ON CCU(S)

Jaap Vente

Mission Innovation Session

19 – 20 June 2019

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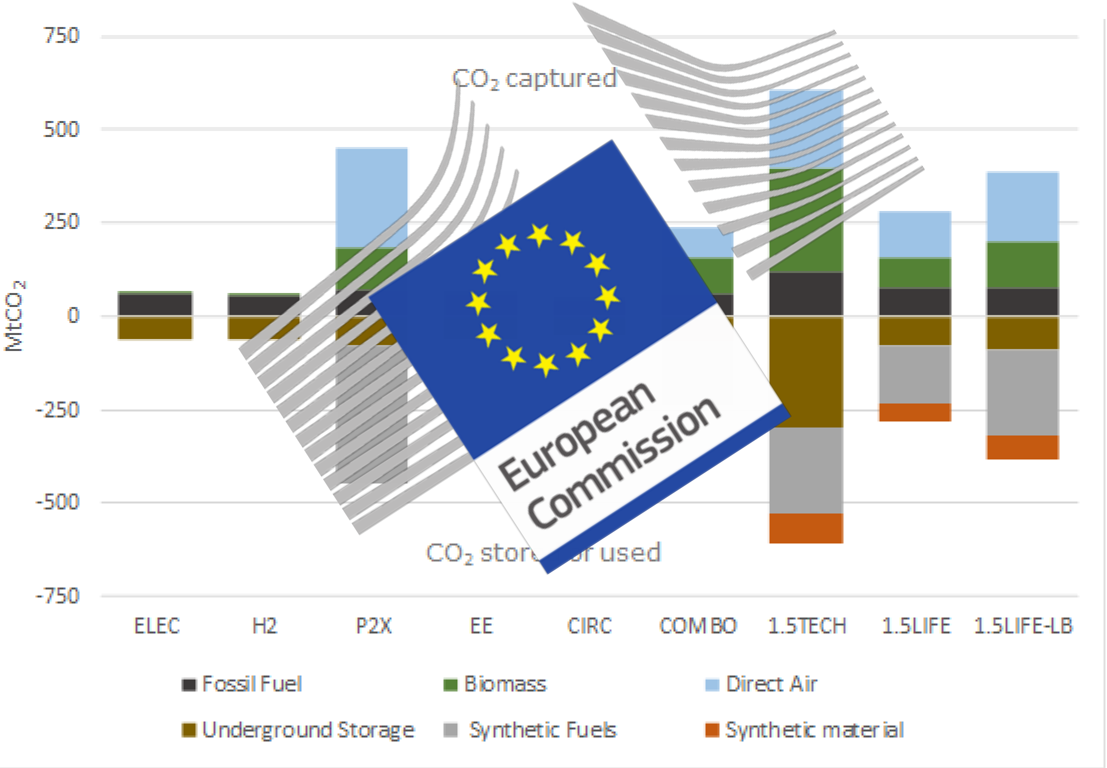
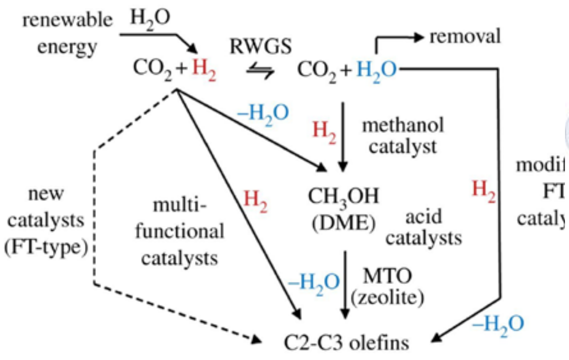
SCENARIO ANALYSIS RESULTS FOR CCUS

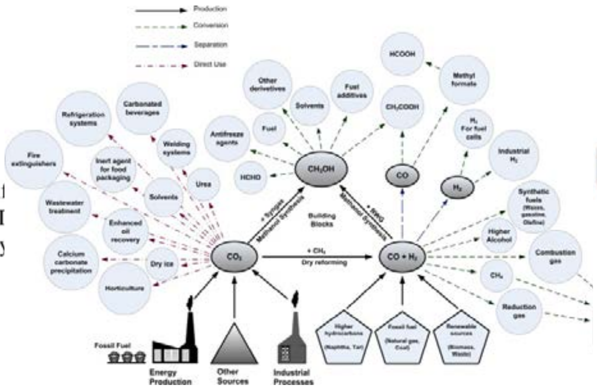


- CCS will be required to reduce emissions of any remaining fossil fuels use (power sector, industry)
- In the case of higher ambition targets, CCS combined with biomass is required to generate negative emissions
- It also seems necessary for certain hard to decarbonize industrial processes
- CCU – synthetic fuels and materials (e.g. in plastics) are also seen as options

CONVERTING CO_2



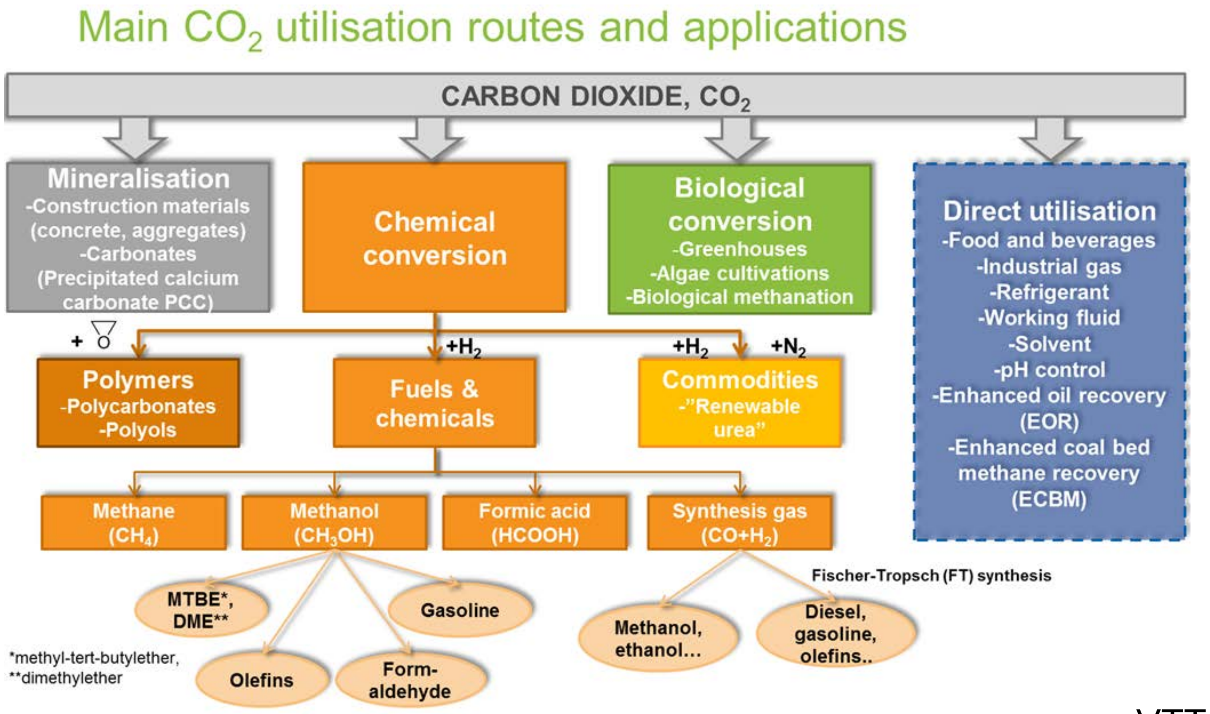
Royal Society



Science direct

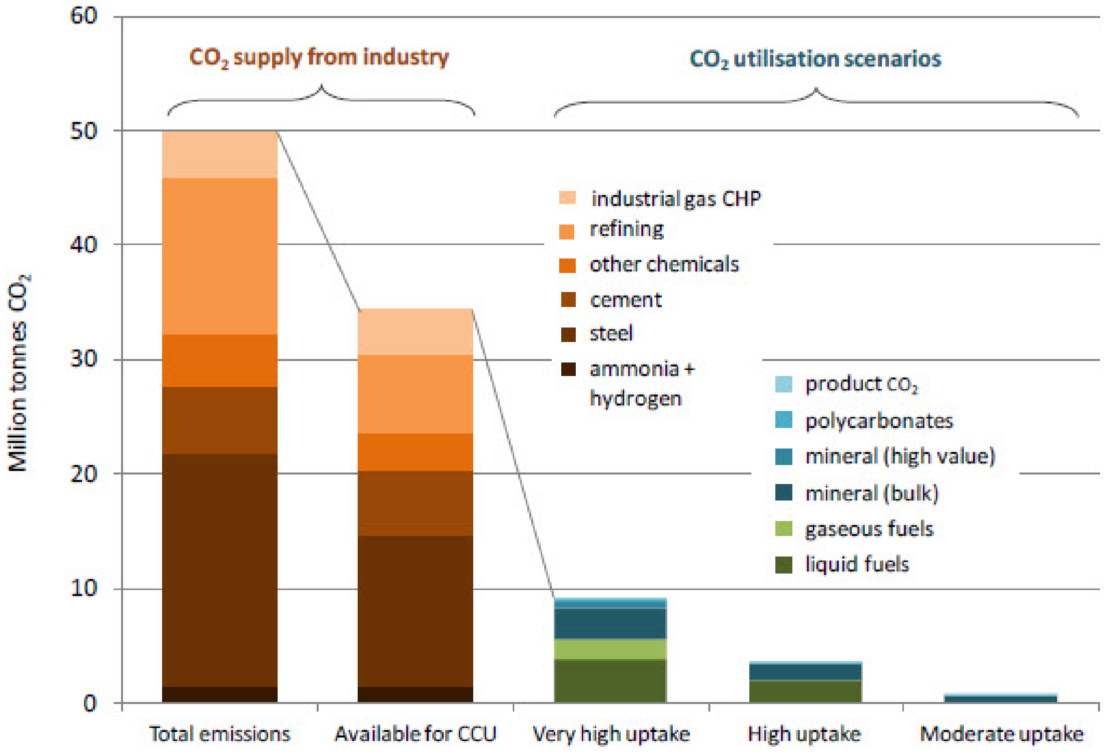
Smart spec platform

MAIN ROUTES



VTT

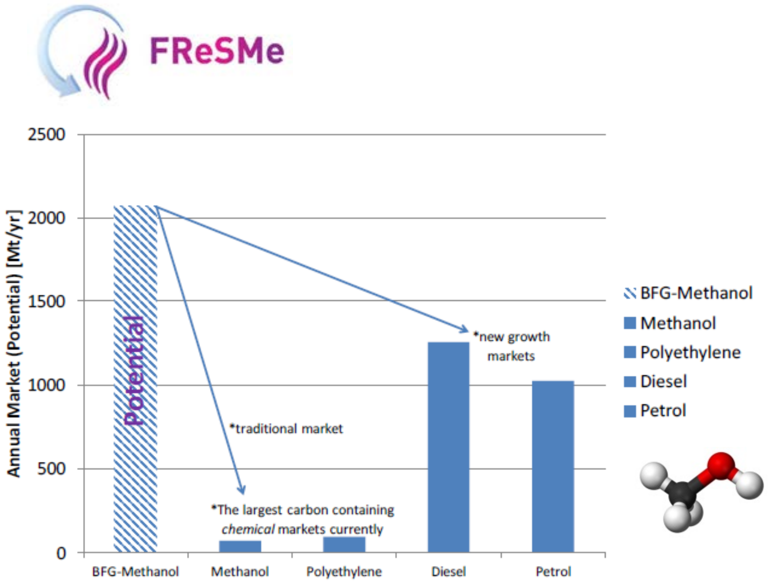
POTENTIAL

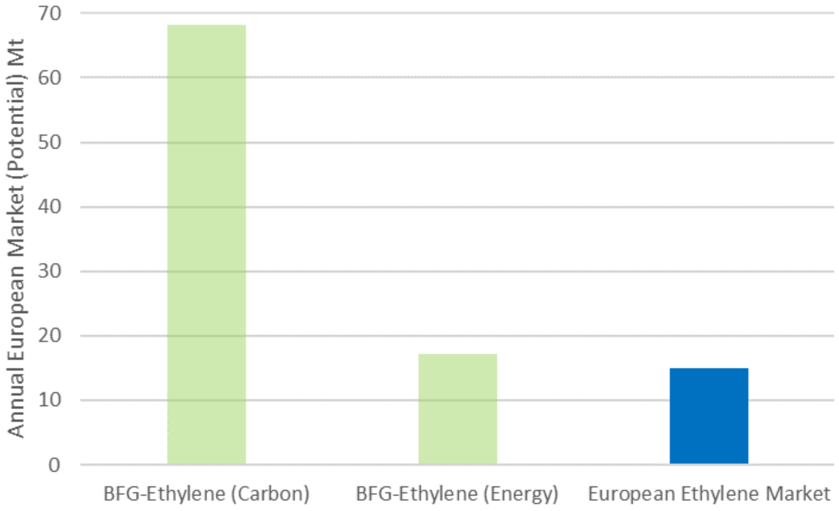


Global CCS institute

PRODUCTION POTENTIAL: CO_2-BASED

- Annual global CO_2-production in steel industry vs. current annual markets



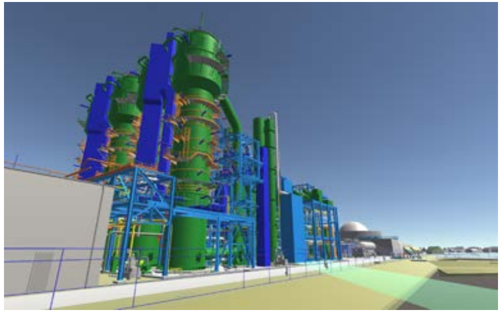


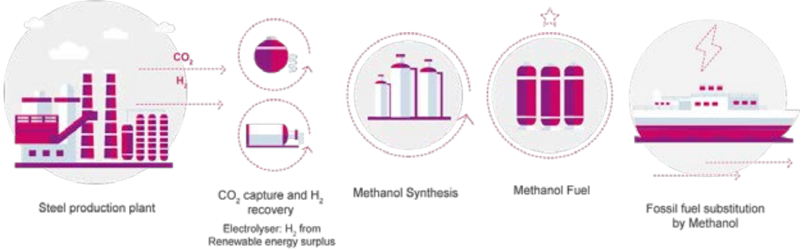
MANY INITIATIVES

Covestro Polyols

CRI Methanol

H2020 Steelanol





H2020 FReSMe project

CHALLENGES

- Often renewable H_2 required
- Most often other options are economic more favourable
- Climate benefits are questioned
- Many routes are still in infancy

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A POSITIVE BUSINESS CASE

ENERGY CONTAINING RESIDUAL STREAMS

- Unique feature of current steel making processes
- Presence of diluted energy containing streams

Gas type	CO_2	CO	N_2	H_2	CH_4	LHV (MJ/Nm^3)
BFG	22	22	49	4	--	3.2
BOFG	14	57	14	3	--	7.5
COG	2	5	7	62	24	15.3

10Mt/year Iron&Steel Mill, see IEAGHG report on Iron&Steel,
http://www.ieaghg.org/docs/General_Docs/Reports/2013-04.pdf

BFG – Blast Furnace Gas
BOFG – Basic Oxygen Furnace gas
COG – Cokes Oven gas

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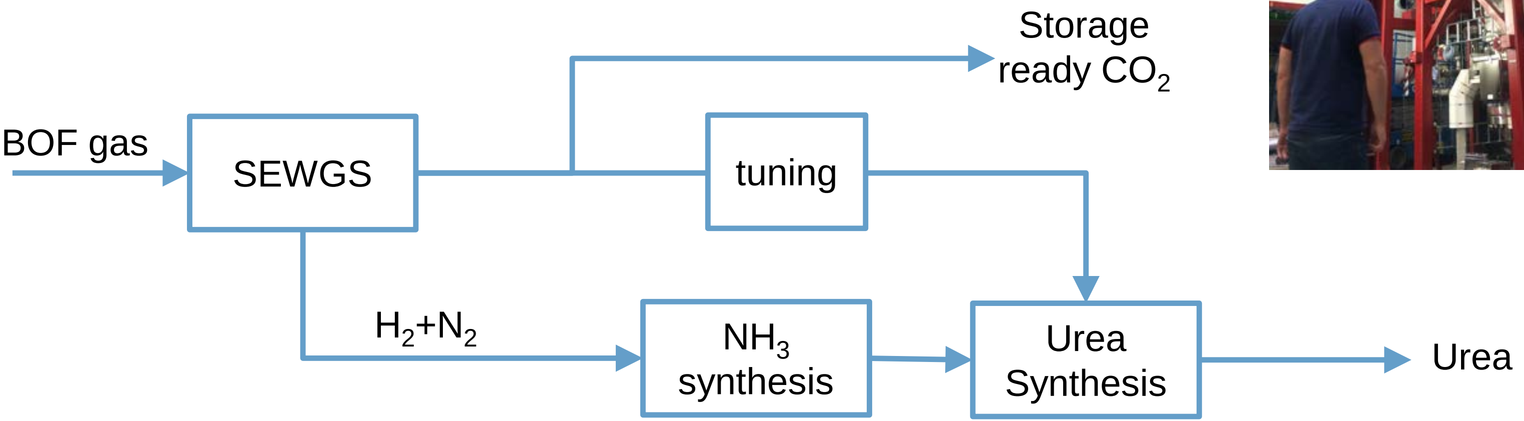
ENERGY TO VALUE ADDED CHEMICALS

- Currently energy is used for electricity production
- After STEPWISE technology
  - N_2 goes with the H_2
  - Treated BOF gas has the right H_2/N_2 ratio for ammonia synthesis



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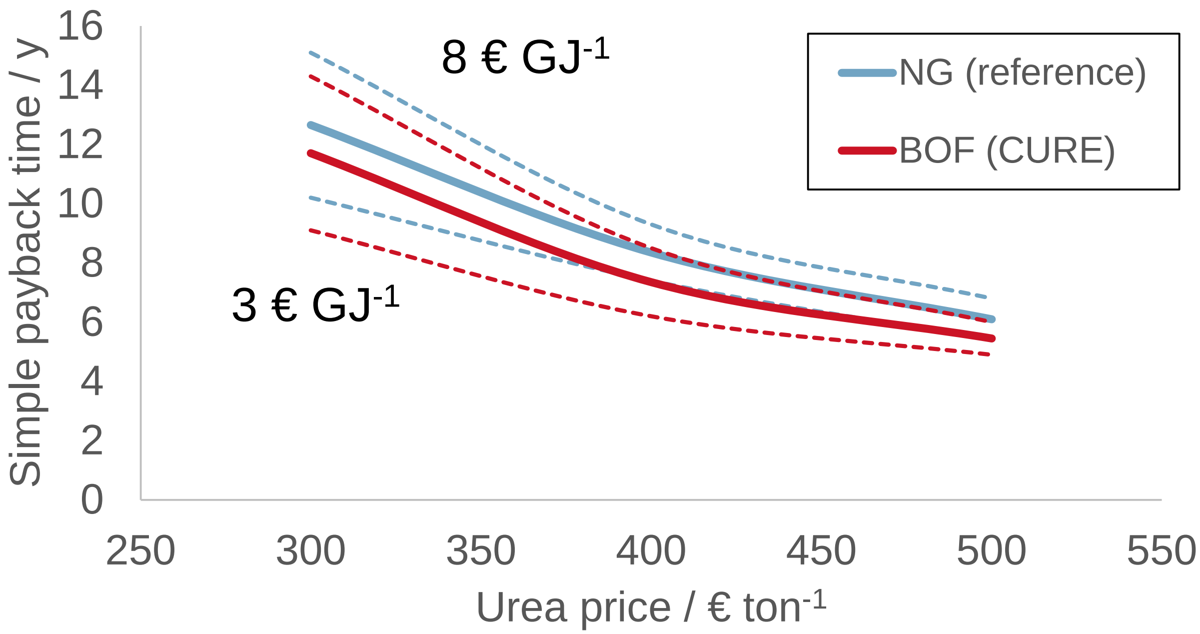
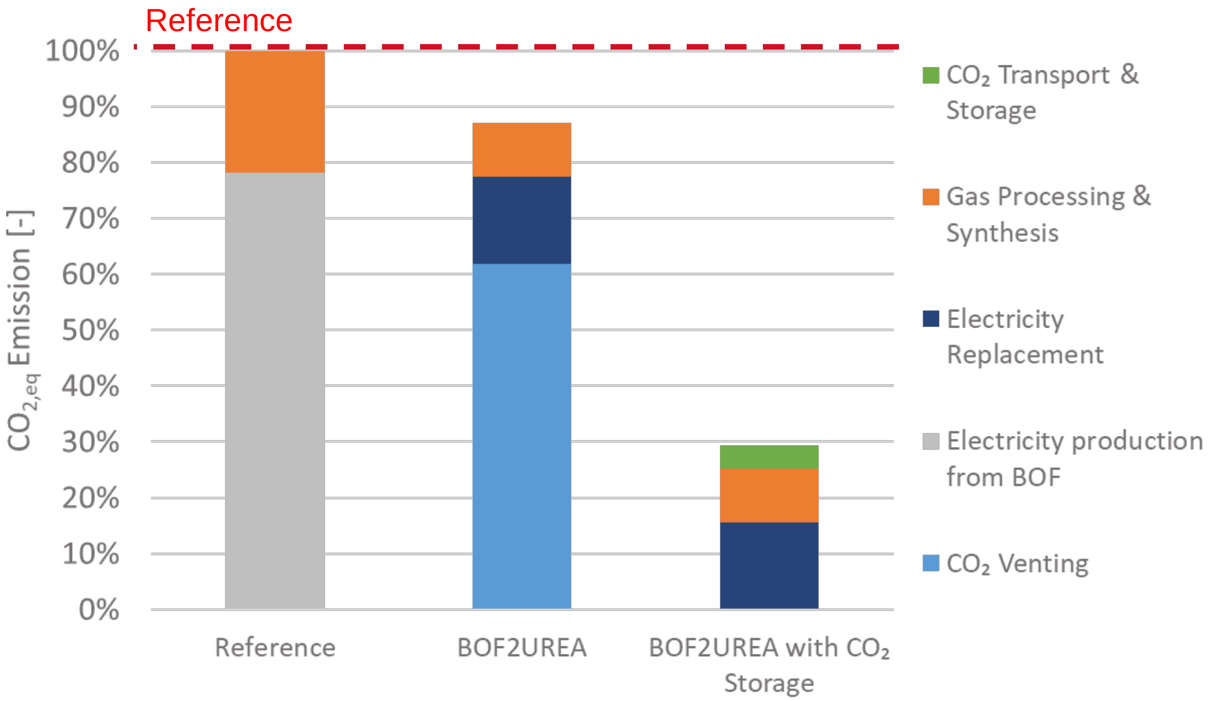
BUSINESS CASE

- Comparable economics for natural gas based and BOF-gas based urea
- Urea pays for capture technology, storage ready CO_2 as side product



LIFE CYCLE ANALYSIS



- Global Warming Potential (GWP) reduction of ~13% <u>without CO_2 Storage</u>.
- 70% $CO_{2,eq}$ avoided if deployed with storage and transport.
- Electricity consumption is the primary source of remaining $CO_{2,eq.}$

THANK YOU FOR YOUR ATTENTION

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