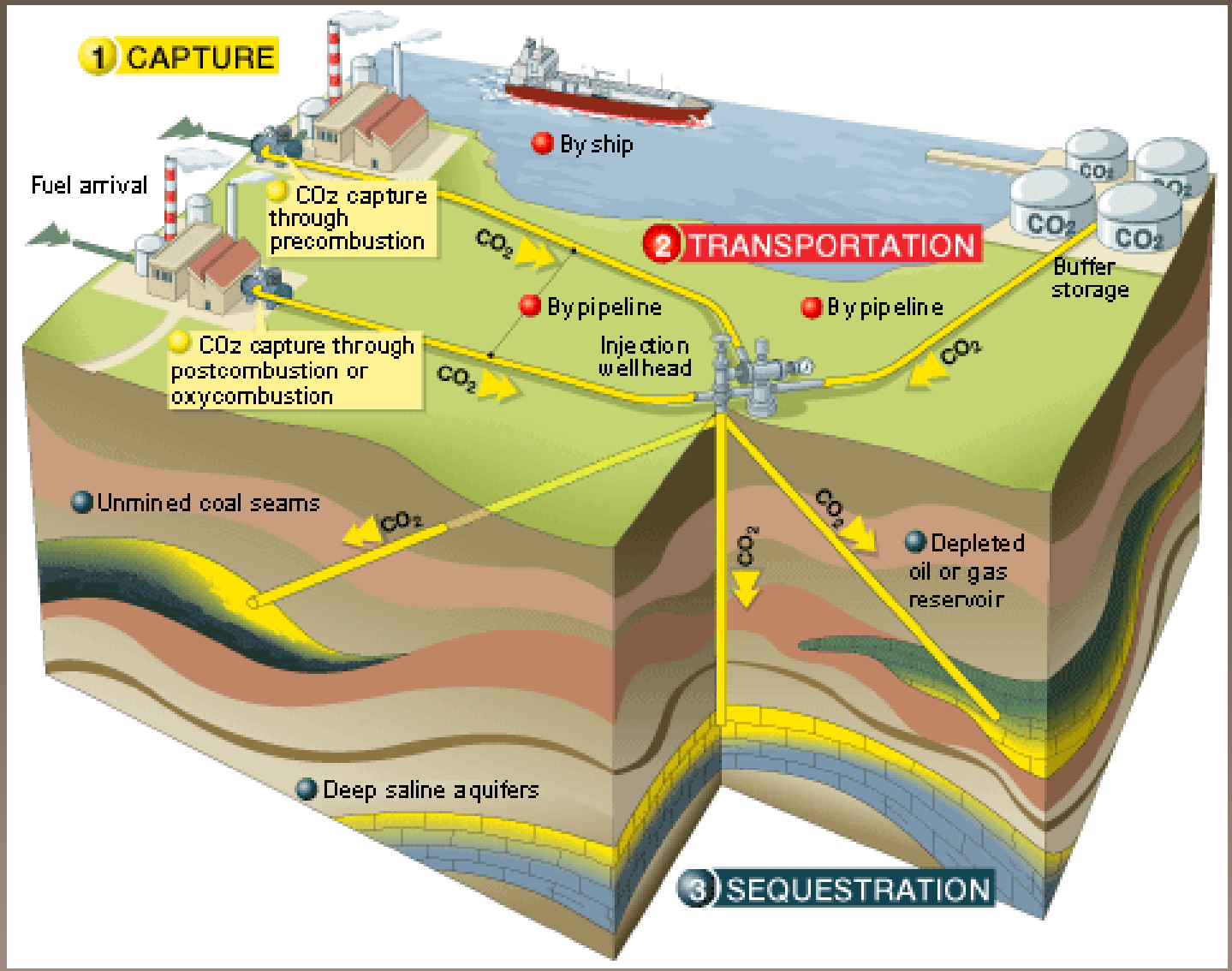
CO_2 capture
Industrial needs for simulation tools

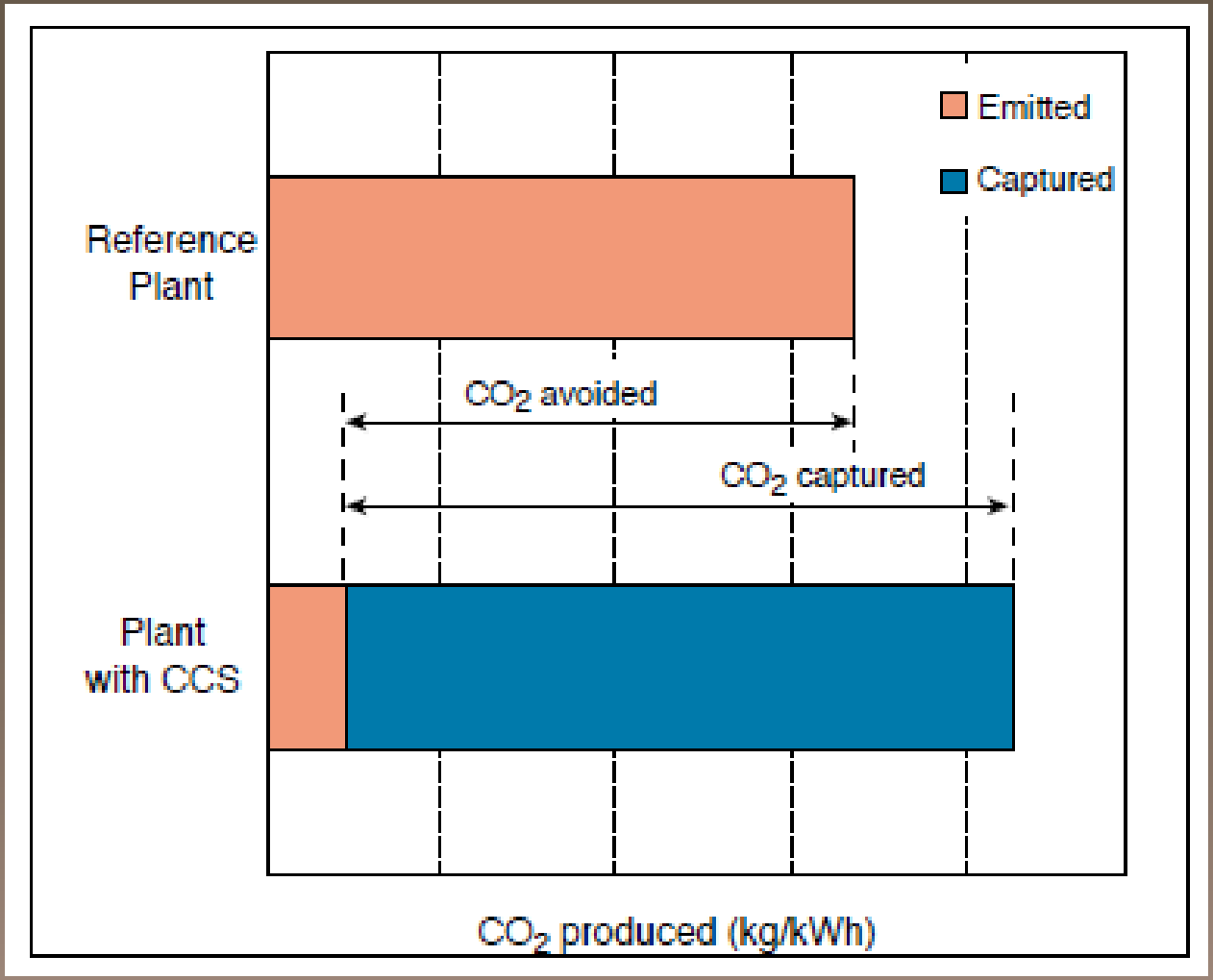
Jing ZHAO, Total E&P

CCS (Carbon dioxide Capture and Sequestration)



TOTAL

CO_2 Capture



Source : IPCC Special Report on Carbon Dioxide Capture and Storage

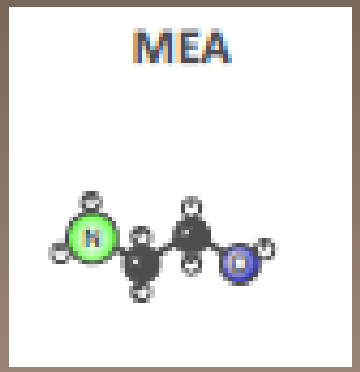
TOTAL

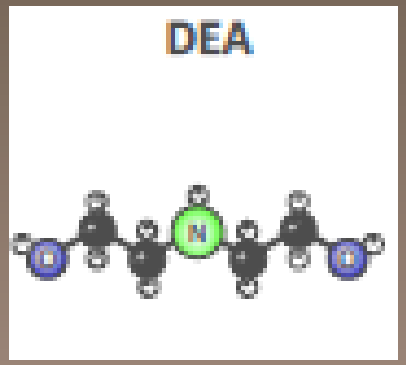
CO2 Capture– two different application cases

	Post combustion	Natural gas
Specifications	% removal rate	50ppm – 2%
Pressure range	Low pressure	Low – High pressure
Constituents	O_2, N_2, SOX, NOX	Hydrocarbons, sulfur compounds
Techniques	Solvent (MEA)	Solvent (DEA, MDEA+X) Membrane etc.

Other technologies :

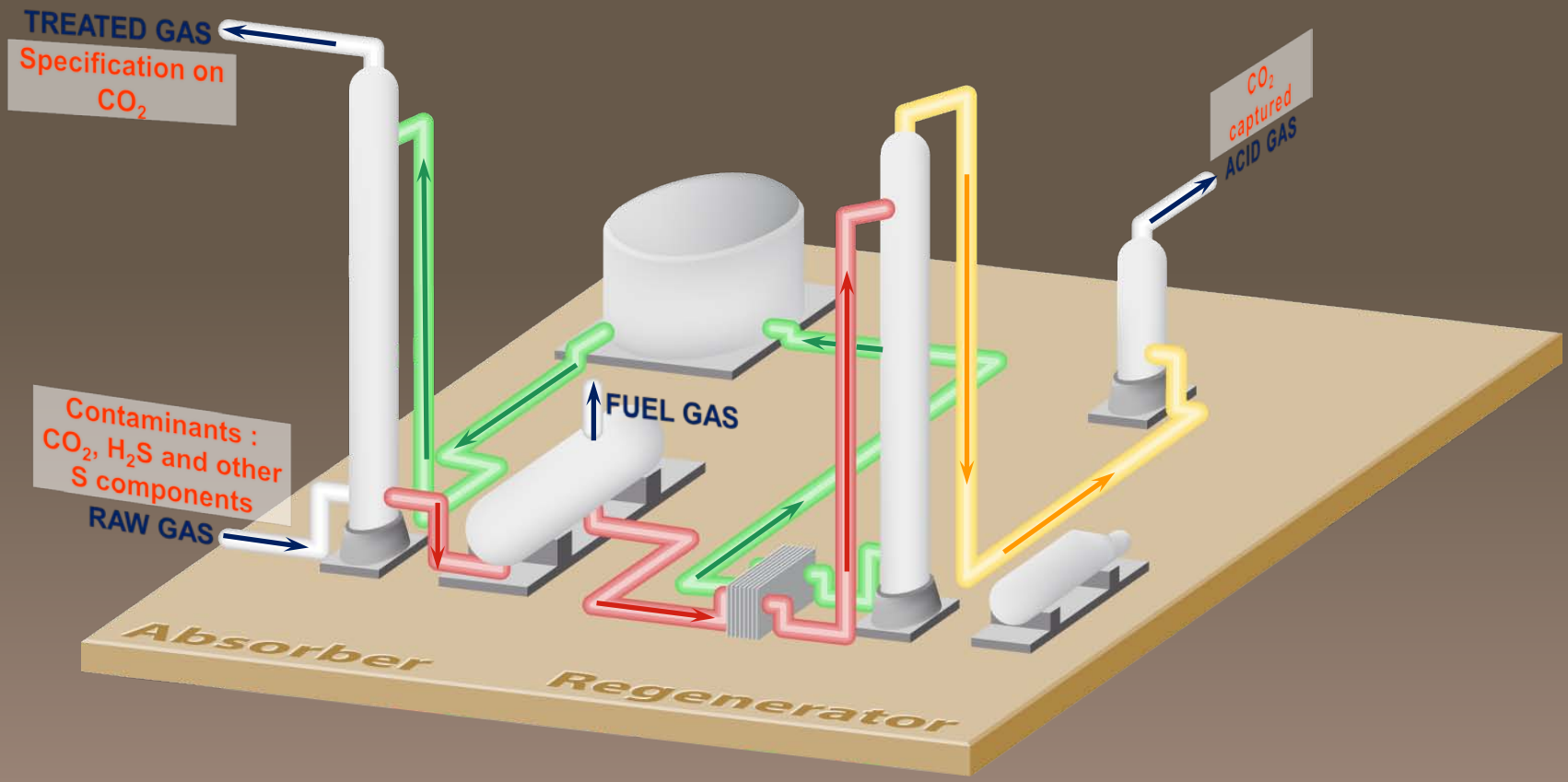
- ❑ Pre-combustion
- ❑ oxy-combustion
- ❑ chemical looping combustion





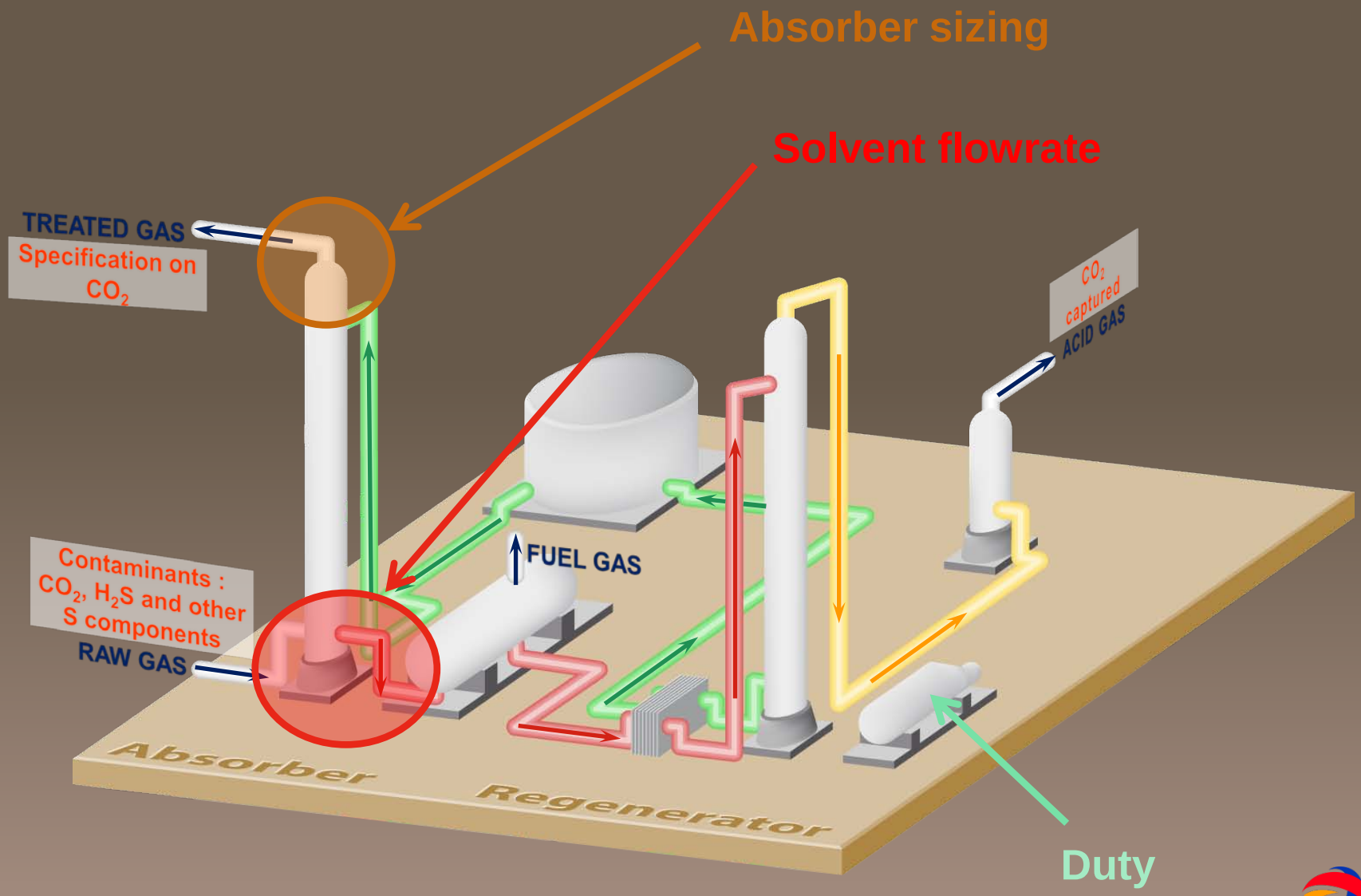
TOTAL

CO_2 capture by amine



TOTAL

Process design needs

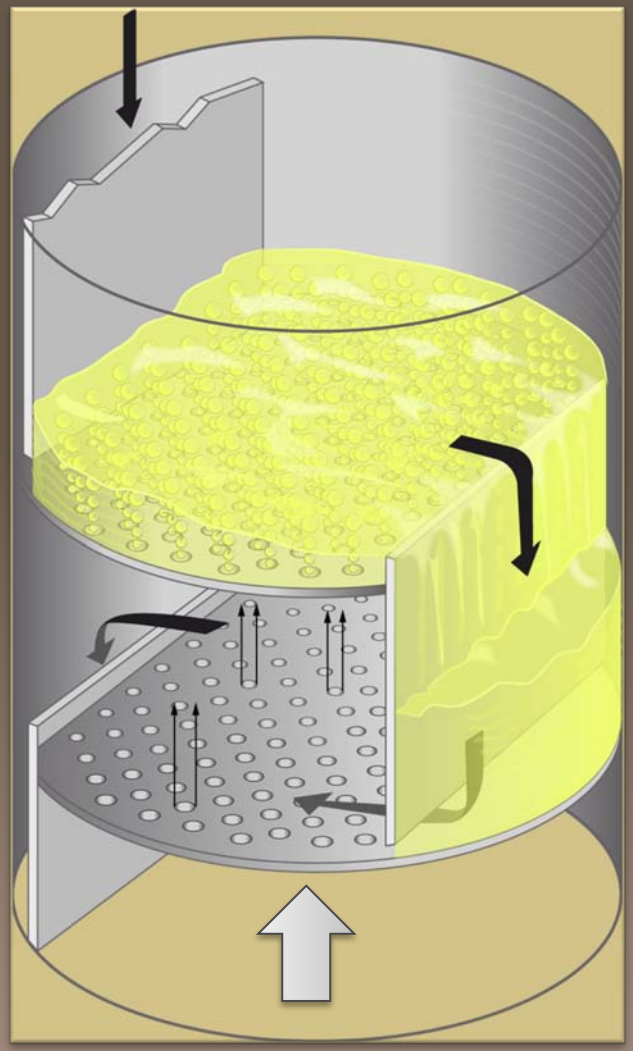


TOTAL

Column inside

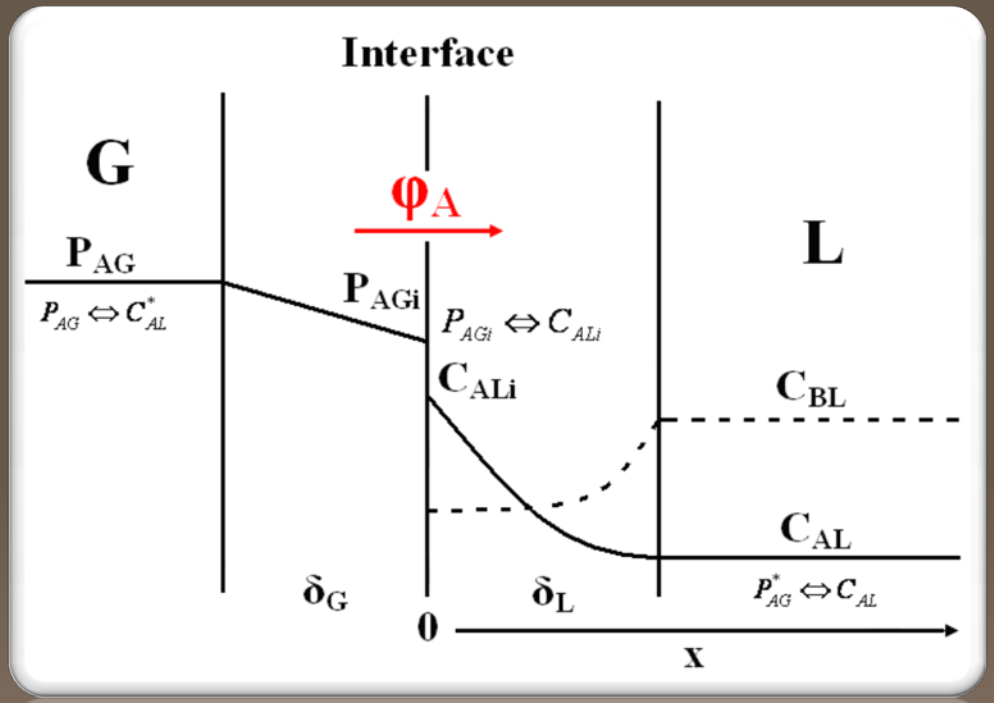
Solvent flow

Contact zone



Gas flow

Mass transfer with chemical reaction



Thermodynamics

$$EM = 1 - \frac{1}{\exp\left[\left(\frac{1}{k_G} + \frac{H_A^{Liq}}{E\,k_l}\right)^{-1} a \frac{P_A^{Gaz}}{Q_A^{Gaz}}\right]}$$

Kinetic
- Chemical reactions

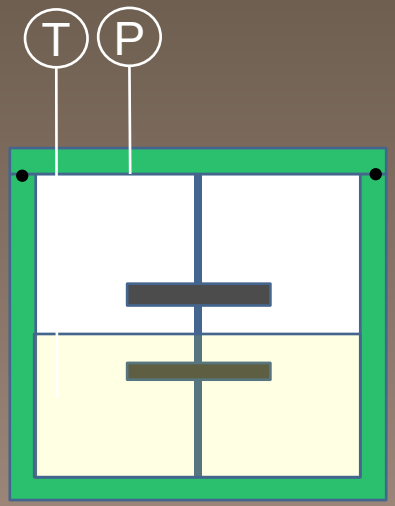
Contactor parameters
- Hydrodynamic
- Liquid/gas properties

- **Mass transfer efficiency calculation**
  - Complex because of chemical reactions along with mass transfer
  - Multi-components
  - No classical values available

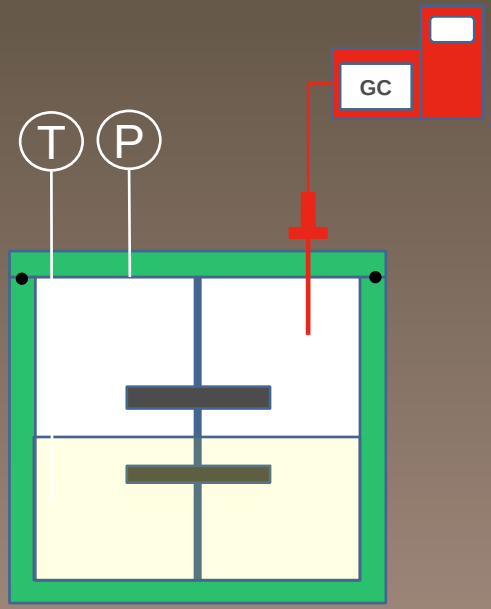
TOTAL

A good tool is half a job

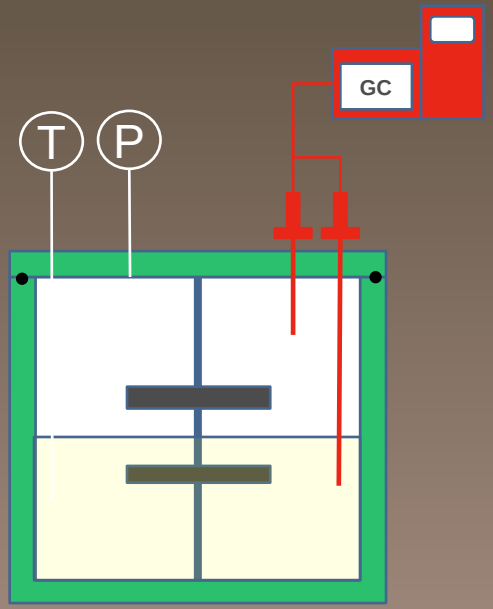
Synthetic method
(Mass balance)



Synthetic-analytic method
(Gas analysis & Mass balance)



Analytic method
(Gas & liquid analysis)



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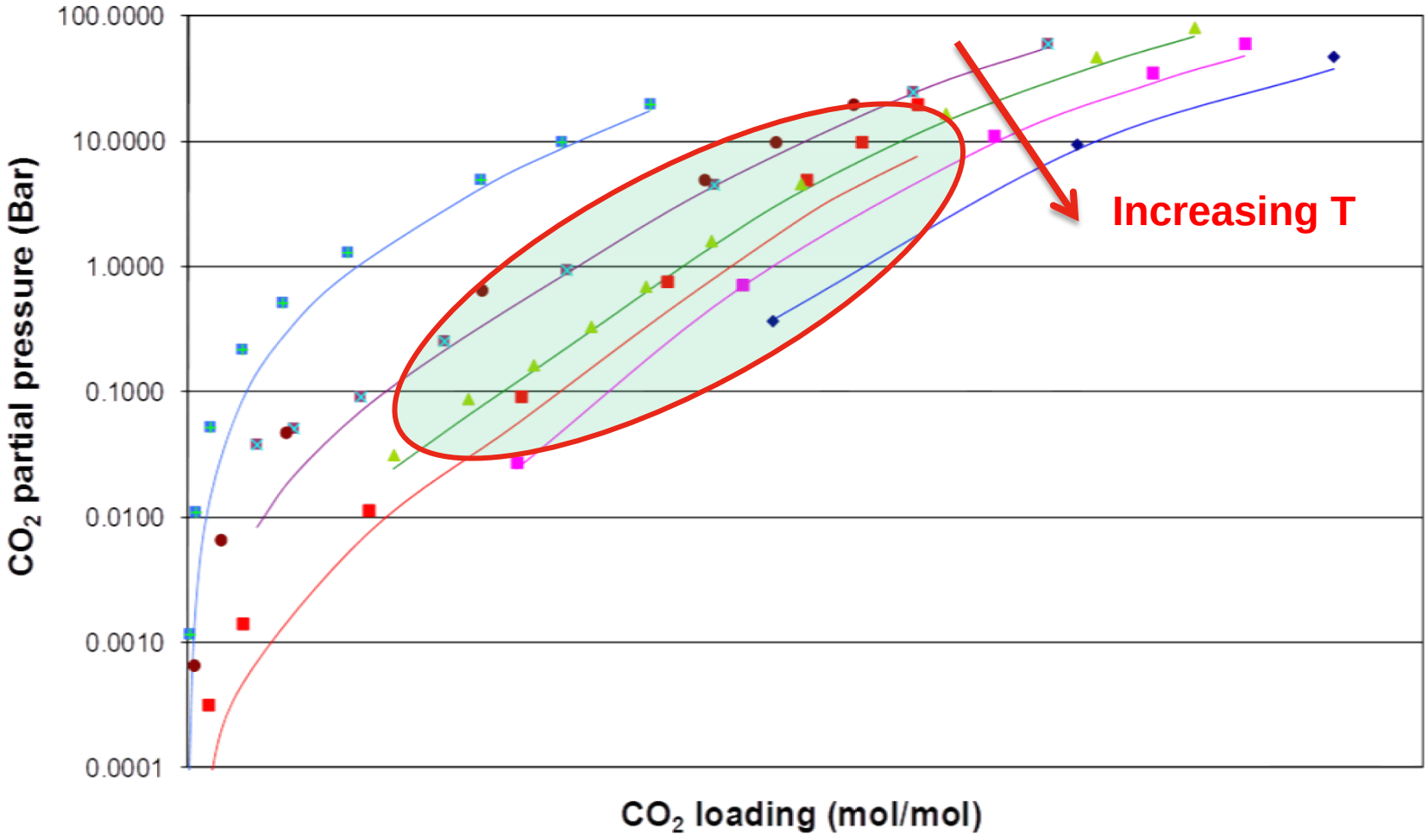
What kind of precision we need?



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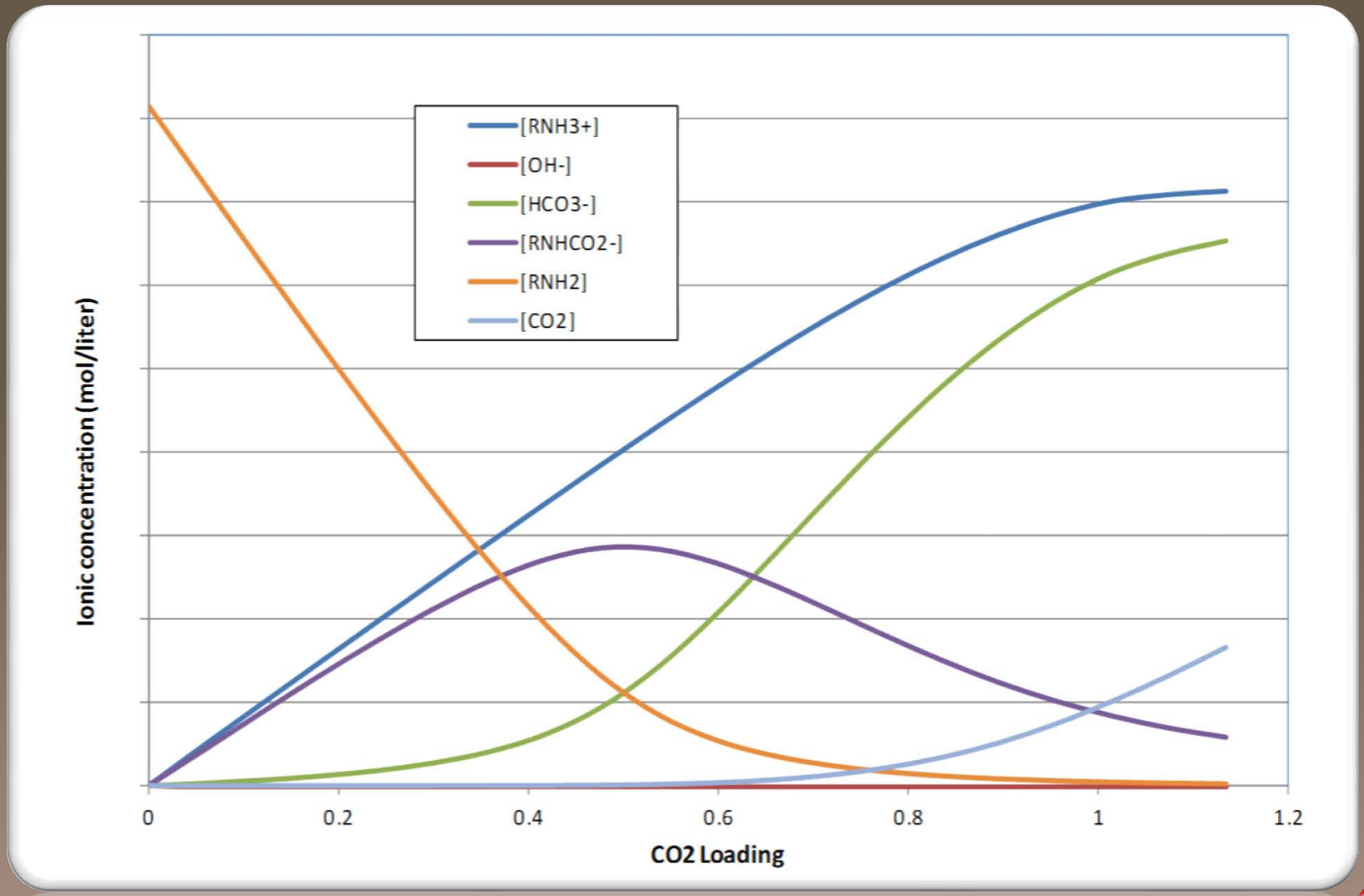

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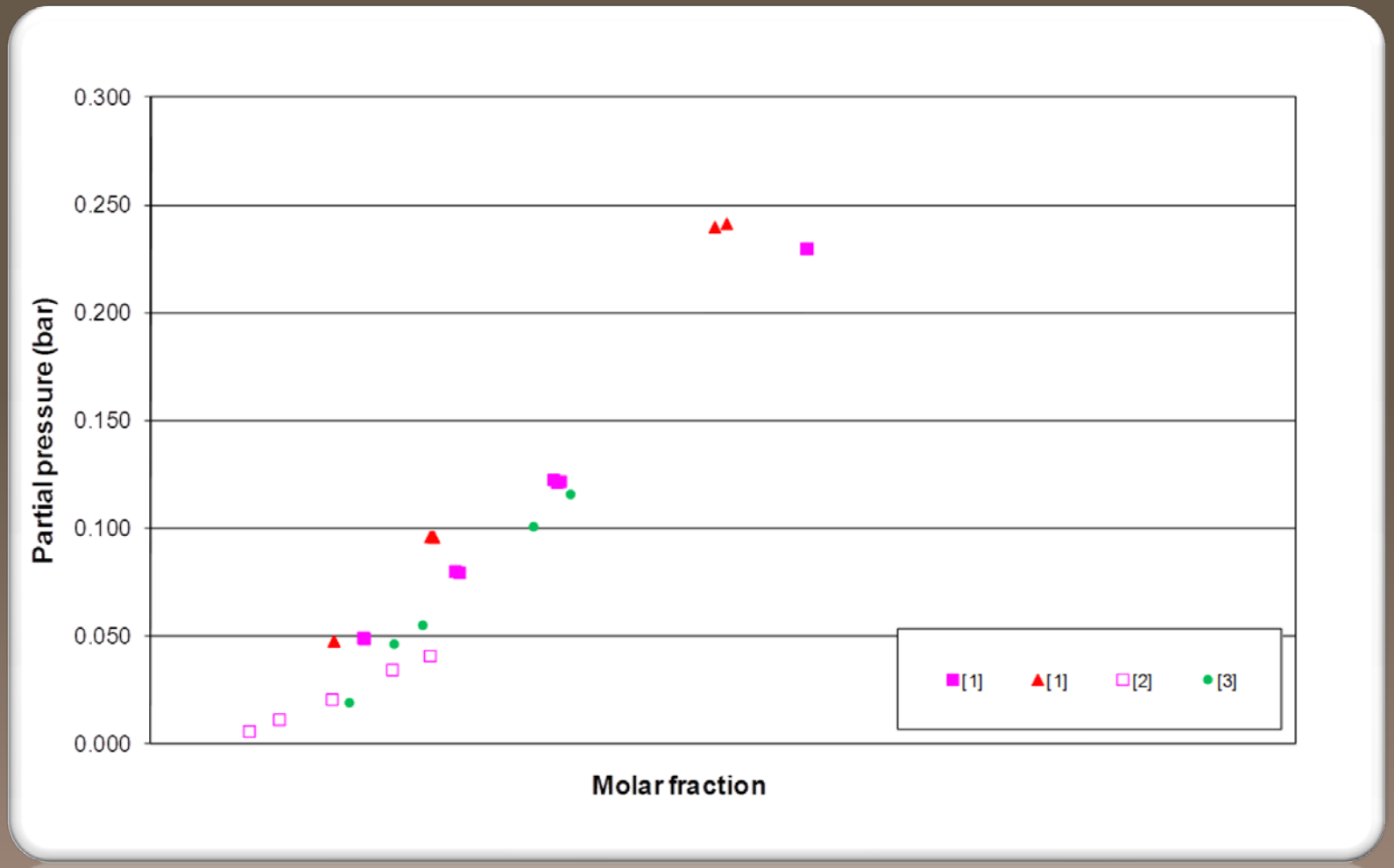

Conclusion

Process engineers' challenges and needs :

- **Experimental challenge to face the more stringent demand**
- **More precise modeling is necessary to reduce design margin and optimize the operations**
- **Fast, robust and flexible models**

"Without CCS, the long term role of gas may be limited to a flexible back-up and balancing capacity where renewable energy supplies are variable."

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