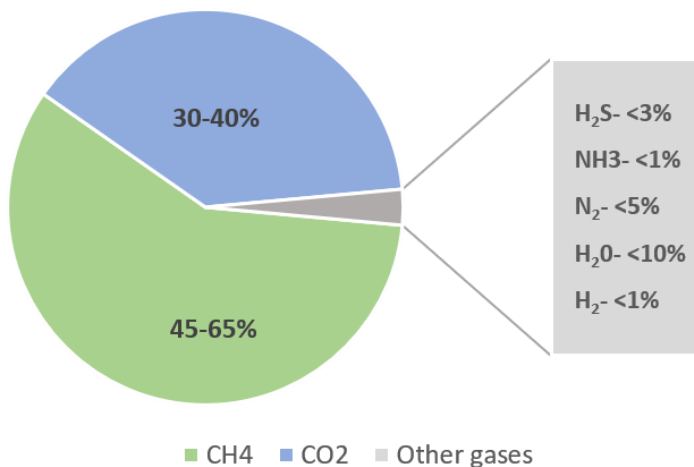


CO₂ capture and utilization in biogas plants – Research activities

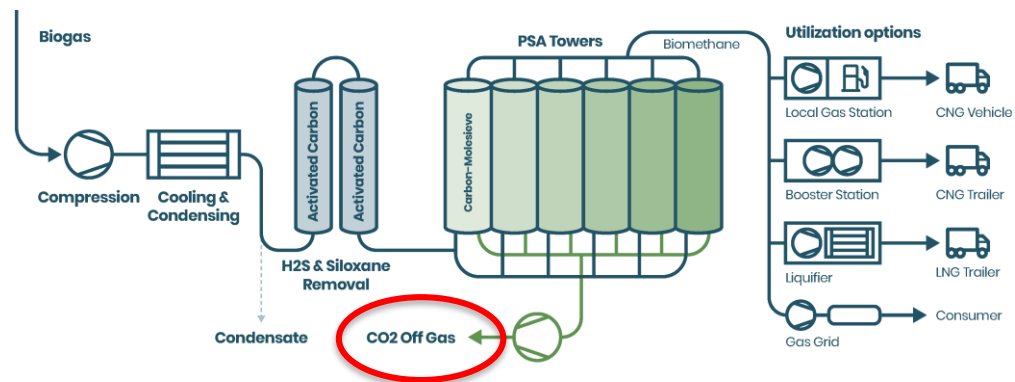
Eemeli Tsupari

24.1.2023 VTT – beyond the obvious

Source of high concentration CO₂

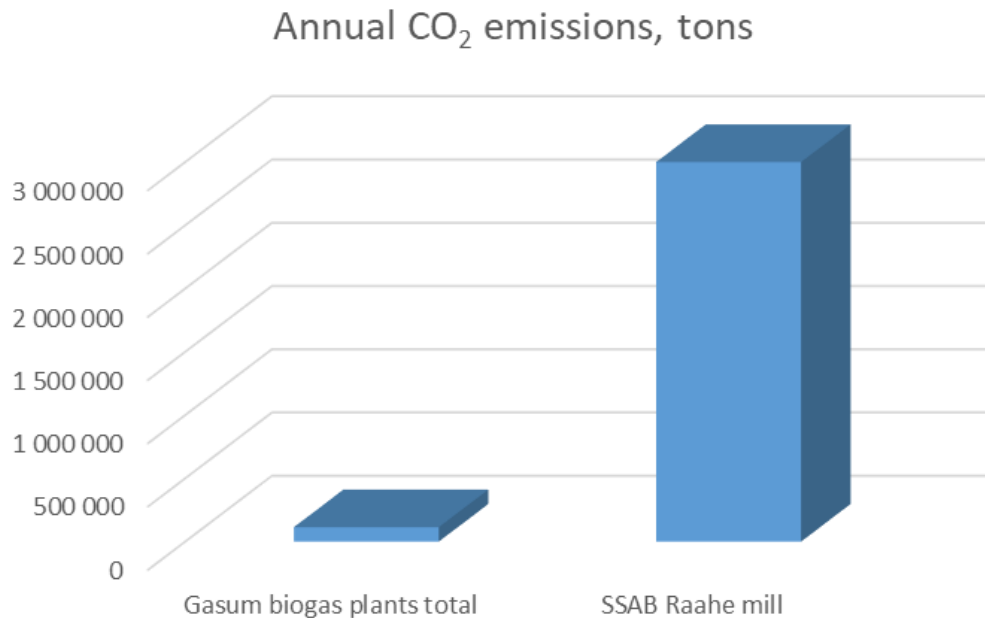


Picture: <https://www.celignis.com/ad.php>



Picture: <https://biovoima.com/en/solutions/biogas-upgrading-unit>

But relatively small point sources



Carbon Capture and Storage Program (CCSP)

<http://ccspfinalreport.fi/>



- 1.1.2011 – 31.10.2016
 - Volume: 15 M€, Finnish public R&D and company funding
- Targets
 - Technological readiness for pilots and demonstrations ->
 - Strong scientific basis for development of CCS ->

System level change to intermittent RES



POWER-TO-X

H₂ SOURCES



CO₂ SOURCES



SYNTHESIS
TECHNOLOGIES

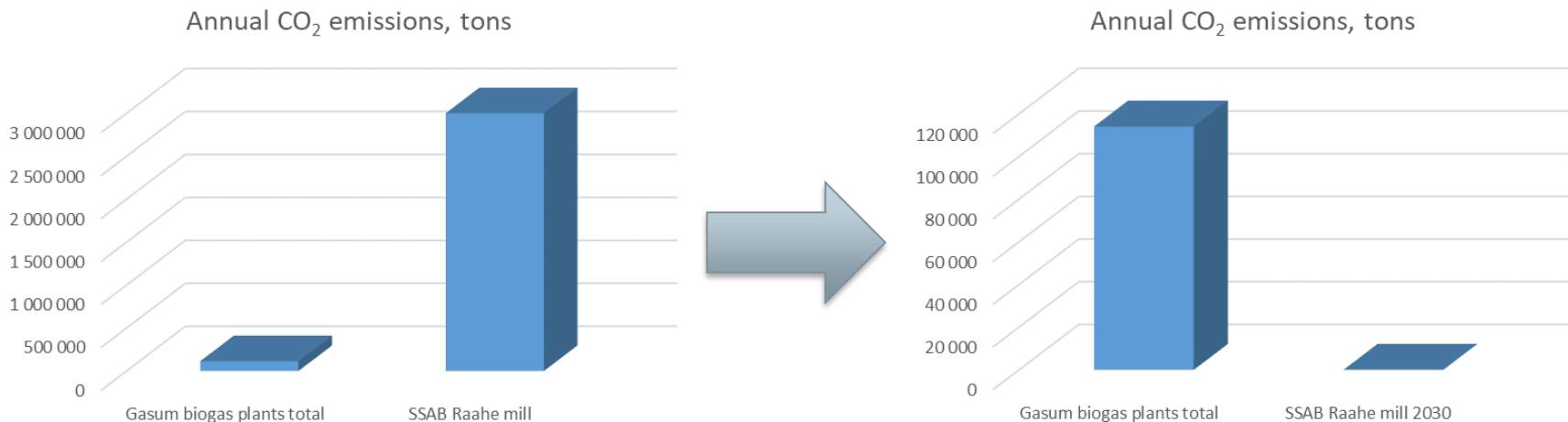
CHEMICALS



FUELS

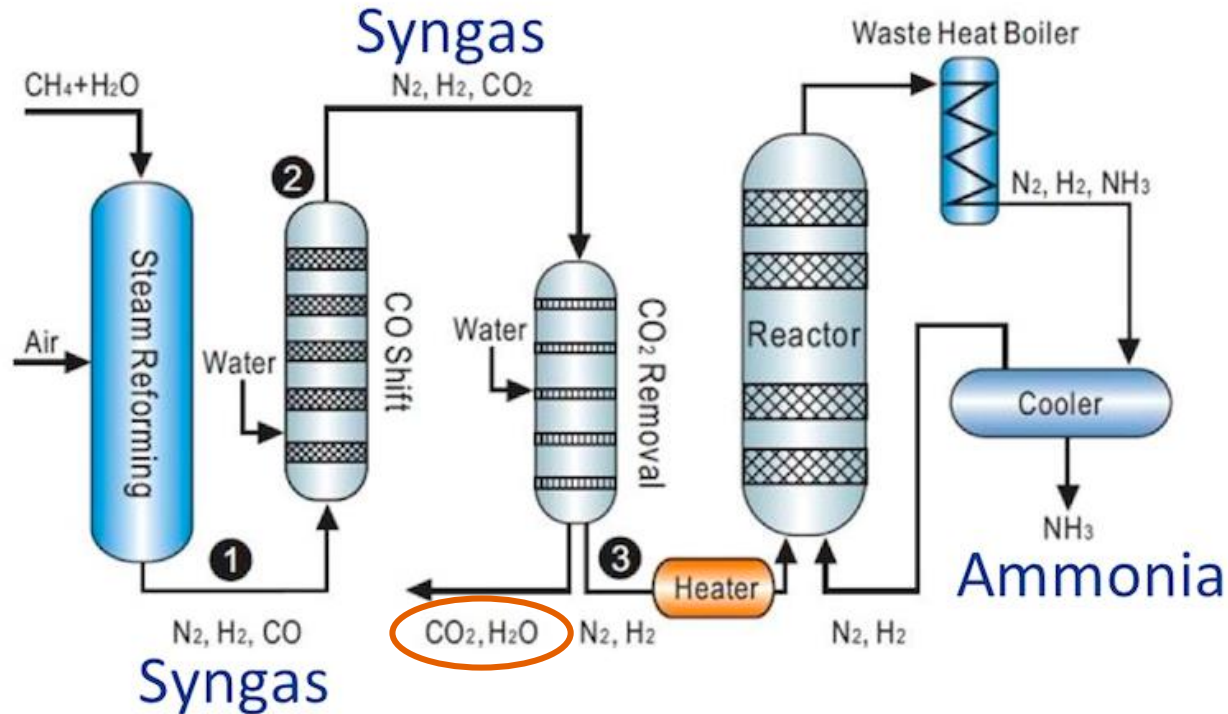


Raising the importance of biogenic CO₂



+ more
profitable
CCU

Simultaneous decrease of CO₂ supply



Hiilidioksidipula sulkee panimoita Euroopassa - Suomalaispanimon johtaja: "Tällaista tilannetta ei ole aiemmin ollut"

28.9.2022 04:30

ENERGIA

KAASU

KANSANTALOUS

TEOLLISUUS

ELINTARVIKKEET



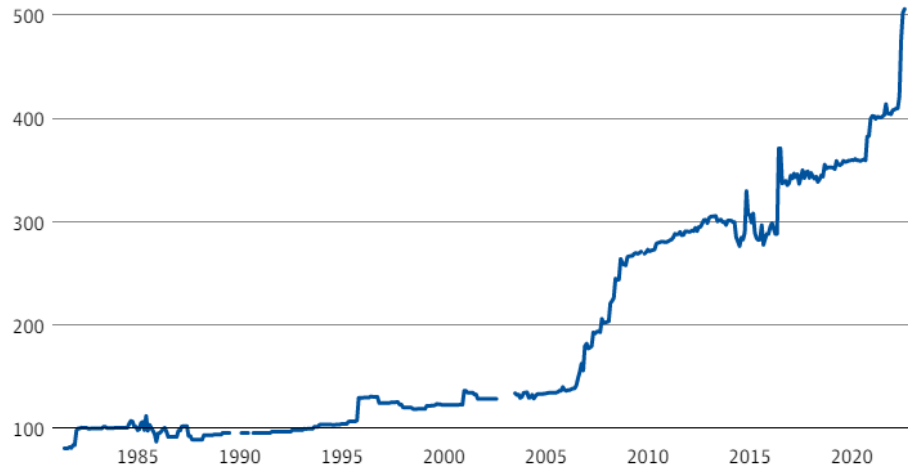
Pulaa. Hiilidioksidista on ollut Suomessakin ajoittain pulaa. Kuvassa Lindenin hiilidioksidilaitos.
KUVA: LINDE

Energiakriisi on johtanut hiilidioksidipulaan, koska raaka-ainetta on niukasti tarjolla. Ilman kaasua virvoitusjuomat eivät valmistu. Saksassa panimoita on jo suljettu.

Hinta pompannut tänä vuonna roimasti

Teollisesti valmistetun hiilidioksidin hintaindeksi (kausitasoittamaton)

1982 = 100



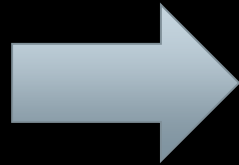
LÄHDE: FEDERAL RESERVE BANK OF ST. LOUIS

<https://www.kauppalehti.fi/uutiset/hiilidioksidipula-sulkee-panimoita-euroopassa-suomalaispanimon-johtaja-tallaista-tilannetta-ei-ole-aiemmin-ollut/cf73dc52-f007-45f1-a3a5-8432495064e0>

Focus from CCS to CCU:

Focus on **good** sources instead of **big** sources

- location (sink and source)
- availability
- high concentration



Biogas



Economy of scale in the
case of **CCS**

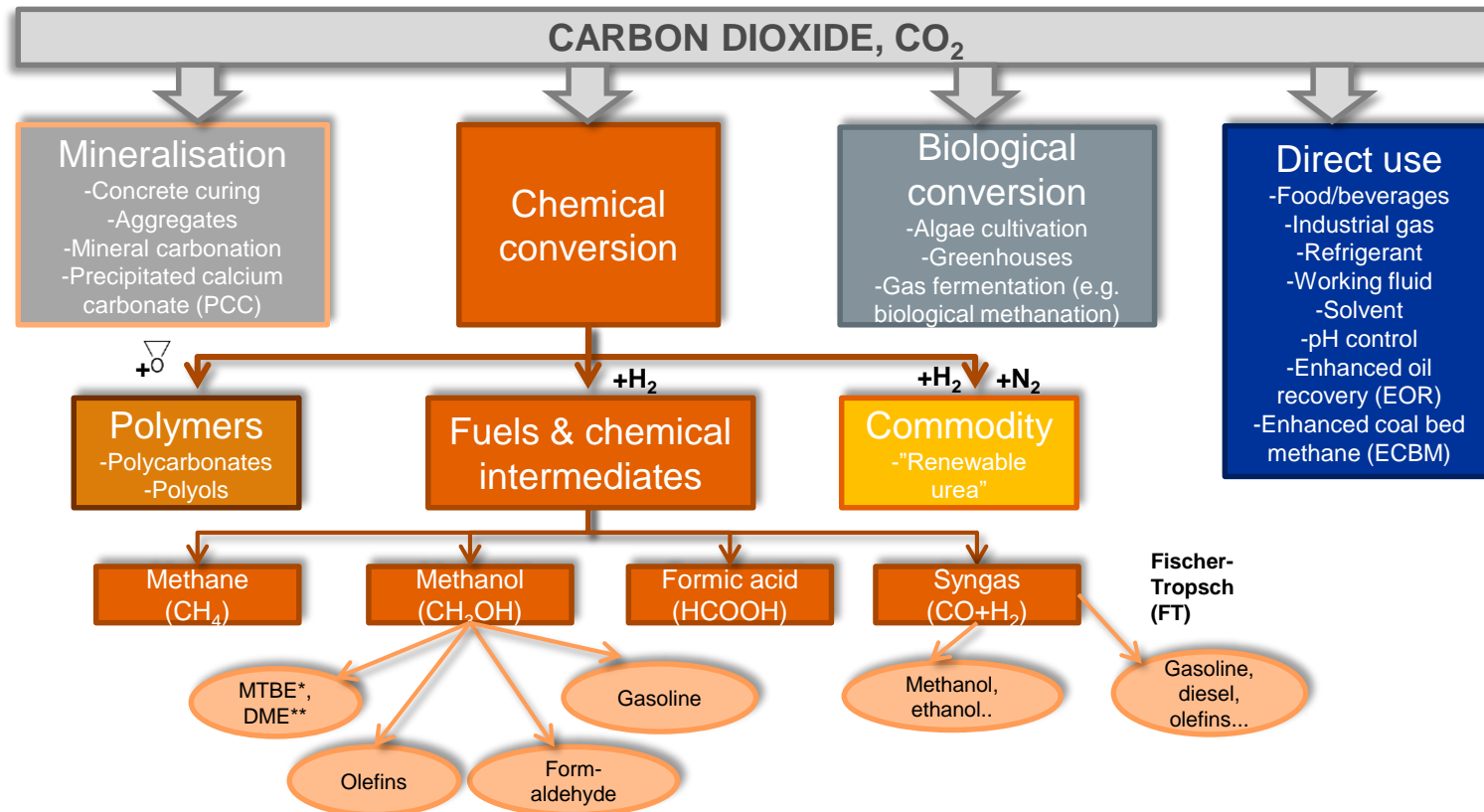
> Mt CO₂ / year



Economy of scale in the case of **CCU**

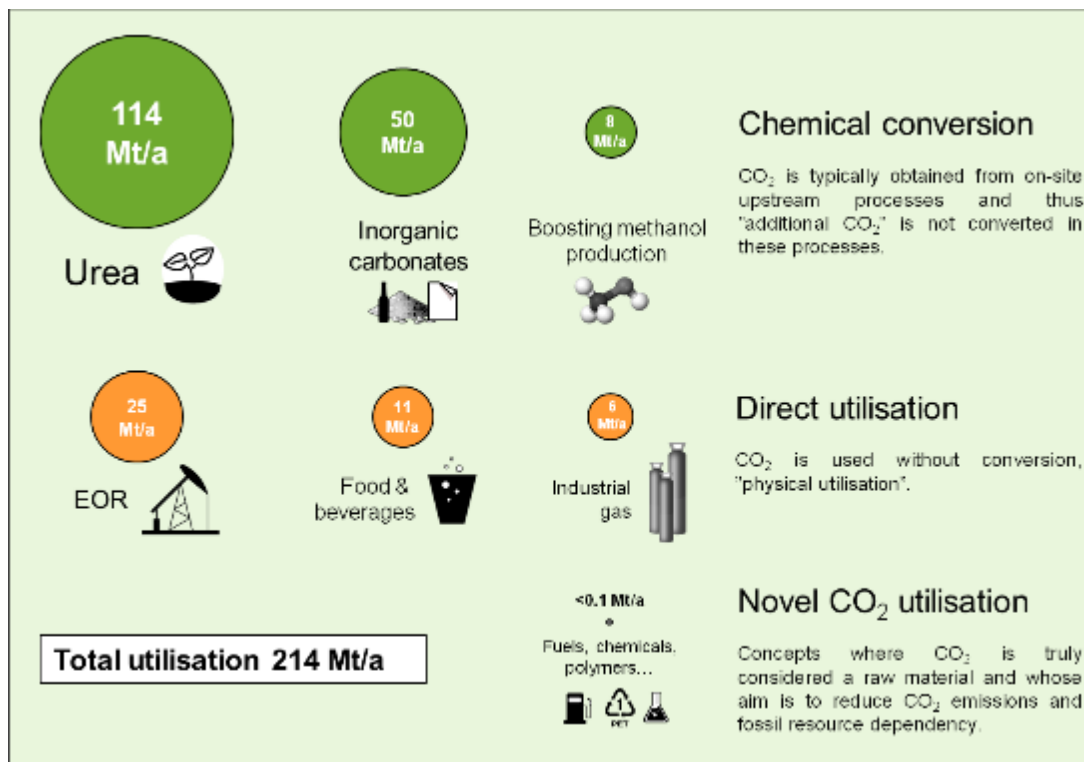
> 10 kt CO₂ / year
(limited by demand)

CO₂ utilisation



NOTE: The diagram presents only the most important options for the near-term . There are other routes such electrochemical and photochemical routes and hundreds of other possible products.

Global CO₂ utilisation today



Data sources:

[1] Aresta M, Dibenedetto A, Angelini A (2013) The changing paradigm in CO₂ utilization. *Journal of CO₂ Utilization* 3:65–73. doi:10.1016/j.jcou.2013.08.001

[2] IHS (2013) Carbon dioxide. *Chemical Economics Handbook*. IHS, Englewood

[3] Global CCS Institute (2014) Status of CCS project database. <http://www.globalccsinstitute.com/projects/status-ccs-project-database>

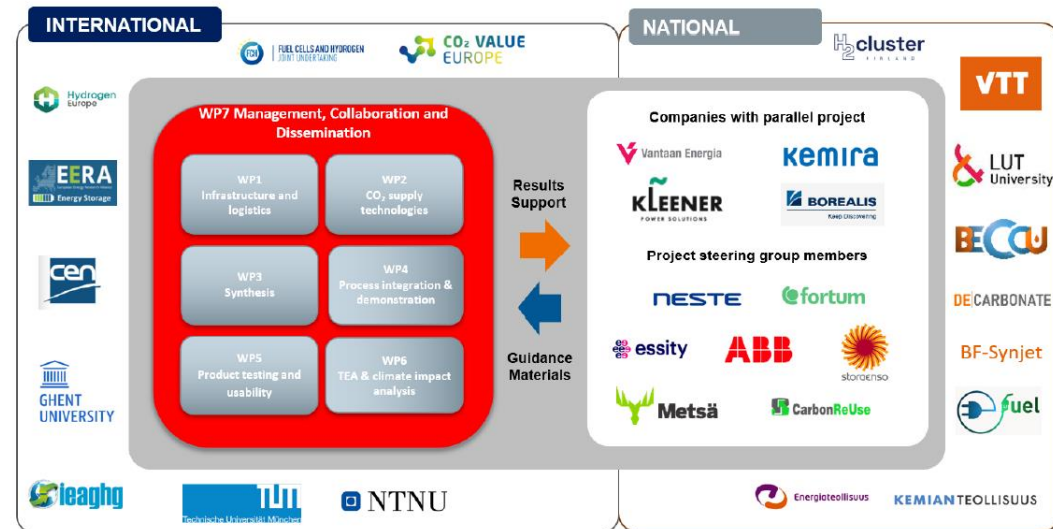
VTT's CO₂ purification and liquefaction unit for small but good CO₂ sources

- Invested with EAKR funding 2022-2023
 - Supplied by Specialty Fuels Ltd.
- To be tested at Mustankorkea at spring 2023
 - Electricity consumption
 - CO₂ production and quality
 - Profitability
- See more <https://www.habahanke.fi/>



Other research activities

- High value products from CO₂ to find first business cases
 - May fit well with the scale of biogas plants
- Piloting and demonstration of CCU (e.g. Forrest Cump project)



Picture: Forrest Cump BF co-innovation project and its linkages