



EL ROL DEL CEMENTO & CONCRETO DE CARA AL CAMBIO CLIMÁTICO



CONGRESO Cemento & Concreto Verde 2050



06 AL **09** 2024
MAYO



Ciudad de
Guatemala

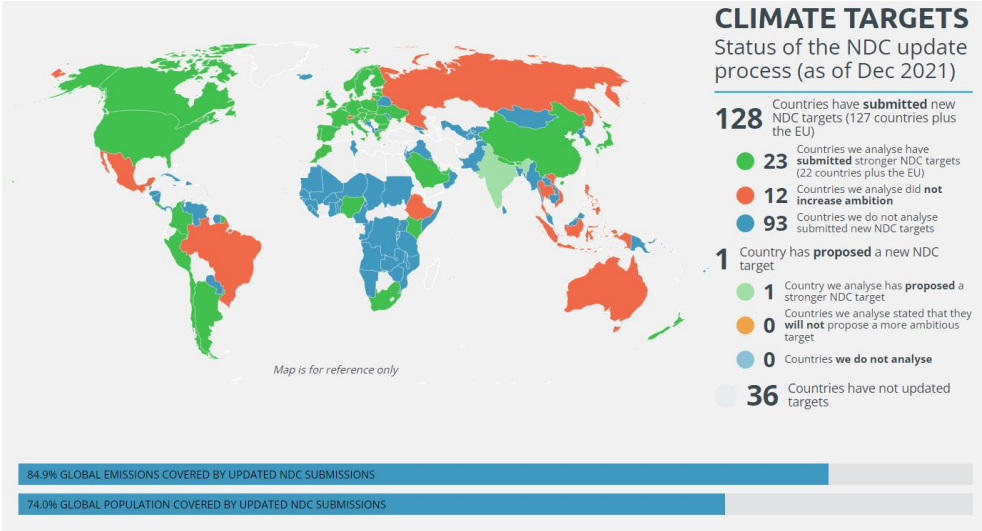
**Carbon capture using oxyfuel
technology - the greenfield and
revamp options**

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Head of #grey2green development



National and company CO2 reduction targets

COUNTRIES*



193 states have ratified the Paris agreement
193 states have submitted NDCs**
EU with Fit for 55 program claiming to reduce 55% of 1990 emissions

Change is happening.

CEMENT producers required to decide on roadmaps!

CEMENT

HeidelbergMaterials

Building a Net Zero Future

We drive the decarbonisation of our sector and provide low-carbon products.

CO₂ & Energy	Reduce our Scope 1 CO ₂ emissions to 400kg per tonne of cementitious material Reduce our total CO ₂ footprint according to the SBTi 1.5°C pathway Capture 10 million tonnes of CO ₂ cumulatively through our CCUS projects
Additional Emissions	Reduce sulphur and nitrogen oxide emissions (SO _x and NO _x) by 40% compared with 2008
Sustainable Revenue	Achieve 50% of our revenue from sustainable products that are either low-carbon or circular

400 kg_{CO2}/t_{CEM} @ 2030***

HOLCIM

SCIENCE-BASED TARGETS

	Target Base Year	2018	2022	2030	2050
SCOPE 1 KG CO ₂ / T cementitious		623 gross	602 gross	-22.4% gross	-95%
		590 net	562 net	420 net	net zero
SCOPE 2 KG CO ₂ / T cementitious		46	37	-65%	

420 kg_{CO2}/t_{CEM} @ 2030****

*CAT Climate Target Update Tracker | Climate Action Tracker

**National Determined Contributions, CO2 mitigation plan

***Heidelberg Sustainability Commitments Overview AW_v2.pdf (heidelbergmaterials.com)

****Climate Action | Net Zero Climate Pledge | Holcim



Status of NDCs in South America



● Country improved ambition

Argentina, Chile, Colombia, Peru, Costa Rica

● Country did not improve ambition

Brazil, Mexico

● Country submitted new target but is not further analysed

Panama, Nicaragua, Honduras, Suriname, Venezuela, Paraguay, Uruguay

Carbon pricing mechanism implemented or considered¹

NDC implemented in nearly all states in South America, ~30% with ambitious targets².

Carbon pricing in states with pricing less than 5 \$/t_{CO2}¹, i.e. insufficient for implementation of expensive CC process.

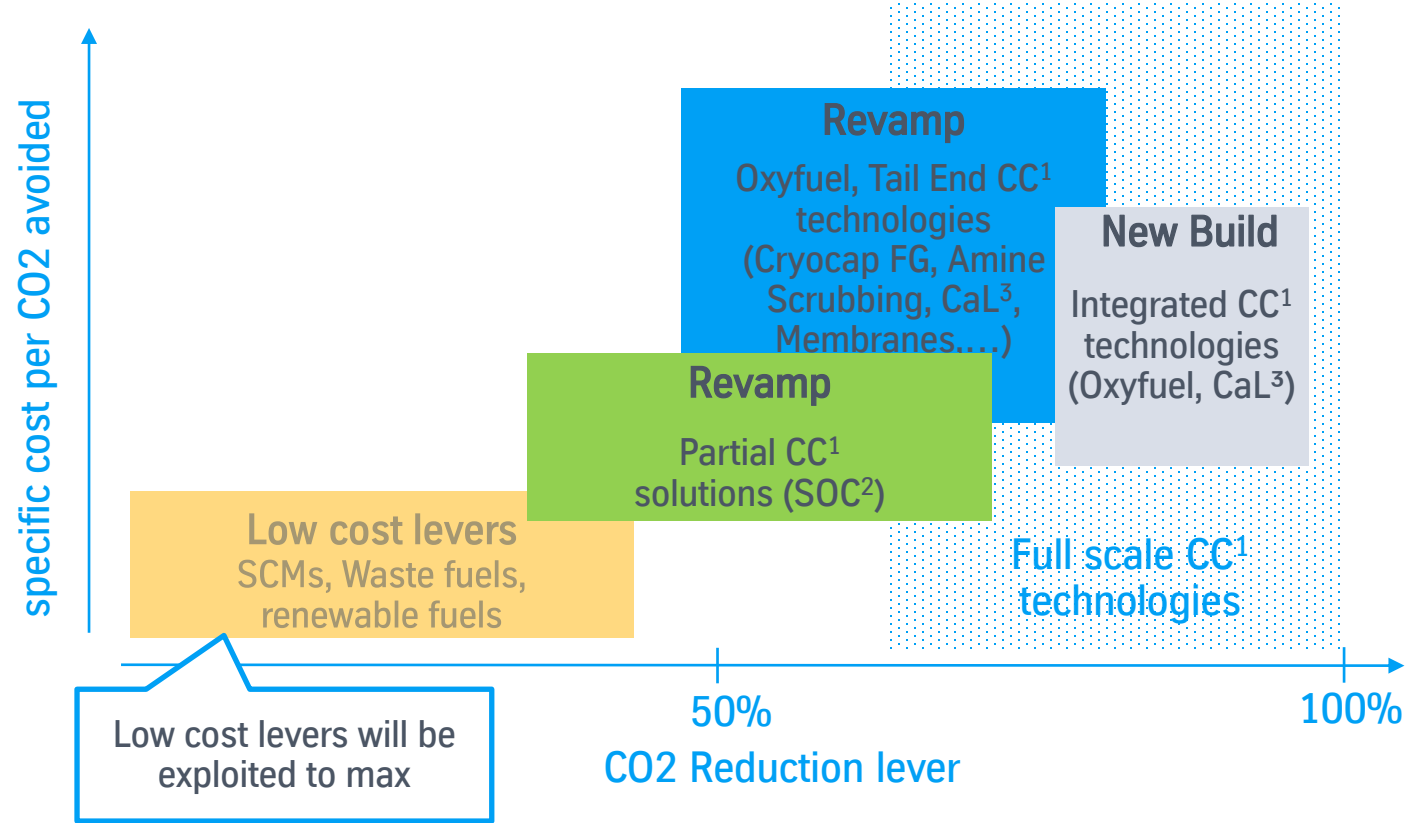
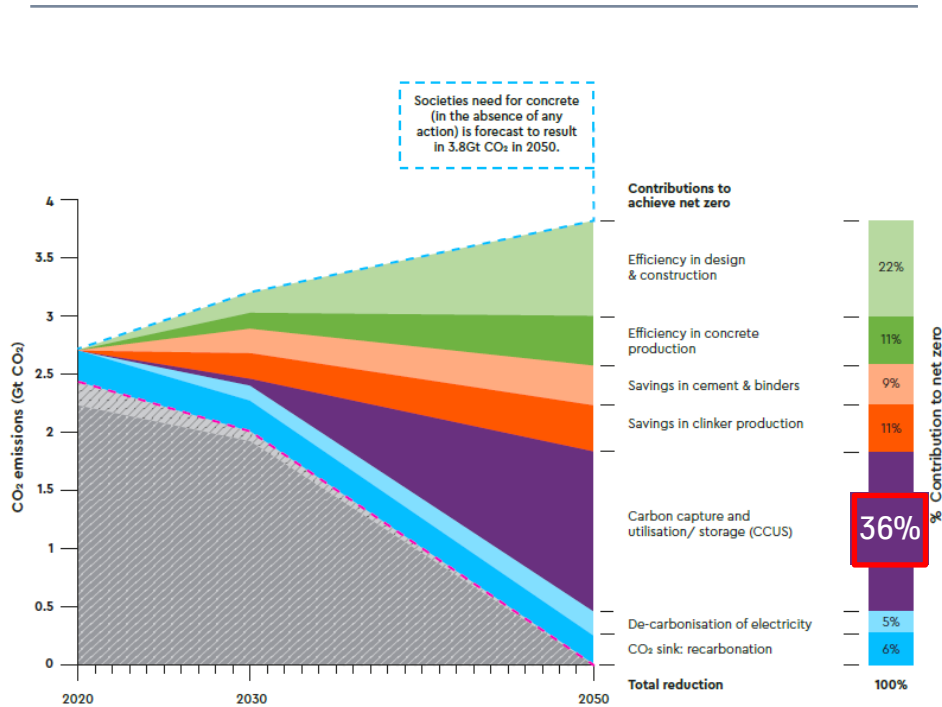
¹ <https://carbonpricingdashboard.worldbank.org/>

² <https://climateactiontracker.org/>

Overview of carbon capture and avoidance technologies for cement

Levers for decarbonisation

The CO₂ reduction levers according to the GCCA



Low cost levers alone will not save the world.

CC technologies required for net zero – full scale CC technologies for mature and partial CC technologies for emerging markets.

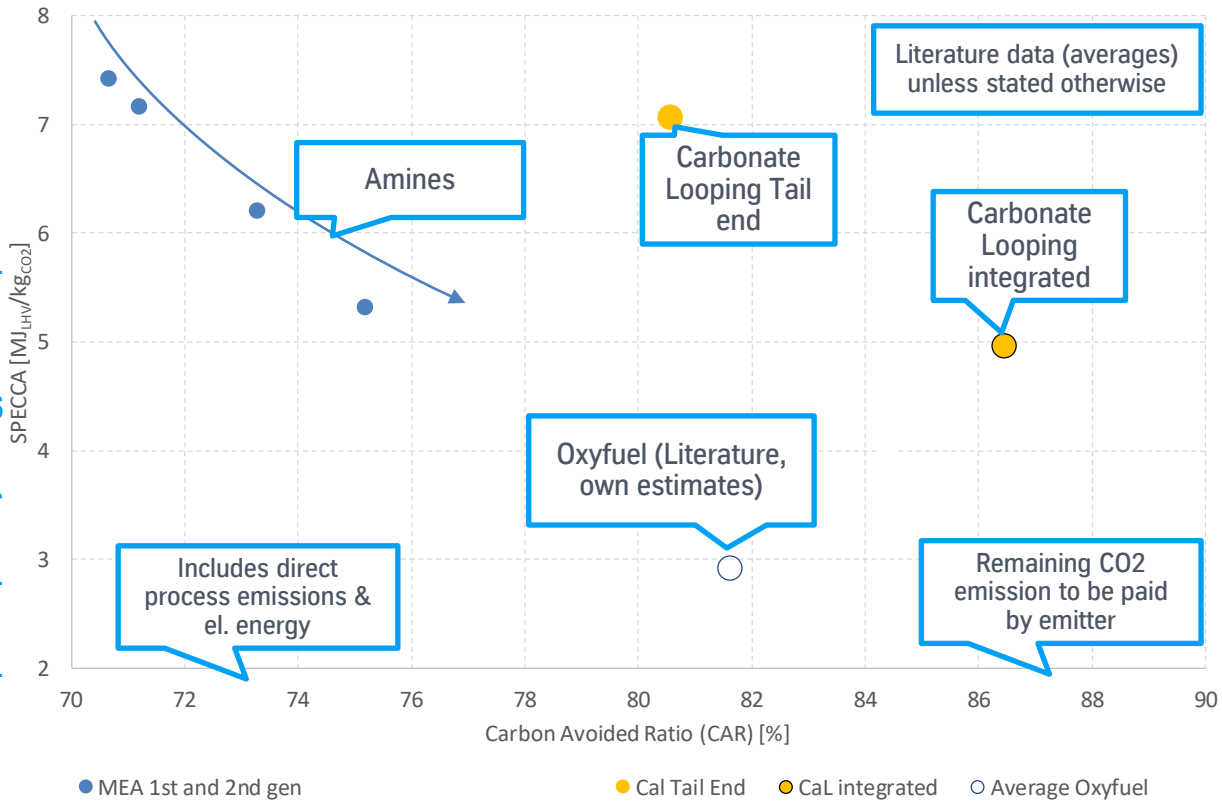
1: Carbon Capture; 2: Separate Oxyfuel Calciner; 3: Carbonate Looping



Technology comparison of full scale carbon capture technologies

Literature data and Polysius data

Specific primary energy consumption for CO2 avoided



Carbon avoidance ratio

SPECCA (Specific Primary Energy Consumption for Carbon Avoided) is used to assess both, thermal and electric energy efficiency. The technology owning the lowest total SPECCA value and the highest carbon avoidance ratio is deemed to emit the lowest amount of CO2 into the atmosphere.

Competing technologies like amines using e.g. new sorbents become more cost competitive

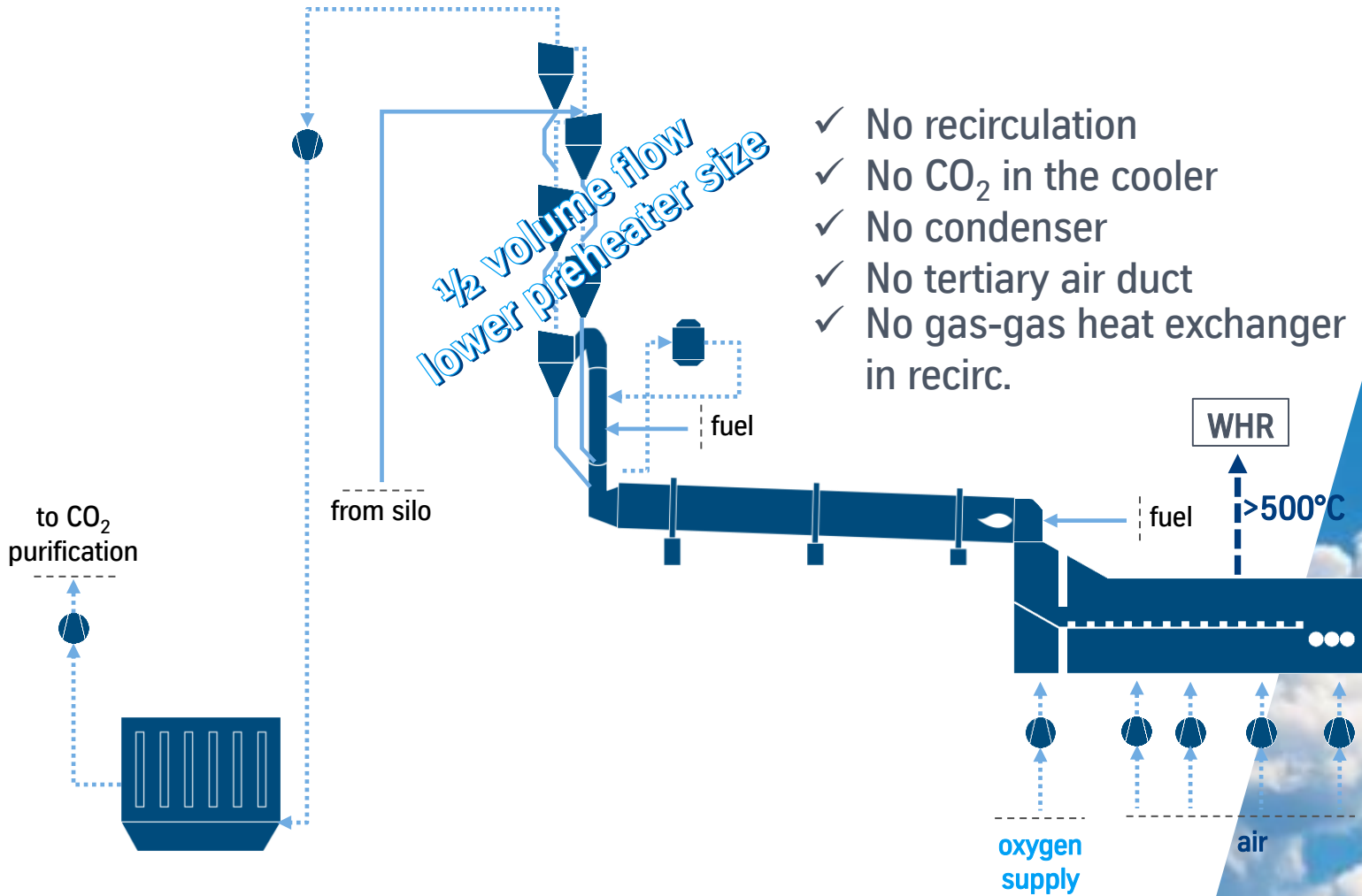
Oxyfuel has a strong potential to be best in class technology in this field

Emerging technologies such as membranes could become more and more competitive (efficiency, SPECCA)

Oxyfuel is the best-in-class technology



polysius® pure oxyfuel technology



- ✓ No recirculation
- ✓ No CO₂ in the cooler
- ✓ No condenser
- ✓ No tertiary air duct
- ✓ No gas-gas heat exchanger in recirc.

- ✓ Cost effective
- ✓ Simple process and layout
- ✓ Unique process improvements

- Higher clinker quality possible
- Less fuel preparation likely
- Strong potential for Waste Heat Recovery
- Higher CO₂ concentration and lower exhaust gas flow

polysius® pure oxyfuel projects portfolio

polysius® pure oxyfuel – the Pilot plant catch4climate project

catch4climate

POLYSIUS as technology and project partner

- polysius® pure oxyfuel process to be developed, built and operated

Demonstration plant at the Mergelstetten site

- 450 t/d semi-industrial scale for further scaling to large industrial size
- different fuel types to be tested
- over 130m€ investment by CI4C JV
- Start of construction: 05/2022
- Planned start of operation: 2024

Capture and utilization of CO2

- CO2 further processed into synthetic fuel for e.g. air traffic

Status March 2024

Source: <https://www.bilbao.com/press/2024/03/2024-03-14-01-1172248.html>

Pilot – 750 tpd

polysius® pure oxyfuel – the Full Scale plant Holcim Carbon2business project

POLYSIUS as technology and project partner

- polysius® pure oxyfuel process to be scaled up, built and operated

New pure oxyfuel kiln line (4500 tpd clinker) at Lägerdorf plant, Germany

- >1 Mio t CO2 per year captured
- Pre-selected by EU Innovation Fund
- Basic design and permitting : 2023 and 2024
- Construction phase : 2025 to early 2027
- Testing, operation and optimization : 2027

Capture and utilization – HySCALE100 IPCEI project

- CO2 processed with green H2 (500MW + 2GW electrolyser) into large scale methanol production + olefin and synthetic fuels

Groundbreaking ceremony on April 2nd, 2024

Source: <https://www.holcim.com/en/press-releases/2024/04/02/groundbreaking-ceremony-at-lagerdorf-plant>

Full scale – 4500tpd

polysius® pure oxyfuel – the Full Scale plant NEXE CO₂NTESSA project

POLYSIUS as technology and project partner

- polysius® pure oxyfuel process to be built and operated

New pure oxyfuel kiln line (3000 tpd clinker) at Nasice, Croatia

- >0.7 Mio t CO2 per year captured
- Applicant to EU Innovation Fund (2024)
- Basic design and permitting : 2023 and 2025
- Construction phase : 2026 to early 2028
- Testing, operation and optimization : 2028/2029

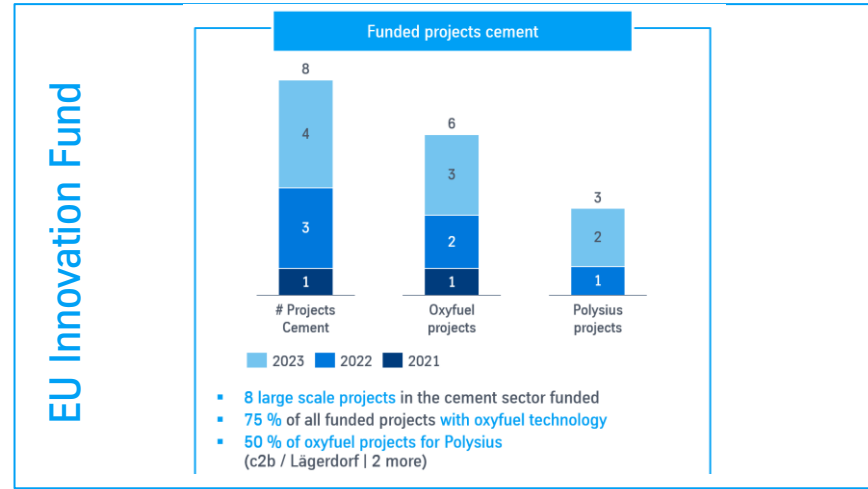
Storage project

- Project Croatia GT CCS applicant PCI project, onshore storage in saline aquifer

Application for funding in 2024

Source: <https://www.nexe.com/en/press-releases/2024/05/07/new-pure-oxyfuel-kiln-line-at-nasice-croatia>

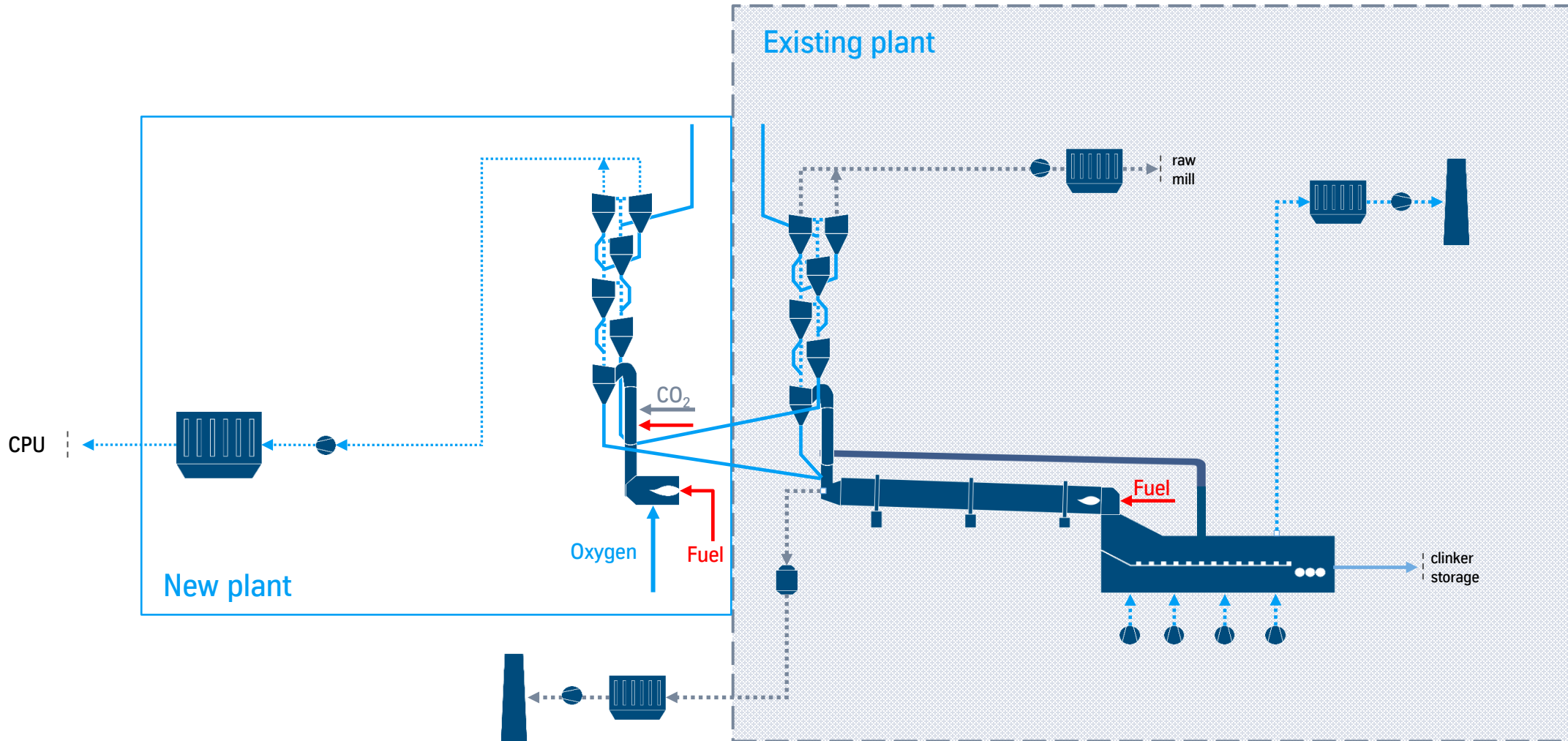
Full scale – 3000tpd



2 x full scale by IF 2023

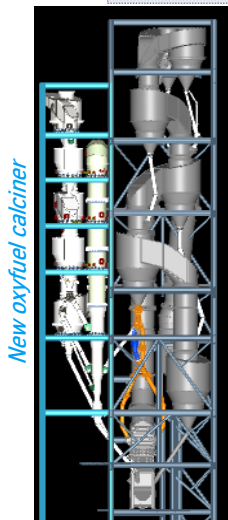
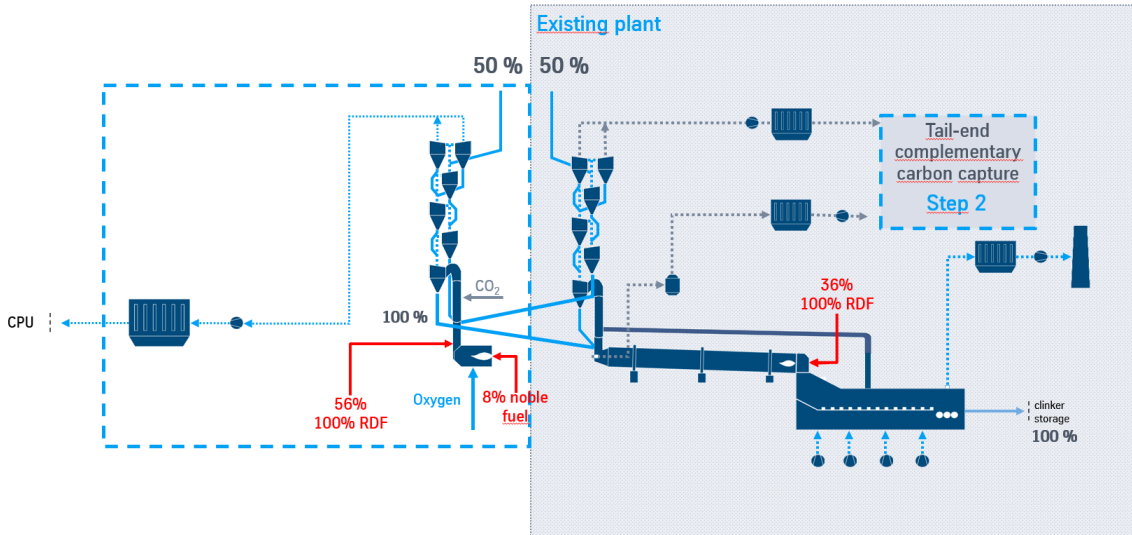
polysius® pure oxyfuel thrives driven by EU IF – 5 projects in total, TRL 9 by 2029

Separate Oxyfuel Calciner | Typical flowsheet



SOC can be built during operation, scale adjustable ~0.1 – 2.5 Mt CO₂/yr

SOC as carbon capture revamp solution



New oxyfuel calciner

Existing calciner & preheater

4500 tpd case study (EU, 2021)

LinkedIn, February 1st, 2024



First prototype to be built with TCC in Taiwan

The solution is a simple, flexible revamp solution and comes at low risk and cost.

Nearly no downtime of existing kiln line, plug&play solution, i.e. clinker production is secured

CO2 recovery of >75% with SOC possible

CO2 neutrality with sufficient biomass in fuel mix

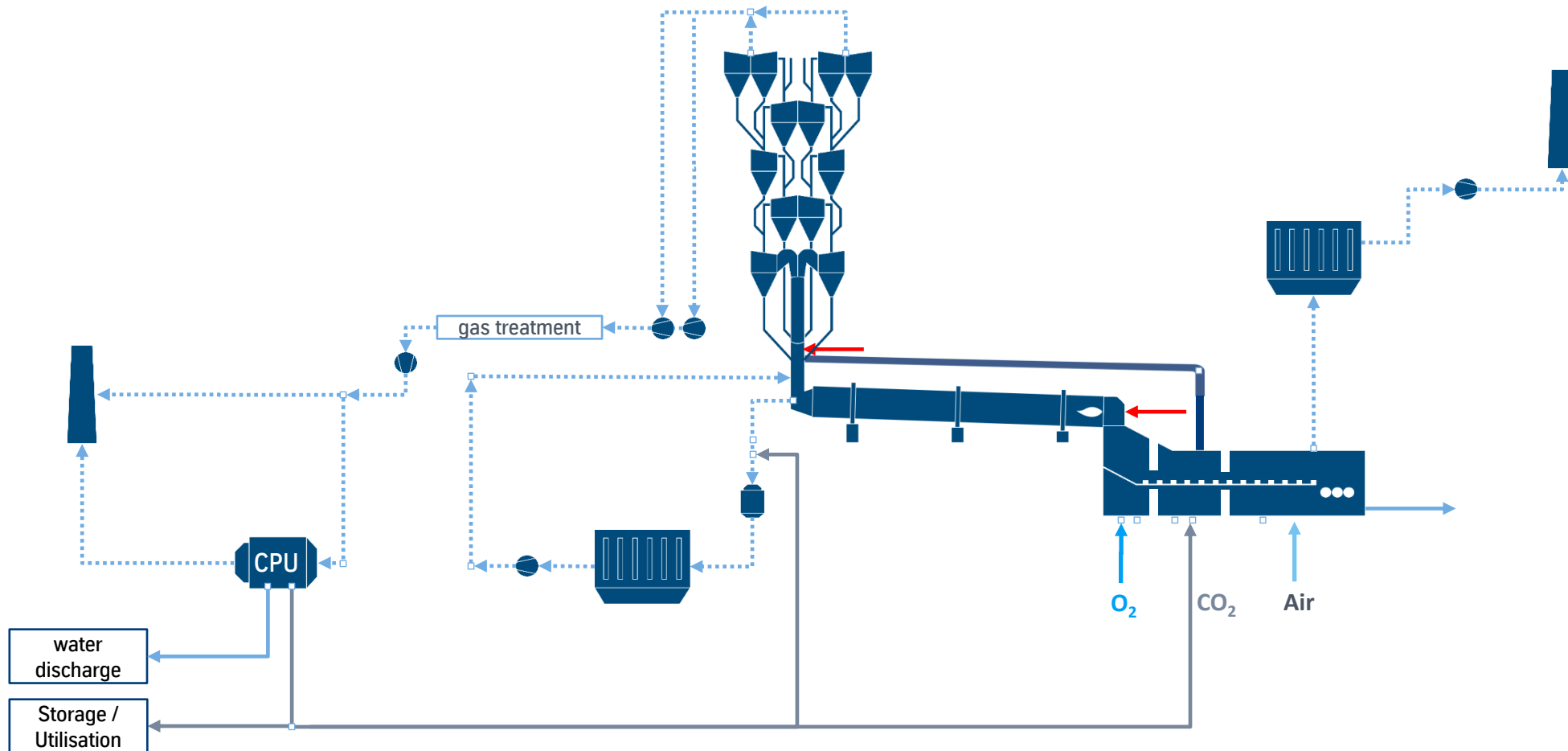
Smart shift of calcination to new calciner by reducing the calcination work in the existing calciner.

The CO₂ comes at high purity, characteristically >90% on dry basis and at low volume flow rate, i.e. low efforts for further purification.

With secondary CC solution for remaining emission, carbon neutrality is achievable, CAPEX is staggered here





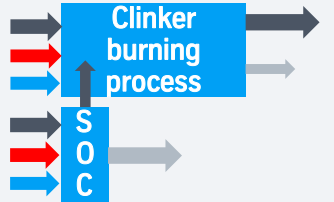
polysius® – Oxyfuel 1.5



Oxyfuel 1.5 is without compromise an enhanced oxyfuel 1



polysius® oxyfuel – the solutions portfolio

	Oxyfuel 2 (pure oxyfuel)	Oxyfuel 1.5	SOC (Separate Oxyfuel Calciner)
			
Pro's	Low Capex + Low Opex Unique process improvements >90% CO ₂	Switchable plant possible Process improvement due to Oxy2 kiln operation	Switchable plant possible >90% CO ₂ Little down time for revamp Extention to Ca-looping
Con's	50% of capacity in air operation	>80% CO ₂ Higher Opex than Oxyfuel 2	Implementation depends on case study
Application	Full CO2 capture New build	Full CO2 capture New build Revamp	Partial CO2 capture Revamp
Implementation Status &TRL	Small pilot (C4C), 3+ IF projects, TRL 6-7, TRL 9 by 2029	Expected to be implemented in current / future IF Oxyfuel 1 projects	2 IF projects, TRL 7, TRL 9 by 2029



For more information,
visit our websites

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Verde 2050



<https://insights.thyssenkrupp-polysius.com/>



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<https://www.thyssenkrupp-polysius.com/en/green-technologies>



#GREY2GREEN

Our vision
of a green polysius®
cement plant