

Uhde innovate 2024

C02 capture for closed carbon cycles

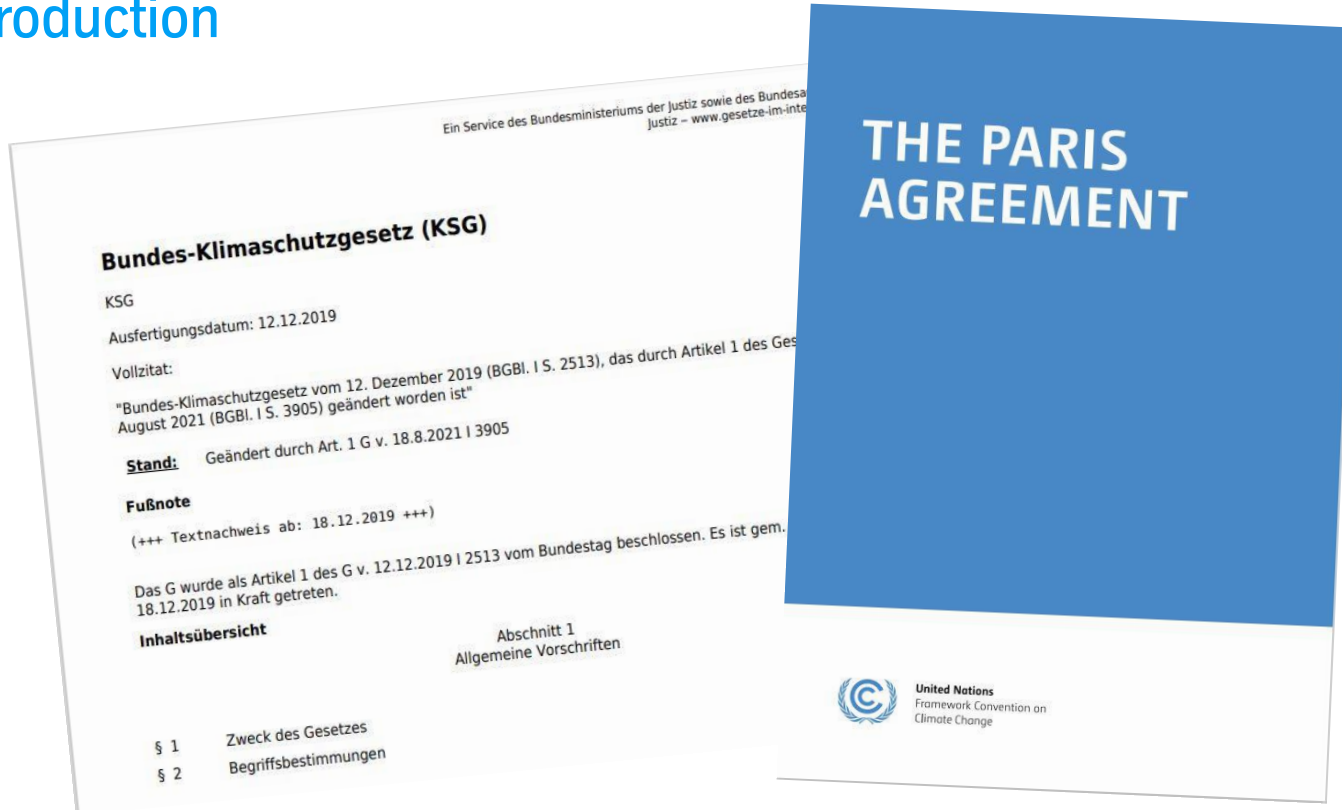
06.06.2024 | Dr. Olaf von Morstein
thyssenkrupp Uhde

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Introduction

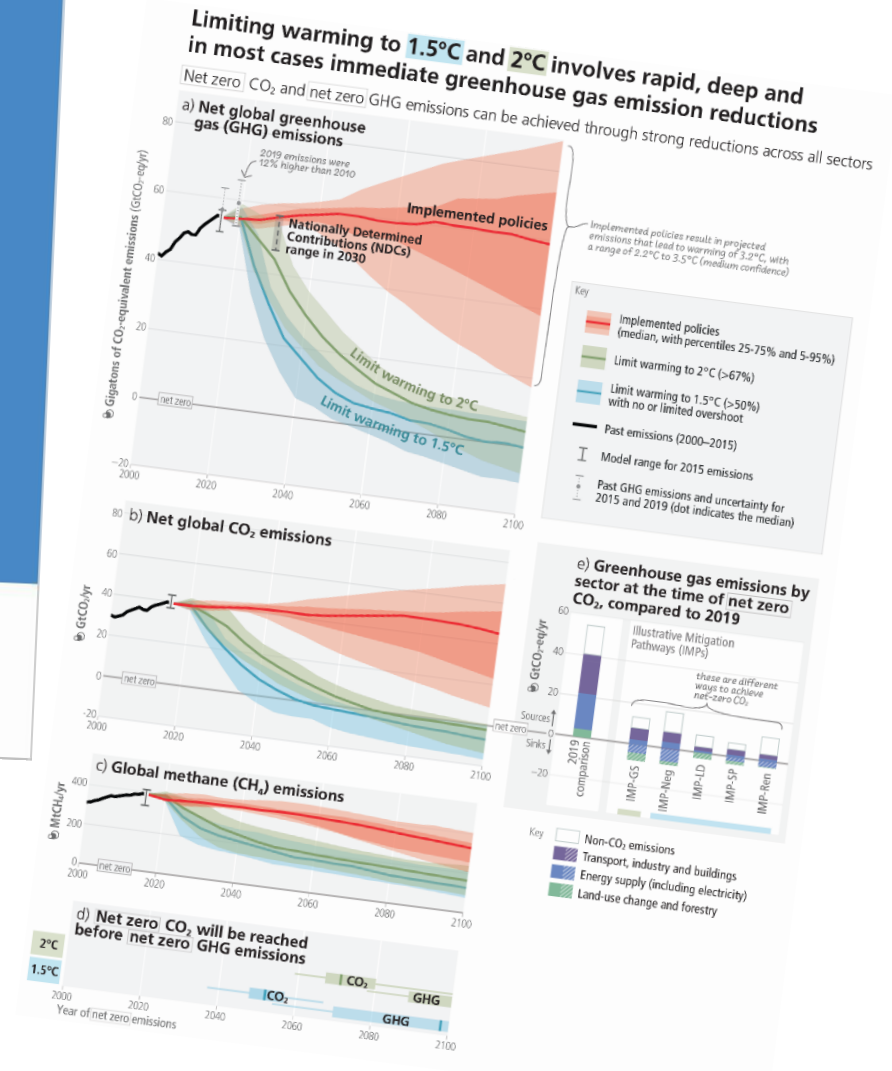


Common understanding:

Climate change and global warming worldwide are manmade.

To limit the temperature increase to 1.5 °C it takes international action.

International agreements and national legislation enforce GHG emission reduction measures

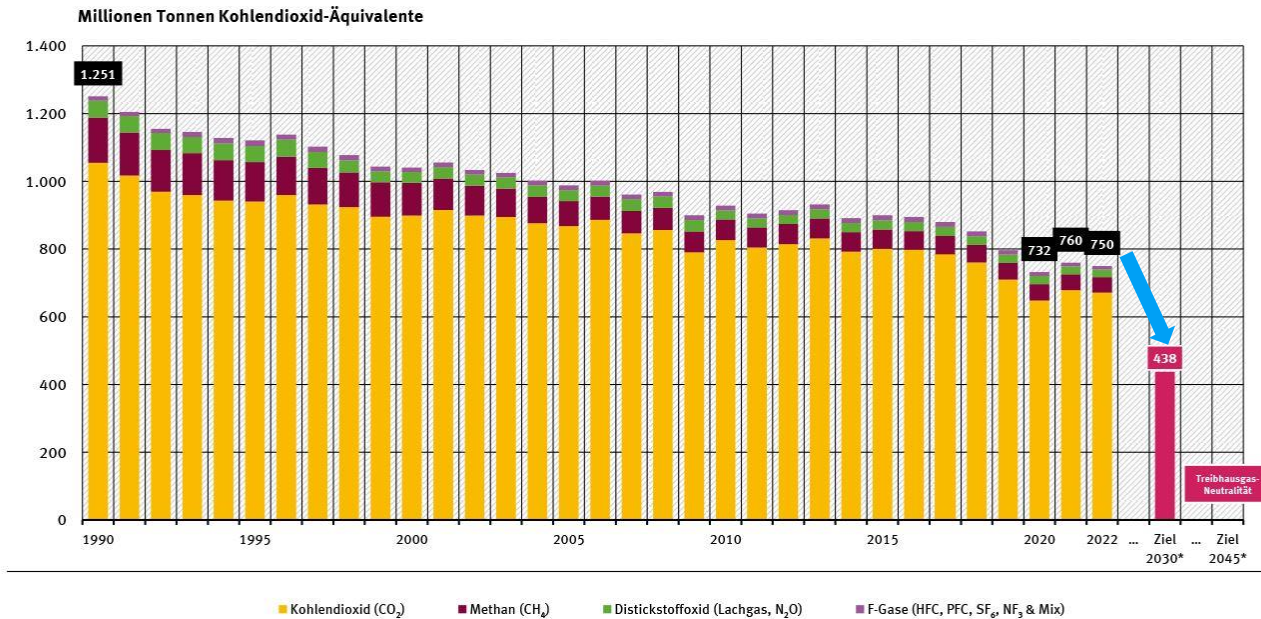


Greenhouse Gas Emissions in Germany

Total greenhouse gas emissions in Germany in 2022:
~ 750 Mio tpa CO₂eq

Emission reduction targets:
2030: 438 Mio tpa
2045: Net zero neutrality

Treibhausgas-Emissionen seit 1990 nach Gasen



Treibhausgas-Emissionen ohne Landnutzung, Landnutzungsänderung und Forstwirtschaft
Quelle: Umweltbundesamt
* angepasste Ziele 2030 und 2045; entsprechend der Novelle des Bundes-Klimaschutzgesetz (KSG) vom 12.05.2021

Quelle: Umweltbundesamt, Nationale Treibhausgas-Inventare
1990 bis 2022 (Stand 01/2024)



Greenhouse Gas Emissions in Germany

Distribution of GHG emissions across industrial sectors in 2022 in Mio tpa CO₂eq:

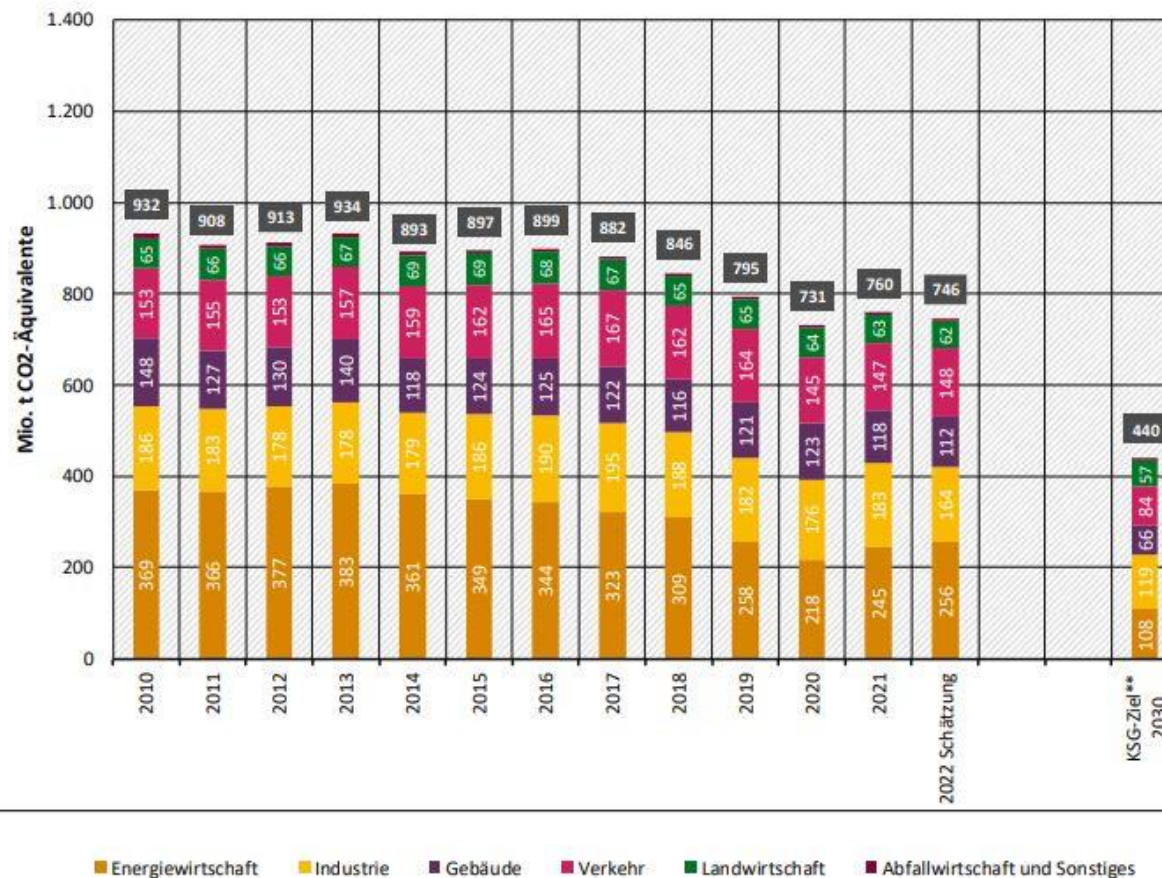
Heat and el. power:	256
Industry:	164
Buildings:	112
Traffic:	148
Agriculture:	62
Miscellaneous:	4

Reduction targets per industrial sector in 2030 in Mio tpa CO₂eq:

Heat and el. power:	108
Industry:	119
Buildings:	66
Traffic:	84
Agriculture:	57
Miscellaneous:	4

Entwicklung der Treibhausgasemissionen in Deutschland

in der Abgrenzung der Sektoren des Klimaschutzgesetzes (KSG) *



* Die Aufteilung der Emissionen weicht von der UN-Berichterstattung ab, die Gesamtemissionen sind identisch

Quelle: Umweltbundesamt 14.03.2023



GHG Reduction Options in different Industries

Potential options for GHG emission reduction
Carbon Direct Avoidance (CDA):

Heat and power sector:

- ✓ Renewable energy sources
(wind, solar, hydro, biomass)

Traffic sector:

- ✓ Electric vehicles, synthetic green fuels, hydrogen

Buildings:

- ✓ Insulation, heat pumps, green fuels (wood, biogas)

Industry sector:

- ✓ Electrical heating, heat pumps, hydrogen

Challenge

Unavoidable CO₂ emissions:

- Limestone
- Cement
- Waste incineration

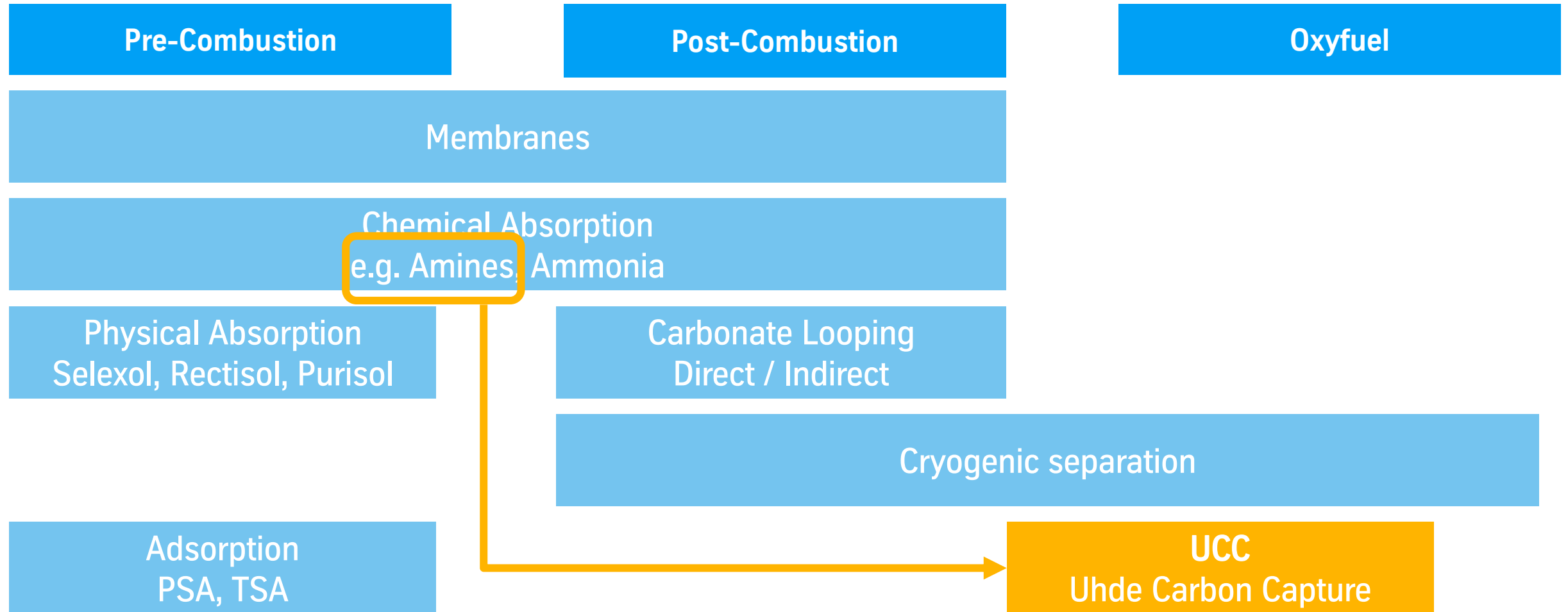
Total CO₂ emissions in 2022:
65 Mio tpa¹

Carbon Capture

1. Requirements for a CO₂ infrastructure in Germany - Requirements for climate neutrality in the cement, lime and waste incineration sectors VDZ report March 2024



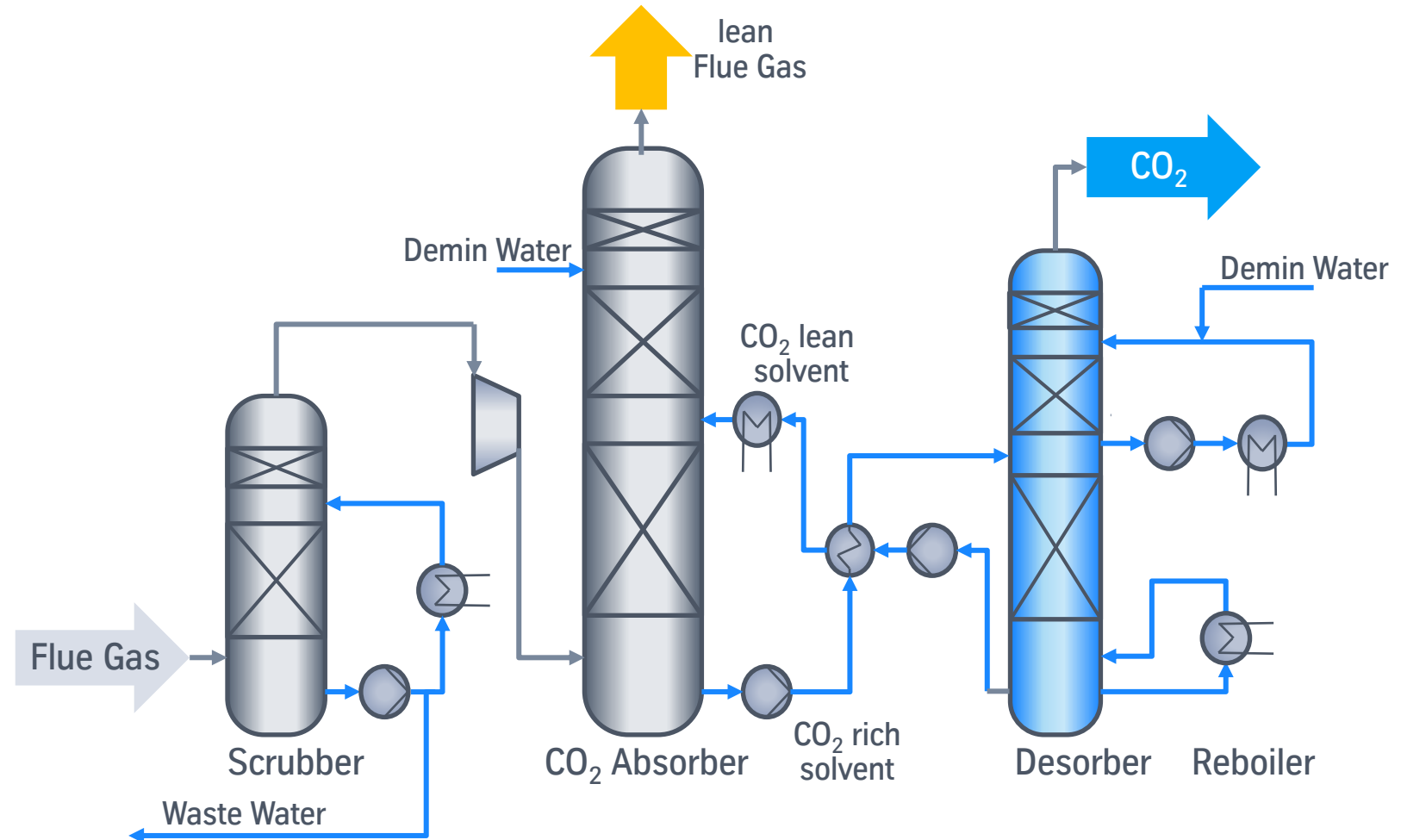
Carbon Capture Technologies



UCC – the Uhde Carbon Capture Process

Process features (USP):

- Amine blend based on generic amine components – no expensive specialty amines used
- Process design for low reboiler duty and reduced cooling water demand.
- Integration of low-level process heat for solvent preheating
- Backwash stages at the column tops for reduction of solvent losses and environmental protection
- Adjustable design for different types of flue gases or waste gas (gas flow, CO₂ content, impurities)
- Optimisation for capture rate / utility demand and equipment expenditures.



Carbon Capture and Chemical Industry Carbon Demand - CCU

GHG reduction results in lower consumption of fossil resources like natural gas and oil

However still demand for carbon components in chemical industry and other branches

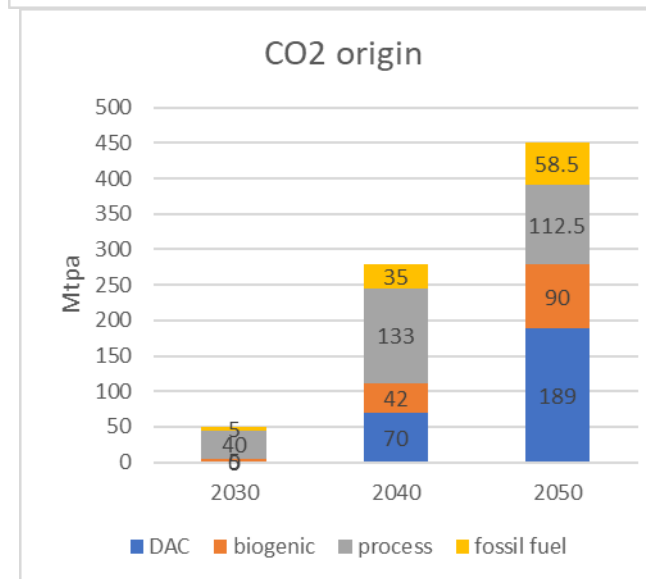
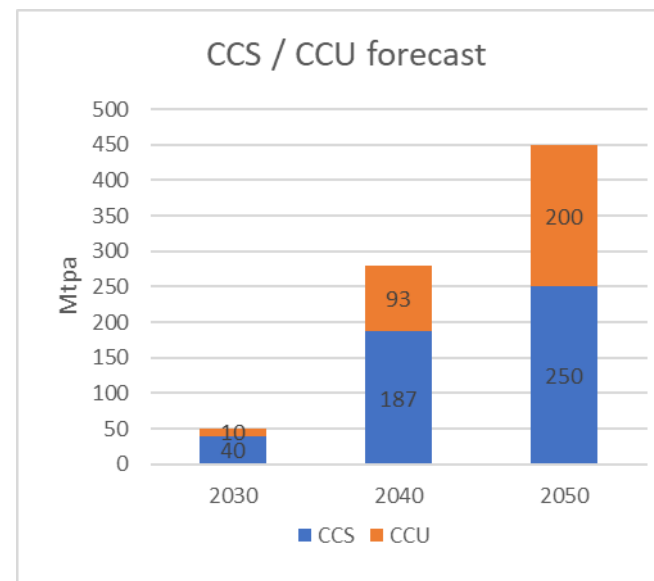
Carbon capture is required not only for CO₂ emission reduction (CCS) but also to provide carbonic components for the industry (CCU)

Rising demand for Carbon Capture until 2050, for separation of fossil CO₂ as well as biogenic CO₂

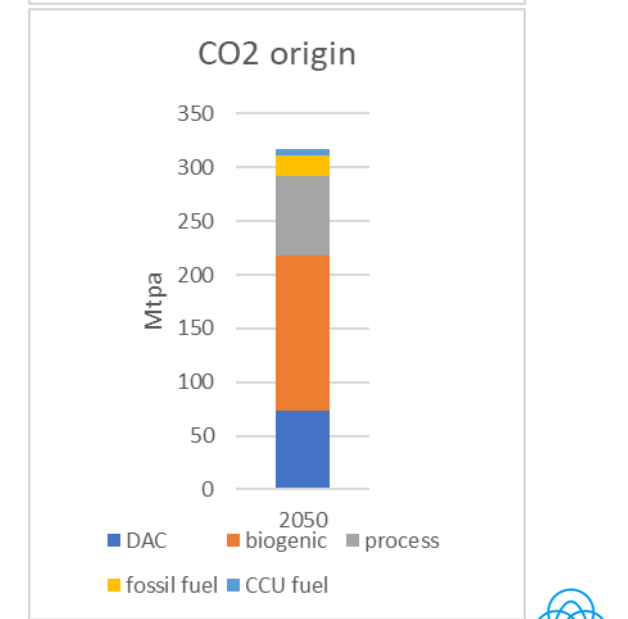
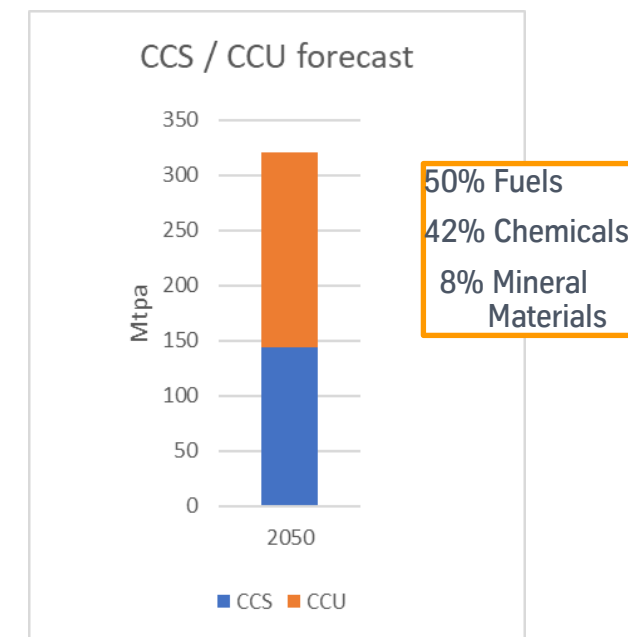
Change in Industrial Carbon Management Strategy for the EU¹⁾ can be observed towards CCU

The pipeline system planned in Germany shall be made accessible not only for CCS purposes but also for CCU

1) COM(2024) 62 final: Towards an ambitious Industrial Carbon Management for the EU (6.2.24)
2) CVEs EU Roadmap for CCU by 2050.pdf (co2value.eu)



1)



2)



Carbon Capture Process – UCC Development Continued

- CemRoCap project in cooperation with TU Berlin and Holcim Germany
- Funded by the Federal Ministry for Economy and Climate (BMWK)
- Test at Holcim cement plant in Beckum (North Rhine Westphalia, Germany)
- Started in 2022, ends in mid 2025

Pilot plant equipped with absorption / desorption columns with structured packings, extension planned:

- Test of new mass transfer equipment -> Rotating Packed Bed contactors (Higee machines)
 - Instead of gravity only liquid is forced to flow through the packing by centrifugal force
 - Potential for higher concentration of amine in solvent (resulting in higher viscosity)
 - Higher concentration -> higher CO₂ load in solvent
 - Higher CO₂ load -> less solvent circulation -> less energy demand for regeneration
 - Lower OPEX and CAPEX

Gefördert durch:

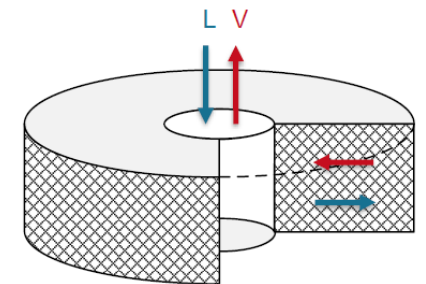
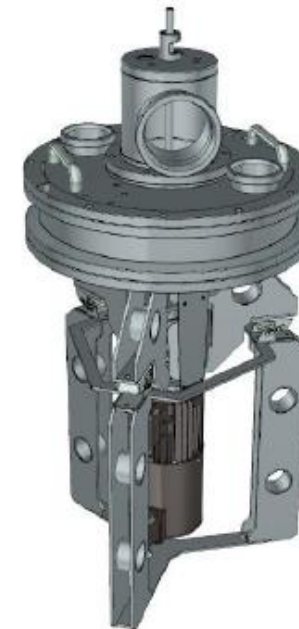


Bundesministerium
für Wirtschaft
und Klimaschutz

aufgrund eines Beschlusses
des Deutschen Bundestages



picture: CemRoCap project



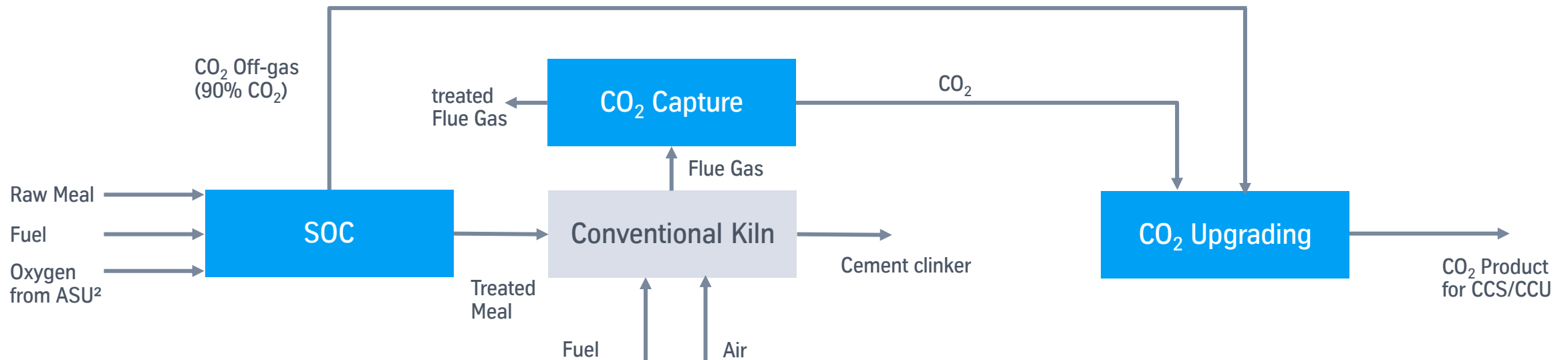
Carbon Capture Process – current Projects

thyssenkrupp Uhde, thyssenkrupp Polysius; thyssenkrupp nucera and thyssenkrupp rothe erde form the new thyssenkrupp segment Decarbon Technology

Current projects in cement industry – a show case for a close co-operation:

1) Phönix cement plant at Beckum

Study for implementation of a novel SOC¹⁾ unit by Polysius in combination with a flue gas carbon capture unit by Uhde



1. SOC separate oxygen calciner: oxygen supported calcination unit for enrichment of CO₂ in flue gas and reduction of flue gas flow | 2. ASU air separation unit | Picture: Holcim Germany internet site



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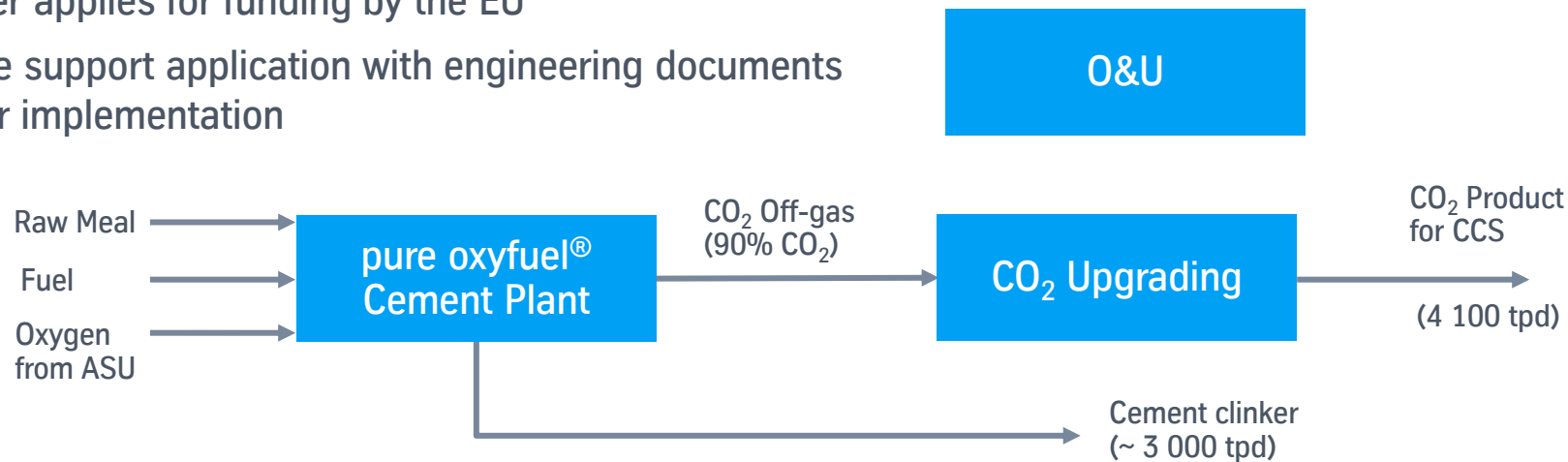
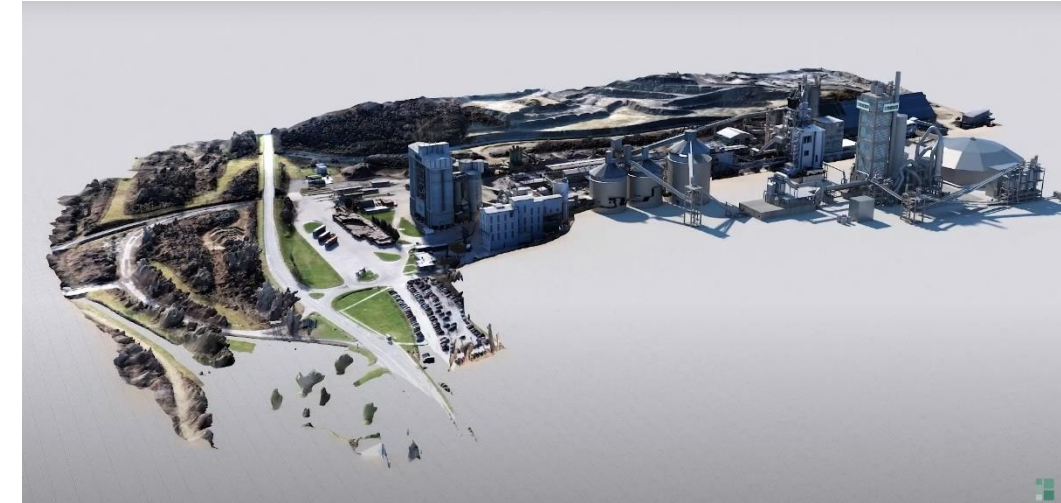
2) CO2NTESSA project of NEXE industries in Croatia

Project for a new pure oxyfuel[®] cement plant by thyssenkrupp Polysius in Nasice

thyssenkrupp Uhde supports thyssenkrupp Polysius with services for offsites and utility facilities and CO₂ upgrading units

Currently customer applies for funding by the EU

Polysius and Uhde support application with engineering documents and apply for later implementation



polysius® pure oxyfuel is a registered trademark of thyssenkrupp Polysius | picture: Nexe internet site



Carbon Capture – Outlook

Next to direct avoidance of CO₂ emissions by changing process technologies in the different industry sectors CO₂ capture plays an important role for CO₂ emission reduction especially in branches where emissions are hard to abate.

CO₂ will play an important role as a commodity in a circular economy, where many products are based on carbon species.

CO₂ capture will be a means for separation of CO₂ either for sequestration (CCS) but increasingly also the generate a valuable commodity (CCU).

thyssenkrupp Uhde is developing any further this technology and works on joint projects together with thyssenkrupp Polysius in the thyssenkrupp Segment Decarbon Technologies especially in cement and limestone industry.





Thank you for your attention



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