

# Carbon capture in cement production and its reuse

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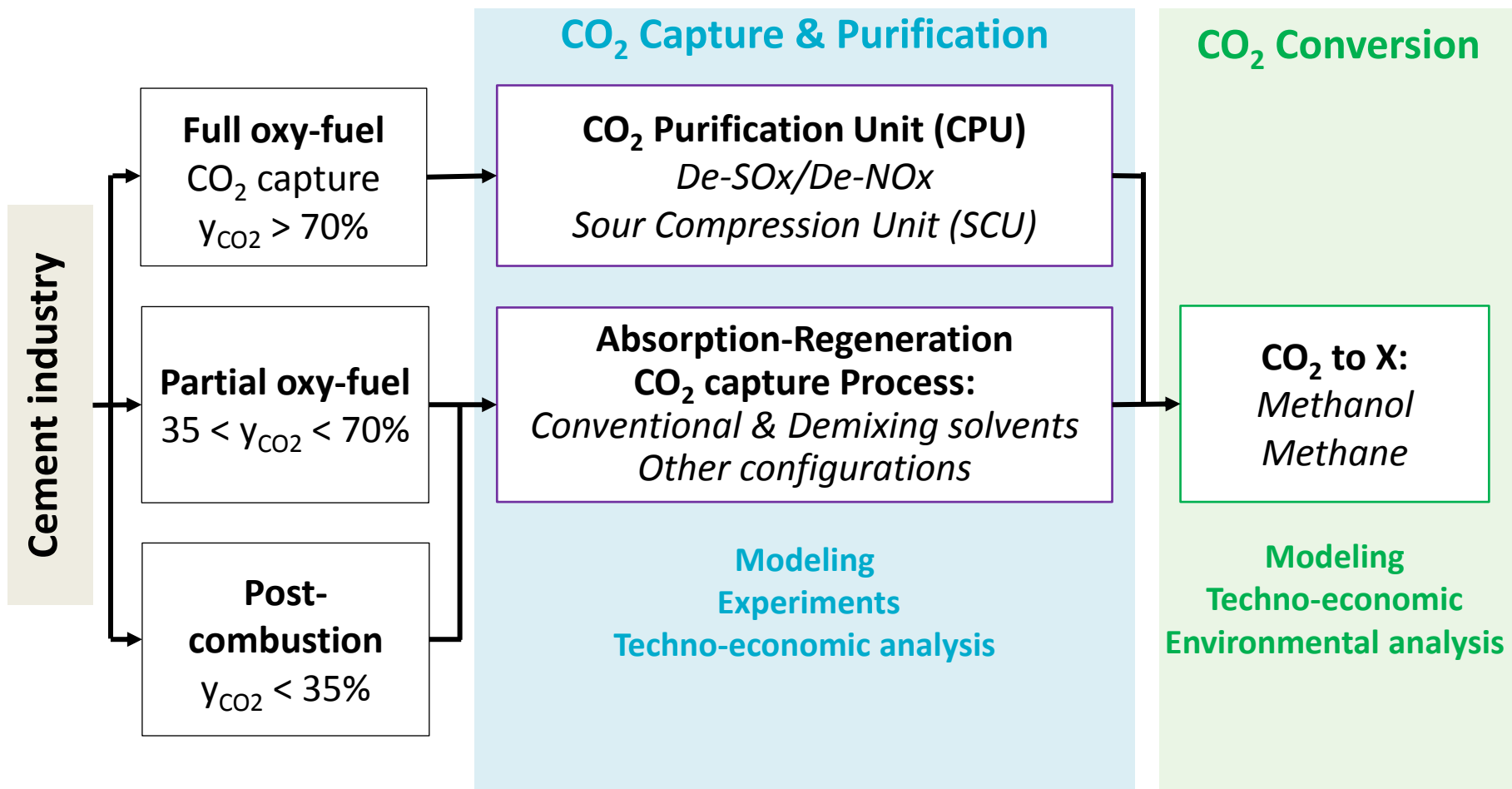
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**ECRA/CEMCAP/CLEANKER workshop - Brussels**

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# ECRA Chair @UMONS



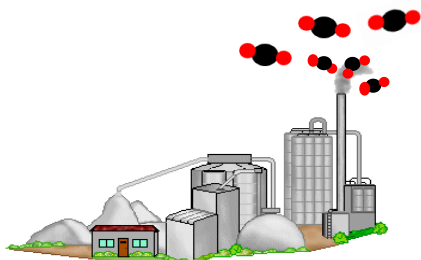
Collaborative team work between 4 PhD, 1 Post Doc

# Context: Carbon Capture & Utilization (CCUS)

CCS/CCU

CCU

**CO<sub>2</sub> capture and purification**



Amine scrubbing  
Membrane  
Pressure Swing  
Adsorption etc.

**Capture and Storage (CCS)**

**Sequestration**

Geological storage  
Saline aquifers

**Capture and Utilization (CCU)**

**Conversion**

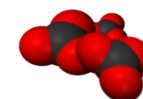
Chemicals  
Mineralization  
Biological  
etc.



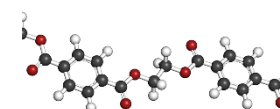
Fuels



Organic  
chemicals



Carbonates



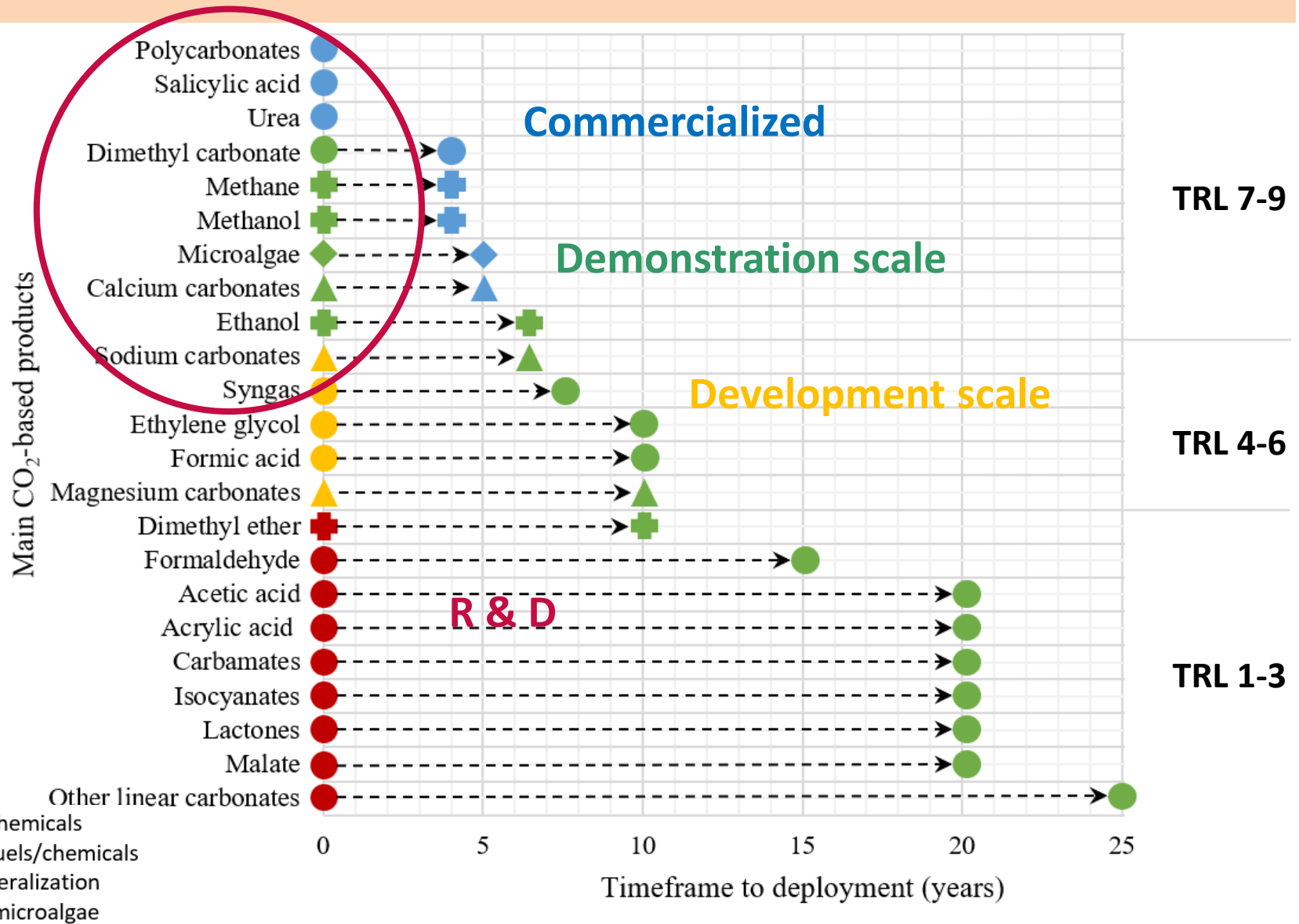
Polymers



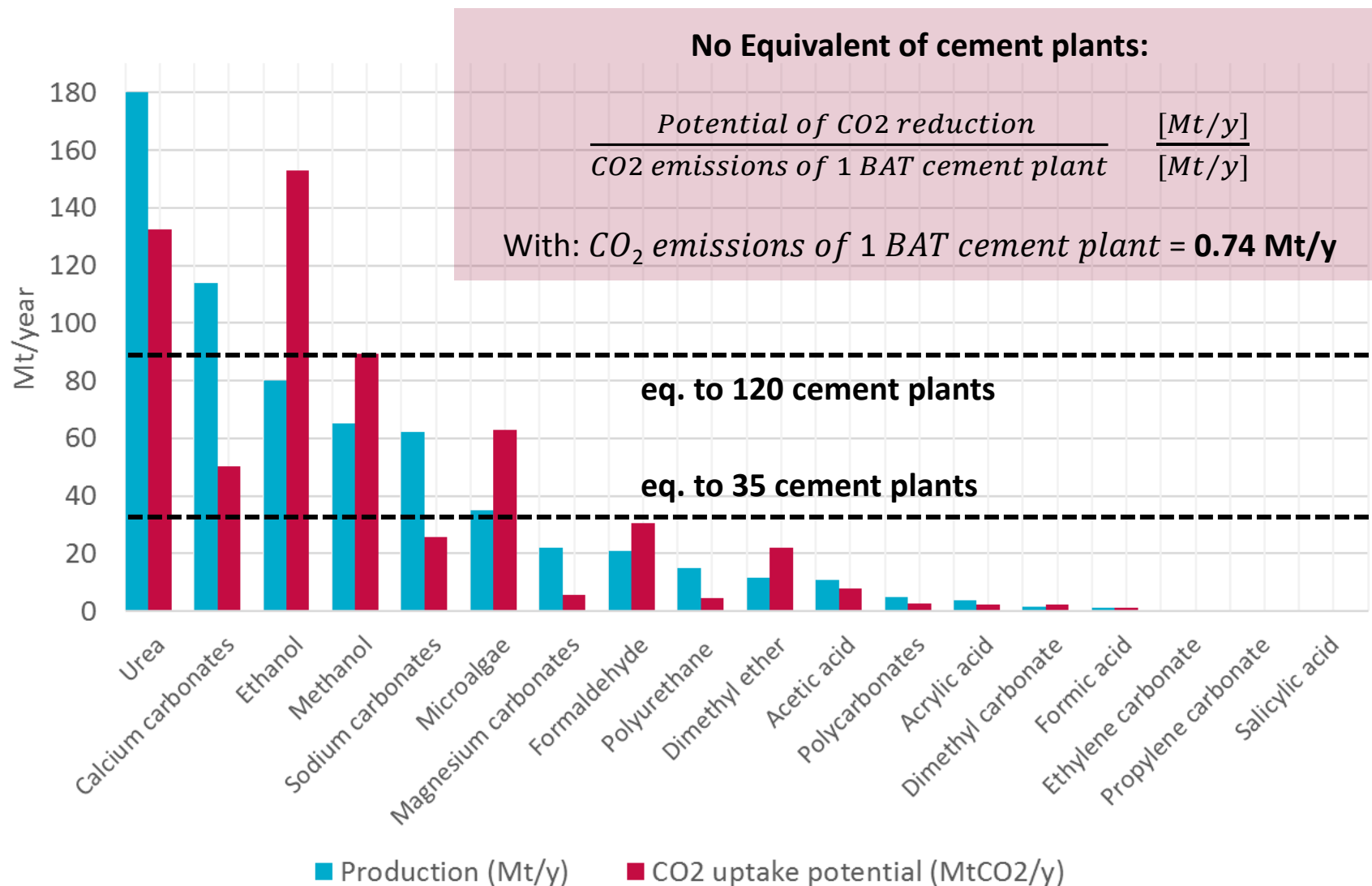
Microalgae

Non exhaustive

# Technology Readiness Level for main CO<sub>2</sub>-based products

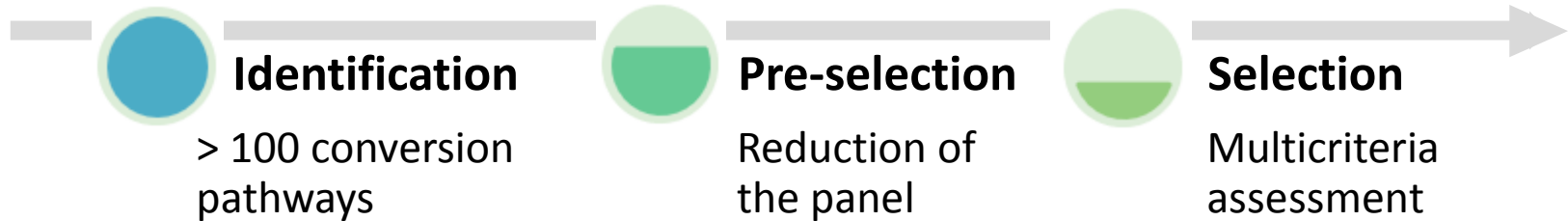


# Size of CO<sub>2</sub> utilization (non-exhaustive)





# Selection of CO<sub>2</sub>-based conversion pathways



## Methodological selection <sup>[1]</sup>

CO <sub>2</sub> -based compound	CO <sub>2</sub> -conversion process	Interest
<b>Methanol</b>	Hydrogenation	*****
<b>Methane</b>	Hydrogenation	*****
<b>Dimethyl carbonate</b>	Organic synthesis	*****
<b>Calcium carbonates</b>	Mineral carbonation	*****
<b>Microalgae</b>	Biological process	****
<b>Polycarbonates</b>	Organic synthesis	****
<b>Sodium carbonates</b>	Mineral carbonation	***
<b>Ethanol</b>	Microbial process	**
<b>Syngas</b>	Dry reforming	**
<b>Formic acid</b>	CO <sub>2</sub> Electroreduction	*

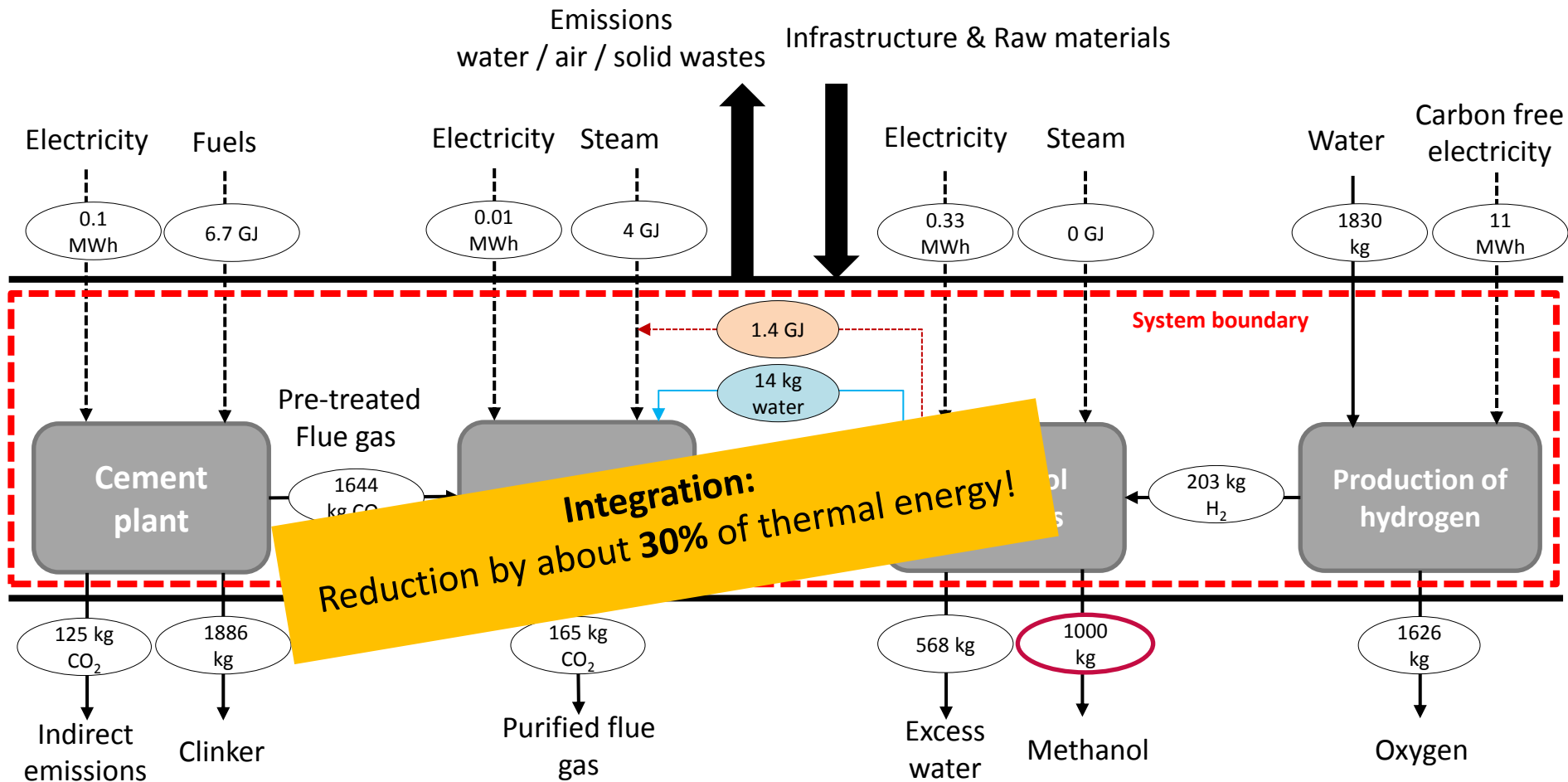
## CO<sub>2</sub> conversion alternatives

<sup>[1]</sup> Chauvy R, et al. Selecting emerging CO<sub>2</sub> utilization products for short to mid-term deployment (2018)

# CO<sub>2</sub> to methanol: Global Chain



Technological metrics of the CO<sub>2</sub> capture and conversion units normalized to the production of one-ton methanol





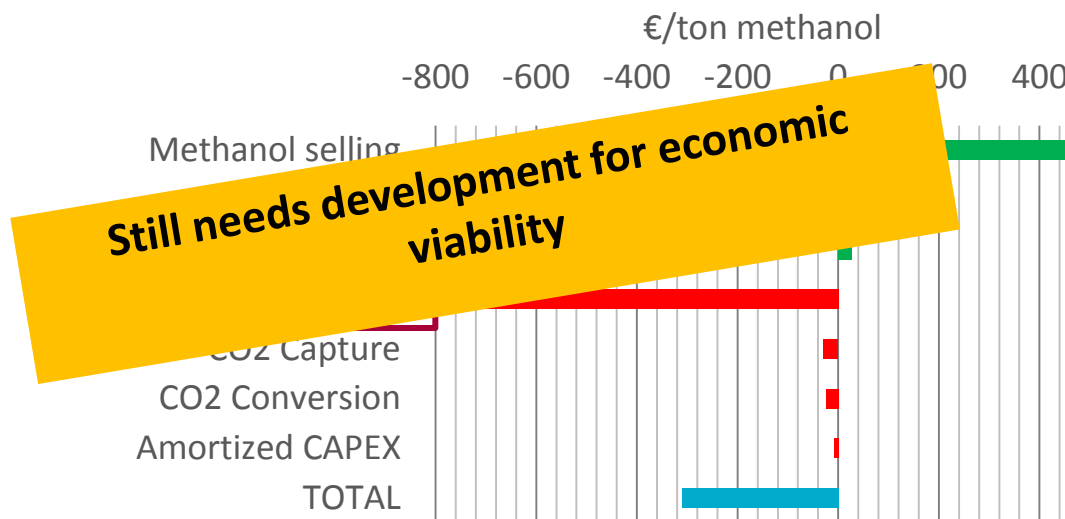
# CO<sub>2</sub> to methanol: Economics

## Project Capital Costs for CO<sub>2</sub> Capture & Conversion

**60 M€ Global CAPEX**  
**Project Investment**  
CO<sub>2</sub> Capture (37 %)  
CO<sub>2</sub> Conversion (63 %)

 **H<sub>2</sub> production**   
**CAPEX: 438 M€**

## Cost Estimations of Operational Expenses (per ton methanol)



O<sub>2</sub> Selling: 86 €  
CO<sub>2</sub> Credit Tax: 20 €

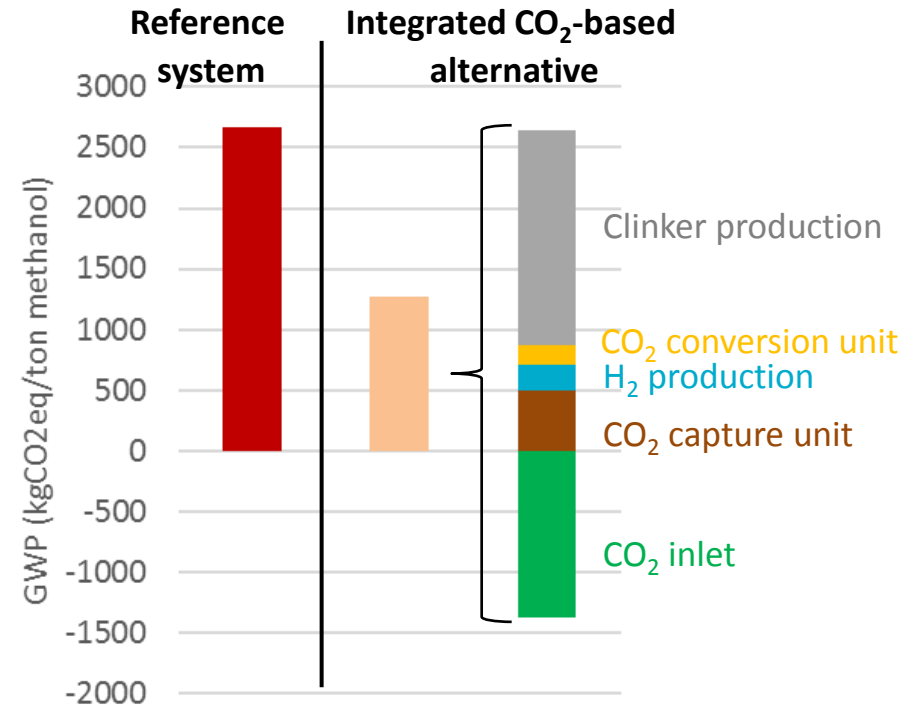
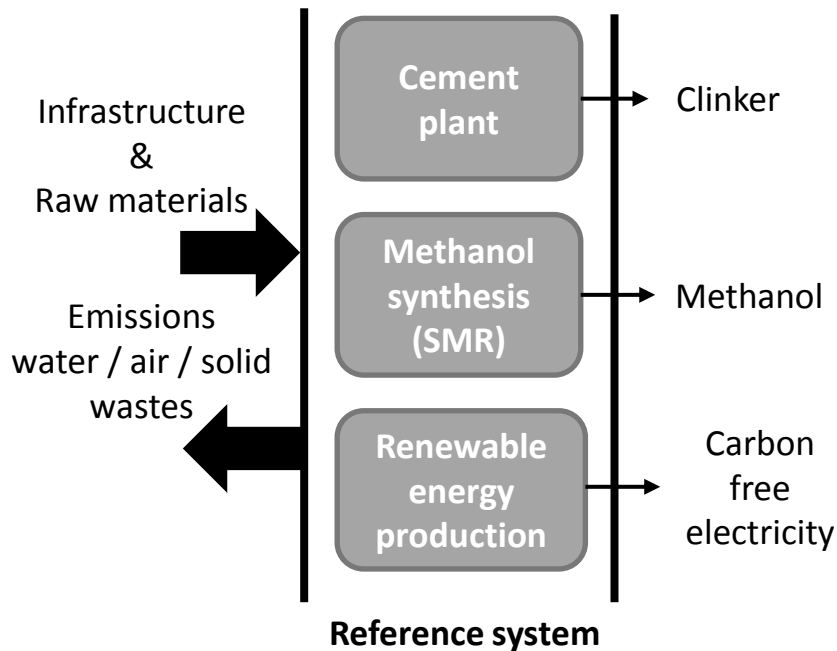
**Global OPEX**  
**90 € per ton CO<sub>2</sub>**





# CO<sub>2</sub> to methanol: Carbon footprint

Comparison between the environmental impacts of reference system and CO<sub>2</sub>-based alternative



➡ Maximum Reduction by **50%** of CO<sub>2</sub> emissions!

➡ Need of additional scenarios

# Concluding remarks

- **Economic viability** of CCU process highly dependent on the assumptions (e.g. **price of electricity**)
- CO<sub>2</sub> reduction may be possible only if **renewable energy use as input**
- Mitigation potential of CCU to methanol: **50% of the original emissions** of the reference system without CCU
- Need to perform additional scenarios
- **CCU is NOT in competition with CCS: COMPLEMENTARY approach for CO<sub>2</sub> mitigation**
- CO<sub>2</sub> to methanol, CO<sub>2</sub> to methane (Power to gas), CO<sub>2</sub> to formic acid : study cases in progress
- Propose **environmentally friendly**, **integrated** and **optimized** CO<sub>2</sub> conversion processes applied to the **cement sector** !

## Thank you for your attention

We gratefully acknowledge the ECRA for its technical and financial support



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