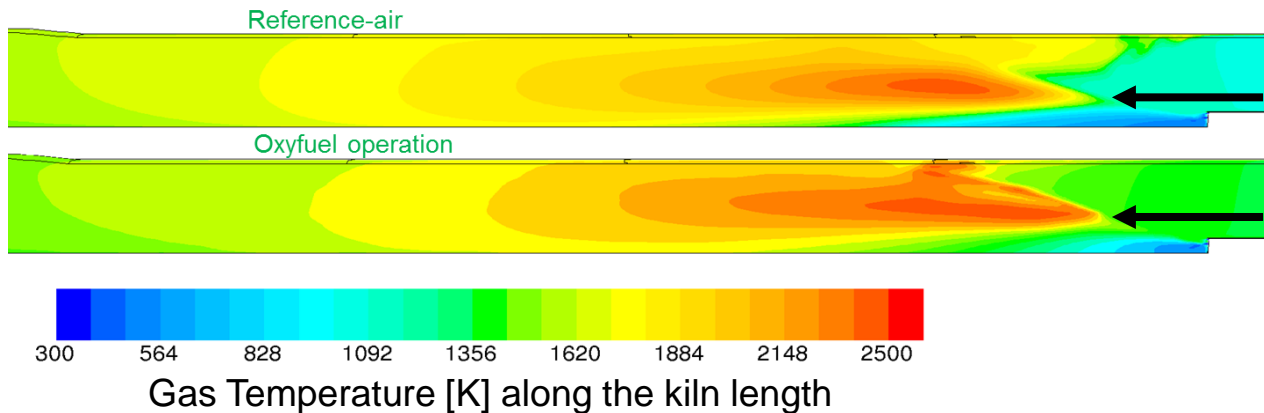
Prototype oxyfuel clinker cooler operated at HeidelbergCement Plant in Hannover



# Oxyfuel clinker burning technology

## CEMCAP WP6 and WP 7

- Modern cement kiln burners can also be used in oxyfuel operation.
- Similar radiation heat to material can be achieved as in conventional air operation.
- Oxygen enrichment is a new parameter to adjust temperature/heat transfer profile.

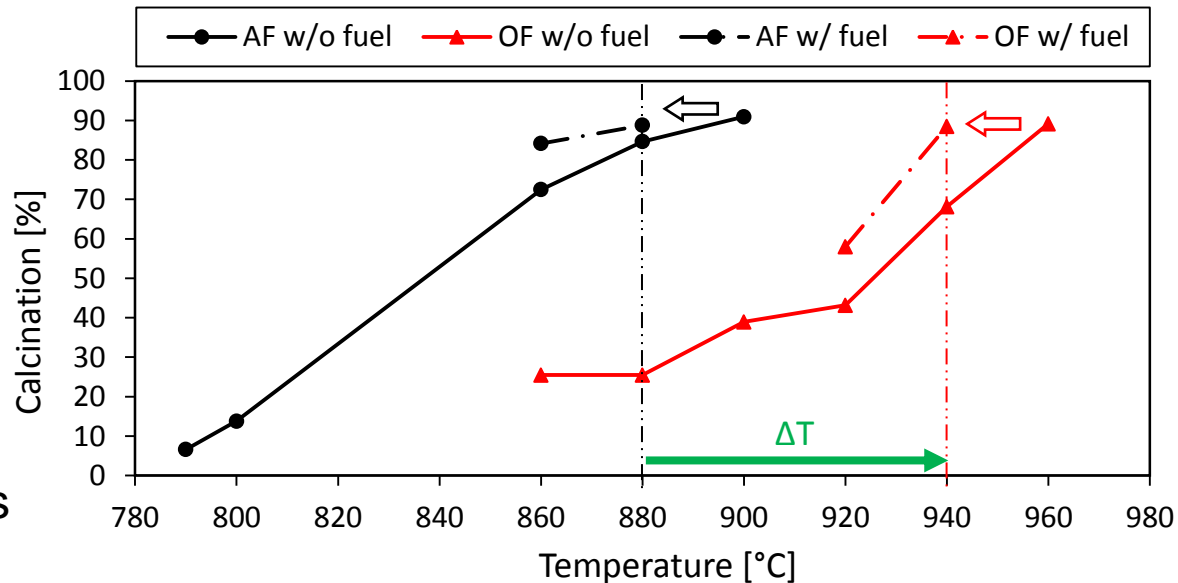




# Calciner technology for oxyfuel process

## CEMCAP WP 8

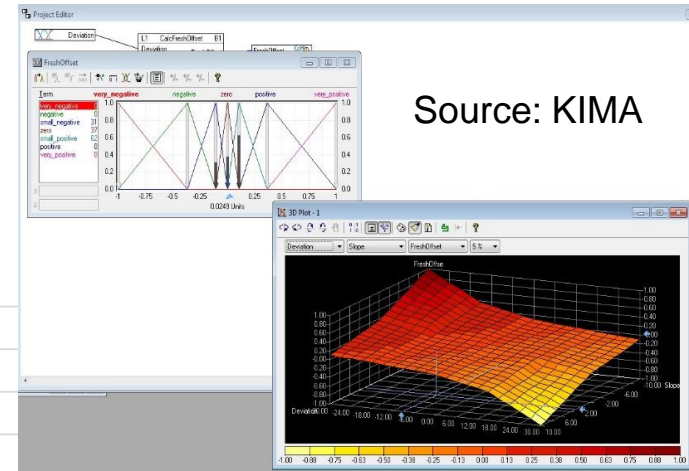
- Higher calcination temperature during oxyfuel operation mandatory
- Optimization of oxyfuel calcination in calciner/kiln to stay within acceptable temperature boundaries
- Heat transfer characteristics to raw meal particles are essential to avoid additional temperature rise



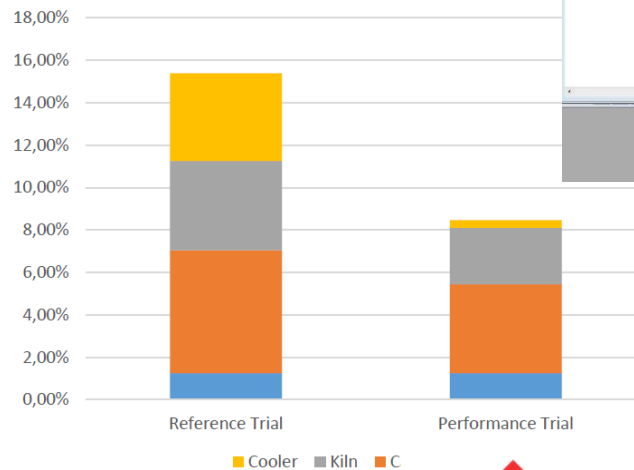
**Temperature increase ( $\Delta T$ ) by 50 to 70 K**  
for calcination in oxyfuel (OF) operation mode

# Current ECRA work on Oxyfuel technology

- Automation and instrumentation



- False air minimization



- Safety aspects



O<sub>2</sub> oxidizing



compressed gas

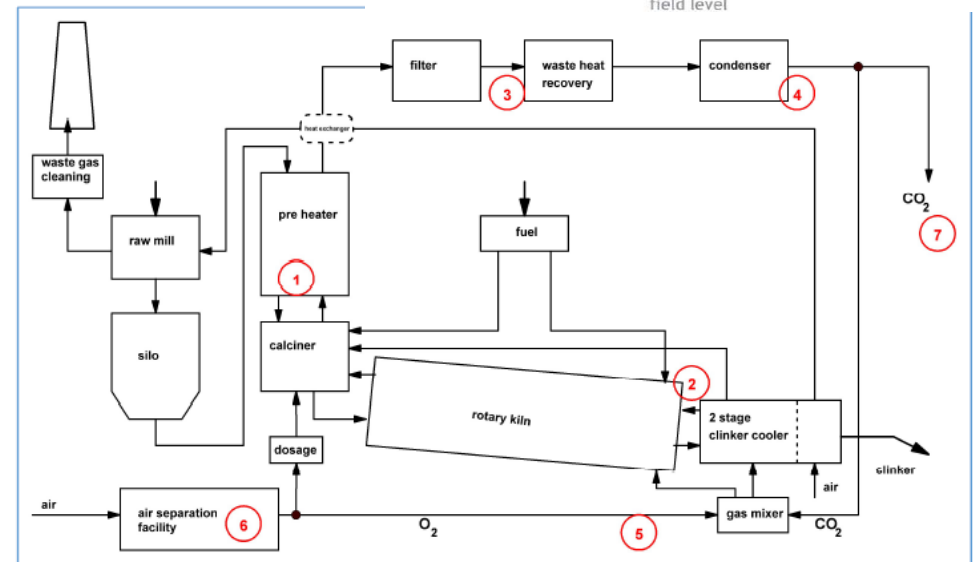
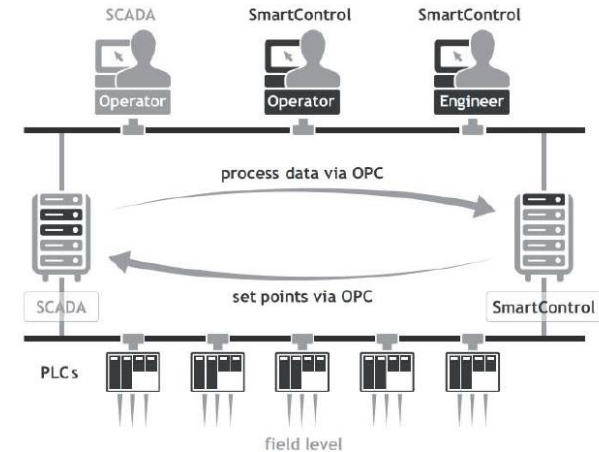


concentrated CO<sub>2</sub> may displace oxygen



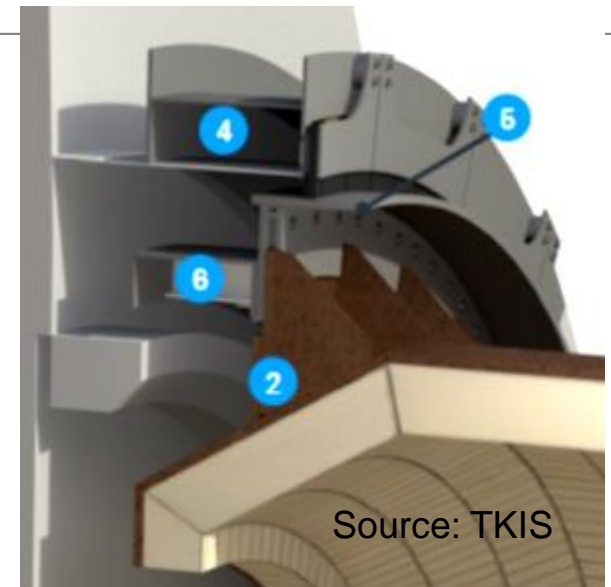
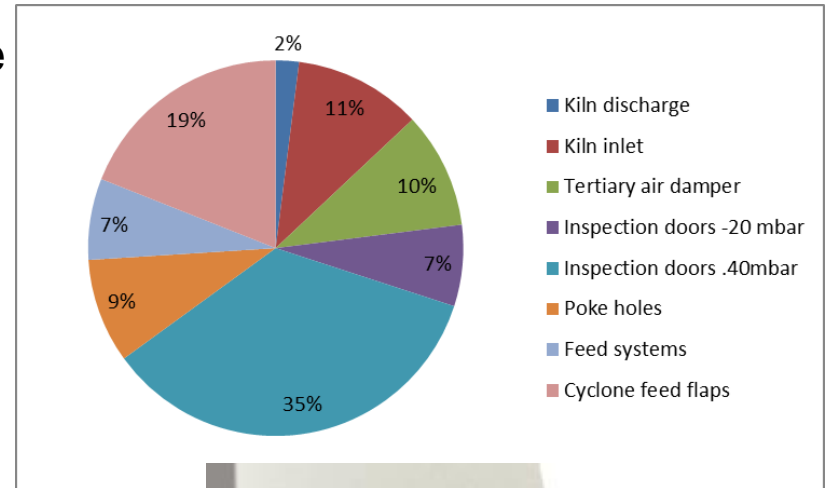
# Control system for oxyfuel pilot kiln

- Oxyfuel kiln operation provides more flexibility regarding process control, e.g. O<sub>2</sub> content in combustion “air”, exhaust air recirculation rate etc.
- Additional measurement systems and control systems required
- New instrumentation needed for:
  - preheater / calciner
  - kiln / clinker cooler
  - waste gas ducts / ID fan
  - CO<sub>2</sub> separation / gas recirculation
  - gas mixer / dosage
  - air separation facility



# False air ingress

- False air ingress is expected to be one the big challenges for Oxyfuel technology
- False air leads to dilution of CO<sub>2</sub> rich exhaust mainly by nitrogen
- Removal of N<sub>2</sub> in CPU is cost intensive
- Therefore optimized “conventional” maintenance is needed as well as
- Advanced technologies e.g. for
  - kiln sealings
  - minimization of need for poking/cleaning
  - flushing of poke/man holes
  - fans
  - clinker cooler outlet



# Safety concept for Oxyfuel kiln

- The operation of a cement kiln in oxyfuel mode requires a safety concept, especially for the handling of the gas streams
- Aspects for safety study:
  - identification, assessment and management of potential new workplace health and safety hazards
  - safe operation with CO<sub>2</sub> enriched flue gas streams
  - safe industrial use of pure oxygen
  - risk assessments, for each major section and for the whole oxyfuel plant (e.g. uncontrolled release of gases)



# Acknowledgment

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The ECRA carbon capture project website and reports are found here:

<https://ecra-online.org/research/ccs/>

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Project website: [www.sintef.no/cemcap](http://www.sintef.no/cemcap), Publications: CEMCAP community in [www.zenodo.org](http://www.zenodo.org)



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