

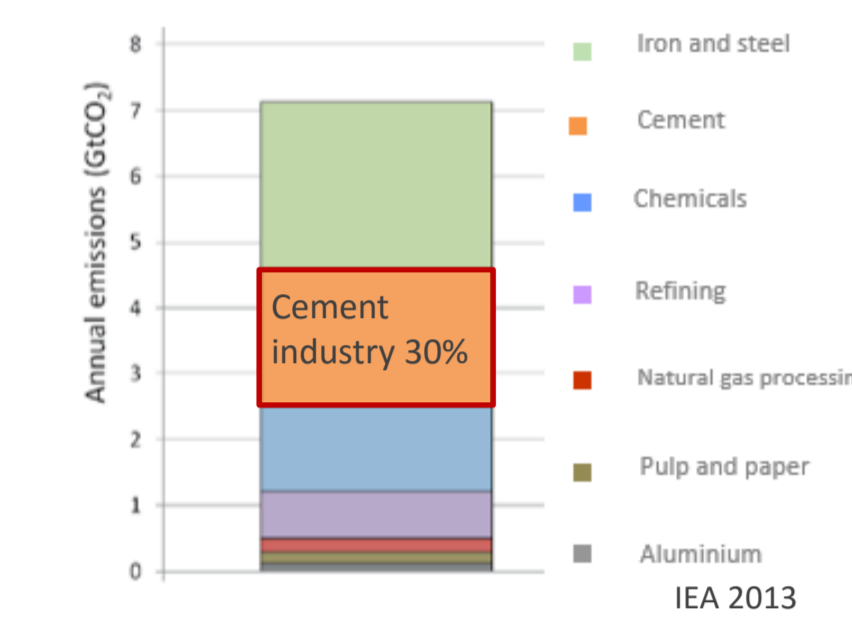
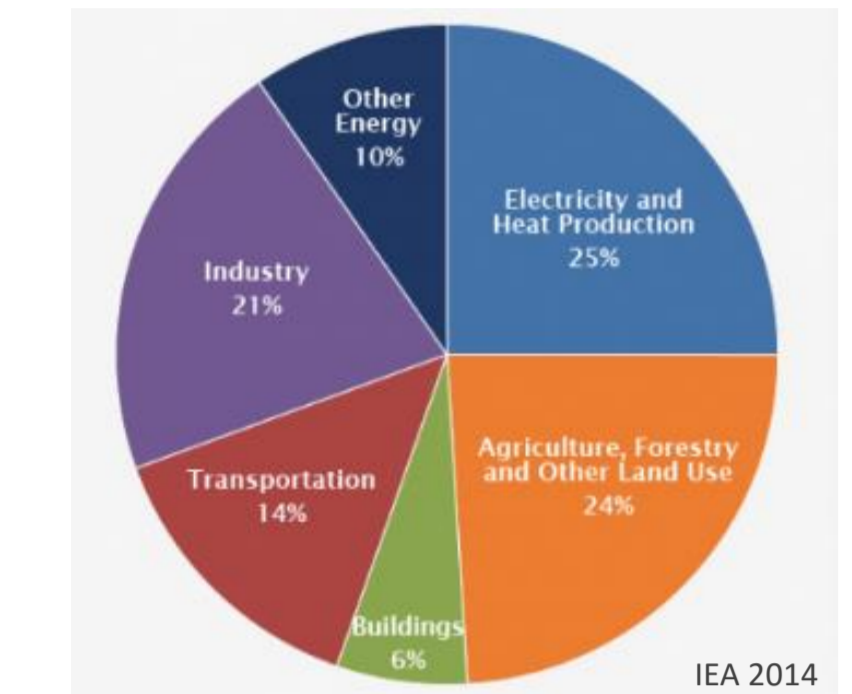
Study of post-combustion CO₂ capture process using biphasic solvents applied to cement flue gases

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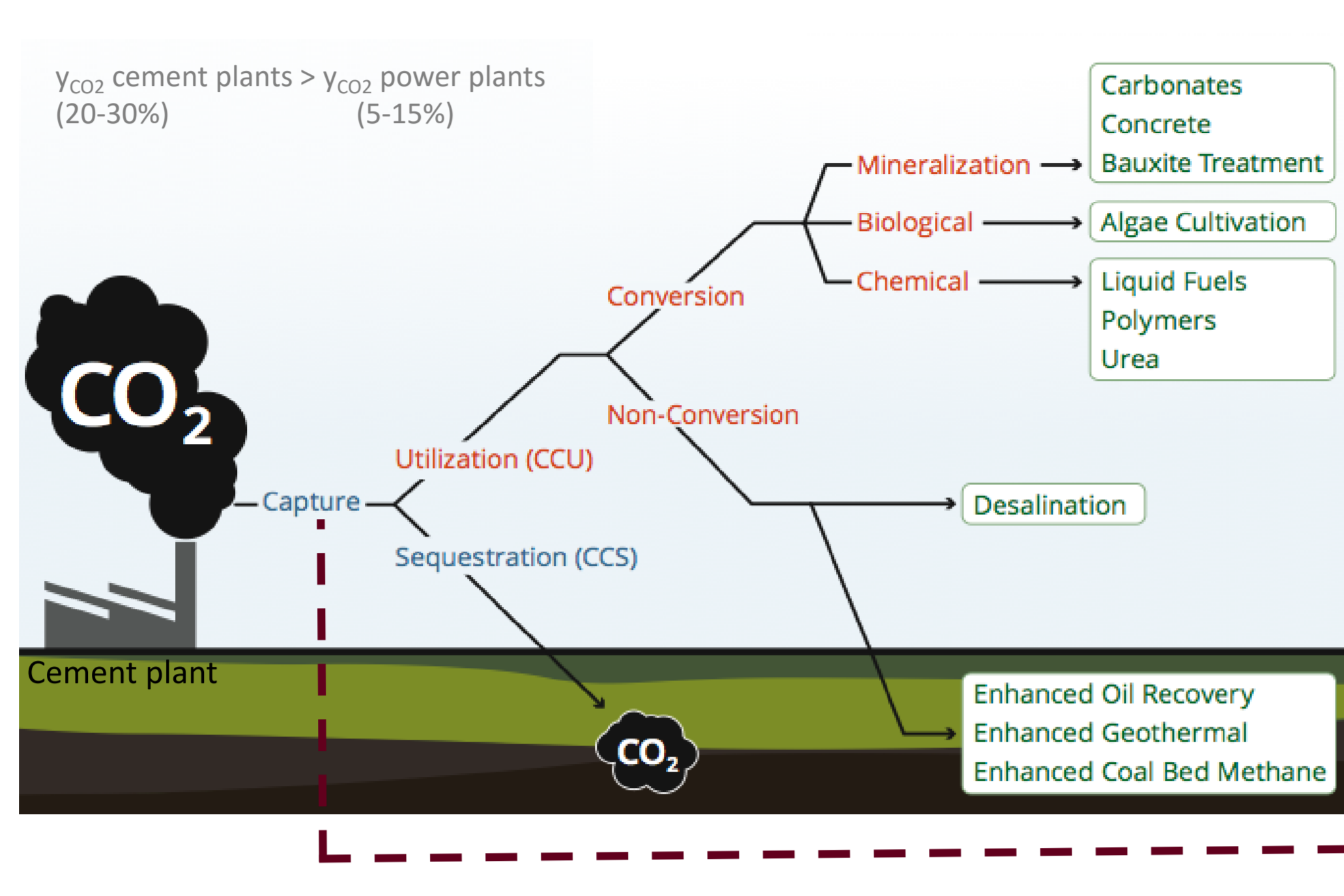
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Context of the study

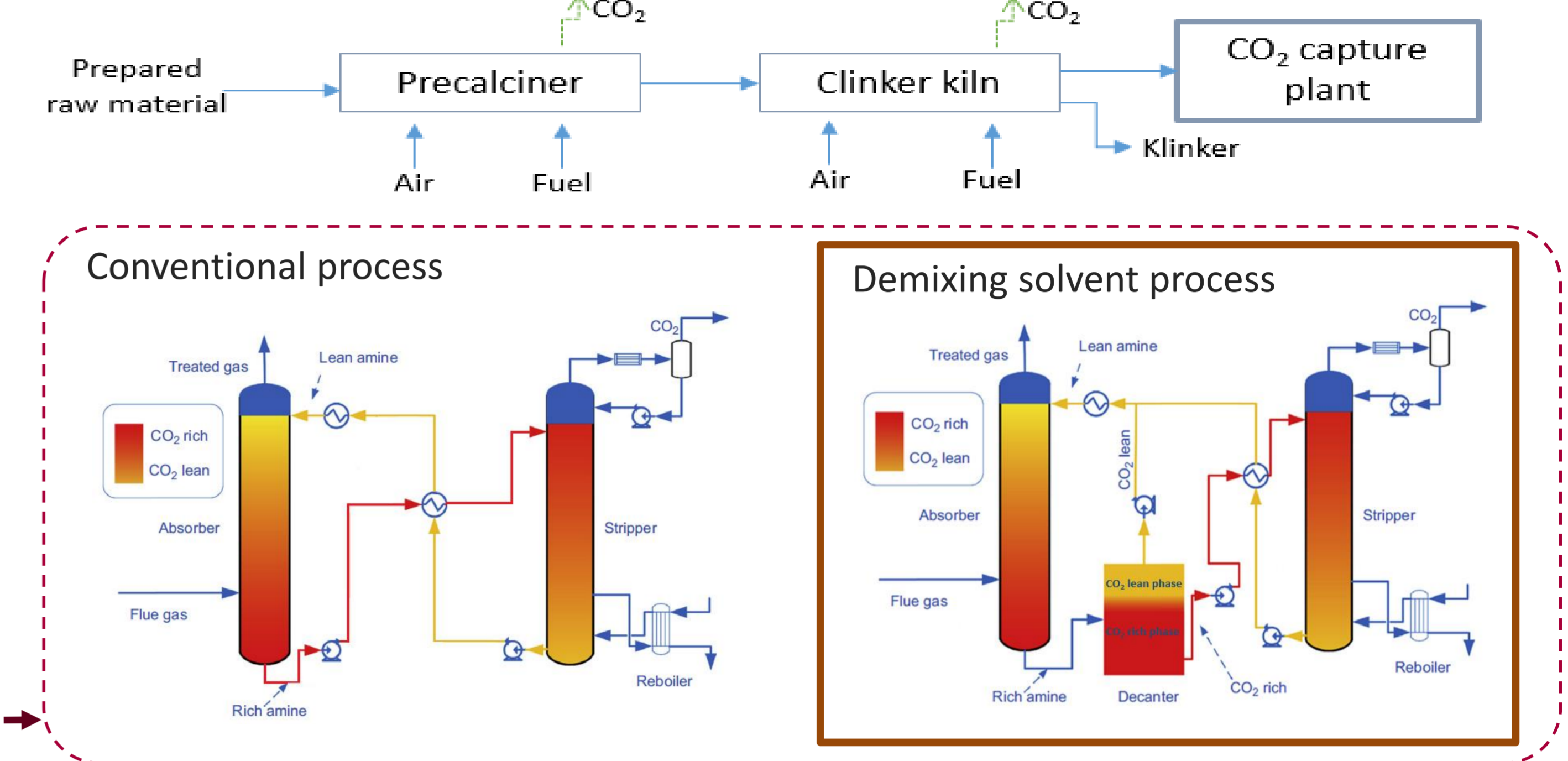
CO₂ emissions by sectors



Carbon Capture and Storage or Reuse

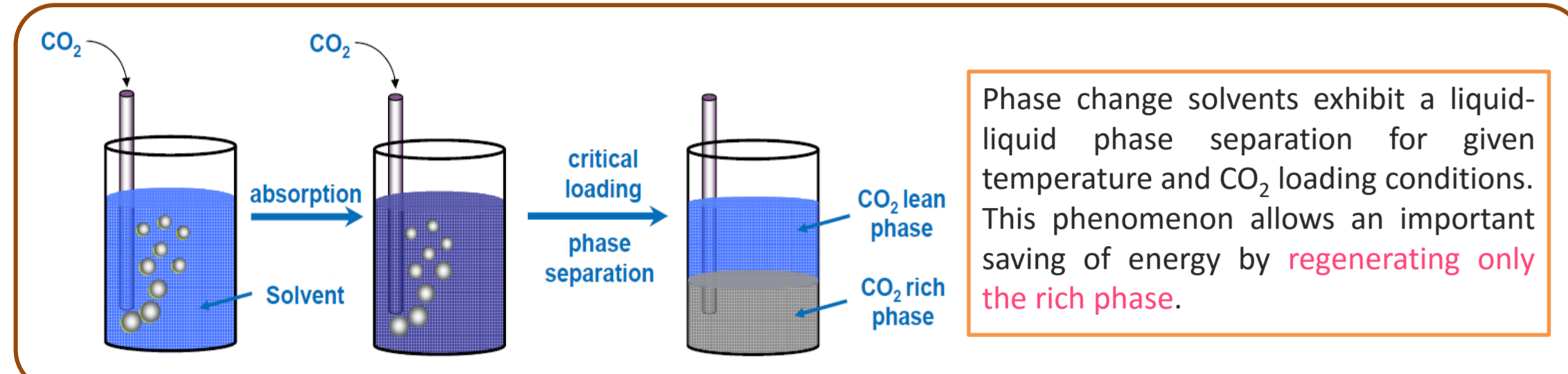


Carbon capture applied to cement production

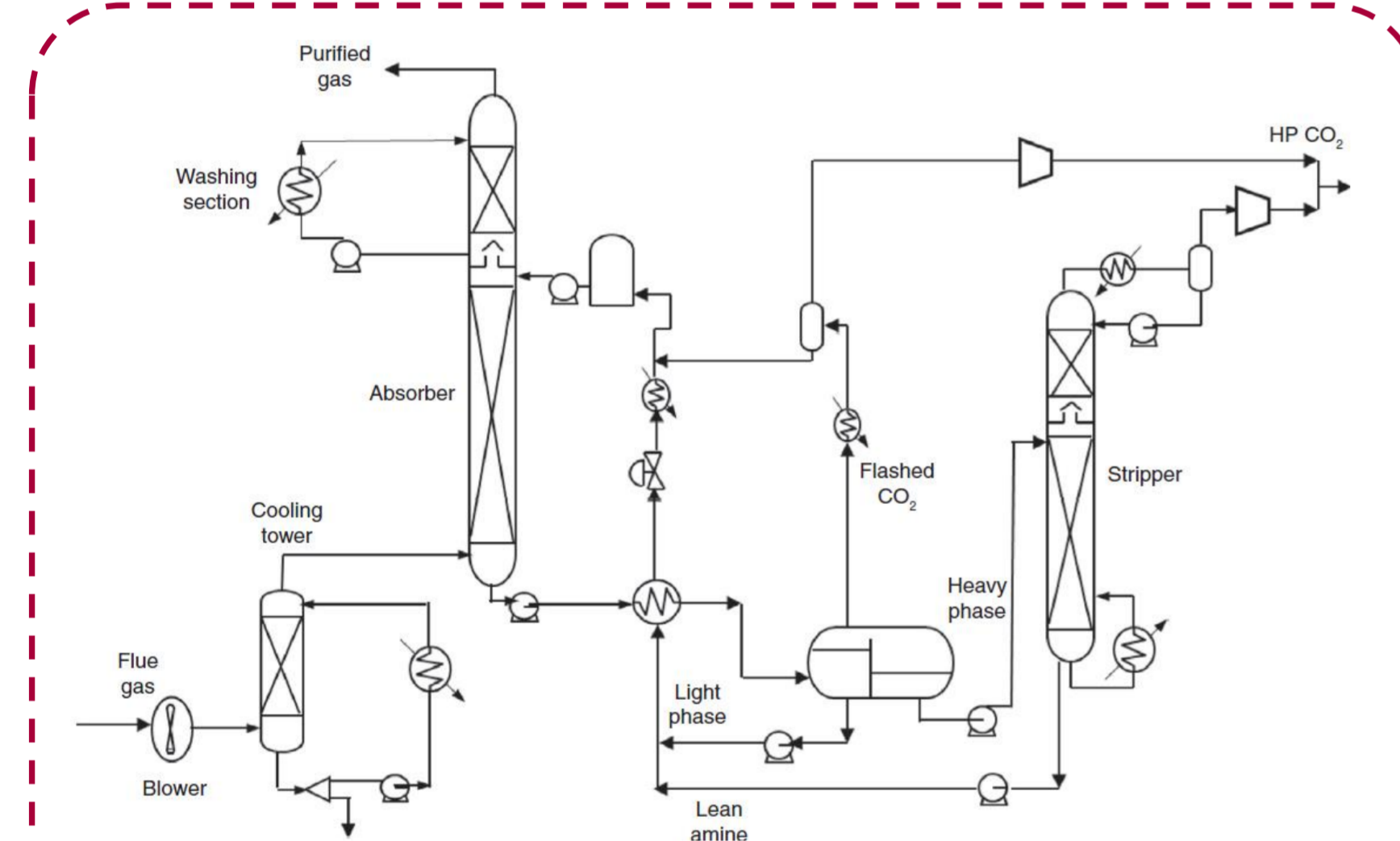


Overview of phase change solvent technologies

Phase change concept



Simplified process of the IFP Energies nouvelles DMX process



Parameter/Case	GDF SUEZ Coal-fired power plant			Fossil			Lafarge		
	MEA	DMX™	Gain	MEA	DMX™	Gain	MEA	DMX™	Gain
CO ₂ captured (t/h)	524	524	39	39	64	64			
Plant efficiency	34.3	35.6	+3.8%	N/A	N/A		N/A	N/A	
CO ₂ capture cost (€/tCO ₂)	37.1	31.4	-15.4%	63	52	-17.4%	93	44.9	-51.7%

Mentioned amines

DEEA: Diethylaminoethanol

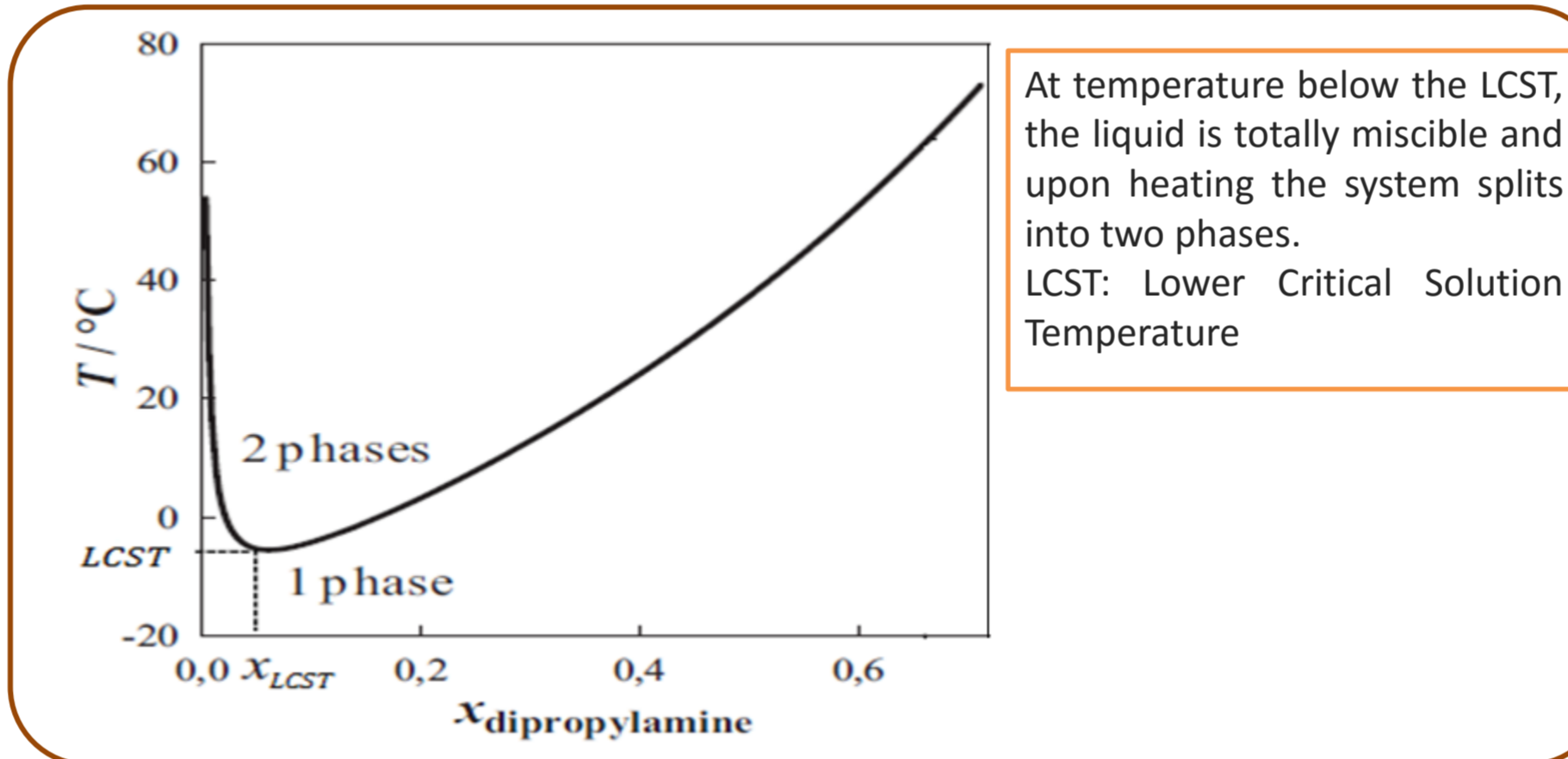
MAPA: N-Methyl-1,3Propanediamine

BDA: 1,4-Butanediamine

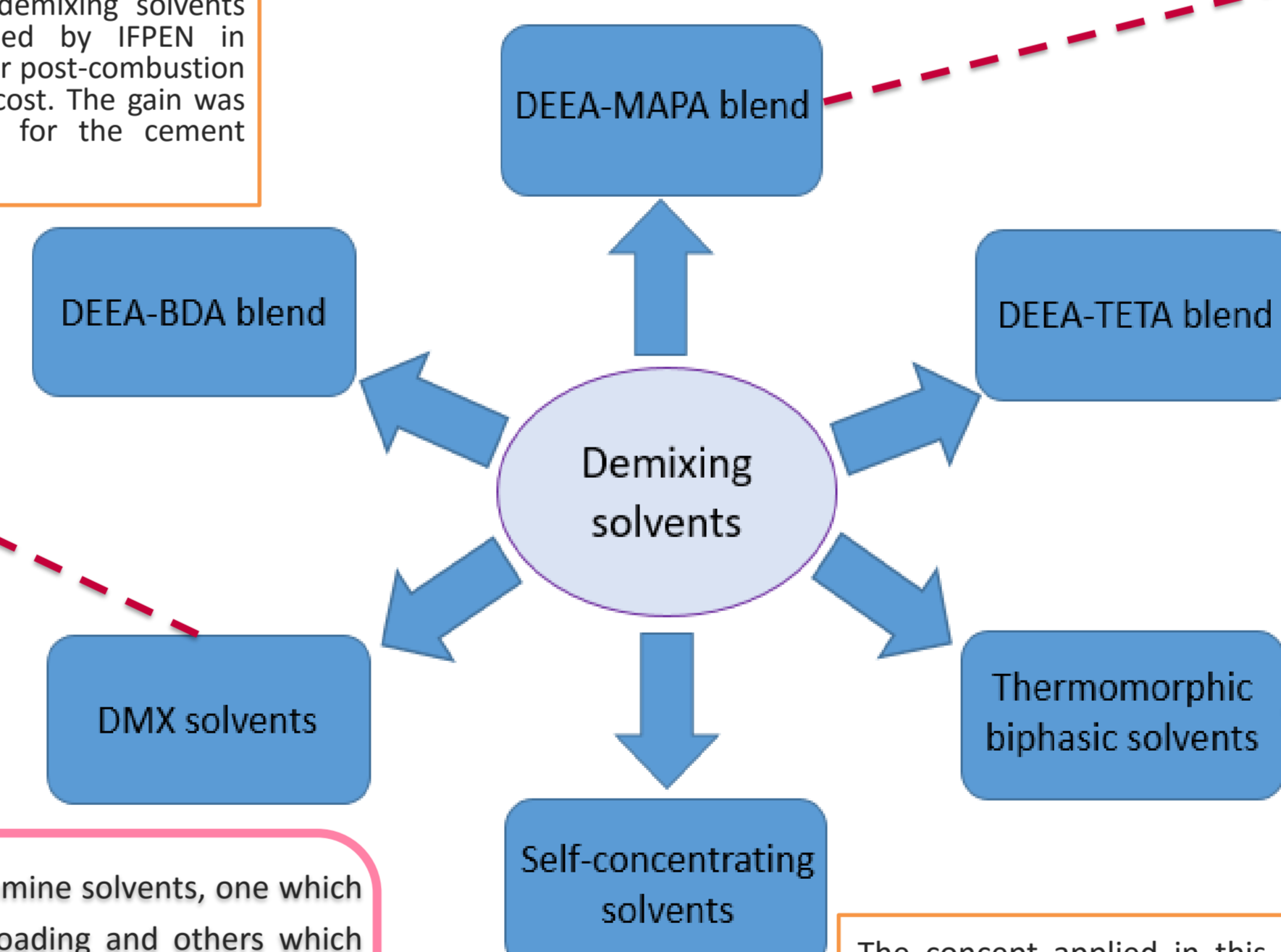
TETA: Triethylenetetramine

Conclusion: There are two types of demixing amine solvents, one which shows a phase separation even without CO₂ loading and others which need CO₂ to make the phase transition. In order to improve the capture performances, amine solutions used in demixing systems are constituted of a blend of amines: amine with good absorption properties and amine with good regeneration performances.

Phase diagram

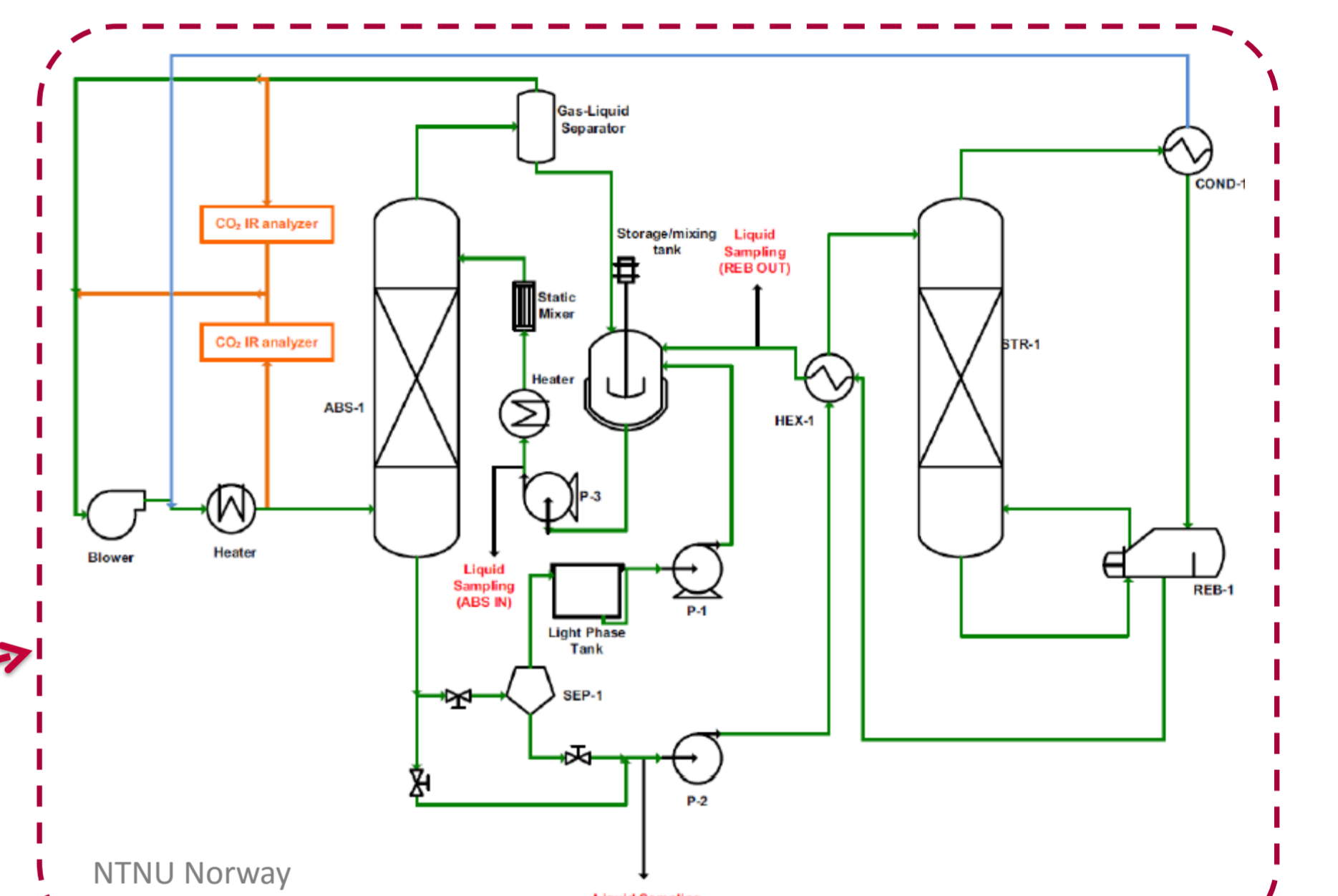


Demixing solvents categories

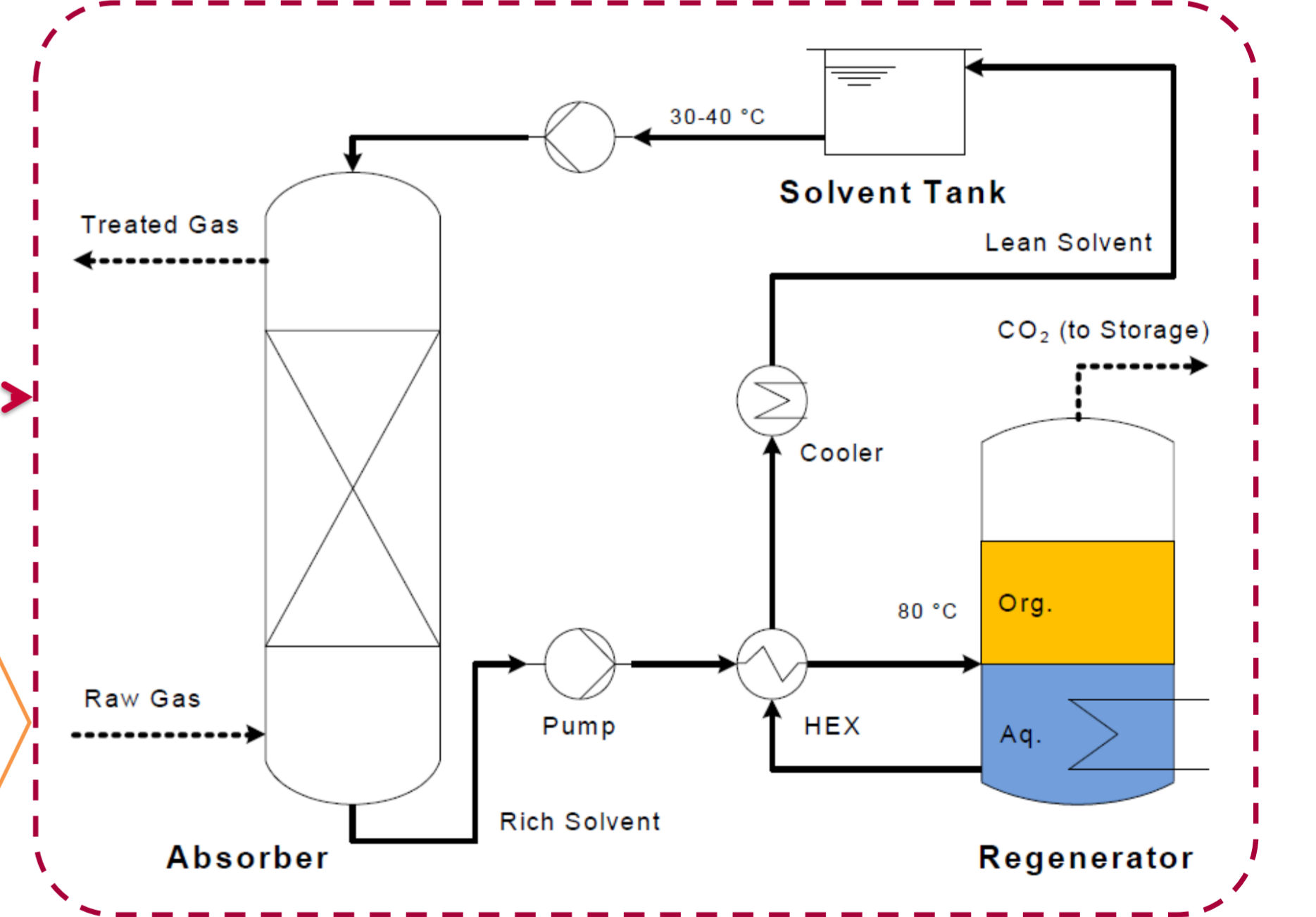


The concept applied in this technique is to employ initially biphasic amine solution. After CO₂ absorption the solution becomes homogeneous then upon heating during the regeneration it becomes biphasic.

Gløshaugen pilot plant of MAPA-DEEA blend

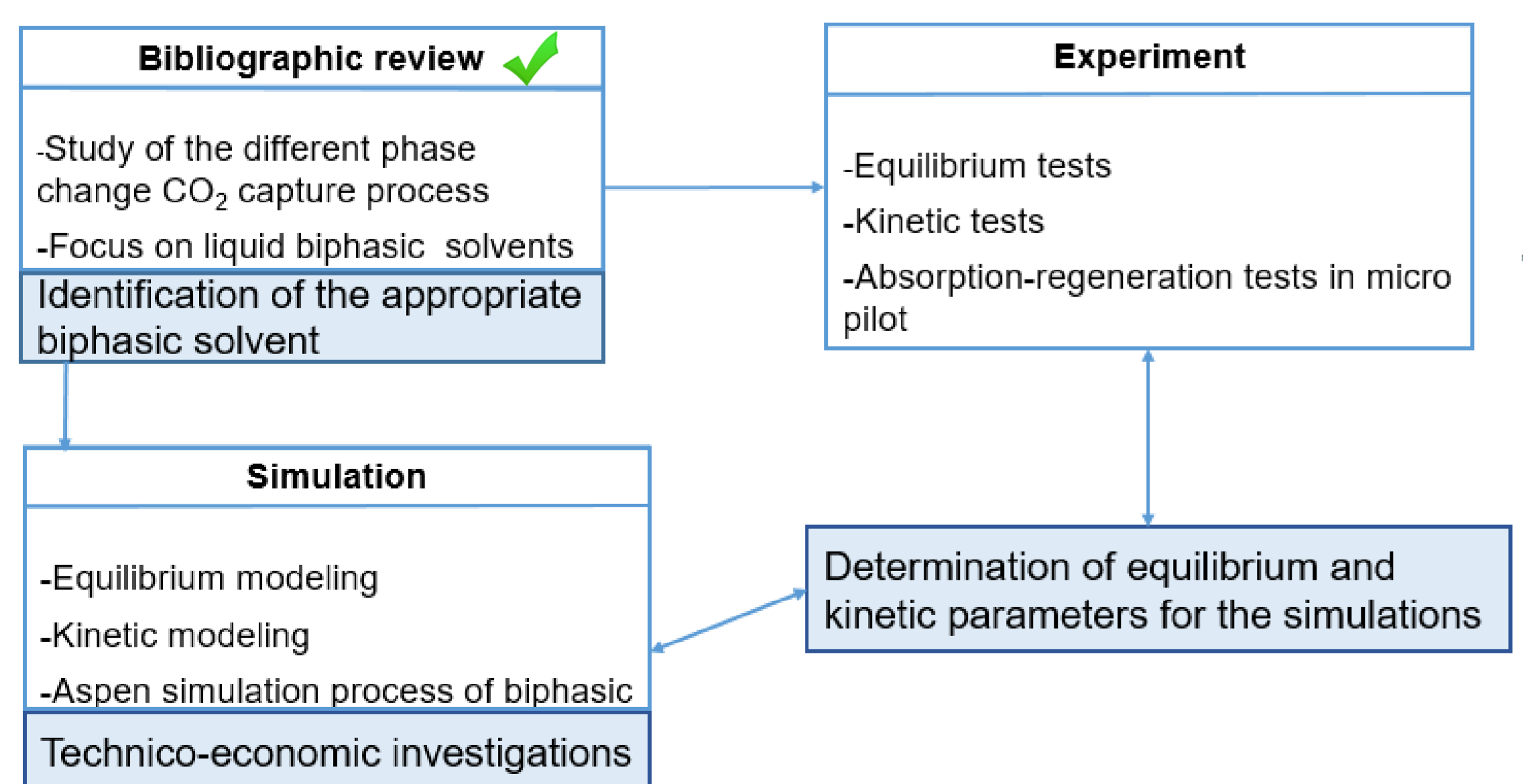


Simplified process thermomorphic biphasic system



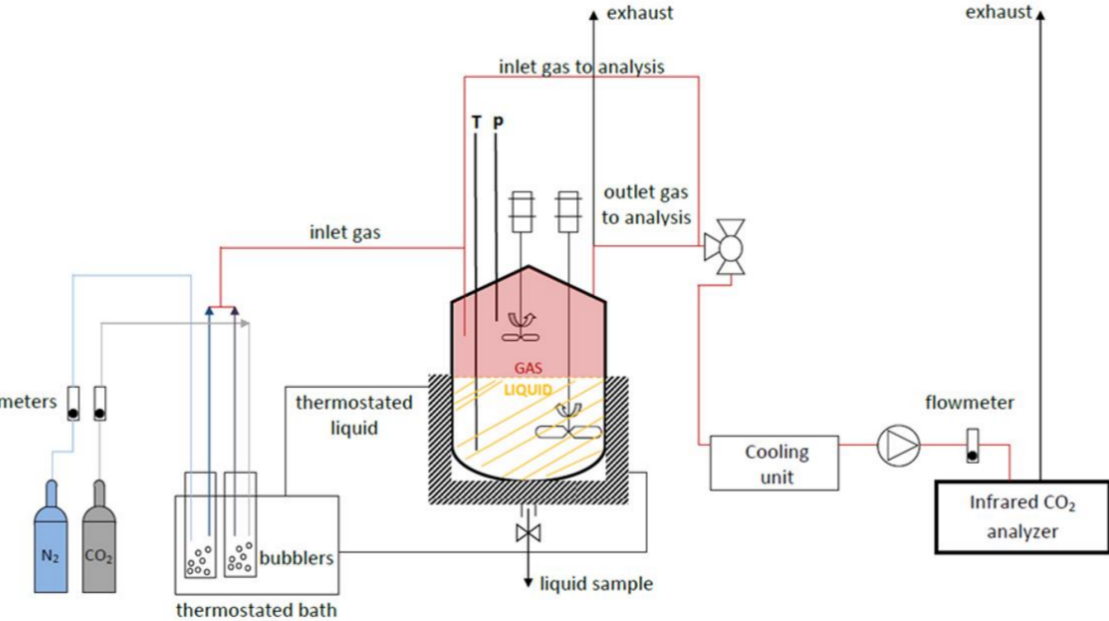
Conclusion and future works

Thesis steps



As a result of our bibliographic review DEEA-MAPA blend was chosen to be studied in a CO₂ demixing solvent process. Equilibrium and kinetic tests will be achieved to determine necessary parameters for thermodynamic modeling and Aspen simulations.

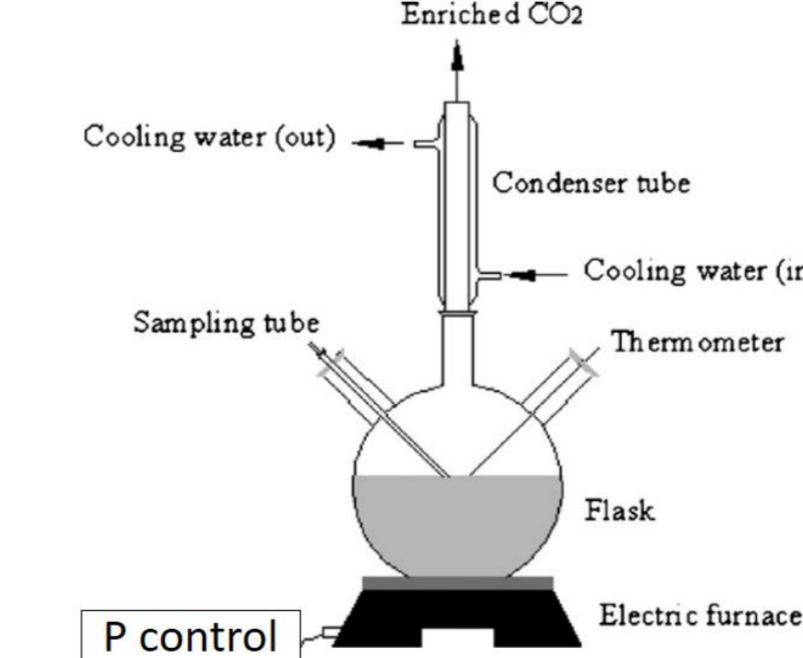
Absorption device



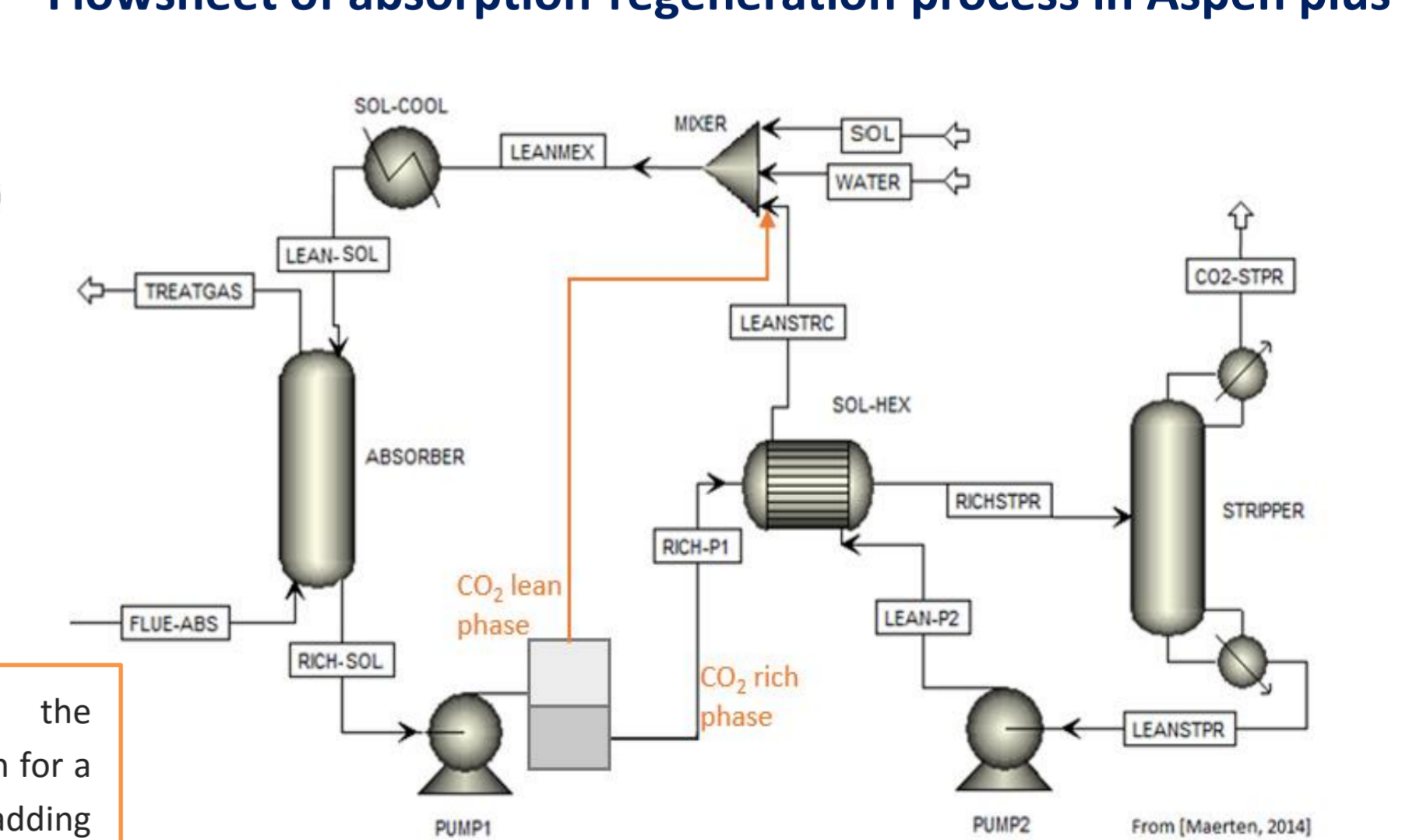
Absorption-regeneration pilot at UMONS



Regeneration device



Flowsheet of absorption-regeneration process in Aspen plus



Planned modifications on the conventional pilot: adaptation for a demixing solvent process by adding a liquid-liquid separator in order to regenerate only the CO₂ rich phase.

The final aim of the thesis will be to model the whole absorption-regeneration process to quantify the energy gain using demixing solvent. Especially for cement plant flue gases application.

Acknowledgements

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