

# The Future of Mining

## The Invisible Mine – Arctic Sustainability

How Digitalization, Decarbonisation and strategic Reorientation redefine modern Mining in sensitive Ecosystems



# Future of Mining

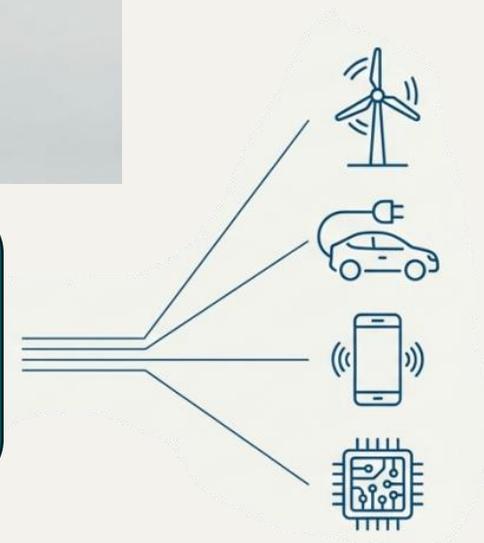
The word 'mining' evokes images of hard labor, dirt, and environmental destruction.

An image that has been shaped over centuries and is stuck in our minds.



The future is built on mineral resources.

Energy transition and digitalization require huge quantities of **copper, nickel, lithium, and rare earths.**



The question is not **whether** we need mining, but **what** it must look like.

## The future of Mining – the sustainable Mine

To meet EU CRM Act Claims we need to extract more in Resources europe – rich deposits in most sensitive ecosystems like the arctic.

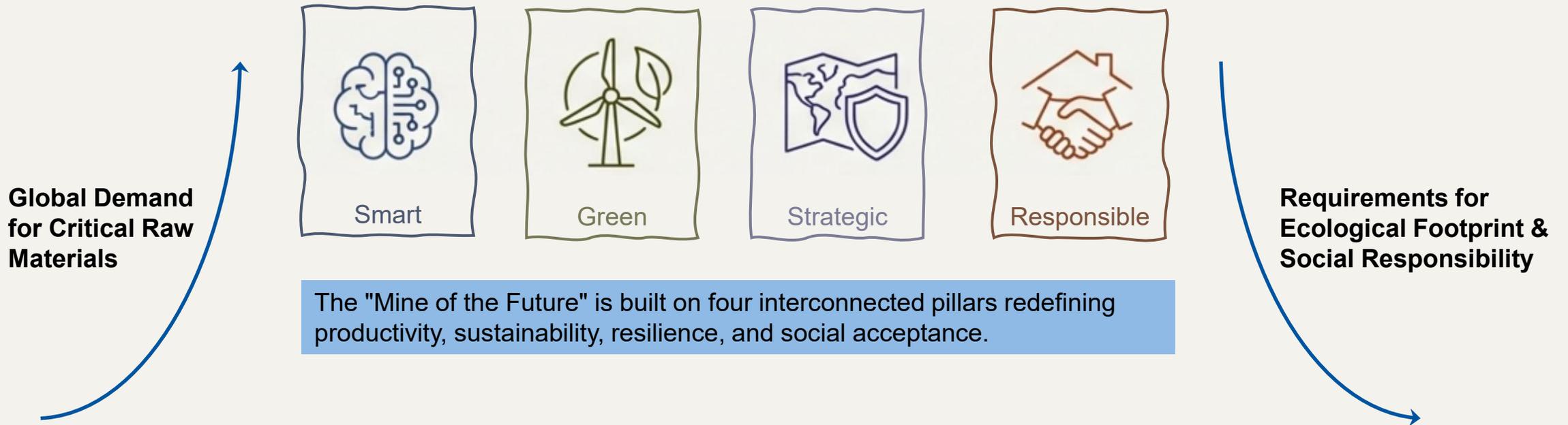
In arctic 31 of 34 CRM can be found. From now on sustainable & modern Mining Approaches can ensure secure, safe and eco-friendly supply.

This is how it can be done & and what challenges have to be tackled 



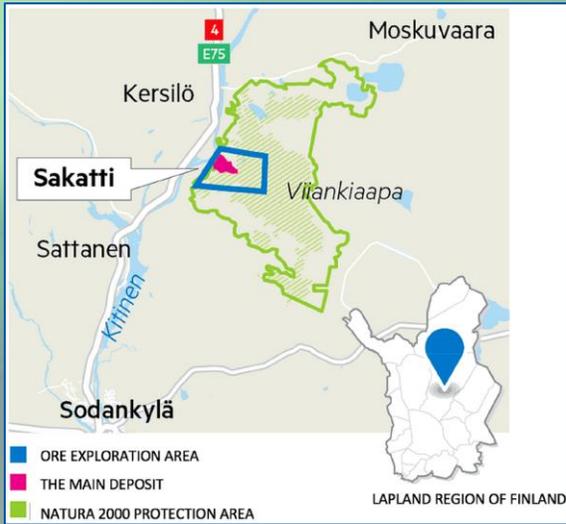
# The Fundamental Tension of the 21st Century: Four Pillars of Modern Mining

Growing demand for raw materials conflicts with the requirement for minimal ecological and social impact.



See how the mining industry responds with innovation & systemic transformation.

# Mining under a Nature Reserve: The Sakatti Project



New technologies and knowledge allow us to go deeper and be more precise, leaving a smaller footprint.

So the environment can continue looking this pretty:



See how this is realised

# Mining under a Nature Reserve: Sakatti Nature Reserve

## Project Timeline

### The Challenge:

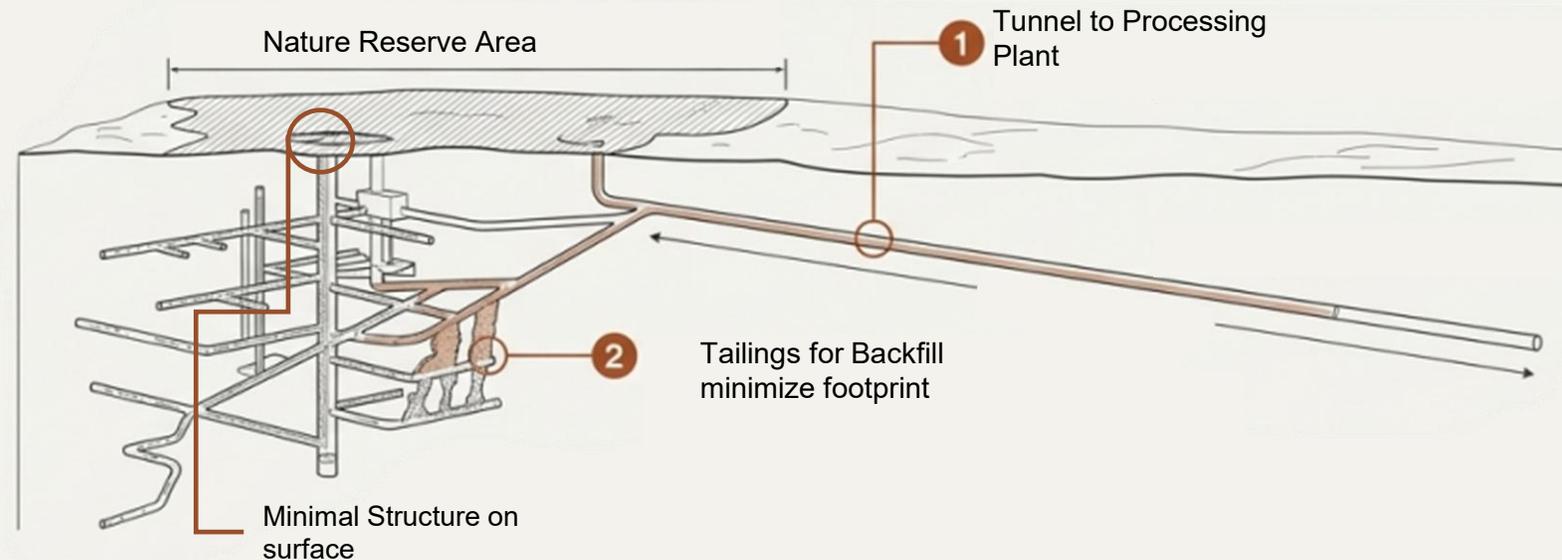
- The Valuable Sakatti Deposit is located beneath the Viiankiaapa-Reserve, protected by EU 2000-natura network

### Process & Studies:

- Detailed Groundwater & Deposit Modelling since 2009 allow further permitting to continue

### The Result:

- A conscious and purposeful Mining Project is planned at Sakatti



## Responsible Mining:

Partnerships with locals and shareholder communities can guarantee responsible operations, following esg and Sustainable Development Goals (SDGs)



### Strategic Alliance:

- Operates through an agreement between Teck Resources and NANA (an Indigenous Regional Corporation).



### Ownership Structure:

- The mine is 100% owned by NANA, ensuring local sovereignty over resources.



### Financial Flow:

- Significant revenue generated through royalties, which are reinvested into the community.



### Employment Priority:

- Implementation of a "Shareholder Preference" policy for hiring and training.

# Energy Systems and Energy Management

## Challenge & Location:

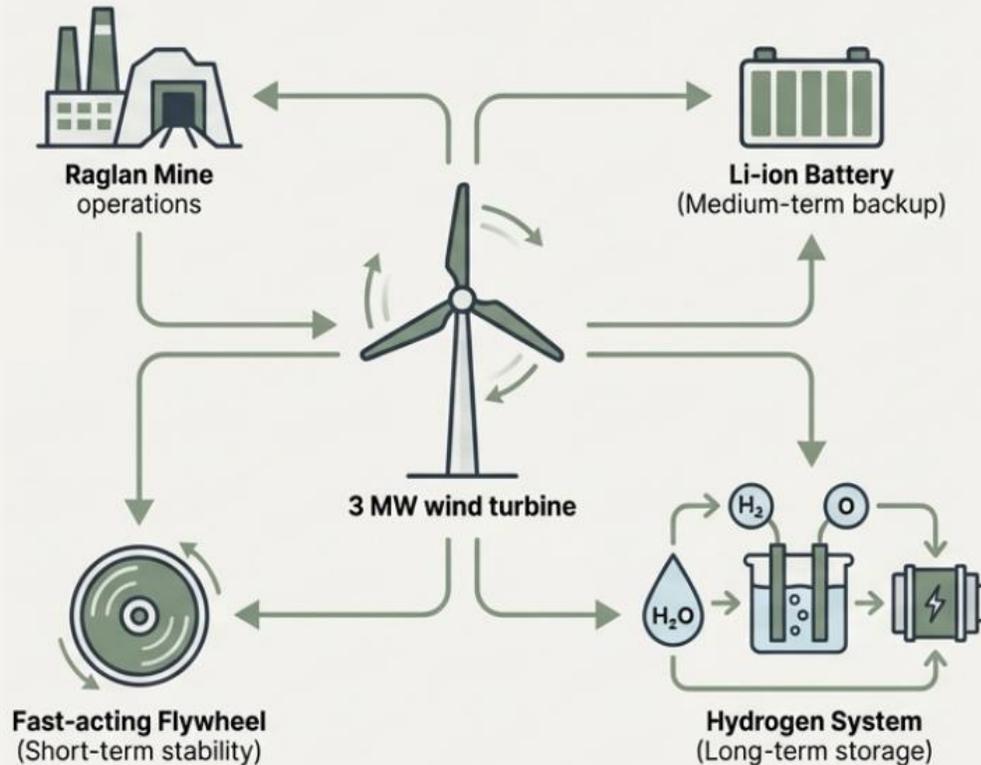
- Powering the Raglan Mine in Northern Quebec (Canada)

## Solution:

- Deployment of an Arctic-ready wind turbine to reduce diesel dependency

## Technology:

- An intelligent storage system ensures stable power supply, even when the wind is not blowing



## Results since installation:

- Saved over 3 million liters of diesel.
- Reduced CO<sub>2</sub> emissions by 9000 tons

# Electrification in Mining Operations: Financial Perspective

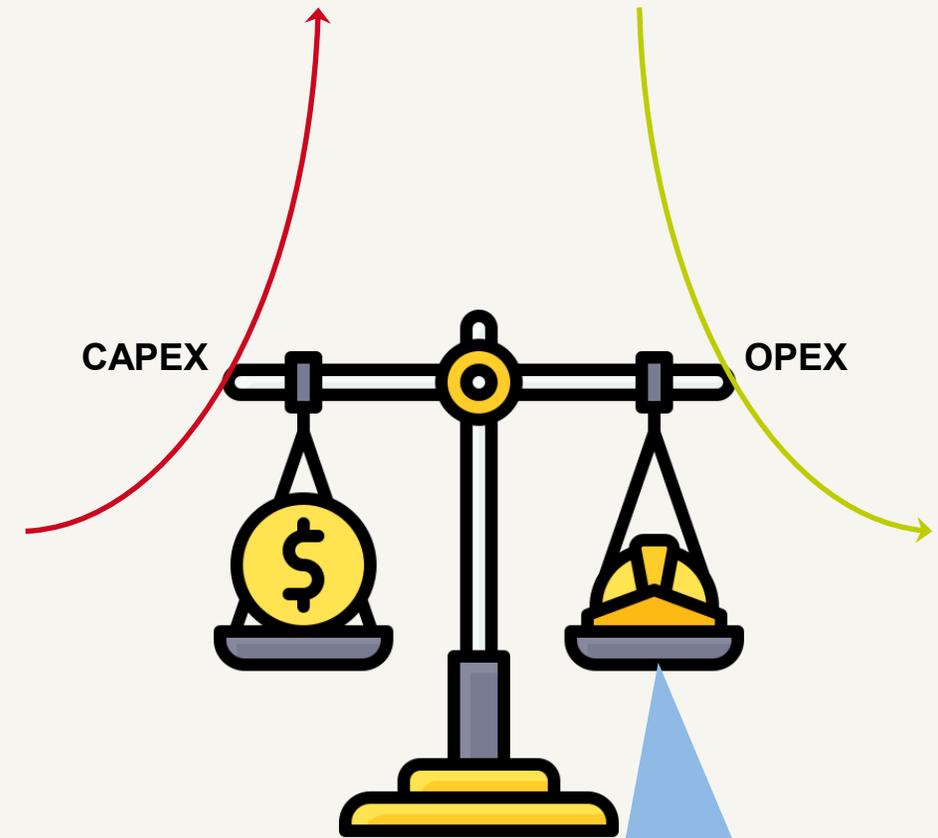
**Minimising operating maintenance costs:** Compared to diesel vehicles, BEVs have substantially fewer moving parts.



**Reducing operating energy costs:** A fully electrified mine can decrease energy costs from anywhere between 30% and 50%



Electrifying mining operations removes diesel exhaust gases and the accompanying waste engine heat, leading to an estimated 40% **reduction in ventilation costs.**

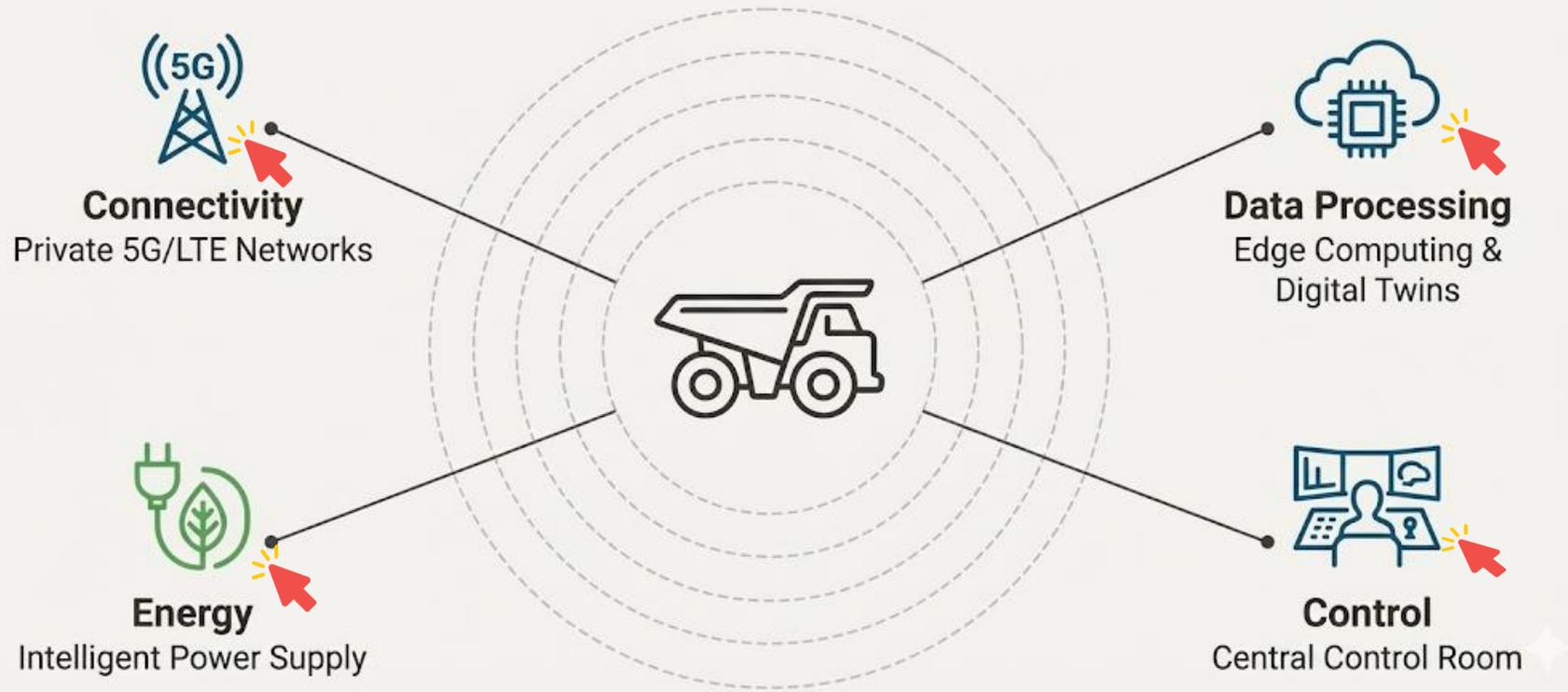


Electrification first appears as expensive, but can cut costs drastically long term!

# Smart, Safe & Sustainable Operations: The Connected Digital Mine

Building an autonomous & economic mine site is complex and Capital Expenditures (CAPEX) intensive, but rewarding in hindsight

Besides operational expenditure (OPEX) advantages: Digitalization will make mining safer, more intelligent, efficient, and greener.



# Data driven optimization through Connectivity

Data Collection from Sensors & Systems throughout Mining Operations



Real-Time Locations Systems

Predictive Maintenance

On-Demand Ventilation

On-Demand Energy provision

Decreased Risk of Downtime

Automatization

Process Optimization

Connected sensors help mining companies to identify the condition of every mine site asset in real time

This can help predict potential failure and extend the lifetime of the assets.



## Data Processing, IoT (Internet of Things) and digital twins

The integration of **data processing**, serves as the "infrastructure spine" of modern mining, shifting the industry from purely moving rock to managing intelligence



### Transformation of the Workforce is the consequence:

New Jobs with higher Qualifications & requirements

Advancing Training for Personnel

Making Operations safer with less human workforce exposed to dangerous locations on site

### Predictive Asset Maintenance:

Collecting data from sensors helps to identify the condition of every mine site asset in real time which can help predict potential failures and use condition-based maintenance to reduce costs, increase utilization and extend the lifetime of the asset.

**Advantages for Mining Applications** 

## Data Processing, IoT (Internet of Things) and digital twins

### Advantages for Mining Applications:

#### Significant Productivity Gains:

The use of analytics platforms to turn Data into real-time decisions typically results in **productivity increases of 10–30%**

#### Enhanced Operational Efficiency:

Data-driven systems allow for **smoother plant feed**, optimized vehicle dispatch, and increased operating hours

#### Improved Safety:

By utilizing remote monitoring and autonomous systems, **fewer personnel are required in high-energy zones**, significantly reducing risk

#### Optimized Maintenance and ESG Reporting:

Telemetry data enables more precise **predictive maintenance plans** and provides accurate data for transparent **ESG reporting**

# Transport: Trolley System

Boliden Mine: Sweden

What can it do?

- 100% Velocity gain (from 15 to 30 kmh)
- many more cycles per day
- Less diesel consumption and less GHGs emitted



Dynamic charge:



Charge whilst on trolley system & recuperation when driving downhill; drive on battery in remote areas

**Goal:  
Zero Emission**



On trolley System: Implementaion of autonomous Trucks self-steering & driving, dodging Rocks and uneven parts

Remote operations and automation, allow personnel to monitor automated processes and operate machinery long distance using virtual presence allowing for 24/7 operations



## AutoMine Concept Drill

- Smart and electric Drilling: a way to maximize Safety for Workers and reduce Ventilation expenditures
- Less noise and no emitting of GHG
- Save capacity and energy through smart fleet management,



## European Response for a new era of strategic autonomy

### EU CRMA Key Points:

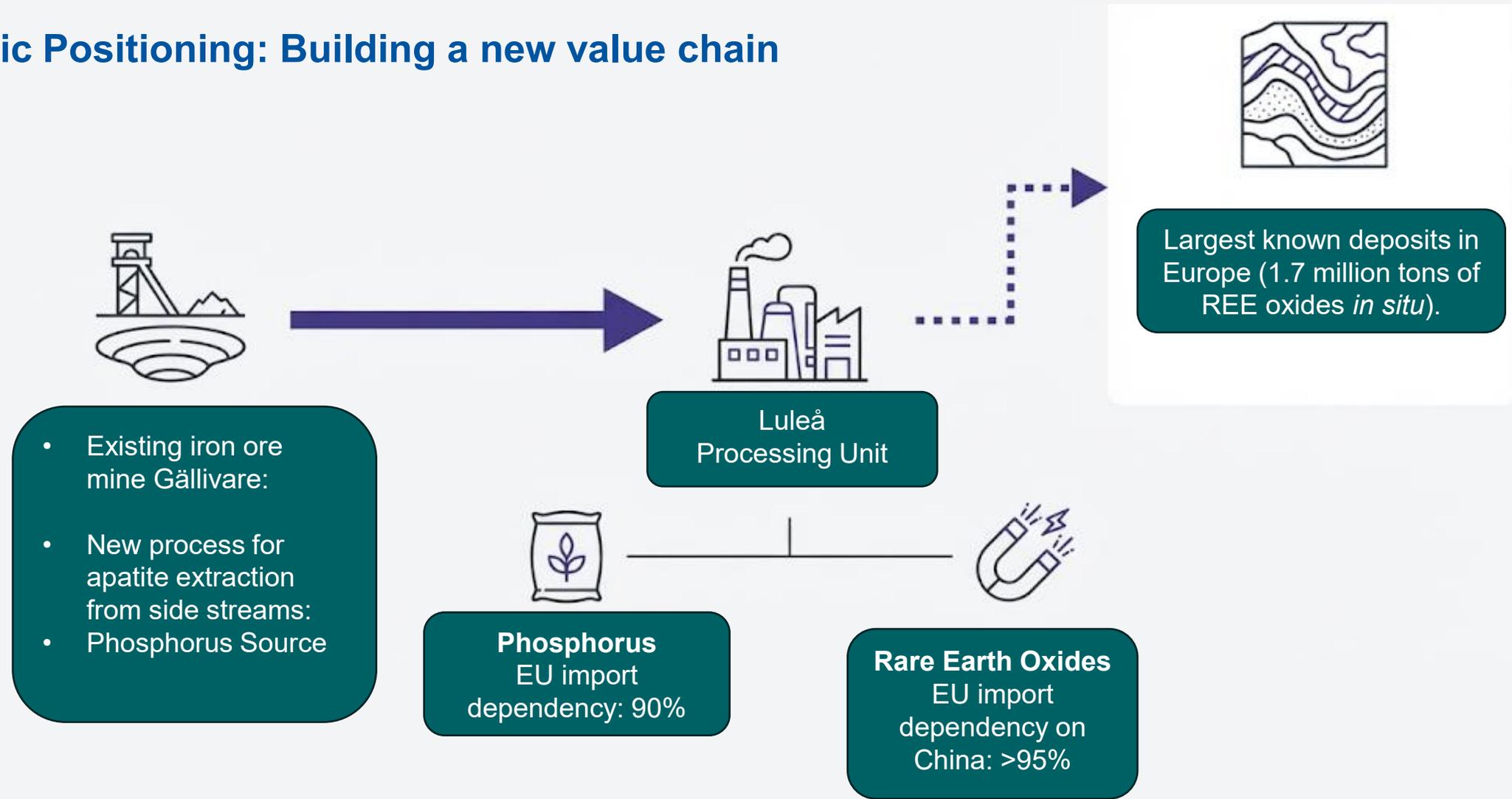
- **secure the EU's supply of critical minerals**
- **minimize reliance on single-country imports**
- **faster and more predictable permitting processes**

LKAB's Approach  
EU CRM Act designates the project als „strategic“

The Project has potential to secure green transition and strengthen Europe's industrial resilience, supporting EU Values and Economy

In a volatile world responsible local sourcing is not just an environmental goal but sustainable in all Matters & strategic necessity

# Strategic Positioning: Building a new value chain



## Summary: Mine of the future

The mine of the future will be smart, green, strategic, and socially responsible.



### Mining IN THE PAST



Diesel-powered & emission-intensive



Manual & dangerous



High land consumption



Waste as an end product

### Mining TODAY



Electric & renewable



Autonomous & connected



Minimal footprint



Waste as a resource (Circular)

Today leading companies treat autonomy, sustainability, geopolitics, and social responsibility as inseparable parts of their core strategy.