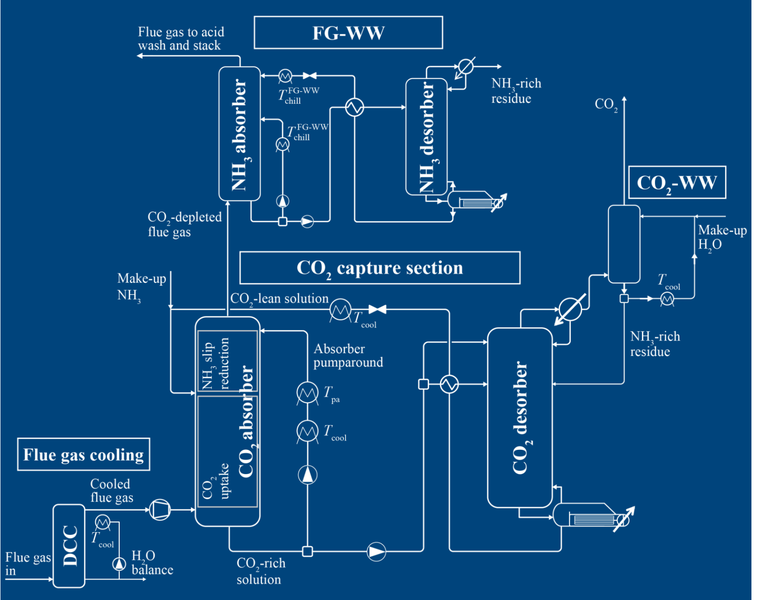
# CEMCAP

*CEMCAP is a Horizon 2020 project with the objective to prepare the grounds for cost- and resource-effective CCS in European cement industry.*




**The Chilled Ammonia Process (CAP)**

- low-cost, chemically stable solvent
- competitive energy penalty
- demonstrated for various applications from NG power plants (4%vol $CO_2$) to coal-fired power plants (~15%vol $CO_2$) at different scales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# Chilled Ammonia Process

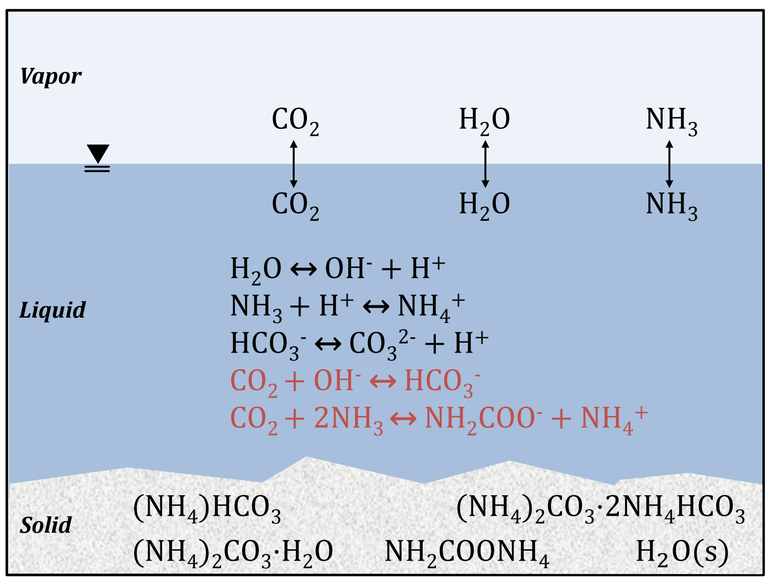
## Application of the CAP to cement plant flue gas

- Adaptation of operating conditions to higher $CO_2$ concentration
- Thermodynamic and kinetic model extensions and development

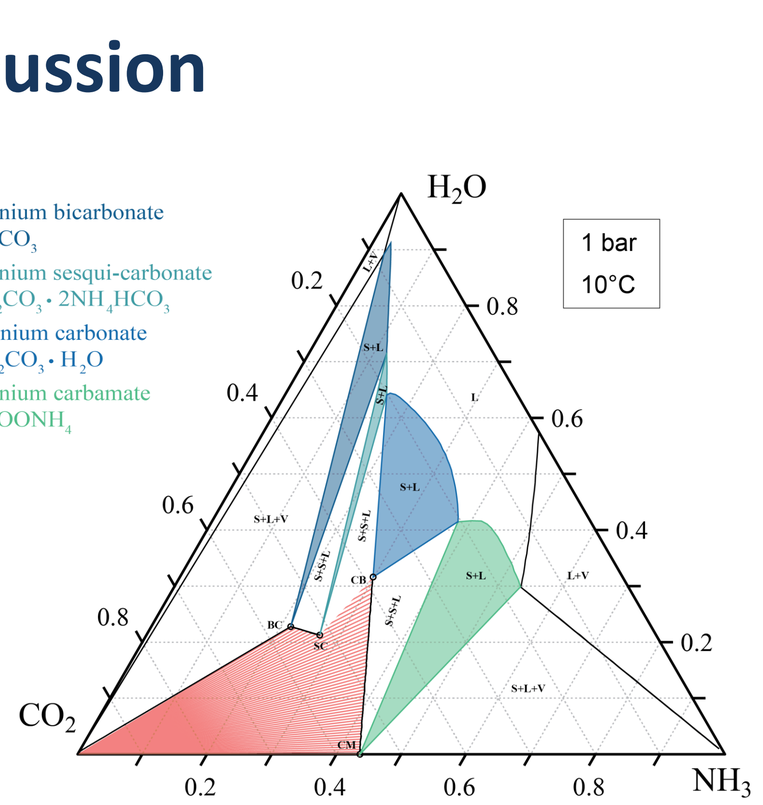
## Conclusions after 2 years

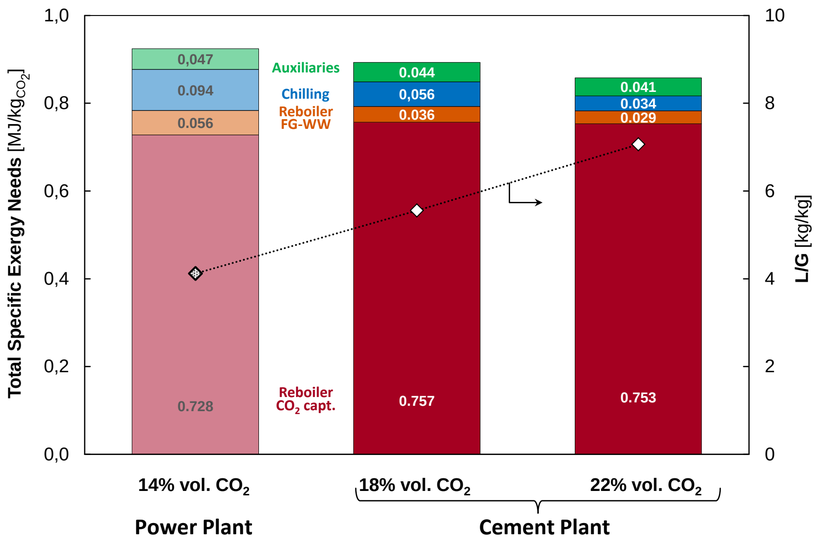
- Applicability of the CAP to cement plant flue gas proven
  - highly efficient capture exploiting the high $CO_2$ concentrations
  - tail-end application, i.e. retrofit possible, lower steam demand than amine-based capture processes
  - robust process performance even at high levels of $SO_2$ in flue gas
- Highly efficient $CO_2$ capture and resilience against flue gas impurities verified in comprehensive 1 t/day pilot tests
  - process models and experimental tests in remarkable agreement
  - further rate-based model development on-going

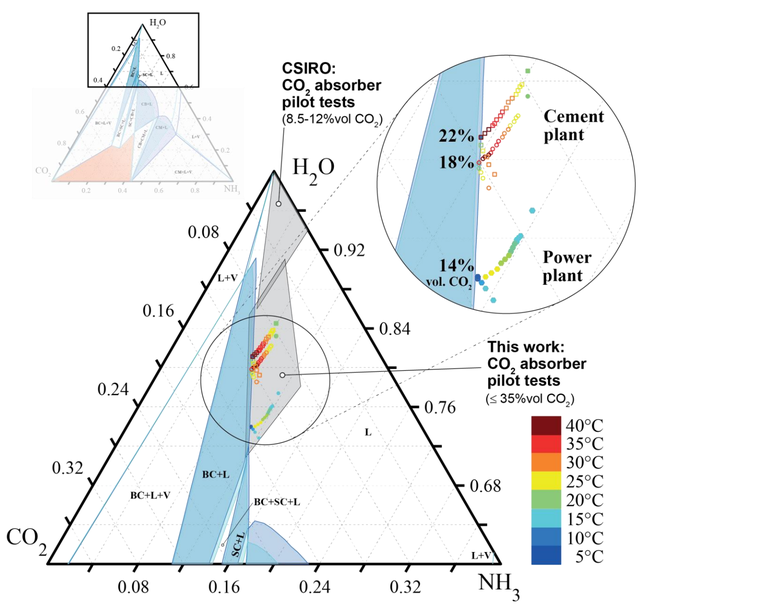
## Results and discussion

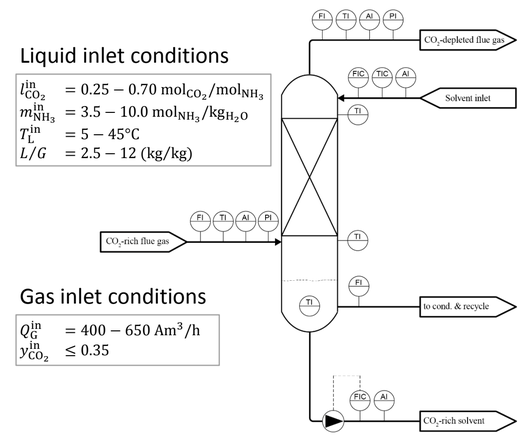


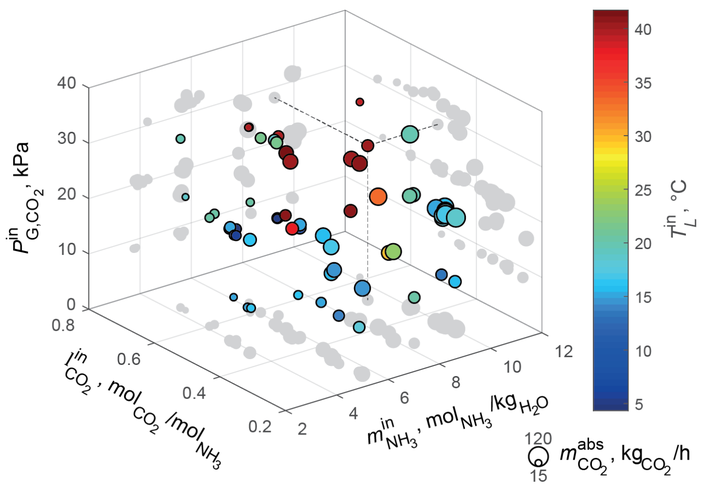

BC ammonium bicarbonate $NH_4HCO_3$
SC ammonium sesqui-carbonate $(NH_4)_2CO_3 \cdot 2NH_4HCO_3$
CB ammonium carbonate $(NH_4)_2CO_3 \cdot H_2O$
CM ammonium carbamate $NH_2COONH_4$

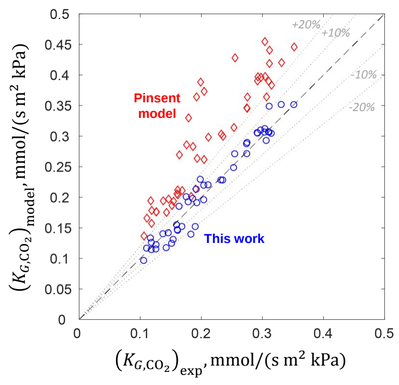



$$r_{cm} = k_{cm} C^{n}_{NH_3} C_{CO_2}$$

$$k_{cm} = k_{0cm,T_{ref}} \exp\left(-\frac{E_{a,cm}}{R}\left(\frac{1}{T} - \frac{1}{T_{ref}}\right)\right)$$

| | $k_{cm}(T = T_{ref} = 298\ K)$ $\left[\frac{m^3}{kmol\ s}\right]$ | $E_{a,cm}$ $\left[\frac{kJ}{kmol}\right]$ | $n$ [−] |
|---|---|---|---|
| This work | 190 | 35300 | 1.3 |
| Pinsent | 431 | 48500 | 1 |