Leading the Green Change in Refractories

RHI MAGNESITA

RHI Magnesita & MIRECO

…Green steel needs CERO WASTE based and CO_2 engineered refractory concepts

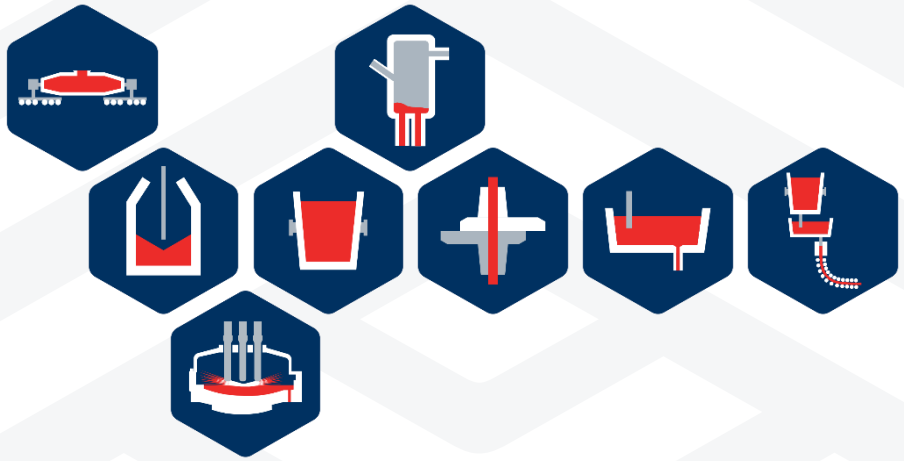
MIRECO
The key force in closing the cycle

Nenad TANASIC – CEO, MIRECO

Karl-Michael Zettl – VP Marketing & Solutions EUR, CIS & Türkiye, RHI Magnesita

Partnership beyond Refractories

Customers Value Chain



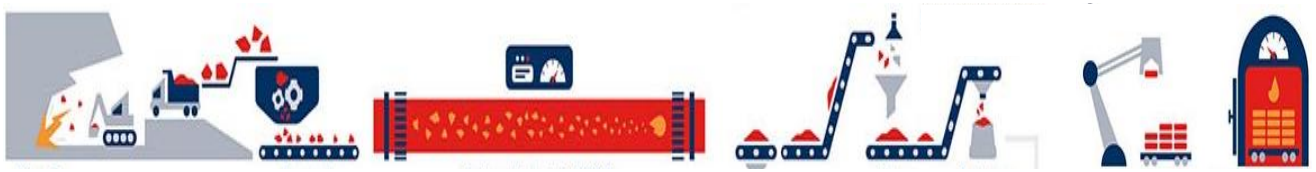
RHIM Offering with MIRECO

- Refractory Material
- Installation Services Maintenance
- Automation Robotics
- Connectivity Sensors
- Process Consulting
- Supervision
- Stock Management
- On-Site Logistics
- Mutual Development Agreements with clear Targets
- **Recycling Concepts**
  Carbon Footprint Reduction

CERO – WASTE
CO_2 engineered refractories
Recycling concepts for used refractory products, Circularity enabling new products with lower carbon footprint.

The challenge of refractories key raw materials

The impact of circular raw material



Fused Magnesia

~2,5-4,5 t_{CO2}/t

Dead burned magnesia

1,2-2,0 t_{CO2}/t

Magnesia raw material

$$MgCO_3 \rightarrow MgO + CO_2 \uparrow$$

Production of refractories key raw materials emit CO2 intrinsically, and it is our priority to reduce RHIM`s carbon footprint

consulting

CONTINUOUS
ECONOMIC
RECYCLING
OPTIMIZATION

conception

MgO-C CRM

<0,1 t_{CO2}/t

MA-Spinel CRM

<0,1 t_{CO2}/t

Circular mg raw material

~~$MgCO_3 \rightarrow MgO + CO_2 \uparrow$~~

Adding circular raw material (CRM) is the only way…

…to reduce the product carbon footprint (PCF) significantly today!

European's leading refractory RECYCLING platform

100+ years of INNOVATION

MIRECO is the result

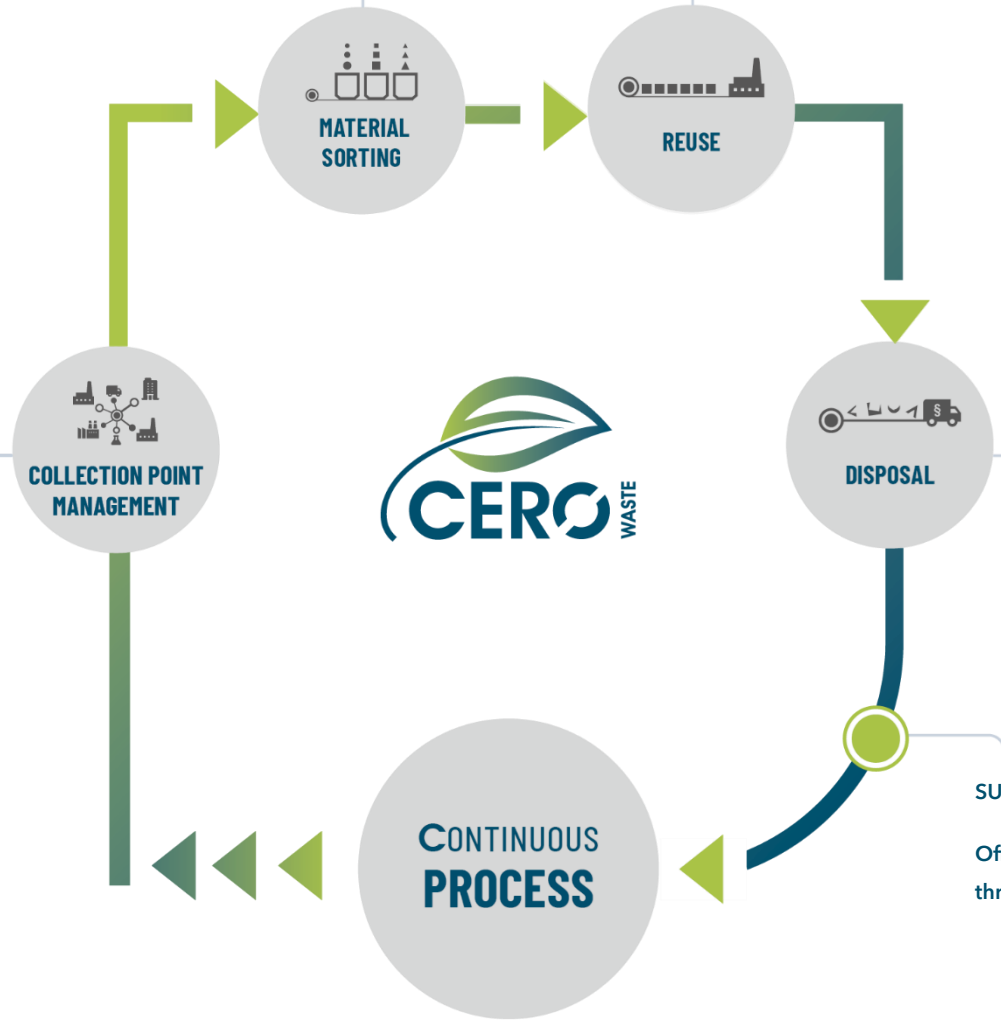
RHI MAGNESITA + Horn & Co. Group joining forces.

With our combined expertise, leadership and over 100 years of refractory history, we are able to **tackle major challenges** of our society and industry such as climate change and resource conservation.
Together with and **for our customers** we design **circular solutions** that provide high quality and performance, while **saving CO_2 emissions.**

CERO-Waste Concept as an answer to
GREEN STEEL, Circularity and Carbon Footprint

TEST SORTING OF ALL VESSELS IDENTIFIED IN ANALYSED PROCESS ABOVE

Calculation of all results according to CERO WASTE ABCD-calculation concept



DISCUSSING AND EVALUATING PRODUCTS/MATERIALS CONTAINING RECYCLING RAW MATERIALS

Creative and out of the box thinking for maximum recycling rate, minimum Carbofootprint and minimum landfill

ANALIZING ACTUAL PROCESS AND MATERIALFLOW OF REFRACTORIES ON-SITE

Identify all players

discover all steps of handling

interpretation of possible outcome

IDENTIFIYING MATERIALS TO BE LANDFILLED

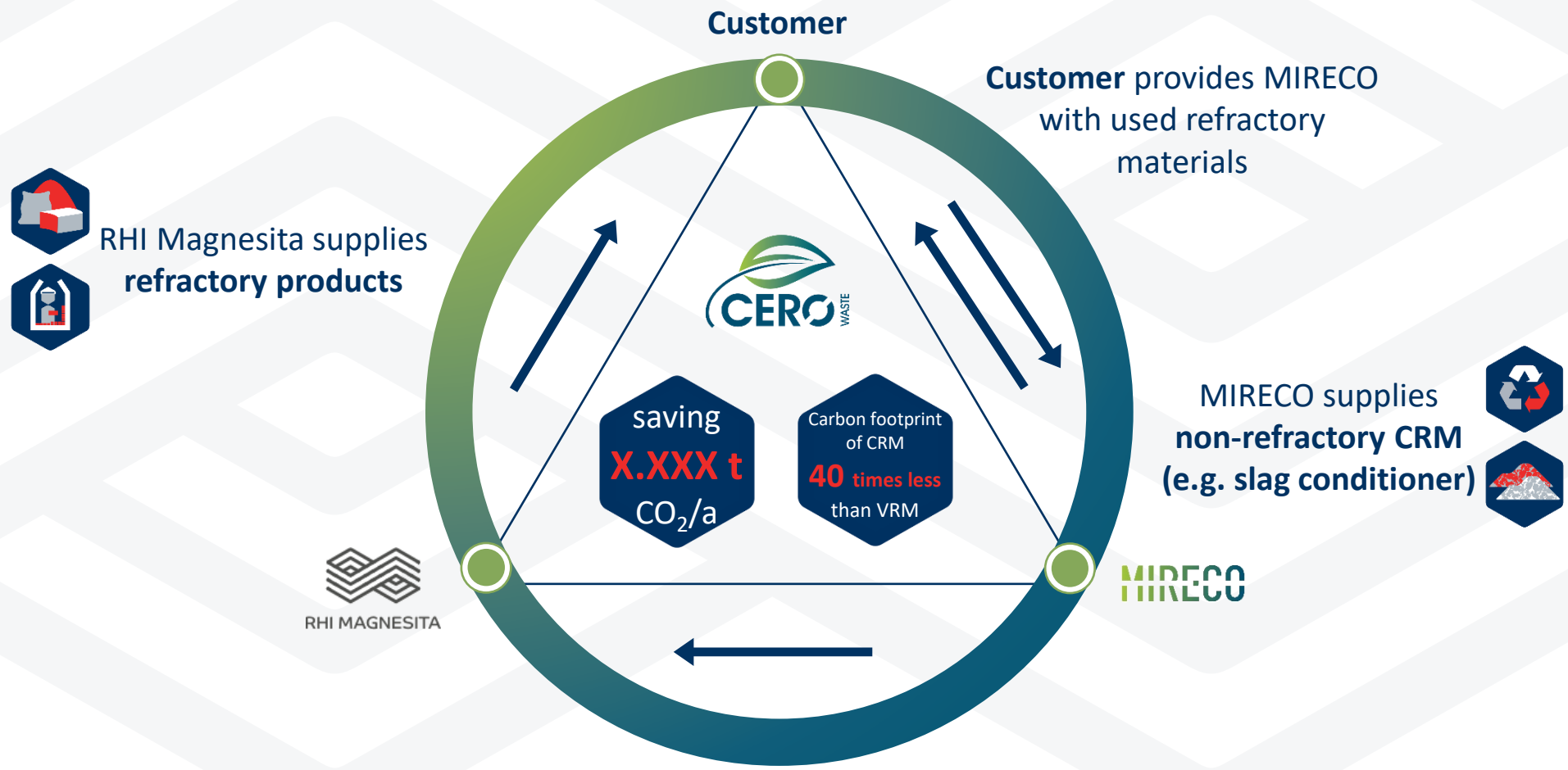
Analizing, monitoring, saving

SUSTAINABLE AND LONGTERM CONCEPT

Offering complete sustainable and longterm concept, adjusting material-flow through all stages at customer and from Horn (internal and external).

Circular Refractory Framework (CRF) - Triangle

Customer x RHIM x MIRECO



RHI MAGNESITA

Recovered refractory from waste to high value products

Want to know the CO_2 footprint of refractory?

Each of our products has its own carbon footprint...

Production

Electricity

Virgin Raw Material

Circular Raw Material

Technical Datasheet

General information	
Classification	Magnesia-carbon product type MC95/10 ISO 10081-3
Main raw material components	Fused magnesia, Graphite
Bonding type	Carbon bonded
Main Application(s)	Converter (BOF), Electric arc furnace
Additional information	tempered

Environmental indicators			
Product Carbon Footprint	2,987	[t CO2e/t prod.]	ISO 14067
The Carbon Footprint of the Product (CFP) has been calculated following the principles of ISO 14067.			

Chemical analysis				
MgO	Al_2O_3	Fe_2O_3	CaO	SiO_2
97,1%	0,3%	0,6%	1,3%	0,7%
Determination on fired substance (1025 °C / 1877 °F) acc. to ISO 12677				
C				
14,0%				

Physical properties				
Bulk Density		3,00	[g/cm³]	ISO 5017
Bulk Density red.atm.(1000 °C / 1832 °F)		2,94	[g/cm³]	ISO 5017
Apparent Porosity		4,0	[vol%]	ISO 5017
Apparent Porosity red.atm.(1000 °C / 1832 °F)		10,0	[vol%]	ISO 5017
Cold Crushing Strength		25,0	[N/mm²]	ISO 10059-1
Cold Crushing Strength red.atm. (1000 °C / 1832 °F)		25,0	[N/mm²]	ISO 10059-1
Thermal Expansion	800 °C / 1472 °F	0,60	[%]	EN 993-19
	1200 °C / 2192 °F	1,20	[%]	EN 993-19
	1600 °C / 2912 °F	1,70	[%]	EN 993-19
Thermal Conductivity (1000 °C / 1832 °F)		9,50	[W/mK]	EN 821-2

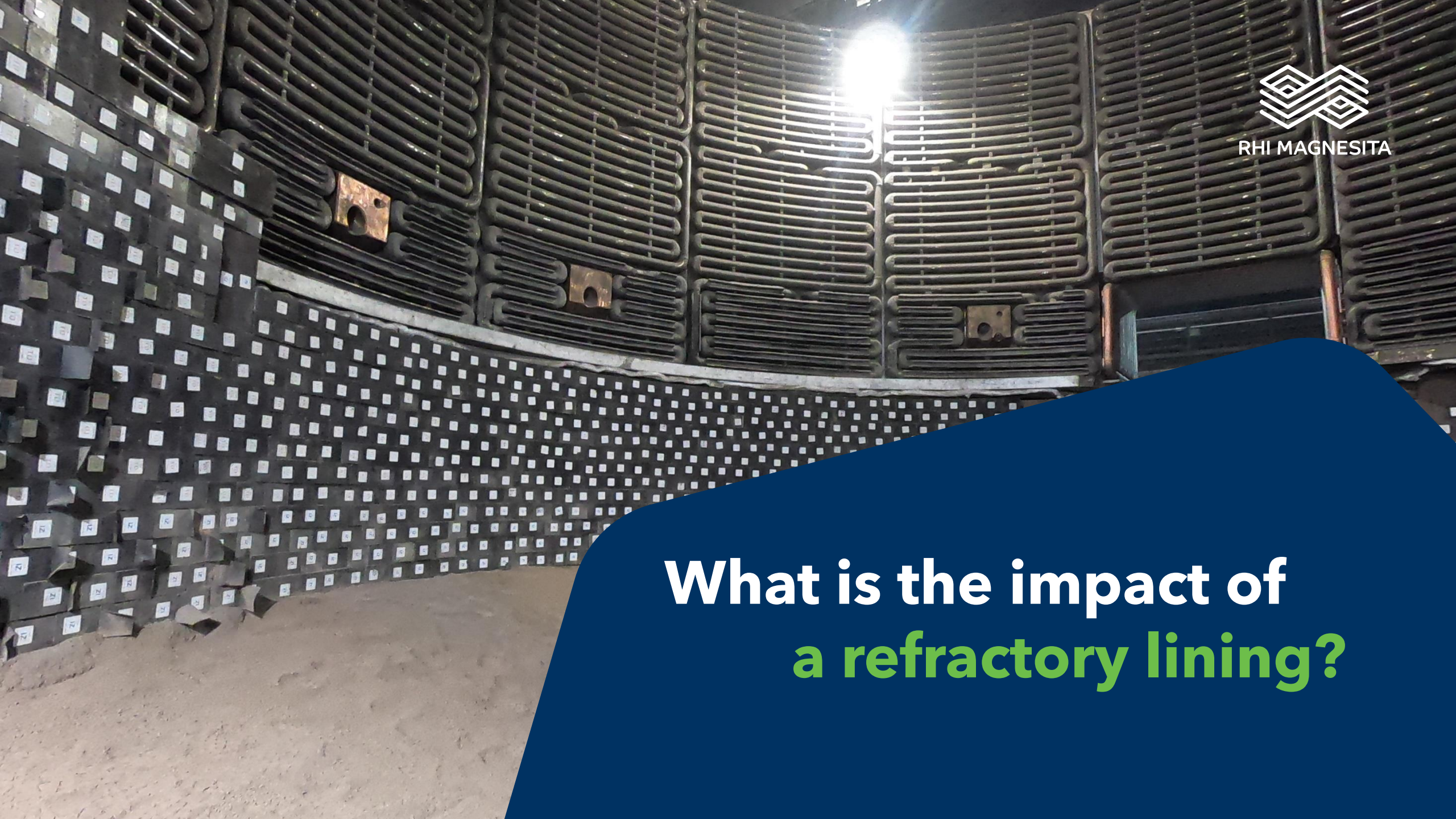
For the same product group, we can offer products with lower PCFs!

ANCARBON Type A (without CRM)

Environmental indicators			
Product Carbon Footprint	2,987	[t CO2e/t prod.]	ISO 14067
The Carbon Footprint of the Product (CFP) has been calculated following the principles of ISO 14067.			

ANCARBON Type B (with CRM)

Environmental indicators			
Product Carbon Footprint	1,842	[t CO2e/t prod.]	ISO 14067
The Carbon Footprint of the Product (CFP) has been calculated following the principles of ISO 14067.			



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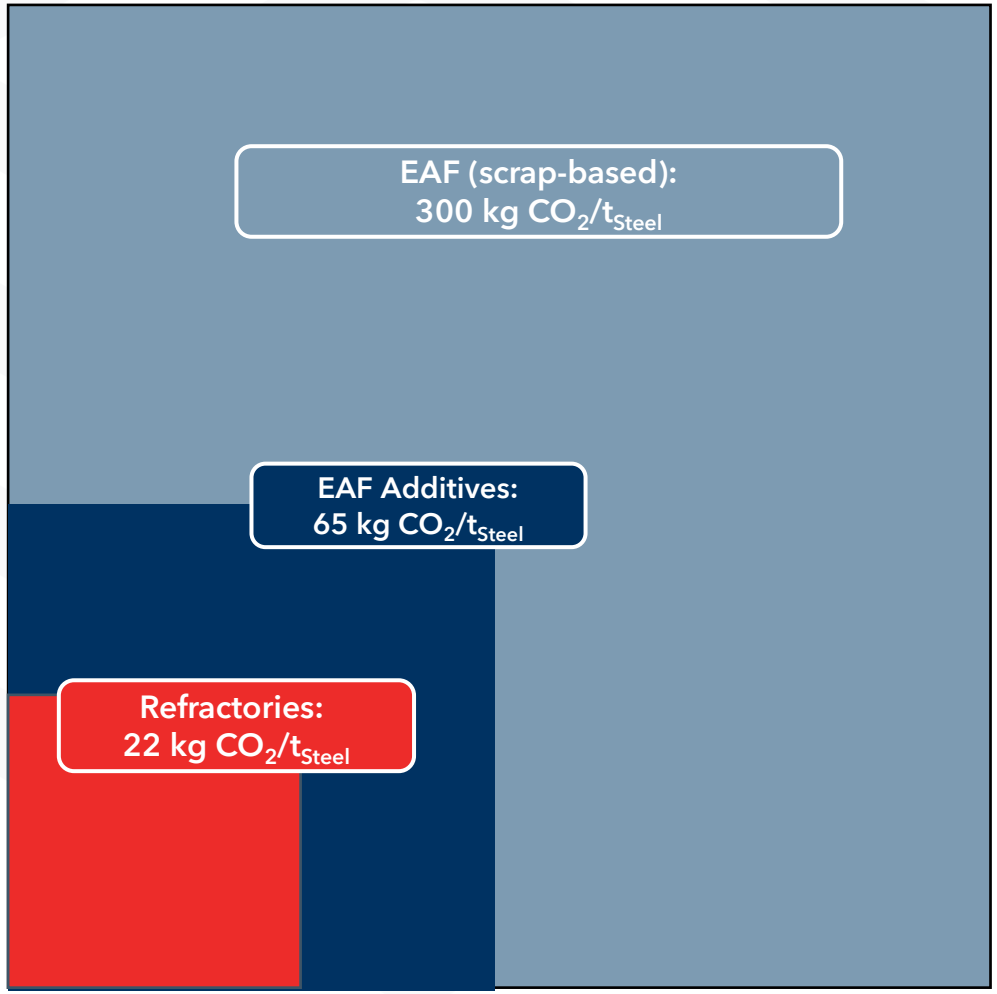
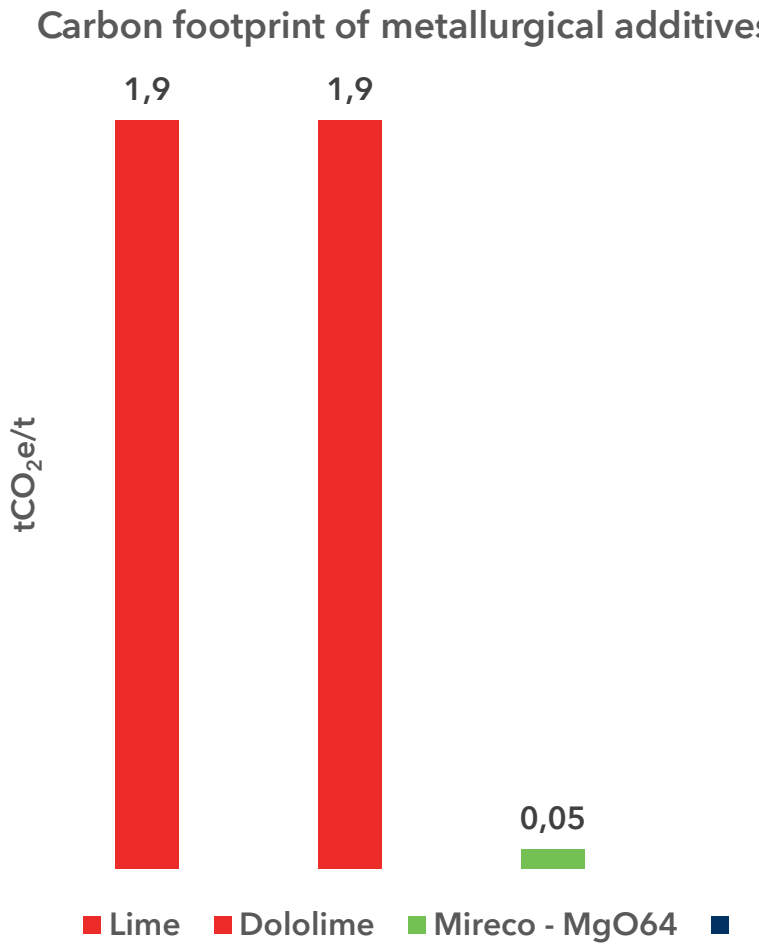
What is the impact of a refractory lining?

Refractories in the realm of challenges for steel makers

CO_2 emissions for steel making





Source: IEA, Iron and Steel Technology Roadmap – Analysis - IEA

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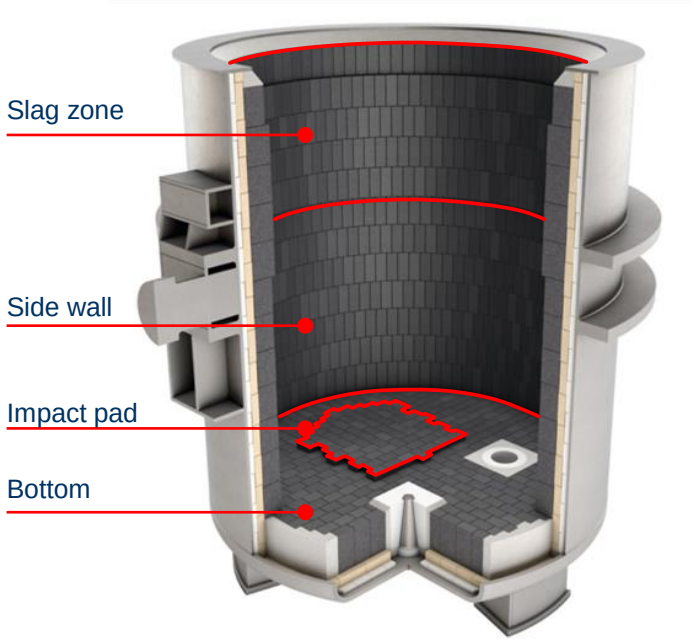
CO_2 engineered Refractories

our way to reduce CO_2

PCF - starting point for "CO_2 engineered Refractories"

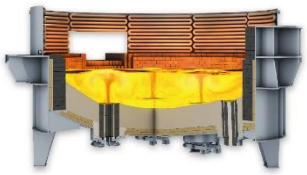
Example: PCF comparison of different Ladle lining concepts

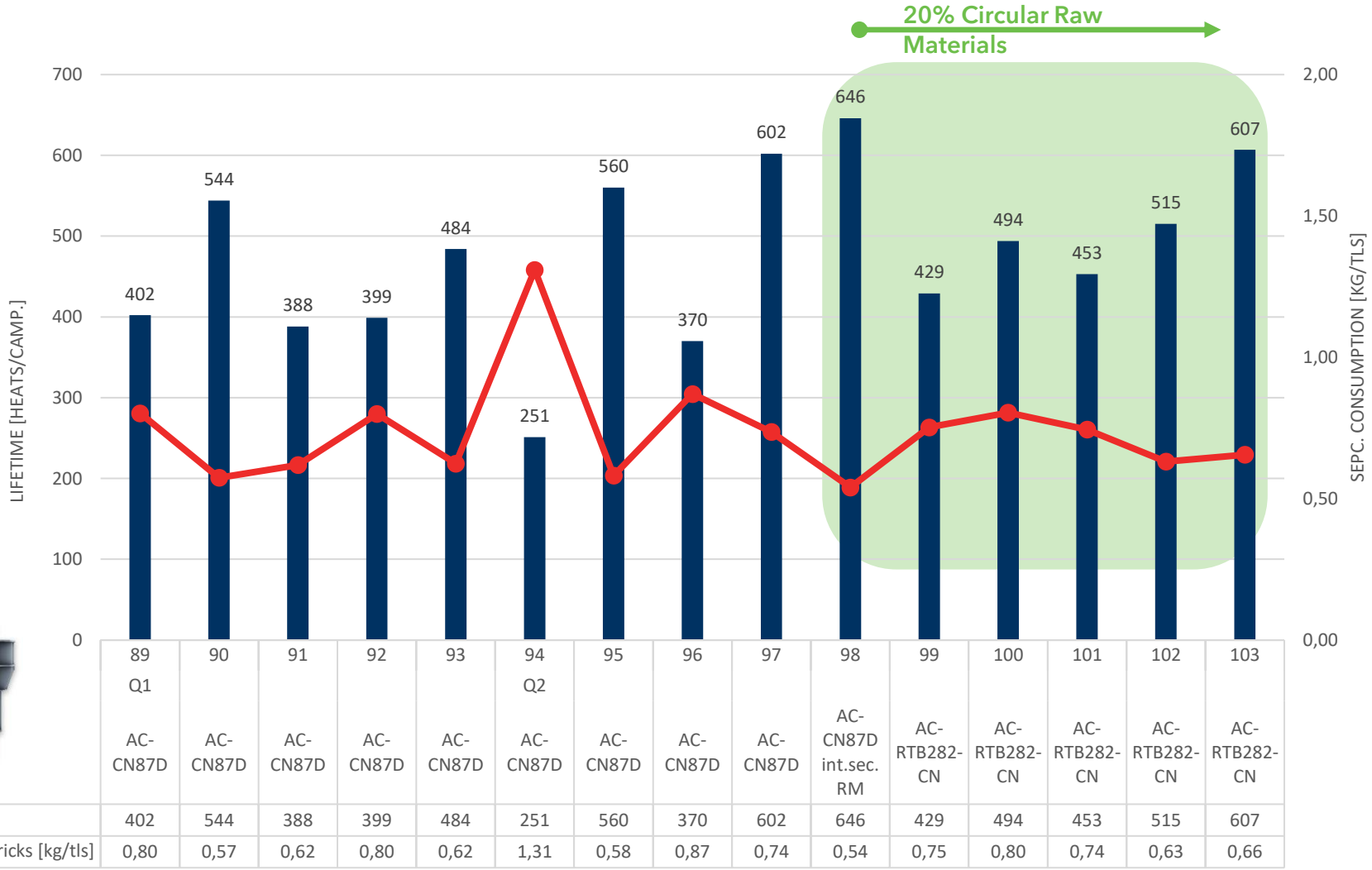


Standard PCF		CFP [t CO_2e/t prod]
Impact pad	ANKO AC90AZ	2,88
Bottom	ANCARBON C F5L08	3,24
Side wall	ANCARBON C F5L08	3,24
Slag zone	ANCARBON C F4L14	2,93
Repair slag zone	ANCARBON C F4L14	2,93
balanced PCF		
Impact pad	ANKO C87AZ	2,51
Bottom	ANCARBON C F7L08-EU	2,20
Side wall	ANCARBON C F6L08-EU	2,20
Slag zone	ANCARBON C *	2,80
Repair slag zone	ANCARBON C *	2,80
low PCF		
Impact pad	ANKO CB85AZ	1,84
Bottom	ANCARBON C S2L08	1,58
Side wall	ANCARBON C S2L08	1,58
Slag zone	ANCARBON C F7L14	2,05
Repair slag zone	ANCARBON C F7L14	2,05

The concepts is proven, and it works!

Case Study on an Electrical Arc Furnace

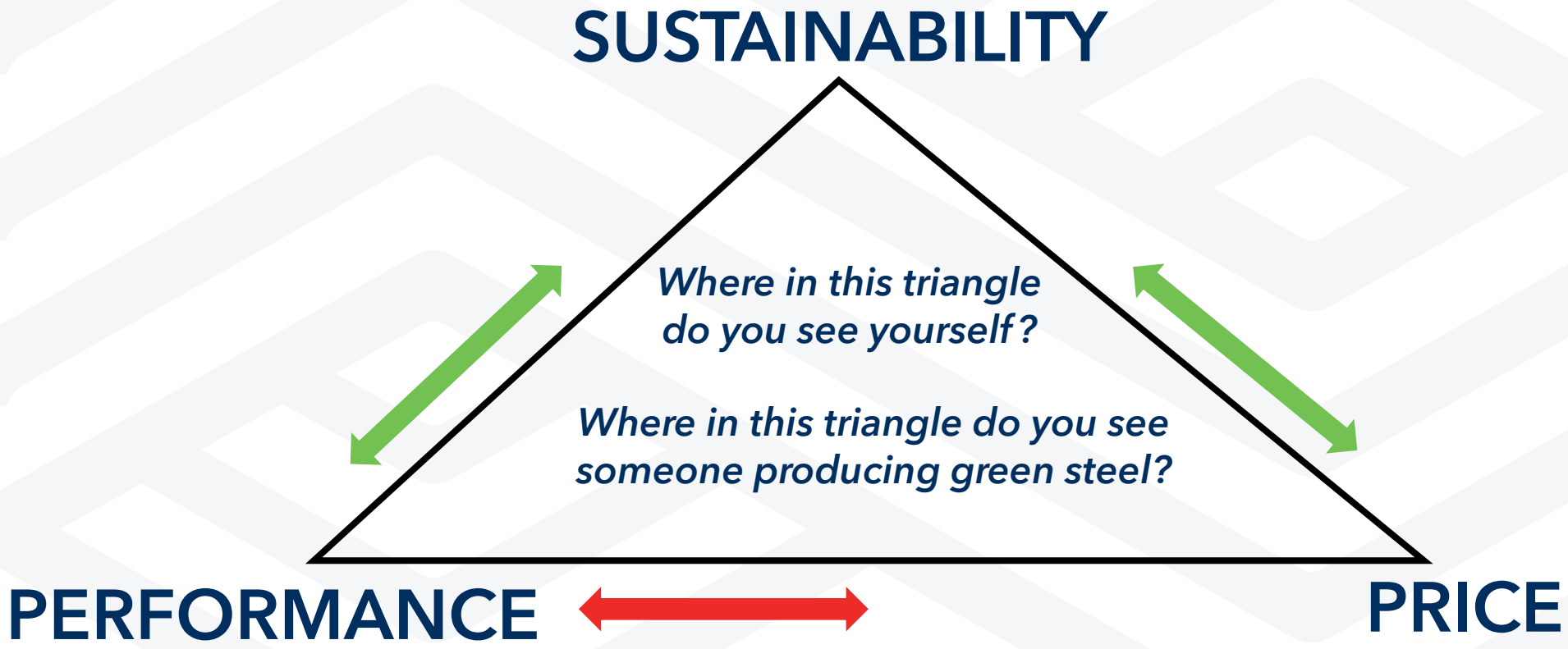




	89 Q1	90	91	92	93	94 Q2	95	96	97	98	99	100	101	102	103
	AC-CN87D	AC-CN87D	AC-CN87D	AC-CN87D	AC-CN87D	AC-CN87D	AC-CN87D	AC-CN87D	AC-CN87D	AC-CN87D int.sec. RM	AC-RTB282-CN	AC-RTB282-CN	AC-RTB282-CN	AC-RTB282-CN	AC-RTB282-CN
Lifetime [heats/camp.]	402	544	388	399	484	251	560	370	602	646	429	494	453	515	607
Specific consumption bricks [kg/tls]	0,80	0,57	0,62	0,80	0,62	1,31	0,58	0,87	0,74	0,54	0,75	0,80	0,74	0,63	0,66

New dimension required!

Negotiations to sell/buy a product



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Thank you for your Interest & Participation

MIRECO
The key force in closing the cycle

We are thankful for your feedback!

Karl-Michael Zettl

RHI Magnesita
Kranichberggasse 6
1120 Vienna Austria

Karl-Michael.Zettl@rhimagnesita.com

Nenad Tanasic

Horn & Co. RHIM Minerals Recovery GmbH
Herrenfeldstraße 12
57076 Siegen-Weidenau, Germany

Nenad.Tanasic@Mireco.com