



# VAL AV CC TEKNIK OCH ANDRITZ FALLSTUDIE

**ANDRITZ**

# NO CHALLENGE IS TOO BIG – A PIONEER IN LARGE-SCALE TECH SOLUTIONS WORLDWIDE



## WHAT WE DO



Developing large-scale, state-of-the-art engineering and service solutions



Elevating customer operations with state-of-the-art technologies



Supporting our customers' operations with lifecycle services



Empowering our customers to drive the green transition



# CLOSE TO OUR CUSTOMERS, IN MORE THAN 80 COUNTRIES



AROUND **30,000**  
EMPLOYEES WORLDWIDE



OVER **280**  
LOCATIONS

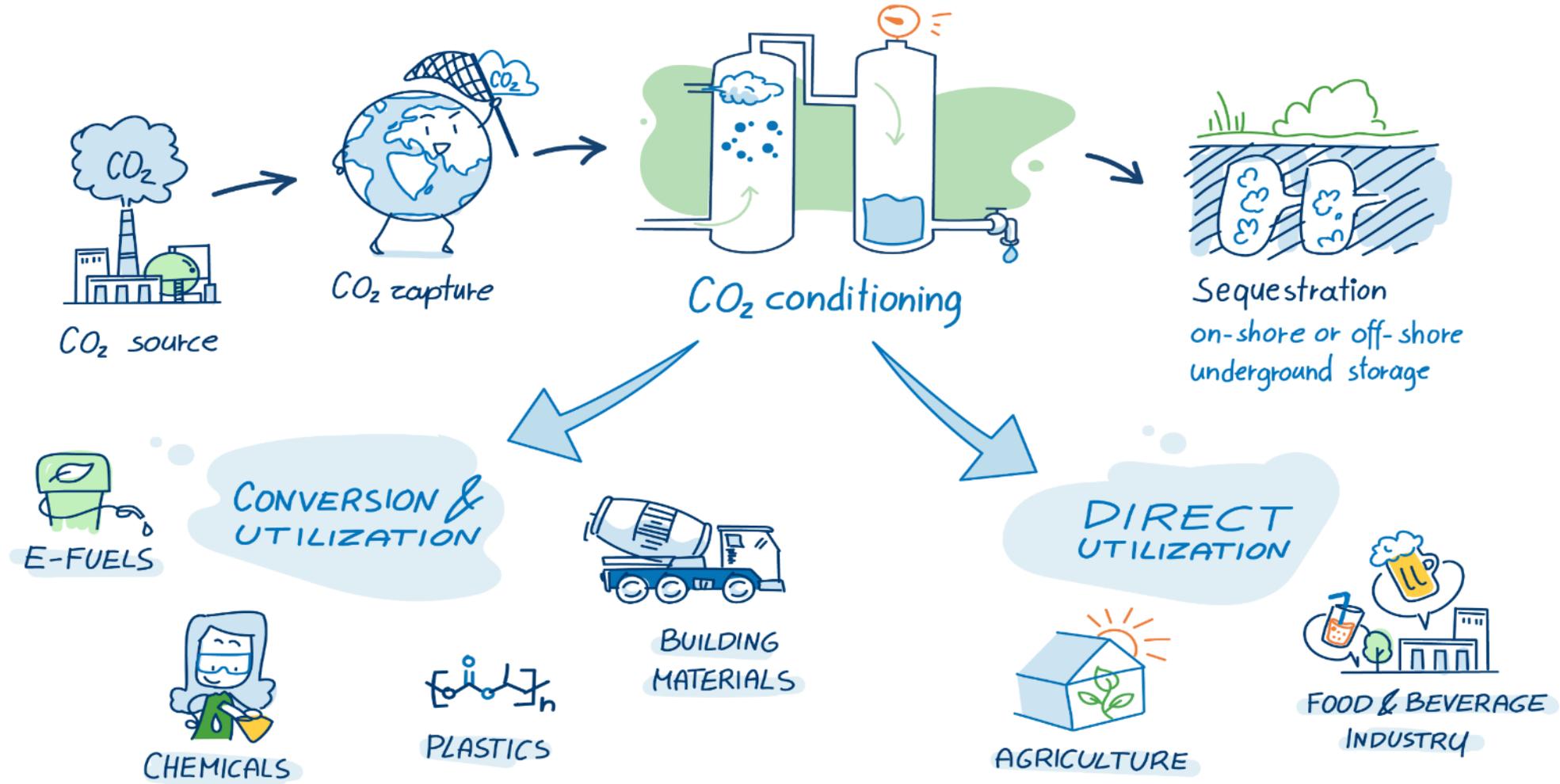


OVER **80**  
COUNTRIES

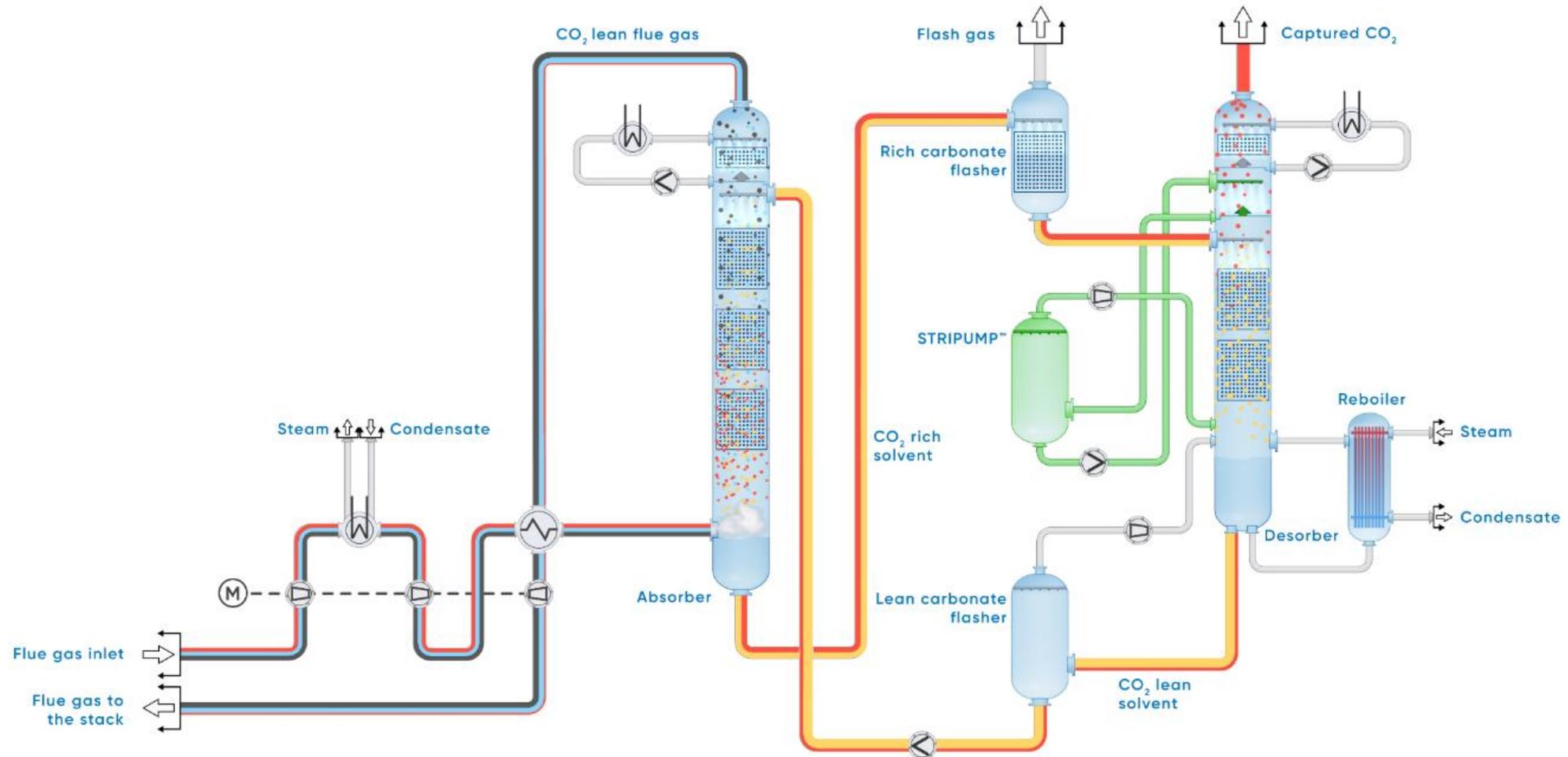


# UTILIZATION PATHS FOR CO<sub>2</sub>

## CONDITIONING – UTILIZATION – STORAGE



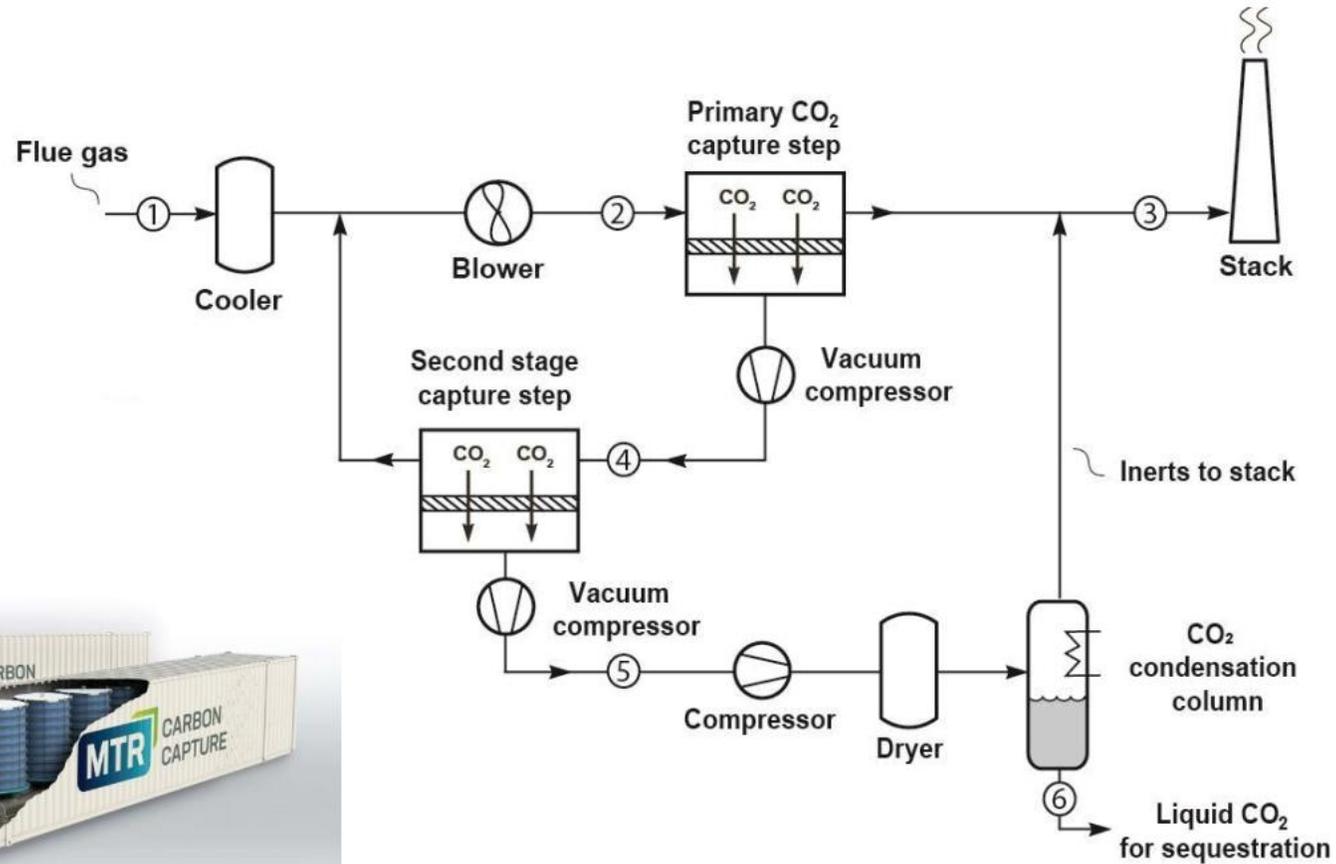
# HOT POTASSIUM CARBONATE (HPC)



# MEMBRANE TECHNOLOGY



## Simplified Block Flow Diagram



# CARBON CAPTURE & GREEN HYDROGEN SELECTION OF TECHNOLOGY



## Offerings

- Technology

- Carbon capture

- Amine based system – Andritz advanced amine , BASF OASE® blue 
    - License - Hot Potassium Carbonate – CATAcarb® 
    - MOU - Membrane – 
    - Sub-Contractors for CPU (CO<sub>2</sub> Processing Unit) and intermediate storage

- Green Hydrogen

- HydrogenPro – electrolyzer

- Commercial

- Feasibility studies – 
  - Pilot & Demonstration Units (rent or buy) – 
  - FEED – 
  - EPC projects – 

# MAIN DRIVERS FOR SELECTION OF TECHNOLOGY



## From source to out-shipment

- CAPEX vs OPEX – evaluation of OPEX has a large impact
  - Order of magnitude 1:0,5-3 (with and without DH heat recovery)
- Host plant steam availability, quality & evaluated cost
- Electricity availability (grid) and cost
- CO<sub>2</sub> Concentration in flue gas
- CO<sub>2</sub> quality (storage, utilization for e.g., E-methanol)
- Footprint and height restrictions
- Emissions to air and effluent
- Work environment
- Technical Risk Level

# AMINE



## Most competitive case for Amine

- Steam available at 4-4.5 bar(a)
- High quality CO<sub>2</sub> without liquefaction if flue gas is relatively clean
- Low CO<sub>2</sub> level in flue gas below 8 vol% (saturated ~ 40 °C)
- Moderate pre-treatment of flue gases
- Advanced amine



## Most competitive case for – CATACARB®

- Low electricity price
- Limited or no steam is available
- Low grade steam is available 2 bar(a)
- Heat recovery is positively evaluated e.g., district heating
- If flue gas CO<sub>2</sub> concentration is above 8 vol% (saturated ~ 40 °C)
- No solvent or degradation product contamination of atmosphere
- Low solution makeup (typically < 20% per year)
- Moderate pre-treatment of flue gases
- CATACARB® compared to ordinary HPC
  - CapEx (smaller footprint, Carbon Steel construction, ...)
  - Lower OpEx (higher efficiency: 30 – 40% increase in CO<sub>2</sub> removal)
  - Long life (additives inhibit corrosion, less outages, ...)



# ANDRITZ CCS – COMPARISON OF TECHNOLOGIES

## MEMBRANE



	Chemical absorption (amine/HPC)	Membrane technology
<b>Energy source</b>	Steam, cooling, electricity	Electricity, cooling
<b>Space requirements</b>	Large equipment	Small modules, modular concept
<b>Complexity</b>	Chemical plant level	Arrangement of mechanical equipment
<b>CAPEX</b>	High	Moderate
<b>OPEX</b>	High	Moderate
<b>Process media</b>	Amine make up caused by degradation	No absorbents required, but membrane replacement to be expected
<b>Safety aspects</b>	Chemicals and high temperature	Negligible
<b>CO<sub>2</sub> removal rate</b>	High (up to 95-99% possible)	Moderate (50–90%)
<b>CO<sub>2</sub> purity</b>	High (> 99.5% w/o purification)	Moderate (up to 90% w/o purification)
<b>Preferred application</b>	Large plants, high removal rates	Small to medium plants, little space available, modular concepts



**ANDRITZ.  
FOR GROWTH  
THAT MATTERS.**

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