


Circular innovation for the production of phosphorus and rare earth elements

2022-10-04



WIND POWER

CARS

BATTERIES

MAGNETS

COMPUTERS

ROADS

WASHING MACHINES

SMARTPHONES

AGRICULTURE

CONCRETE

HOUSE

TOOLS

RADIATION PROTECTION

WATER TREATMENT

BRIDGES

PACKAGING

PHOTOVOLTAIC

LIGHTING

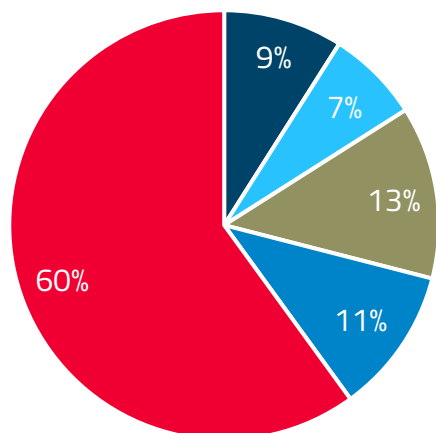
CABLES

COLOR

It starts in the mine

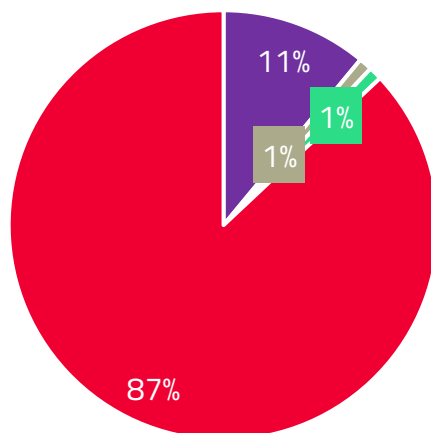
Europe needs rare earths but has no extraction and marginal refinement

Rare earth oxide
mining



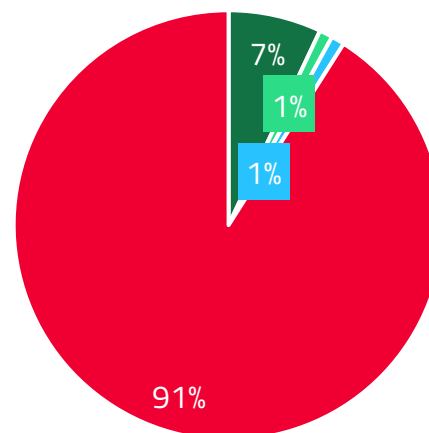
Australia
 USA
 China
 Others
 Myanmar

Rare earth oxide
processing



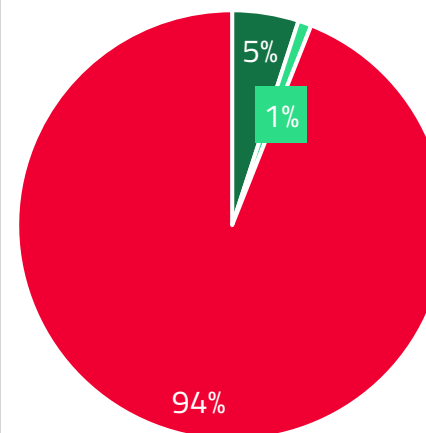
Malaysia
 EU
 India
 China

Rare earth metals



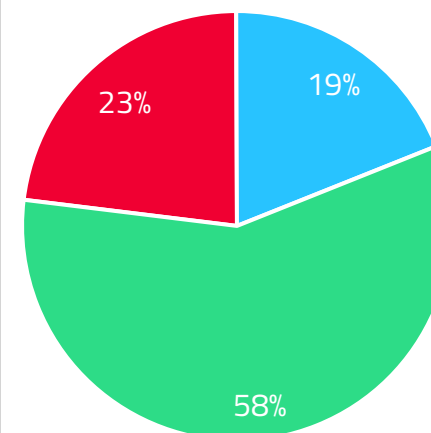
Japan
 EU
 Others
 China

Permanent magnets



Japan
 EU
 China

Example: Wind turbines

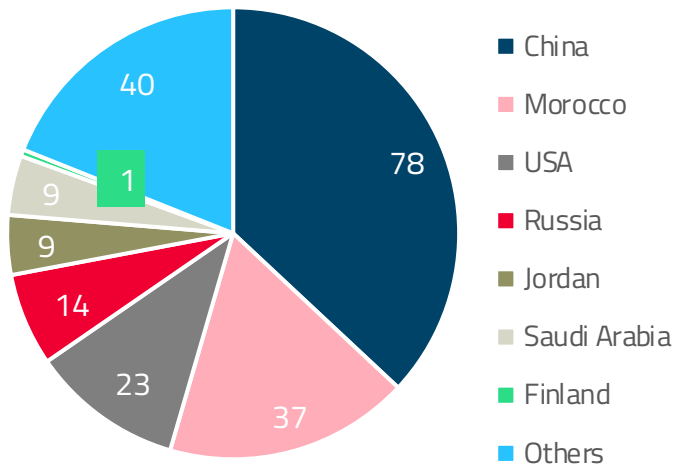


China
 Others
 EU

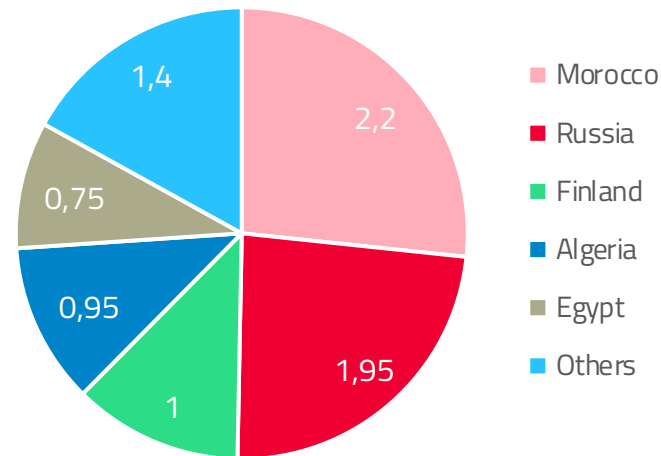
Mineral fertilisers enable 50 percent of the world's food production

We are import dependent on phosphorus

**Mining production
phosphorus ore**
2020 (~210 million tonnes)



**Europe's supply of
phosphorus ore**
2020, CIS excluded (~8,3 million tonnes)





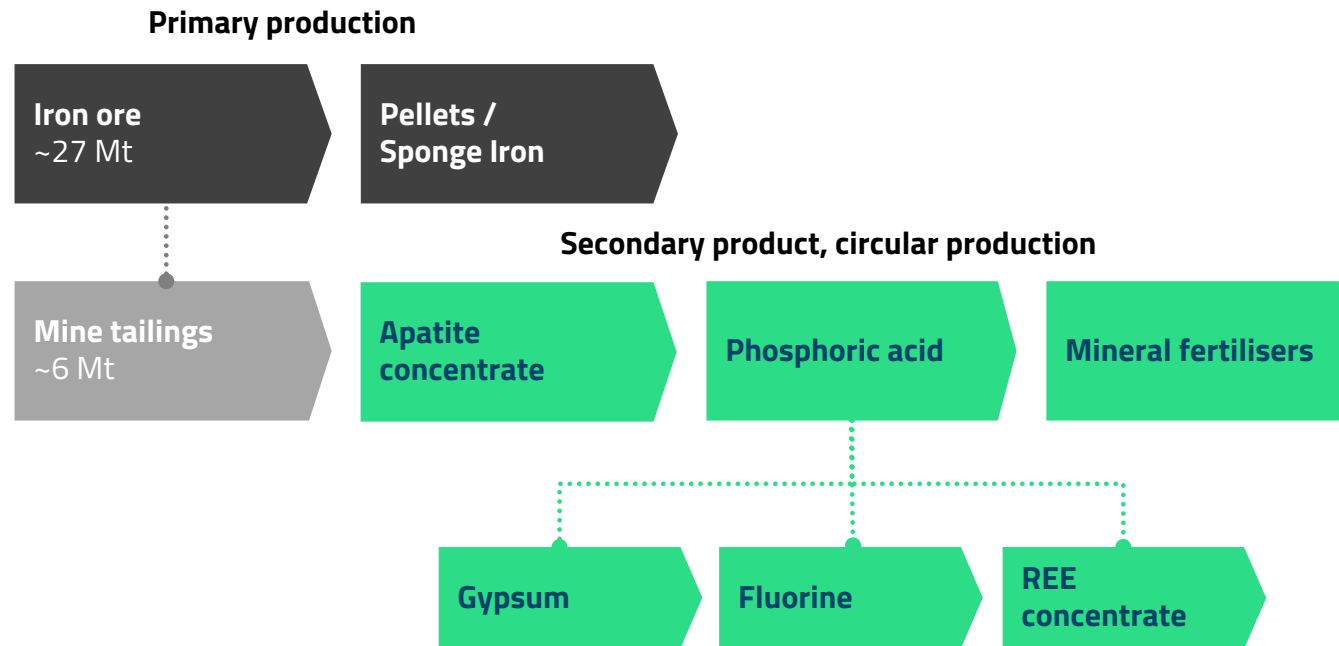
Large mineral resources waiting to be extracted

4 billion tonnes of ore
Iron, Phosphorus and Rare
Earth Elements

**Large-scale iron ore
production beyond 2060**

**Valuable mineralisations
are deposited today**

Innovation for circular production of phosphorus and rare earth elements





The circular mine?

Recycling, waste avoidance and the use of renewable energy are part of **circular business** models.

Mining waste is extracted into phosphorus and rare earth oxides.

Fossil-free energy replaces fossil processes and energy.

Sulphuric acid is produced from Boliden's mining waste containing pyrite.

Hydrochloric acid is regenerated (recycled) using the sulphuric acid.

Commercialises new by-products (gypsum, fluorine, etc.)

Energy and heat recovery from the processes.

Future expansion in all parts of the business



Detailed map of the industrial park

Planned expansion of logistics and storage for carbon free sponge iron

Production of mineral fertilisers

Production of green ammonia

Extraction of phosphorus, rare earth oxides, fluorine and gypsum

Sulfuric acid production

Offices and service buildings

LKAB's circular industrial park

LKAB's existing iron ore port and bentonite production

LKAB's planned expansion of logistics and storage for carbon free sponge iron

LKAB's circular industrial park for phosphorus and rare earth elements



Feasibility study, 2018-2022

Engineering and permits 2022-2026

2023- Construction and industrialisation

2027
Production

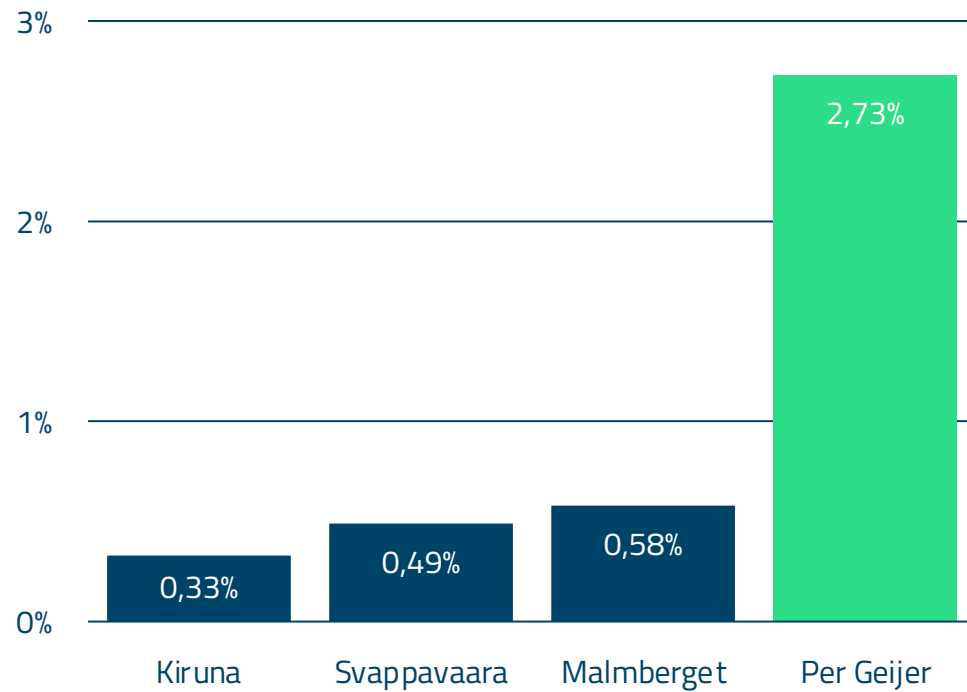


A European Critical Raw Materials Act

“Lithium and rare earths are already replacing gas and oil at the heart of our economy. By 2030, our demand for those rare earth metals will increase fivefold. And this is a good sign, because it shows that our European Green Deal is moving fast.”

Ursula von der Leyen, State of the union address

Potential to increase REE and phosphorus production




A completely new industry from today's mine waste

We are broadening our business by extracting critical minerals



Phosphorus for
mineral fertilisers



Rare earth elements for
electrical vehicles and wind
turbines



Gypsum for construction



LKAB