RHI MAGNESITA

Decarbonization of the refractory industry through CCUS technologies

Net Zero Industries Mission, 21/05/2025

The global leader in refractories

There for you, wherever you need us

65 production sites
(incl. raw material sites)

12 recycling facilities

+100 countries shipped to worldwide

5 R&D hubs and centres

>22,000
Employees

€ 3.5bn
2024 revenue

+ 1,700
Active patents

€ 83m
Investment in R&D and Technical Marketing

Refractories:
the building blocks of modern life

1 tonne of STEEL
demands ~10-15 kg
of refractories

1 tonne of CEMENT
demands ~1 kg
of refractories

1 tonne of GLASS
demands ~4 kg
of refractories

1 tonne of ALUMINIUM
demands ~6 kg
of refractories

1 tonne of COPPER
demands ~3 kg
of refractories

Concrete
1,500°C

Copper
1,350°C

Steel
1,760°C

Glass
1,650°C

Aluminium
1,250°C

A complex range of tailored refractory products and solutions

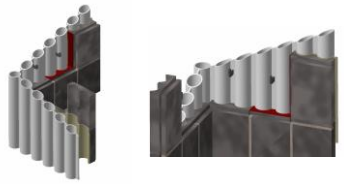
Bricks

1 Permanent lining

2 Non-basic, ex. Alumina

3 Basic, ex. Mag-Carbon

Tile system - Didotherm Fix



Monolothics & pre cast

4 Mixes

5 Pre Castables

Digital Solutions

APO

Functional products

6 Slide Gates

7 Nozzles

8 Purge Plugs

9 ISO

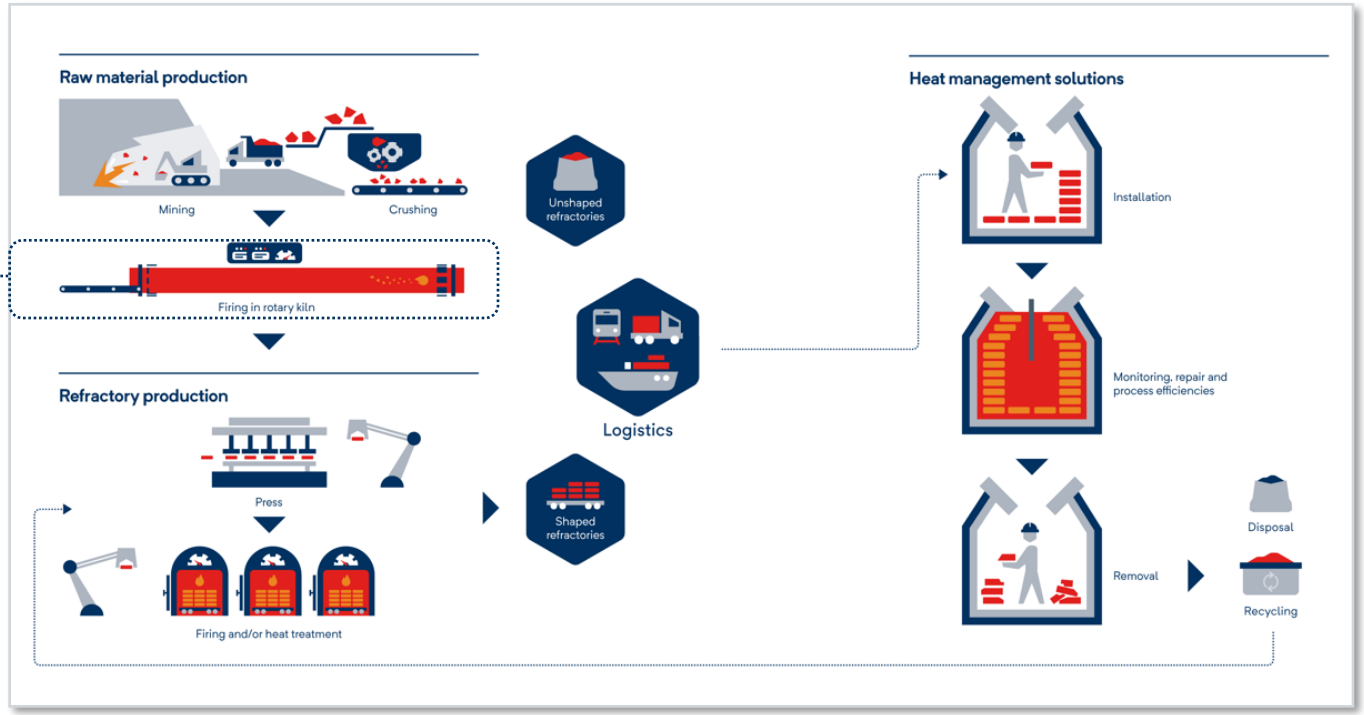
Systems & Machinery

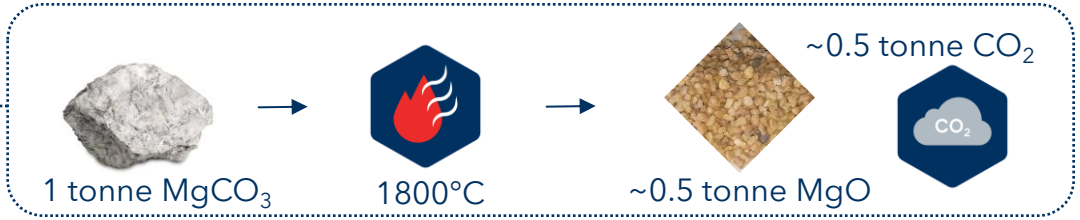
The industries we serve

- Cement & Lime
- Environmental
- Non-Ferrous Metals (Cu, Ni, Pb, Zn, PGM, ...)
- Chemical & Petrochemical
- Iron & Steel
- Waste to Energy
- Glass
- Chimney

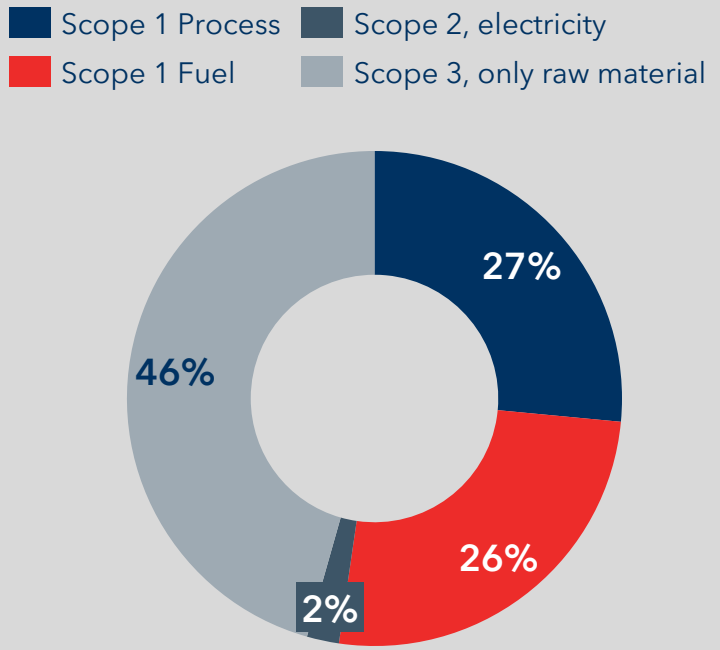
We operate in a “hard-to-abate” industry with majority of emissions as scope 1 process/fuel

Raw material and refractory production process overview





Carbon emission per Scope 1-3

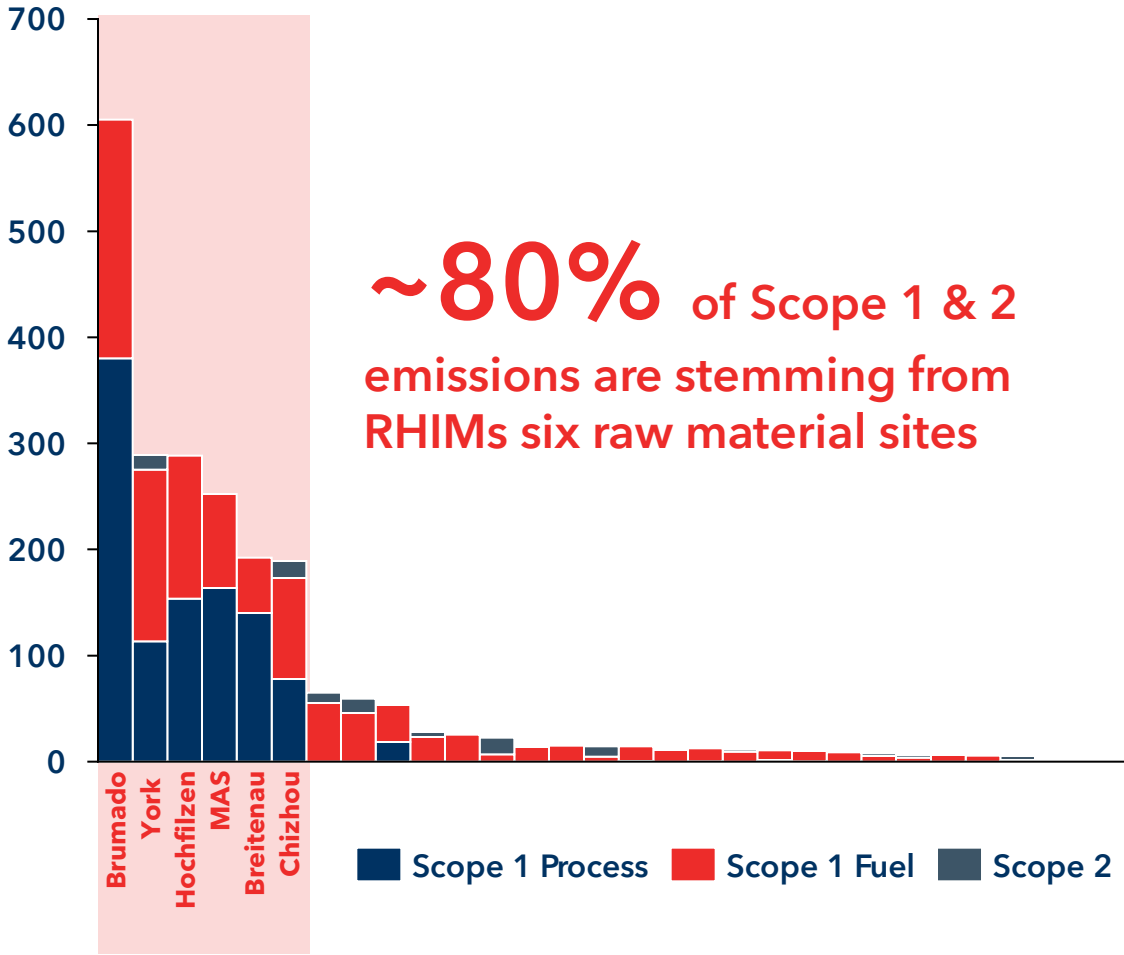


TOTAL: ~5mt CO_2 emissions/year (2023)

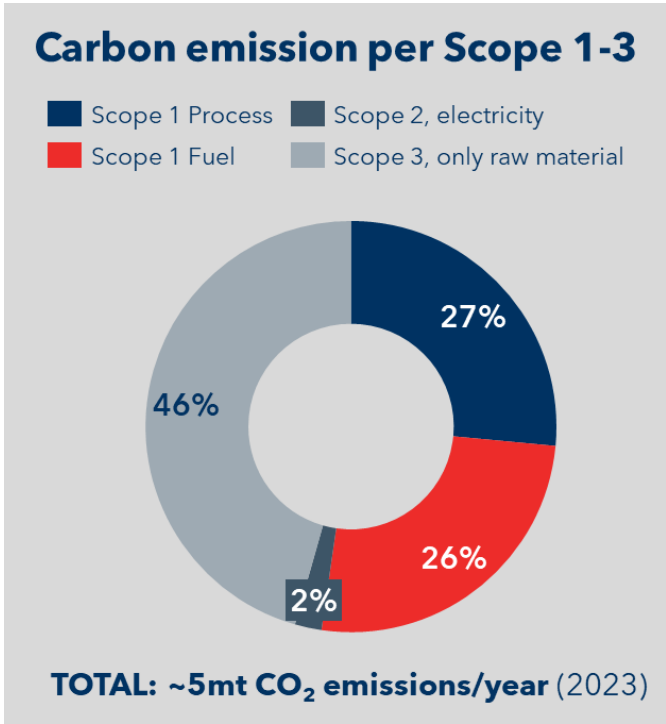
Details on Scope 1&2 next

6 raw material sites as decarbonization challenge as CO_2 is burnt out of the magnesite or dolomite

RHIM CO_2 emissions by type and plant, 2023 in kt



~80% of Scope 1 & 2 emissions are stemming from RHIMs six raw material sites



Decarbonization
Pathway

Our commitments:

- **Leading the industry** by decarbonizing our operations as fast as sustainably possible
- **Invest in the development of new technologies** to reduce CO_2 emissions, e.g., MCi Carbon process for remineralization
- **Continuously improve our recycling rate** with strategic investments, e.g., through M&A
- **Offer our customers enabling technologies** with full carbon footprint transparency
- **Work with industry partners sector** to develop new renewable energy solutions and hydrogen energy networks

RHIM is committed to sustainability

Targets 2030[1)]

CO_2 emissions[2)]

Reduce by 10% per tonne

Recycling

Increase use of secondary raw materials to 15%

Energy

Reduce energy consumption by 1% each year

Safety

Total recordable injuries frequency rate TRIFR < 1.2 per 200,000 hours worked

Sustainable Supply Chain

Enhancing supplier sustainability management: 80% Spend Coverage

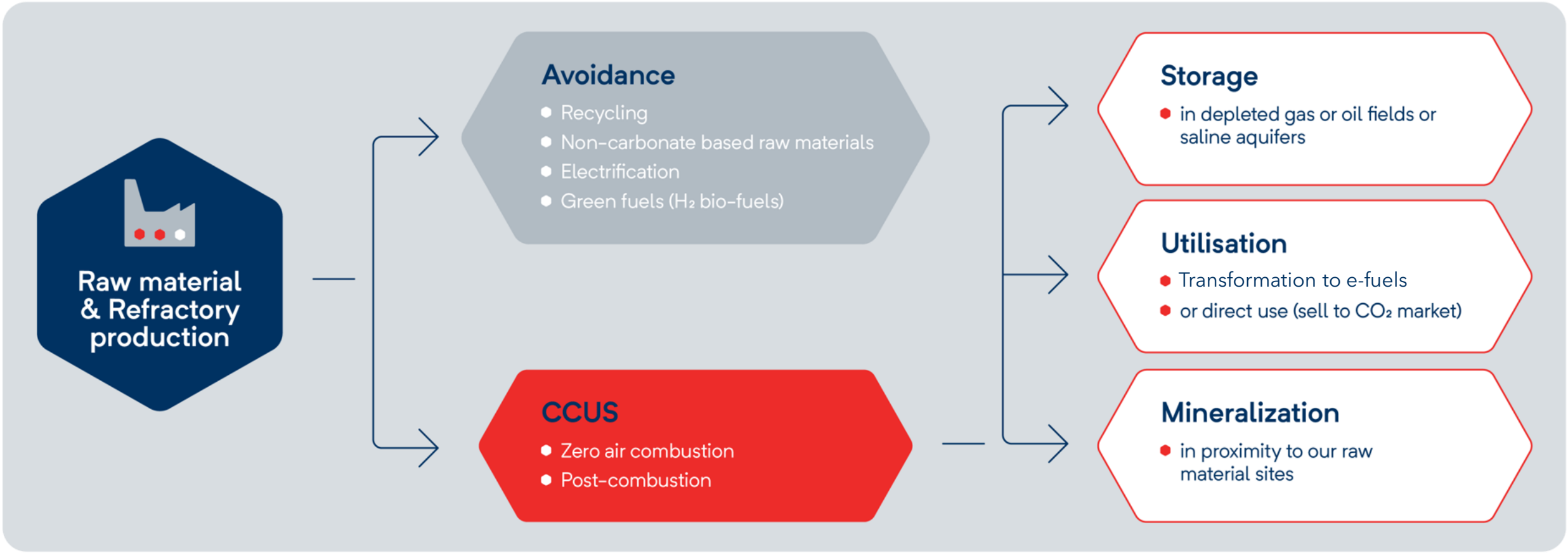
For external sustainability validation, ***RHI Magnesita engages with each of the major independent ESG rating agencies***

Note:
1) The targets are set against a 2024 baseline
2) CO_2 includes Scope 1, Scope 2 and Scope 3 emissions from raw material

RHIM Decarb Options

Infrastructure is KEY

The applied technological options will depend on the specific site parameters



Options for Decarbonization

RHIM's Activities in CCUS

CCS

Bilateral cooperation Austria – China
Funded project **AbateC**

- CCS applicability in the Anhui Province of China
- Geological pre-screening and detailed scenario development
- Numerical simulation and experimental validation of CCS scenario for Chizhou plant

CCU (Mineralization)

Australia-Austria – Industrial Decarbonisation
Funded project **CCUpScale**

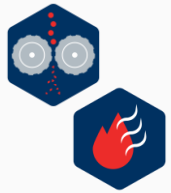
- Scalable industrial integration of MCi's technology
- Optimized energy management
- Development of carbon embodied materials

General Process Overview
Mineralization of CO_2

Mining → Rotary Kiln → Raw Mat. Log. → Refractory Prod.

Mineral Carbonation

Serpentinite



Pre-treatment

CO_2

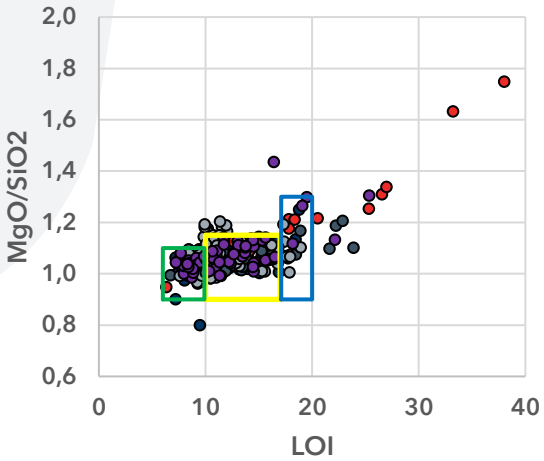
Reactor

Siliceous Product

Precipitated Magnesium Carbonate

Feedstock for Mineral Carbonation

Serpentinite



- Serpentinite abundant worldwide and **available in large quantities**
- Current serpentinite applications (e.g. road gravel) do not require chemical and mineralogical characterization
- Serpentinite **feedstock quality** is pivotal for the entire process chain, e.g. quantity transported, throughput, abatement potential, product specifications
- Open pit mines with **direct rail access**

CCU Goal: Carbon neutral by 2050 &

Reach new industry standard

Output products with a low carbon footprint:

Silica-rich product

$MgCO_3$ product

Multiple applications:

- Building materials (cement, concrete)
- Refractory Ceramics
- Plaster- and cardboards
- Fertilizers
- Paper production

CCUS

Technical highlights of the MCi Process:

CO_2 capture directly from flue gas without the need for purification

Process requires no additional chemicals

Energy-efficient reactor conditions at low temperatures & pressures

New business opportunity

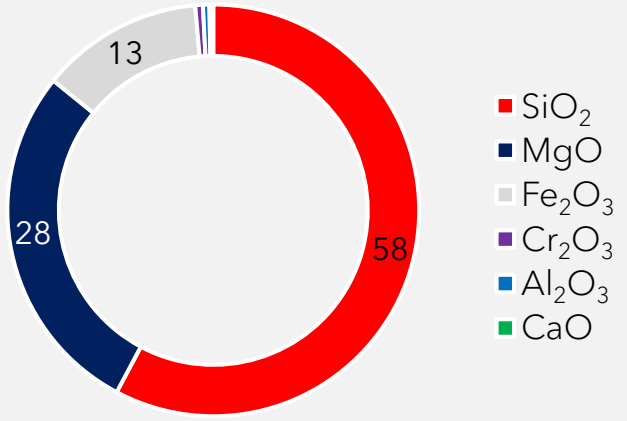
Siliceous product
Technical specifications*

Appearance: Brown fine powder

Amorphous content >50 wt.%

Specific surface area (BET) >190 m^2/g

D_{10}	2 µm
D_{50}	6 µm
D_{90}	25 µm



Pozzolanic Reactivity	passed according to EN 196-5, 8 days
Moisture Content	available as wet filter cake or dried powder
Product carbon footprint	3-20 kg CO_2/t (unverified)

RHI MAGNESITA x MGI

*typical values for guidance; material under development and specifications may change

Precipitated Magnesium Carbonate

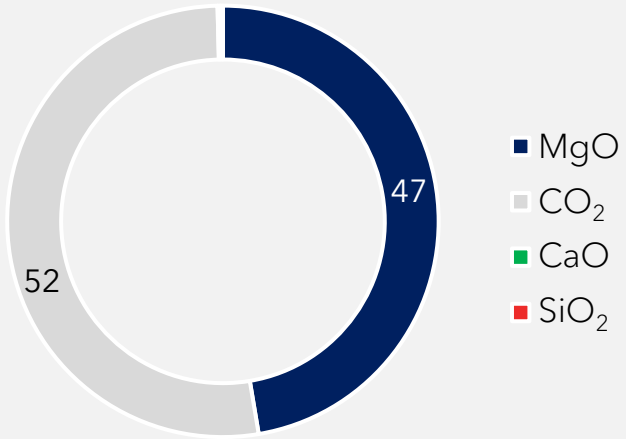
Technical specifications*

Appearance: White fine powder

Whiteness (L*, CIELAB) >98

High purity $MgCO_3$

D_{10}	6 µm
D_{50}	12 µm
D_{90}	18 µm



Mineralogy	Nesquehonite $MgCO_3 \cdot 3H_2O$ Hydromagnesite $Mg_5(CO_3)_4(OH)_2 \cdot 4H_2O$ Magnesite $MgCO_3$
Moisture Content	available as wet filter cake or dried powder
Product carbon footprint	4-34 kg CO_2/t (unverified)

*typical values for guidance; material under development and specifications may change

RHI MAGNESITA x MCI

Key developments

First commercial pilot plant in Europe

Pilot Plant
2016 – now

University of Newcastle

~10-20 tonnes of CO_2/year

Validate global customers through pilot studies & materials development

„MYRTLE“
Commissioning

Orica's Kooragang Island manufacturing plant, Australia

~1.000 tonnes of CO_2/year

Test customer scenarios & trial output materials

„KOALA“
First Commercial Pilot Plant
2028+

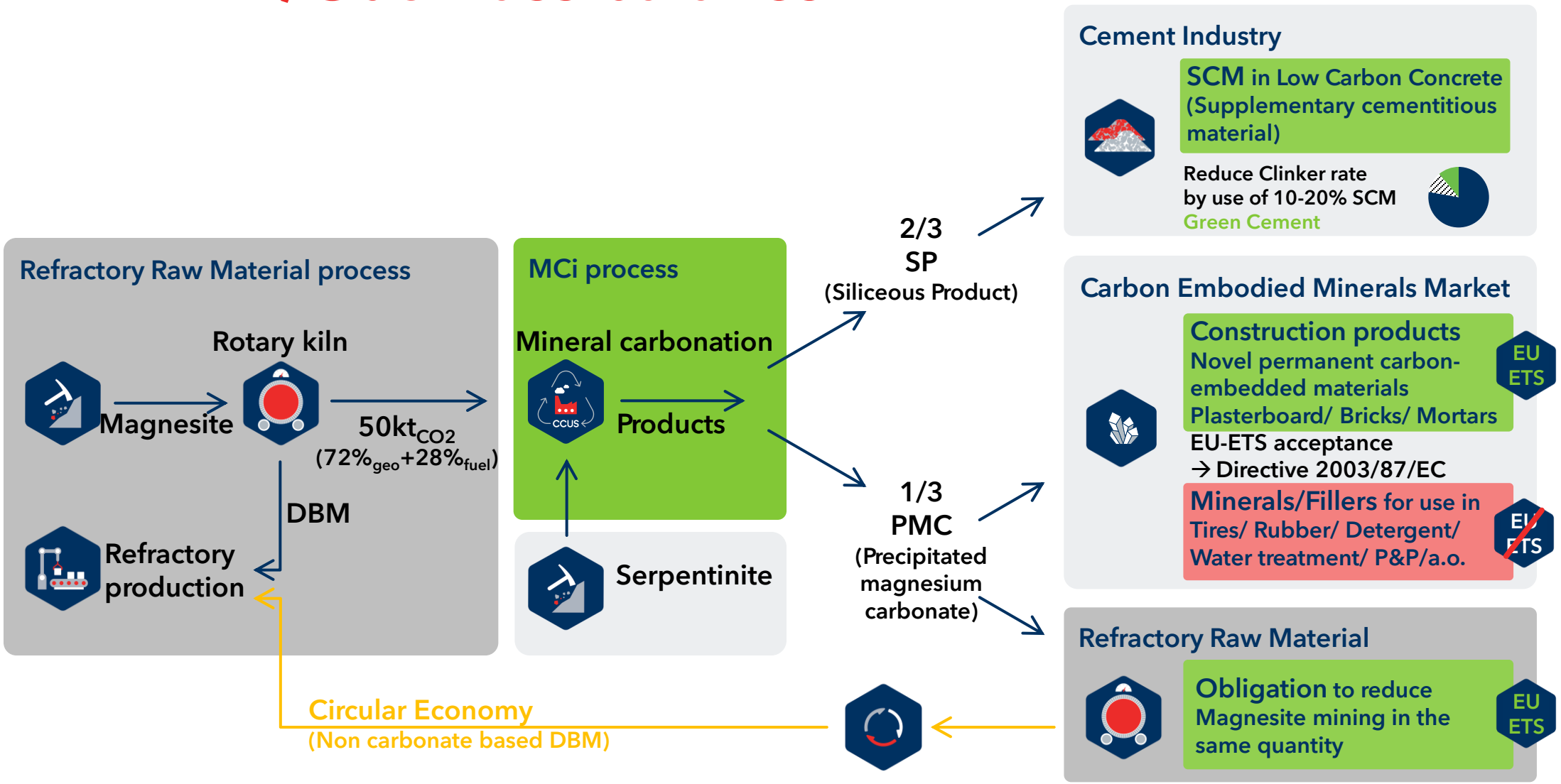
RHI Magnesita, Austria, Hochfilzen

~ 50.000 tonnes of CO_2/year

Scalable industrial integration of MCi´s technology

Mineral Carbonation

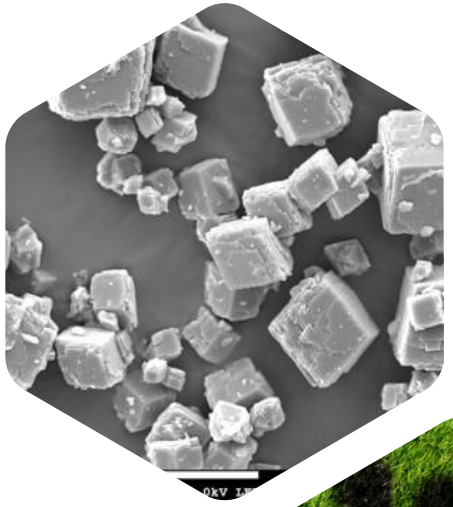
In/Out mass balance

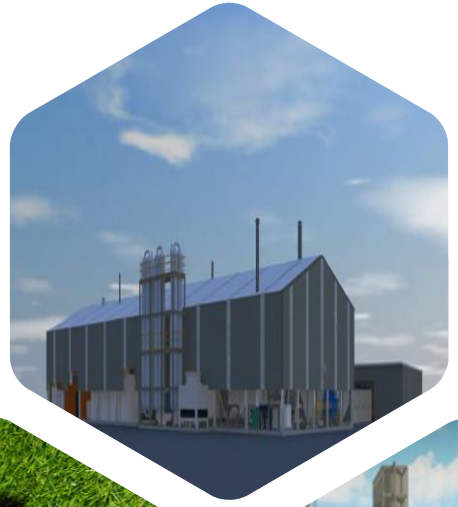


Simplified: e.g. water contents not considered

CO_2 turned into valuable materials: Towards new industry applications

- New fine-grained low-carbon products
- New material applications in various industries
- Carbon footprint reduction
- Establishment of new cooperations





For further Facts & Figures

Check out our Hubs

CCU

Magnesite Matters

CCU
https://a-rhi-magnesita.vev.site/ccu-hub

Magnesite Matters
https://a-rhi-magnesita.vev.site/magnesia-information-hub

RHI MAGNESITA

Thank you for your attention

Get in Touch

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