

ReeMAP

WASTE TO CRITICAL RAW MATERIALS

Recycling LKAB mine waste through innovative processing, producing valuable MAP and REE

Presentation at the Circular Economy Workshop - Climate Action Innovation Fund

3 December 2019



AN INTERNATIONAL HIGH-TECH MINING AND MINERALS GROUP

1890

LKAB is one of Sweden's
oldest industrial companies

#1

80 % of the iron ore production
in Europe

1365 / 1250

metres below the ground is where we operate
our iron ore mines in Kiruna and Malmberget

100%

Owned by the Swedish state

4200/12

LKAB has 4200 employees in 12 countries.

"LKAB aims to create prosperity by being
one of the most innovative, resource-
efficient and responsible mining companies
in the world"

>30

Industrial minerals

25.9

Billion SEK turnover 2018



Our values, Committed, Innovative and Responsible, form
the basis for the way our operation is run.

MINERALS AND METALS ARE ESSENTIAL TO MEET THE GLOBAL GOALS

A word cloud is centered on a background of sand dunes under a blue sky. The word 'EVERYWHERE' is the largest and most prominent. Other words are scattered around it, representing various applications of minerals and metals. The background transitions from a light blue sky at the top to a dark, textured foreground of gravel or crushed stone at the bottom.

CARS COMPUTERS WIND FARMS
PAINT ROADS
WASHING MACHINES CELL PHONES
EVERYWHERE AGRICULTURE
LAMPS CABLES HOUSES CONCRETE
SOLAR CELLS TOOLS
PACKAGING BRIDGES RADIATION PROTECTION
WATER TREATMENT

ON OUR WAY TO A SUSTAINABLE FUTURE

MAIN INITIATIVES

HYBRIT

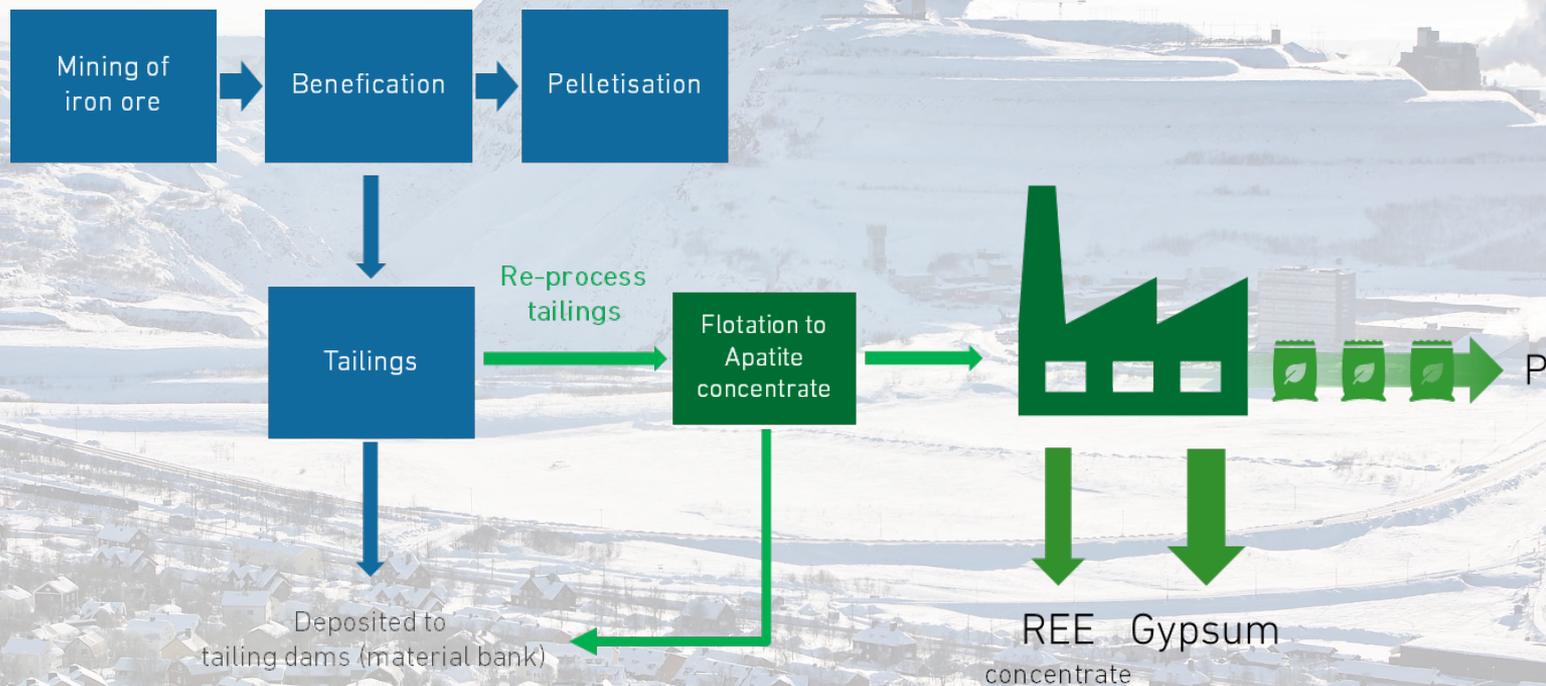
Sustainable
Underground
Mining

ReeMAP

GGBS



EXTEND LKAB'S PRODUCTION PROCESS



ReeMAP FROM WASTE TO CRITICAL RAW MATERIALS

CIRCULAR ECONOMY

Recycling LKAB mine waste

REE – Rare Earth Elements, 1 % of global production

MAP – mineral fertiliser, 5x Sweden's need

Gypsum – pure, 100% of Sweden's need

A SUSTAINABLE BUSINESS

In a finite world, secondary raw materials are increasingly important to create a circular economy.

Critical raw materials that are used in applications that are essential for the global goals.

A NEW INDUSTRY IN SWEDEN

Pilot project – scale up technology

Decision 2021

Localisation: environmentally best option:

- Freights
- Harbour
- Process material
- Market

SUSTAINABLE SOURCE OF PHOSPHORUS

HIGH PURITY, NO CONTAMINANTS IN A CIRCULAR ECONOMY

NON-SUSTAINABLE SUPPLY TODAY

- Only 1 European source of Phosphorus
- Issues with import material
 - Security of supply
 - Geo Political issues/risk
 - Low purity
 - Cadmium

A SUSTAINABLE SOURCE IN SWEDEN

Swedish production

Circular economy – secondary raw material

Low energy production

High purity

No impurities

ESSENTIAL FOR FOOD PRODUCTION

World agricultural production would be halved without mineral fertilisers

Safe and effective mineral fertiliser

A EUROPEAN REE SOURCE

FROM AN EXISTING MINING OPERATION

(NOT SO) RARE EARTH ELEMENTS

- REE's: abundant in low concentration
- Large and costly mining operations
- China produces abt 95%
- No European production

EUROPEAN SOURCE

Establish a European source.

Separation of REE's from mine waste, from existing mining operations – no new mine.

LOW CARBON AND HIGH-TECH

Computers and smartphones

Generators in wind power plants

LKAB REE's considered valuable and forecasted to grow in demand

EXCEPTIONALLY CLEAN GYPSUM

DECLINING GYPSUM SUPPLY

By-product from coal fired power plants,
decreasing output

Recycled, secondary raw material, can replace
increase in virgin extraction

A SUSTAINABLE SOURCE IN SWEDEN

Circular economy - secondary raw material

Reduced need for virgin extraction

High purity

No impurities

BUILDING BLOCKS OF TOMORROW

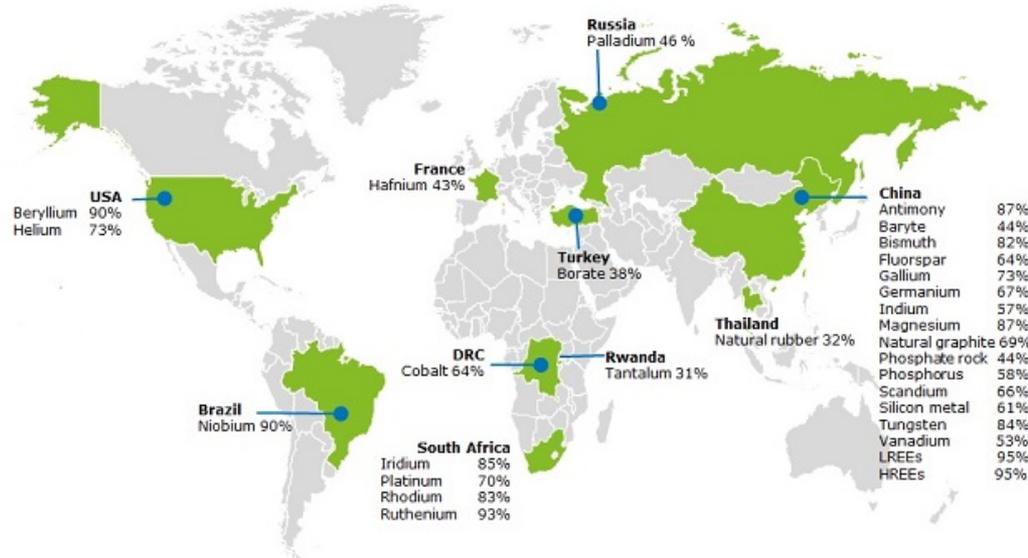
Cement production

Plaster boards

Volume, 100% of Sweden's need

EU: CRITICAL RAW MATERIALS

PRODUCTION OF CRM



WHY CRITICAL?

- Economic importance
- Supply risk

Phosphorus imports to EU

- 27 % Morocco (phosphate rock)
- 77% Kazakhstan (phosphorus)

REE (light and heavy) production

- 95 % China

The EU Raw Materials Initiative sets out a strategy with three pillars to facilitate:

- Fair and sustainable supply of raw materials from global markets;
- Sustainable supply of raw materials within the EU;
- Resource efficiency and supply of "secondary raw materials" through recycling.

POLICY AND MARKET OPPORTUNITES

INCREASE DEMAND AND VALUE

- European produced material
- Recycled/Circular/Sustainable
- Pure and free from contaminants
- Energy efficient / Low CO2 production

POLICY AND MARKET OPPORTUNITIES

POLICY (INCL. NGO'S)

- Purity of P (low Cd)
- Ecological classification
- Existing vs. New industry
- Public procurement standards
- Waste restrictions

INCREASE DEMAND AND VALUE

- European produced material
- Recycled/Circular/Sustainable
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MARKET

- Awareness and demand of low Cd
- Industry labelling
- Consumer labelling