



DE|CARBONATE

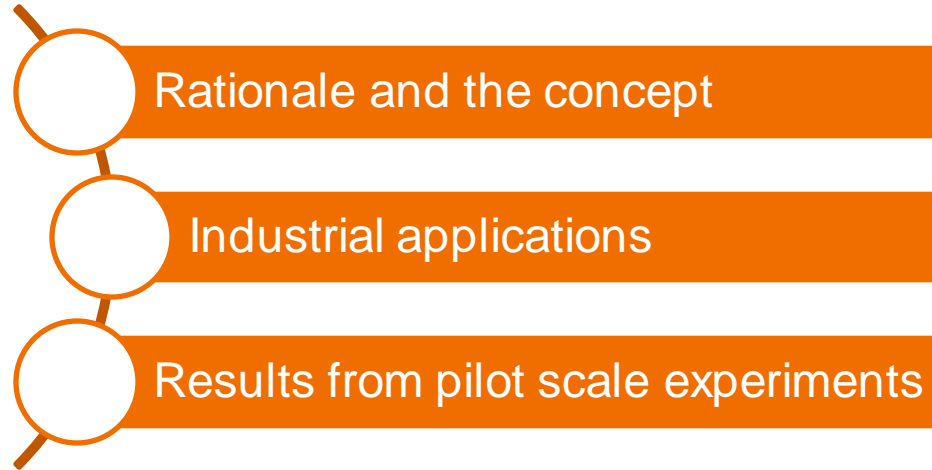
VTT

Reduction of industrial CO₂ emissions by electric calcination

Eemeli Tsupari and Oona Katajisto

01/03/2022 VTT – beyond the obvious

Content



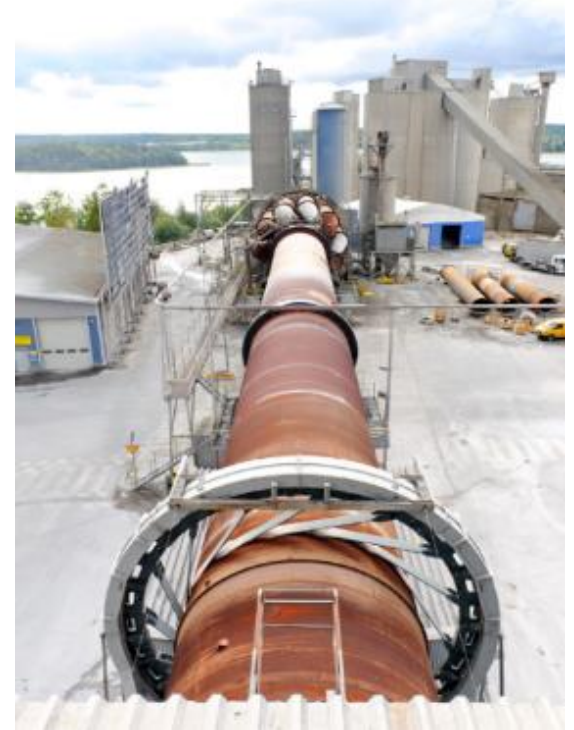
Rationale and present state

- Limestone is one of the most used materials
 - 3,0 Gt of CO₂ from cement production
→ 8 % of global emissions
- Increasing emission allowance price in the EU ETS
- Unstable fuel prices
- Demand from customers



Shifting from fossil fuels to
electricity

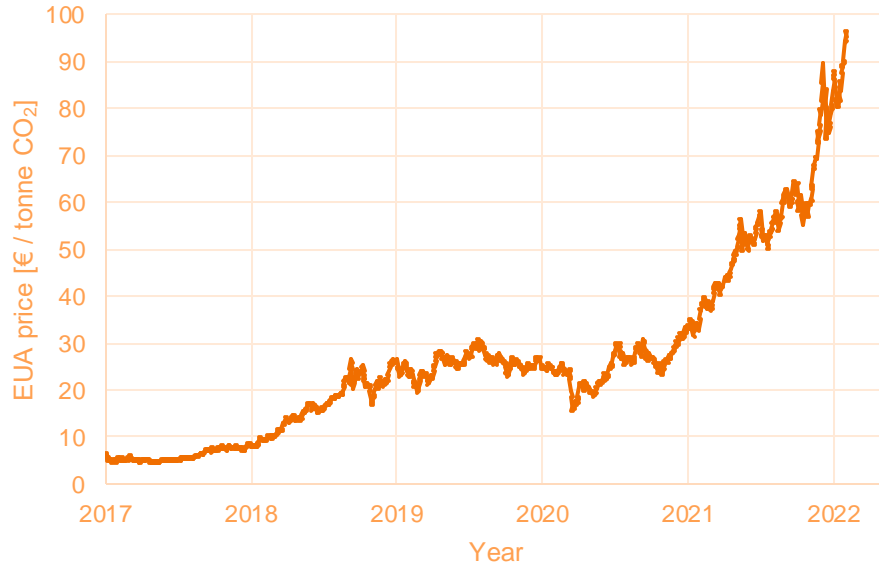
Almost 100% concentration!



Picture: Finnsementti

Changes in operational environment

Emission allowance price in the EU ETS



Data: <https://www.investing.com/commodities/carbon-emissions-historical-data>

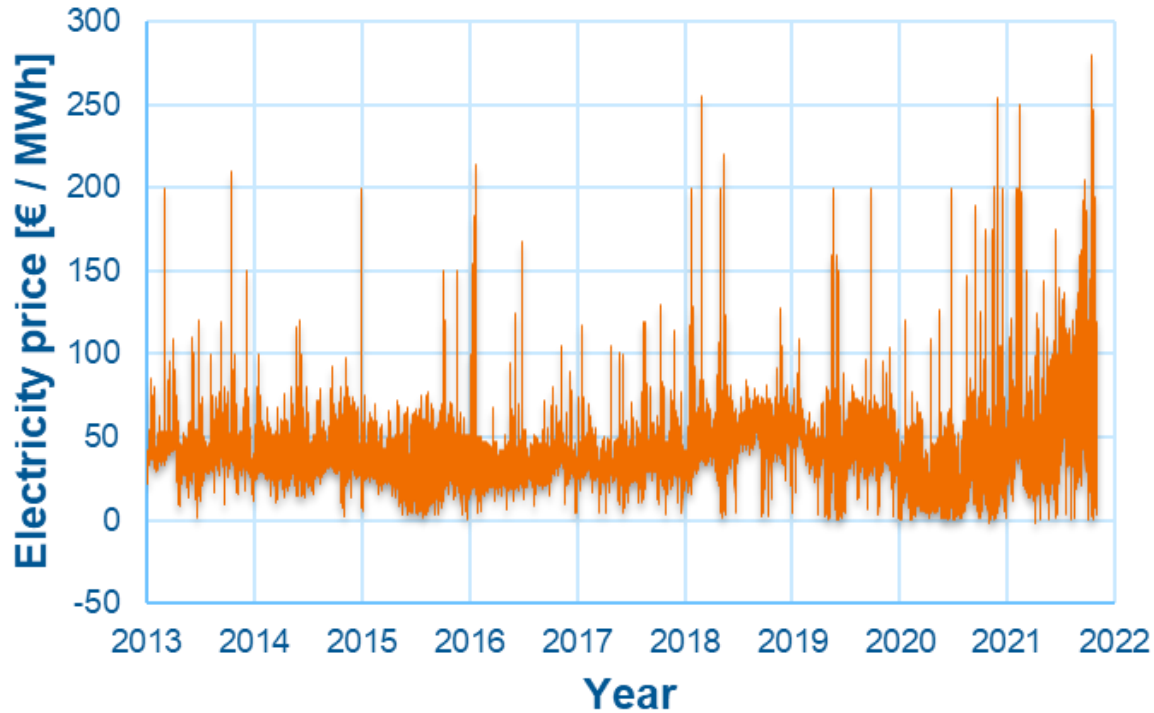
Natural gas price (Dutch TTF benchmark)



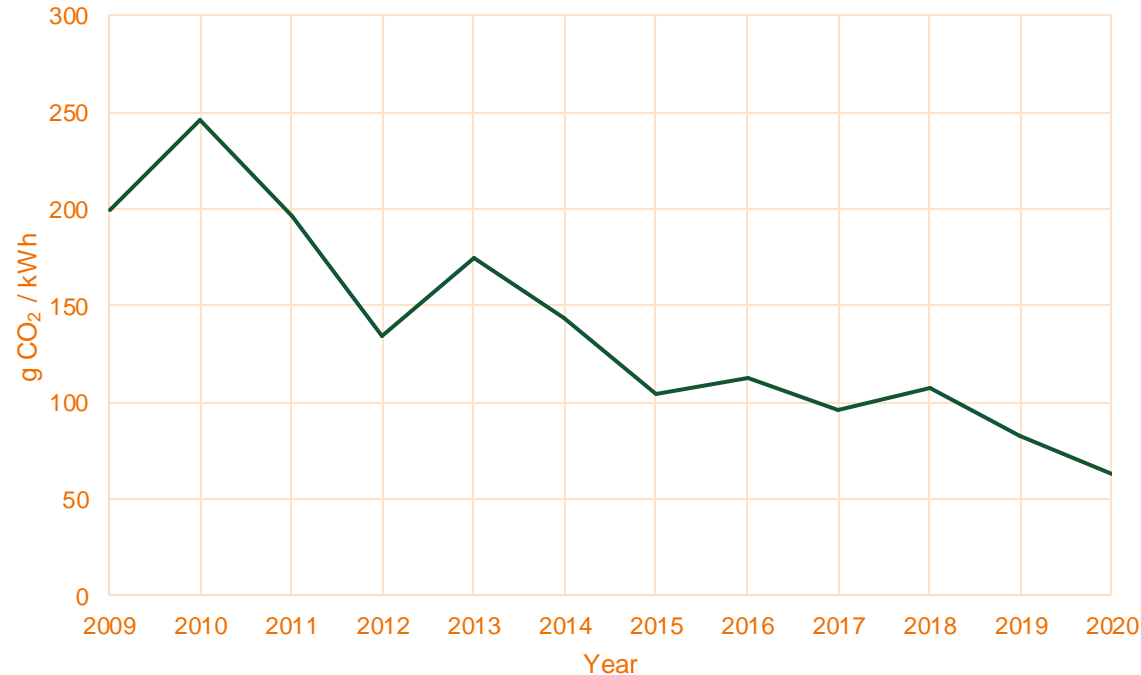
Picture: <https://tradingeconomics.com/commodity/eu-natural-gas>

Electricity price

Nordpool spot, Finland market area



Specific CO₂ emissions of power production in Finland



Data: https://pxhopea2.stat.fi/sahkoiset_julkaisut/energia2020/html/suom0011.htm

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- Using indirect heating by electricity roughly 50 % of CO₂ emissions can be directly avoided (by substituting fossil fuels)
- Pure CO₂ stream can be used for utilization (CCU) or permanently stored (CCS)
- The **Decarbonate** project will prove the concept using electrically heated rotary kiln integrated by CO₂ capture and upgrading

VTT's budget: 1.2 MEUR
Schedule: Oct/2019 – Mar/2022

VTT's pilot infra for complete CCU chain

Electrical kiln (Kumera)



CO₂ synthesis (Ineratec)



PEM electrolysis (H2B2)



CO₂

H₂

Carbon neutral
fuels

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Objective

To test and develop selected industrial CO₂ capture and utilisation solutions towards commercial scale

Co-funding partners

FINNSEMENTTI
A CRH COMPANY

SSAB

Nordkalk

STI



UPM

ANDRITZ

BF-supported projects

KUMERA

KELIBER

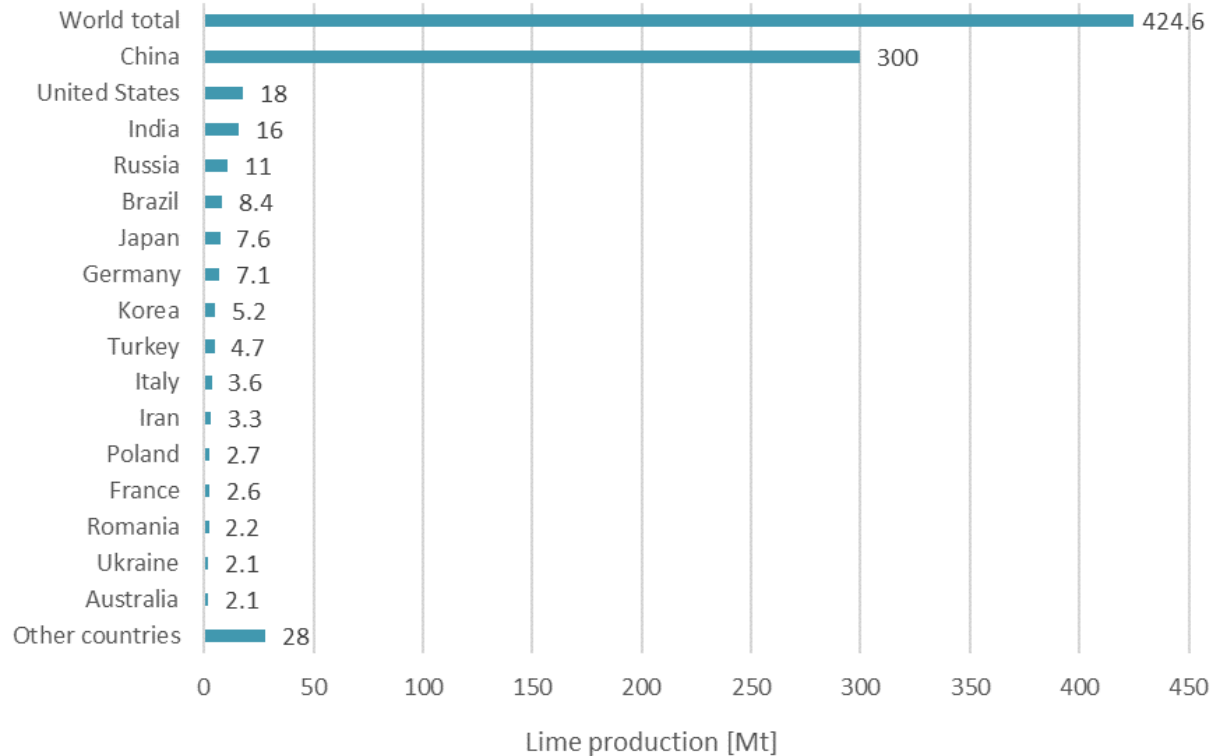
Inkind-partners

CarbonReUse

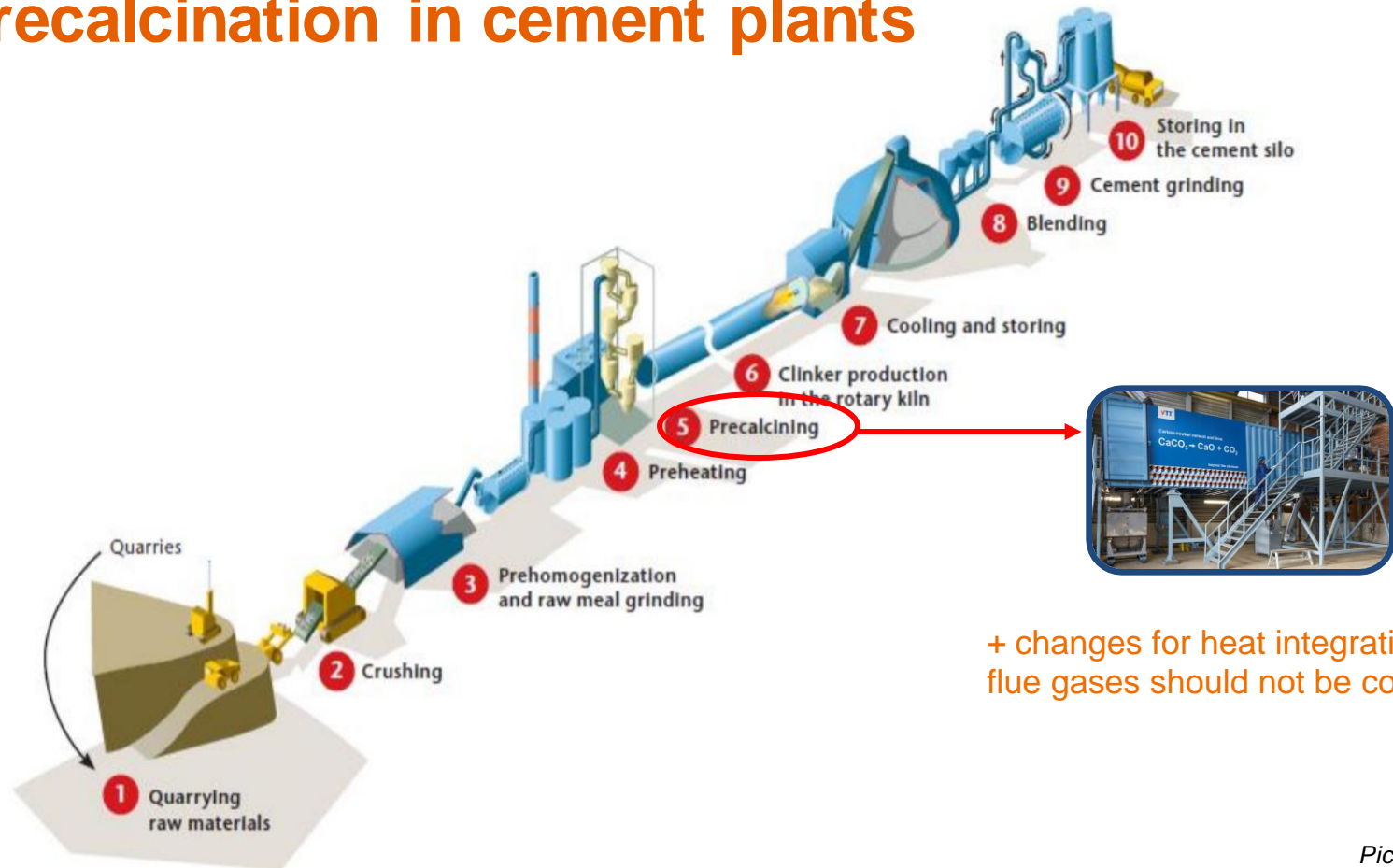
WETEND
Technologies

IC
INERATEC

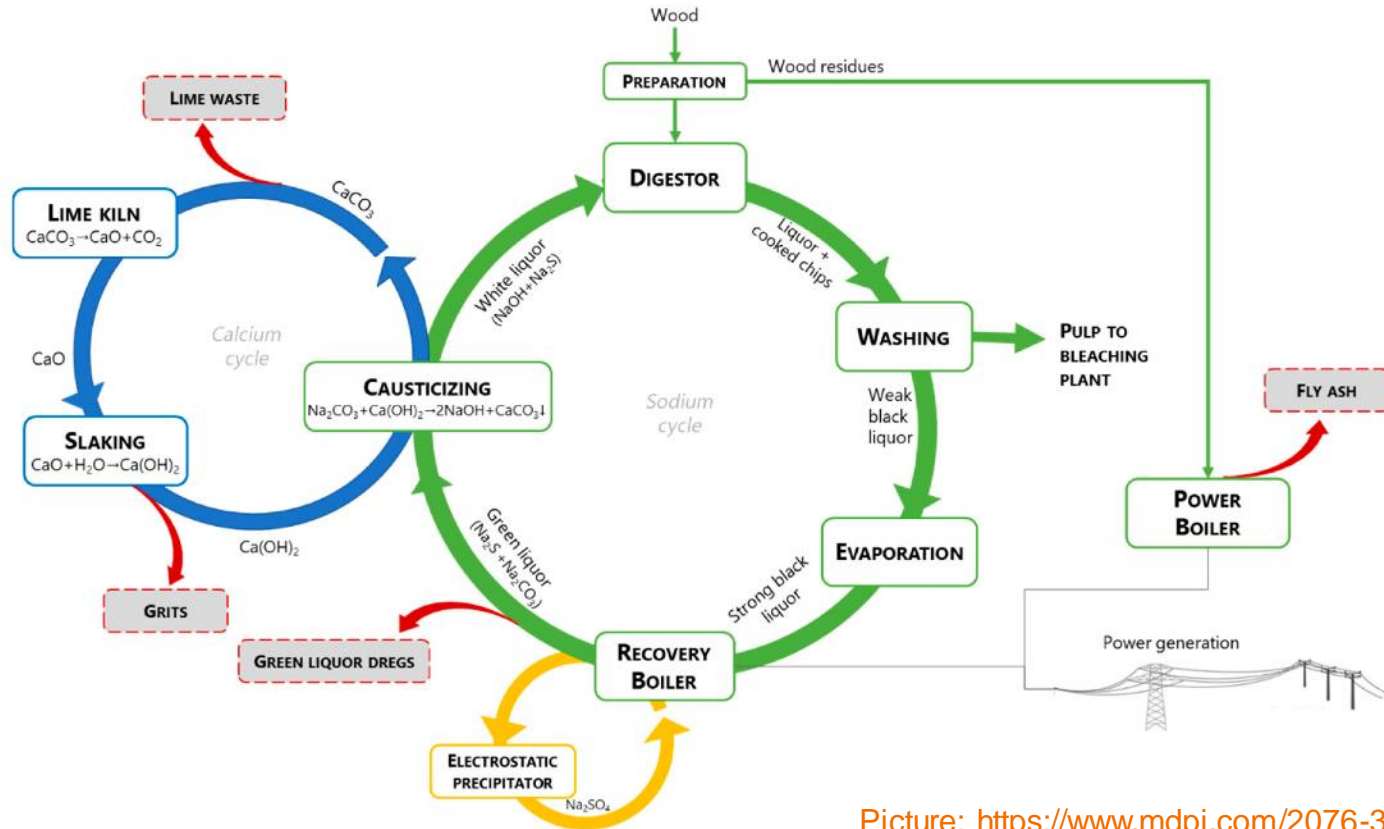
Directly suitable for burnt lime production



Precalcination in cement plants



Calcium looping at pulp mills





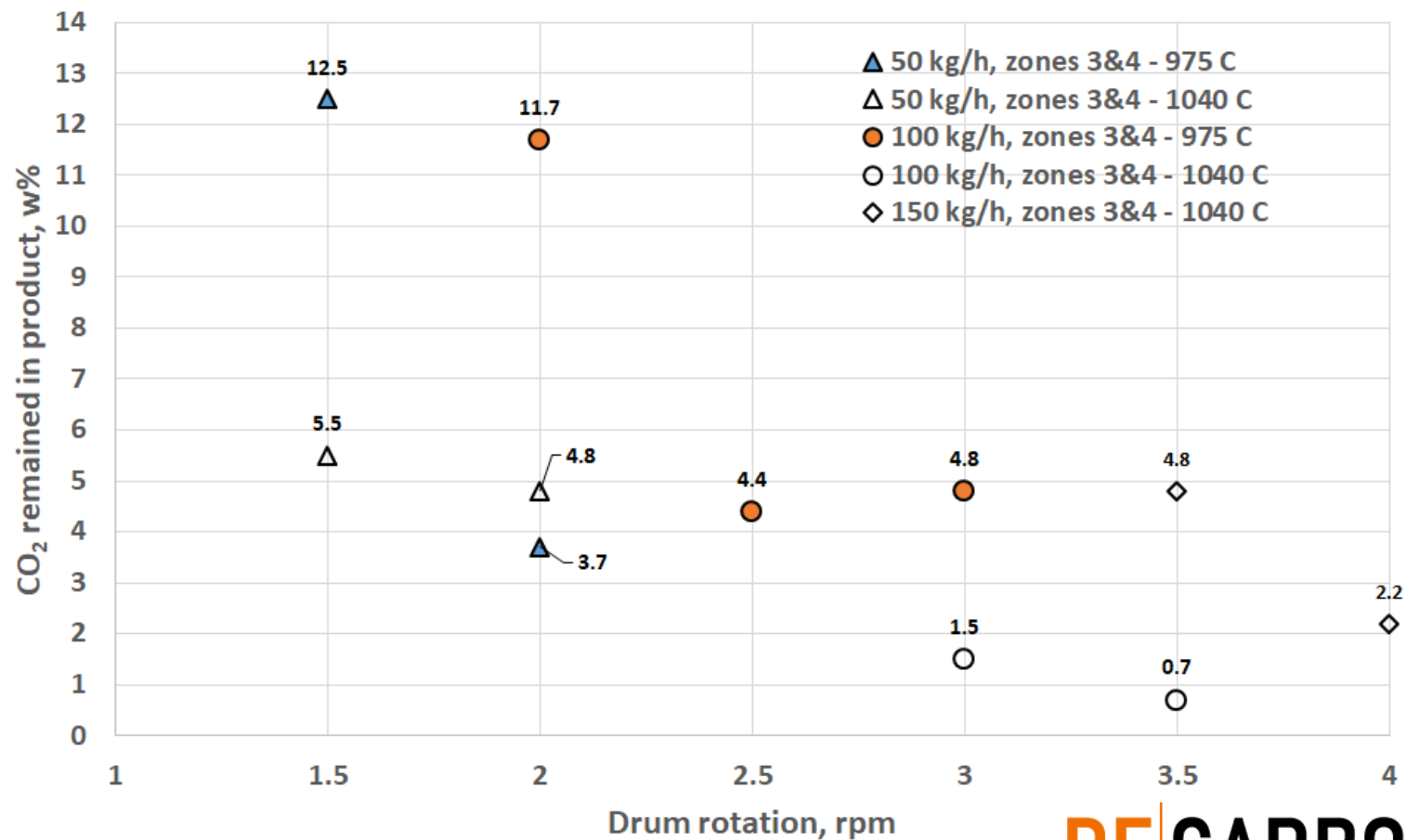
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Carbon-neutral cement and lime



beyond the obvious

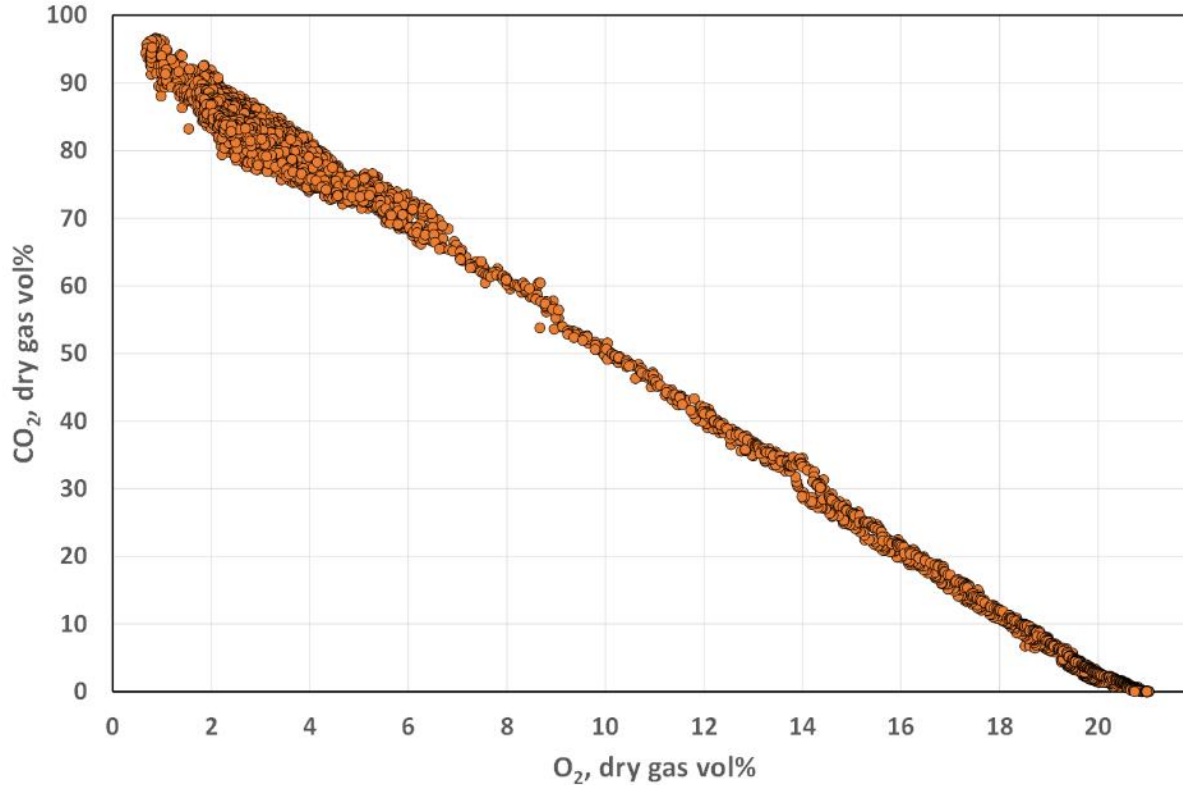
Decarbonate tests - Limestone



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High CO₂ in raw offgas

Mainly dependent on air ingress



Observations from the pilot scale rotary kiln first trials

CO₂ content in kiln off gases up to 98 vol-% (dry)

Degree of calcination 88-98%

Continuous 3 x 4 day operation at ~1000 °C

No shutdowns or major availability issues

