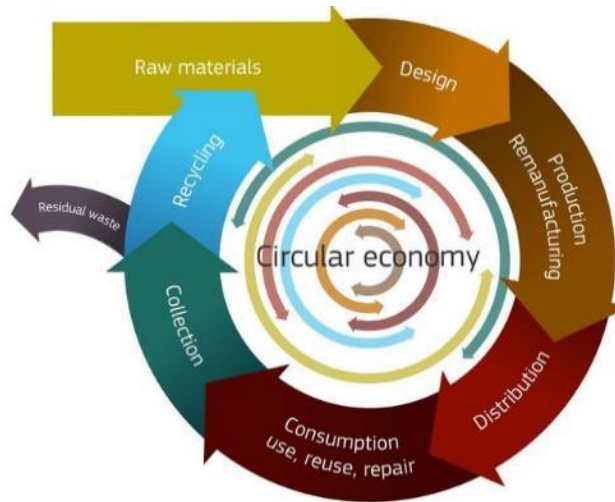


SUMMARY SLIDE DECK

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Hilton Imperial Dubrovnik, 28-30 March 2023

Secondary raw material sources, supply, processing, and markets



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Salt Partners Ltd
SECOPTA Analytics GmbH
Sojitz Corporation
Steuler Linings
Titan Salt
Vesuvius Group Plc
Vesuvius Poland
Voestalpine Rohstoffbeschaffungs GmbH

Quite simply this conference was just superb, a huge congratulations to IMFORMED.

Emmanuel Laporte, Sales & Marketing Manager, Cofermin Rohstoffe GmbH & Co. KG, Germany

Exceptional event organisation in the fantastic city of Dubrovnik. The Forum provided a lot of food for thought on the development of mineral recycling

Nenad Tenasic, CEO, MIRECO, Germany

Excellent programme, wide range of interesting topics. Great to have enough time for networking.

Jan Lampke, Expert for Pelletizing, Haver Engineering, Germany

Great to know other industries' viewpoint for recycling, beautiful place and hotel.

Serina Koyama, Sales Manager, Sojitz Corp., Japan

Thank you very much. I got to know a new world, and I was happy to know new people. I will definitely attend the next Forum.

Yongdon Joo, CEO, Korea Material Co. Ltd, South Korea

Thanks again for the wonderful meeting in Dubrovnik. I'm really looking forward to 2024.

Dr. Thomas Schemmel, Head of R&D, Refratechnik Steel GmbH, Germany

Thanks once more for the excellent and smooth organisation of the event.

Dr Aurela Shtiza, Director Industrial Affairs & Raw Materials, IMA-Europe, Belgium

Very good programme, interesting topics, very good organisation.

Tomasz Bilinski, International Product Manager, Vesuvius, Poland

PROGRAMME

WEDNESDAY 29 MARCH

08:00 Registration

INTRODUCTION & OVERVIEWS

09:00 **Opening Remarks & Introduction**

Ismene Clarke, Director, & Mike O'Driscoll, Director, INFORMED, UK

09:30 **How is the minerals sector balancing Climate, Circularity, Criticality and Competitive business models in time of crisis?**

Dr. Aurela Shtiza, Director Industrial Affairs & Raw Materials, IMA-Europe, Belgium

10:00 COFFEE

INITIATIVES: UK | FINLAND

11:00 **UK industrial mineral recycling: status and objectives**

Colum McCague, Technical Manager, Mineral Products Association, UK

11:30 **Combining science and business in efficient use of circular materials**

Janne Rauramo, Exec. VP Strategic Partnerships & Jenni Kiventerä, R&D Director, Betolar Plc, Finland

12:00 LUNCH SPONSORED BY



PROGRAMME

WEDNESDAY 29 MARCH

LI BATTERIES | SALT | LIBS | AMMONIUM SULPHATE

- 14:00 **Closing the loop on the lithium-ion battery supply chain**
Daisy Jennings-Gray, Snr. Price Analyst Benchmark Mineral Intelligence, UK
- 14:30 **Salt recycling: When does it make sense?**
Vladimir Sedivy, President, Salt Partners Ltd, Switzerland

15:00 COFFEE

- 15:30 **LIBS-based analytical techniques in mineral recycling**
Dr. Lucas Zimmermann, Head of Project Management,
MIRECO, Germany
- 16:00 **Recycling ammonium sulphates**
Robert van Voorst, Managing Director, Titan Salt, Netherlands

16:30 CLOSE OF DAY 1 & DRINKS RECEPTION



**subject to change*

PROGRAMME

THURSDAY 30 MARCH

REFRACTORY RECYCLING 1

- 09:00 **MIRECO: the key force in closing the cycle – circular raw materials developed from used refractories**
Patrick Stahl, Director Sales & Product/Material Management, MIRECO & Barbara Zocratto, Head of Recycling Strategy and Global Management, RHI Magnesita
- 09:30 **Refractory recycling trends in the USA**
Rebecca Mohr, Strategic Marketing Manager-Recycled Materials, & Dave Hartwich, Director of Fired Shape Technology, HarbisonWalker International, USA
- 10:00 **Refractory recycling developments in South Korea**
Yongdon Joo, CEO, Korea Material Co. Ltd, South Korea

10:30 COFFEE

REFRACTORY RECYCLING 2

- 11:30 **Recycling in refractories: innovative raw material solutions from waste & beyond**
Vatsal Dhandharia, Proprietor, Global Recycling, India
- 12:00 **Refractory Sorting Using Revolutionising Classification Equipment – ReSoURCE**
Alexander Leitner, Recycling Technology & Innovation Specialist, RHI Magnesita & ReSoURCE Co-ordinator, Austria
- 12:30 **CESAREF solutions for EU Green Deal steelmaking challenges: recycling, reuse, hydrogen, & artificial intelligence**
Andrea Salerno, Researcher, Vesuvius Group PLC, Italy

13:00 LUNCH & CLOSE OF CONFERENCE

New era of mineral exploration, sourcing, development... ...& **RECYCLING!**

“Going where the minerals are greener”

- Inevitable development spotlighted & advanced by pandemic/Ukraine War
 - = Mineral sourcing strategy rethink
 - = Accelerated mineral recycling



“We are experiencing a global race for the supply and recycling of critical raw materials.”

Thierry Breton, Commissioner for the Internal Market, EC, 22 September 2022



“The next decades will see the greatest industrial transformation of our times – maybe of any times.”

EC President Ursula von der Leyen at the World Economic Forum, Davos, 17 January 2023

New era of mineral exploration, sourcing, development... ...& *RECYCLING!*

“Going where the minerals are greener”

Tomorrow’s “mining” will in large part be efficient and economic utilisation of today’s industrial waste.

- But how to go about getting involved in this sector?
- Whether to vertically integrate? Invest for an in-house business/plant?
- How much and how far to invest?
- Partner with an independent recycler?
- Join forces with same-sector end-use players?
- And crucially, what impact will this have on customers and markets?

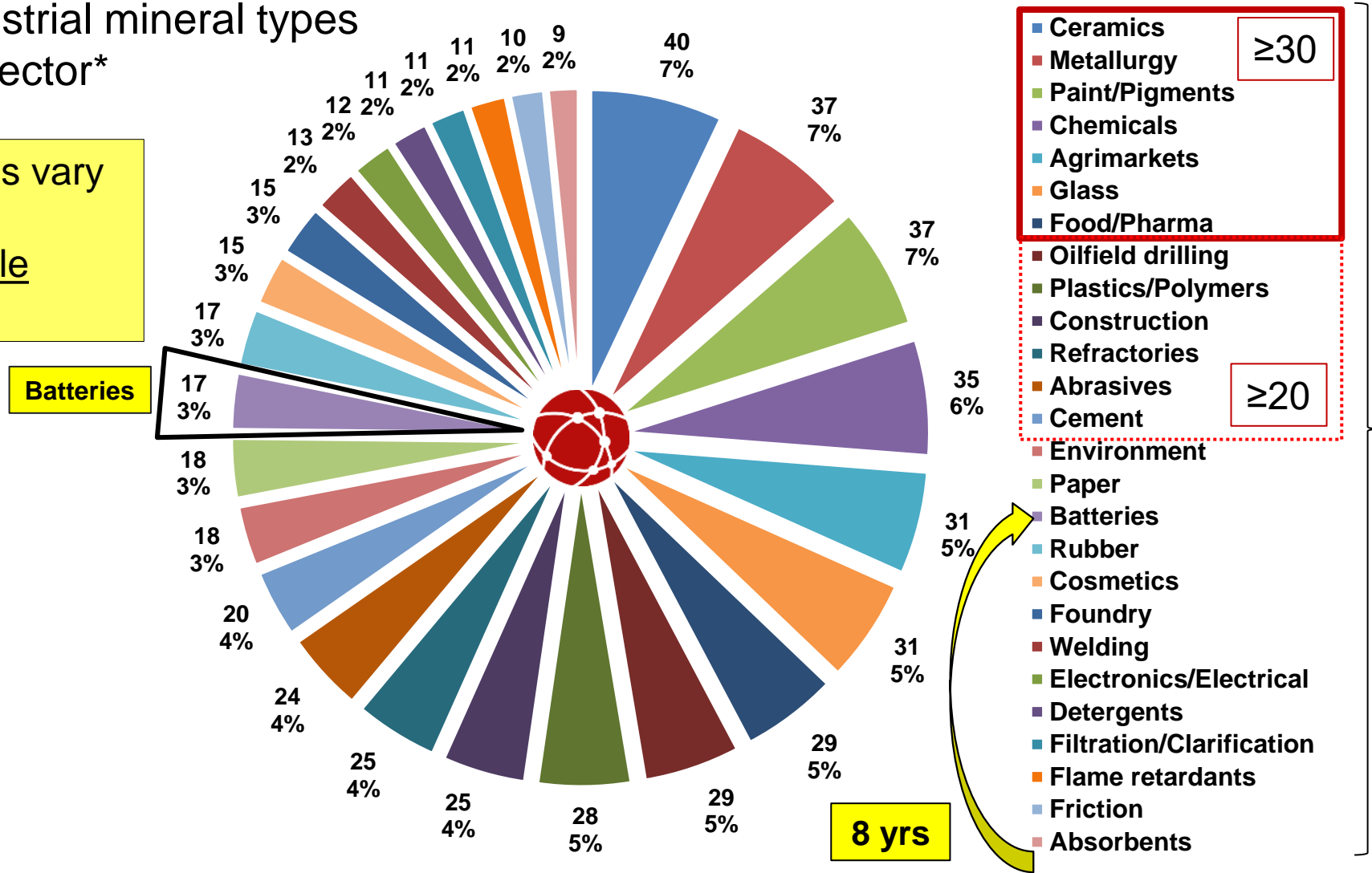
1. Industrial minerals: importance, “criticality”, “essentiality”

The industrial mineral/market “Kaleidoscope”!

Estimated total of industrial mineral types used in each market sector*

- Industrial mineral uses vary widely
- minerals serve multiple markets

* Pie chart data compiled from:
IMFORMED
Industrial Mineral Forums & Research
MINERAL MARKET MATRIX
Wall Chart available from IMFORMED



All market sectors targeting recycling

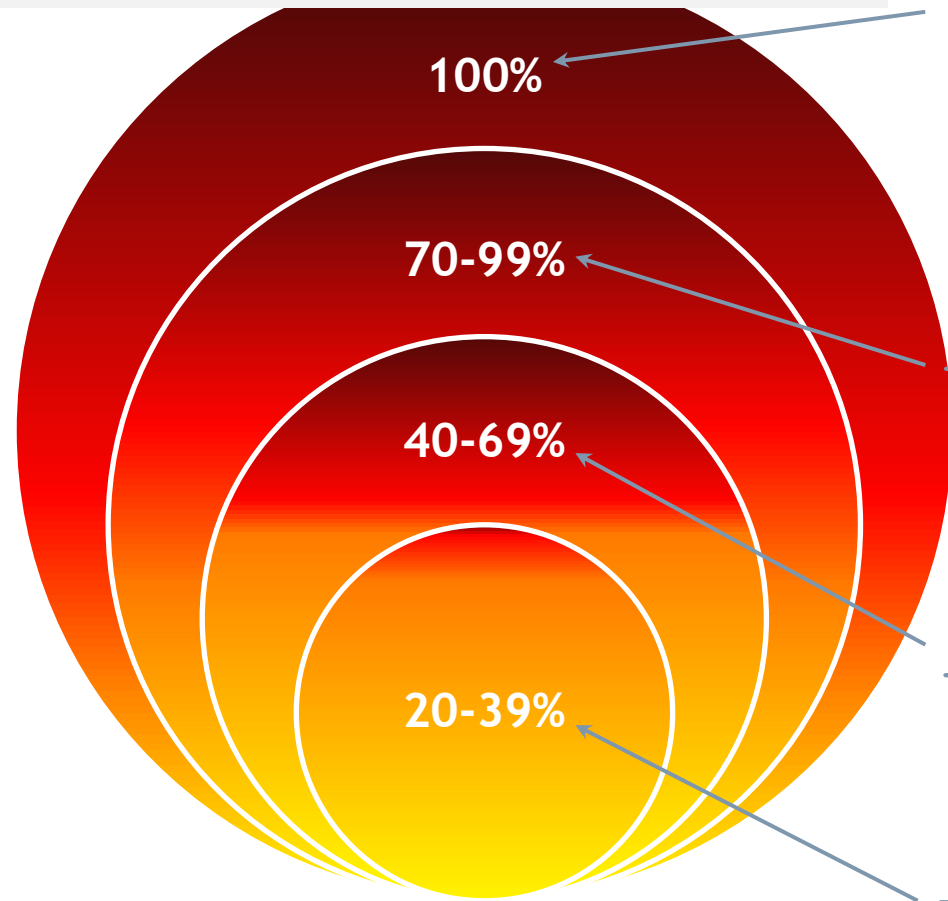
8 yrs



1. Industrial minerals’ “Criticality”: influencing factors

Source overreliance eg. US mineral import reliance

- in 2022 **24** industrial minerals @ ≥50% import dependency
- **9** @ 100% import dependency, of which **6** sourced from China
- **+8** sourced from China @ 50-91% import dependency (=14 total)



Asbestos		Brazil, Russia
Bauxite (non-met)		CHINA , Guyana, China
Fluorspar		Mexico, Vietnam, S. Africa, Canada
Graphite		CHINA , Mexico, Canada, Madagascar
Mica (sheet)		CHINA , Brazil, Belgium, Austria
Manganese		Gabon, S. Africa, Australia, Georgia
Scandium		Europe, CHINA , Japan, Russia
Strontium		Mexico, Germany, CHINA
Yttrium		CHINA , S. Korea, Japan
Neph. syenite	>95%	Canada
Rare earths	>95%	CHINA , Malaysia, Estonia, Japan
Potash	94%	Canada, Russia, Belarus
Diamonds	89%	S.Africa, India, DRC, Sierra Leone
Iron oxide pig.	87%	CHINA , Germany, Brazil, Canada
Antimony	83%	CHINA , Belgium, India
Chromium	83%	South Africa, Kazakhstan, Russia
Titanium min.	81%	S.Africa, Australia, Madagascar, Canada
Silicon carbide	>79%	CHINA , Brazil, Netherlands, S. Africa
Barite	>75%	CHINA , India, Morocco, Mexico
Fused alumina	>75%	CHINA , Canada, Brazil, Austria
Garnet	69%	S. Africa, CHINA , India, Australia
Alumina	59%	Brazil, Australia, Jamaica, Canada
Magnesia	53%	CHINA , Israel, Canada, Brazil
Iodine	>50%	Chile, Japan
Zircon	<50%	S.Africa, Senegal, Australia, Russia
Feldspar	39%	Turkey, Mexico
Salt	29%	Chile, Canada, Mexico, Egypt
Perlite	28%	Greece, CHINA , Mexico
Lithium	>25%	Argentina, Chile, CHINA , Russia
Bromine	<25%	Israel, Jordan, CHINA
Mica (scrap,flake)	24%	Canada, CHINA , India, Finland
Vermiculite	20%	S.Africa, Brazil

Source: adapted from USGS 2023 data for 2022
Major import sources 2018-21; US net export minerals excluded, eg. boron, clays, diatomite; and <20% net import reliance

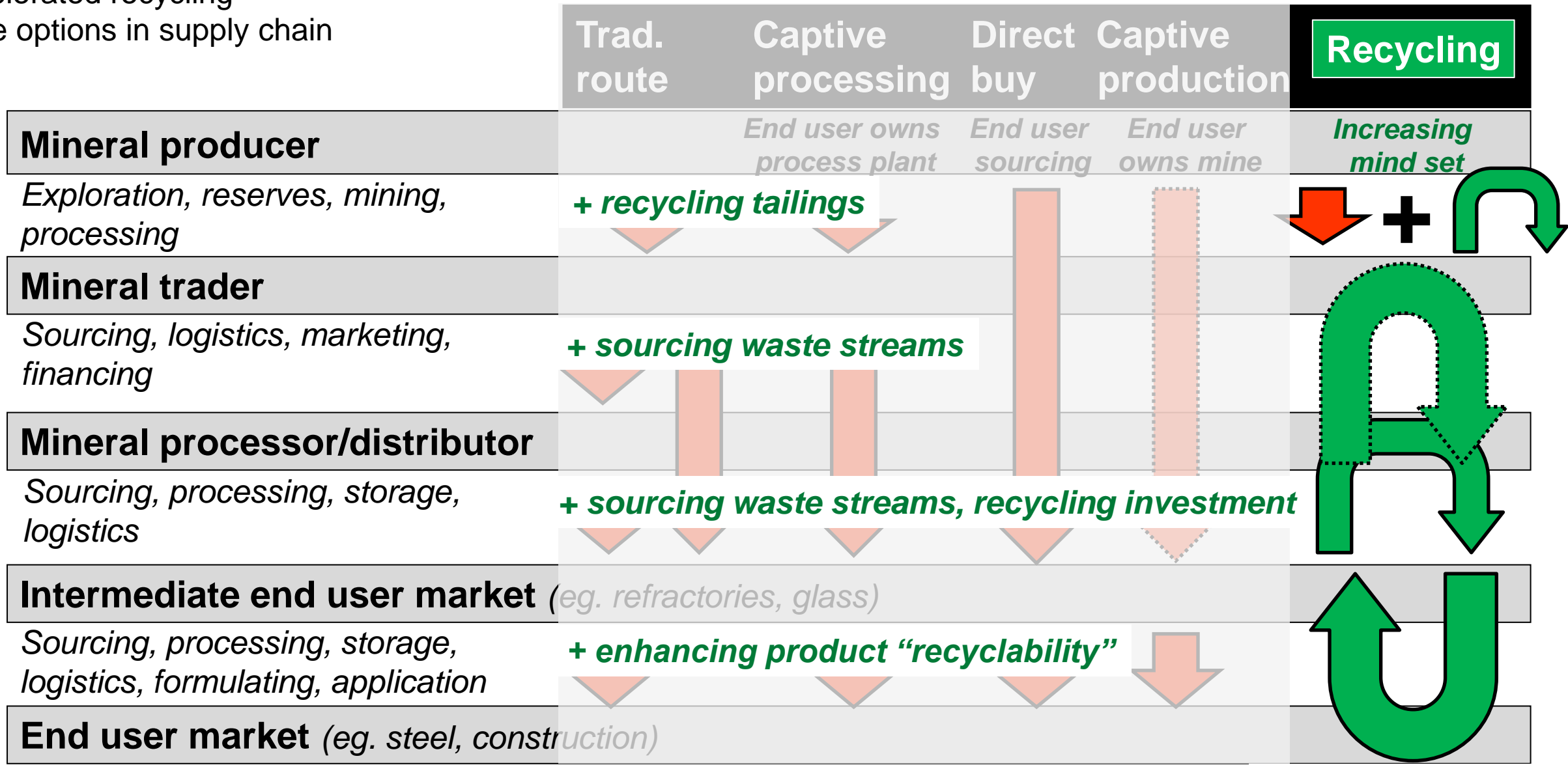
Upshot? Entering a new era of mineral recycling

Primary drivers: “Rule of Six”

1. **Environment:** saving the environment; drive for the “Circular Economy” gathering momentum; CO₂ reduction
2. **Limited primary sources:** shortage of commercially developed mineral resources and processing plants: “critical” + “strategic”; **Source overreliance:** risky overreliance on supply/trade from limited overseas sources; logistics stress; vulnerability spotlighted by Covid-19 pandemic, Russia-Ukraine war
3. **China in change:** supply issues, wide range of factors; end of an era for low cost import reliance?
4. **Emergence of hi-tech growth markets requiring “critical” raw materials:** to become more mainstream, particularly in the energy sector (eg. Li-ion batteries, EVs, solar, wind), and thus demand for respective critical minerals (eg. lithium, graphite, rare earths); increasing government awareness/reaction
5. **Cost factors:** rising cost of primary minerals, energy, waste treatment, landfill; future penalties, legal costs
6. **Recycling technology more economic/established:** evolved from esoteric, expensive sideshow, to mainstream processing line; opportunities sensed and sought after

2. New era: trends & developments

Accelerated recycling
More options in supply chain



2. New era: trends & developments

Secondary Raw Materials (SRM) for industrial mineral markets, examples

SRM waste source*	SRM recovered	Market
Aluminium salt slag	alumina	cement; ceramics; geopolymers; metallurgy; mineral wool; refractories;
Batteries	graphite; lithium; manganese dioxide	batteries; ceramics; chemicals; glass; refractories
Brick/tile	clay	low-CO ₂ cement
Filter cake	diatomite	fertiliser
Fly ash	aluminosilicate, cenospheres	ceramics; coatings; construction; foundry; plastics; proppants (oil & gas drilling); refractories
Glass	REE; silica	abrasives; chemicals; coatings; concrete; glass; plastics; sealants
Gypsum wallboard	gypsum	wallboard
Refractories	alumina; andalusite; bauxite; chromite; dolomite; mag-carbon; graphite; magnesia; silicon carbide; zirconia	ceramics; metallurgy; refractories
Steel slag	alumina; calcia; magnesia; silica	abrasives; aggregate; cement; concrete; fertiliser; filtration; metallurgy
PV cells (Si wafer sawing)	silicon carbide	abrasives; refractories
Waste water/sewage	phosphate	fertiliser
WEEE**	antimony trioxide; bromine FR; fluorspar; graphite; REE	batteries; ceramics; chemicals; flame retardants



Steel slag is a well-established waste source for range of markets



Mobile phone circuit boards & Li-ion battery waste source potential

* ie. waste from processing, or used/discarded mineral-bearing end products to be recycled

** waste electrical and electronic equipment

3. Outlook: opportunities

- **Increasing recyclability:** development of new product formulations to enhance/ease SRM use and ultimate recyclability to achieve Circular Economy
 - Mindset of new manufacturing R&D with recycling at EOL, eg. Li-ion battery evolution
 - Blends of primary and SRM?
 - Provides mineral suppliers & mineral consumers with “green” portfolio branding
- **Added value product development:** for more diverse market applications
- **Strategic partnerships:** increasing long term strategic alliances and co-operation (technical + investment) between waste sources, recyclers, and end users
- **Education:** of end users to positively engage in and recognise benefits of recycling
 - = employment opportunities, better for environment



Recycling red mud residue from bauxite processing continues to be evaluated for a wide range of uses



Since 2019 Sibelco has significantly upped its game in glass recycling with several EU joint ventures; 2m tpa glass waste processed at 10 EU plants.

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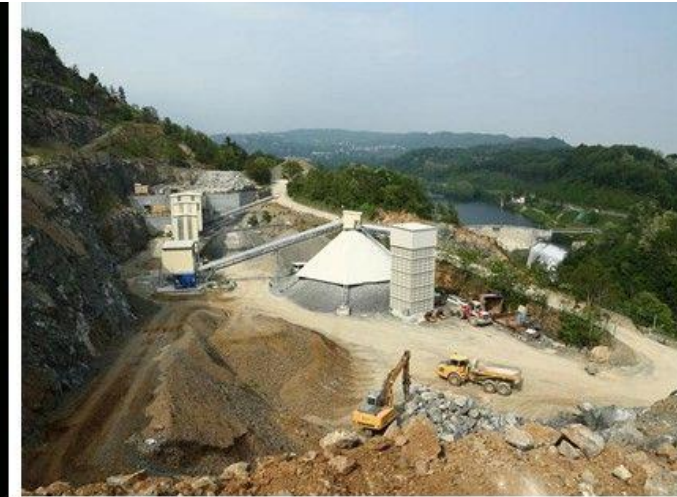
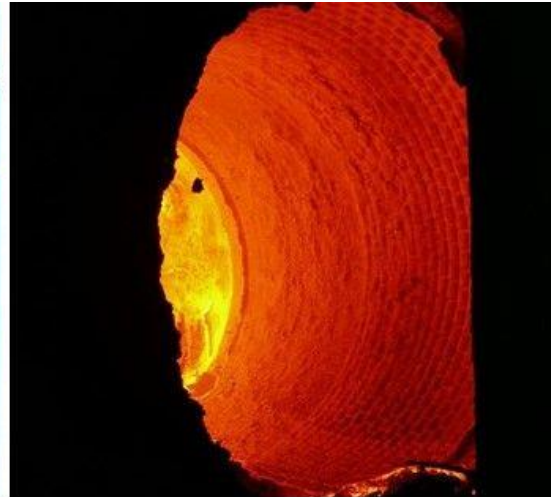


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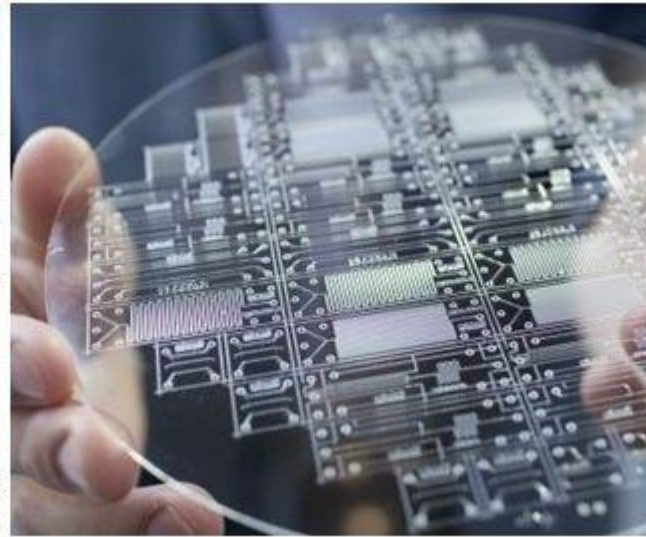
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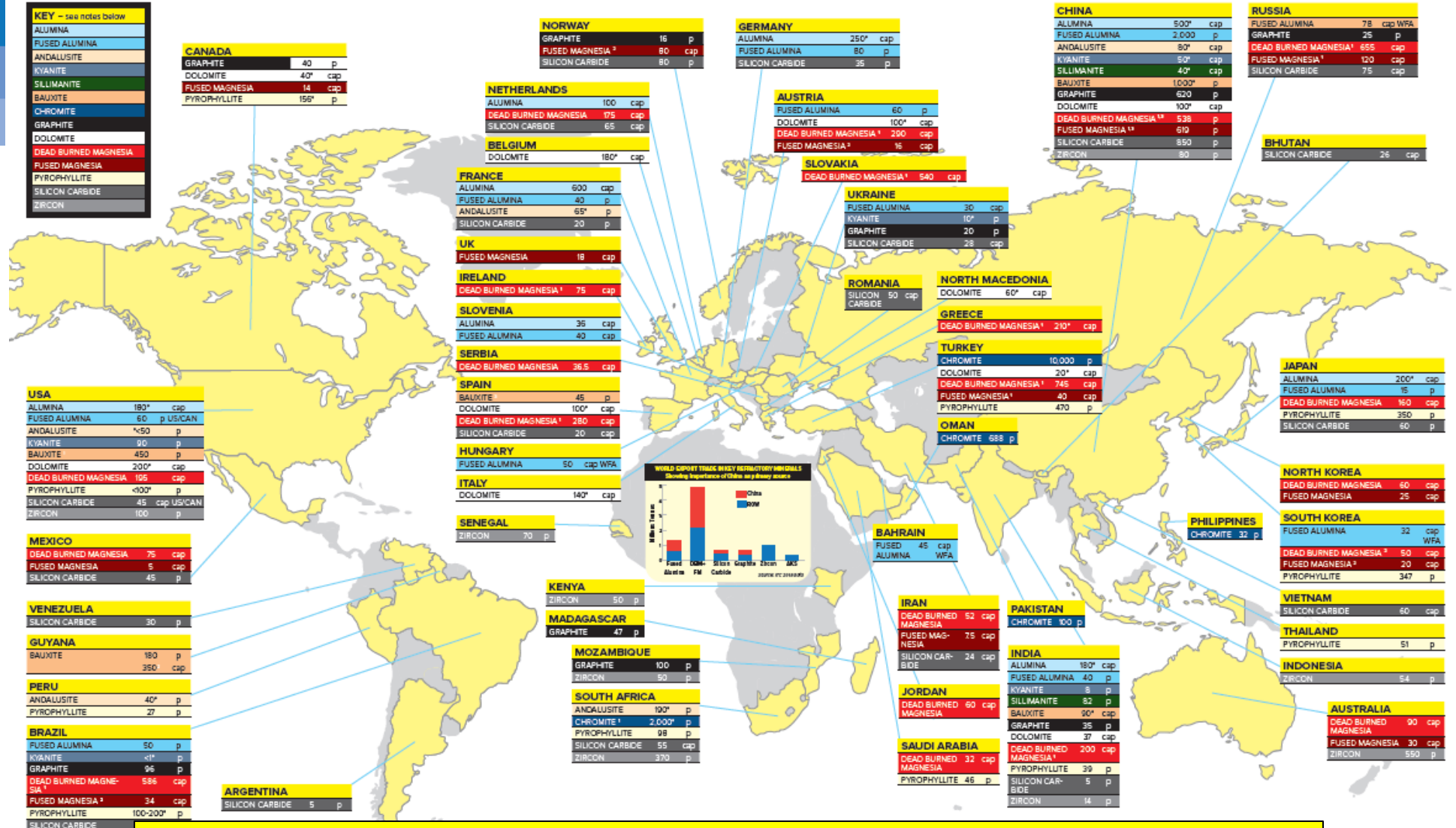
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