

# Taking the green: Raw materials for the economic transition

Mark Burnett: AMC Consultants



**RESOURCE MANAGEMENT WEEK 2021**

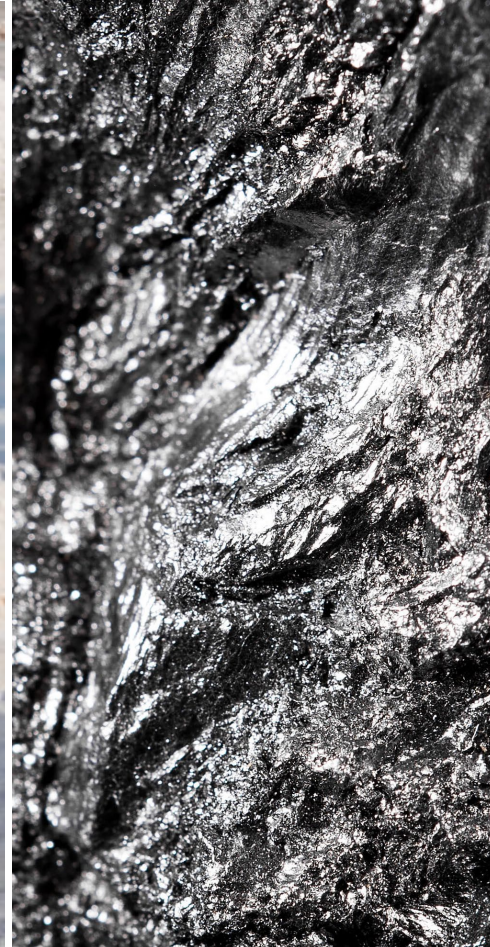
ENABLING SUSTAINABILITY PRINCIPLES IN RESOURCE MANAGEMENT



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# Mineral intensity requirement



*“Under a **2-degree scenario** (2DS), production of **graphite, lithium, and cobalt** will need to be significantly ramped up by **more than 450 percent by 2050** — from 2018 levels — to meet **demand from energy storage technologies**”.*

# Mineral intensity requirement



*“Though demand for some base minerals, like **aluminum** and **copper**, appears to be smaller in percentage terms, their absolute production figures are significant, at **103 million tons** and **29 million tons** by 2050, respectively”.*



# Mineral intensity requirement

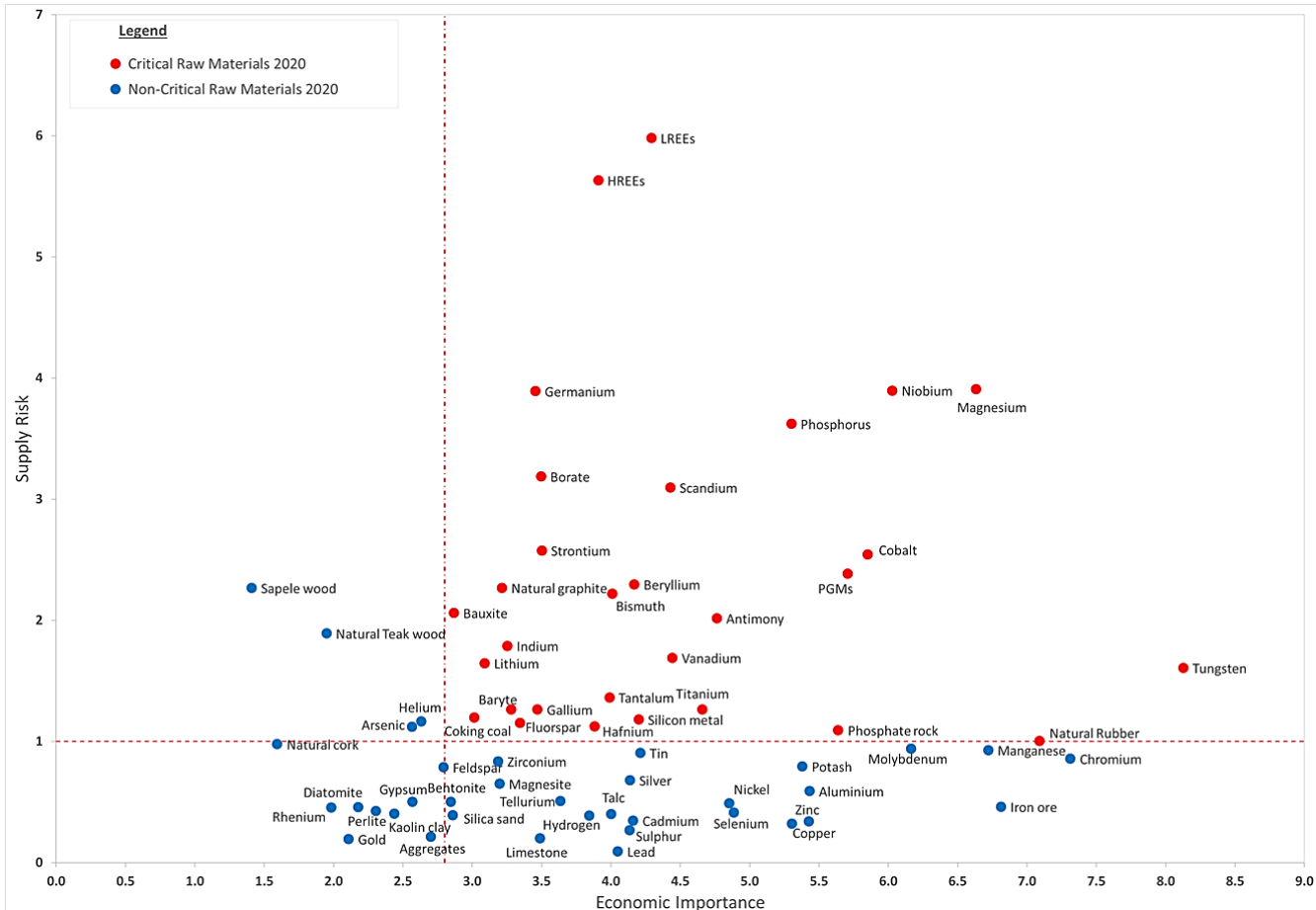


“These projections *do not include the associated infrastructure* needed to support the deployment of these technologies (for example, *transmission lines*) or the *physical parts* (like the chassis) of newly built electric vehicles”.





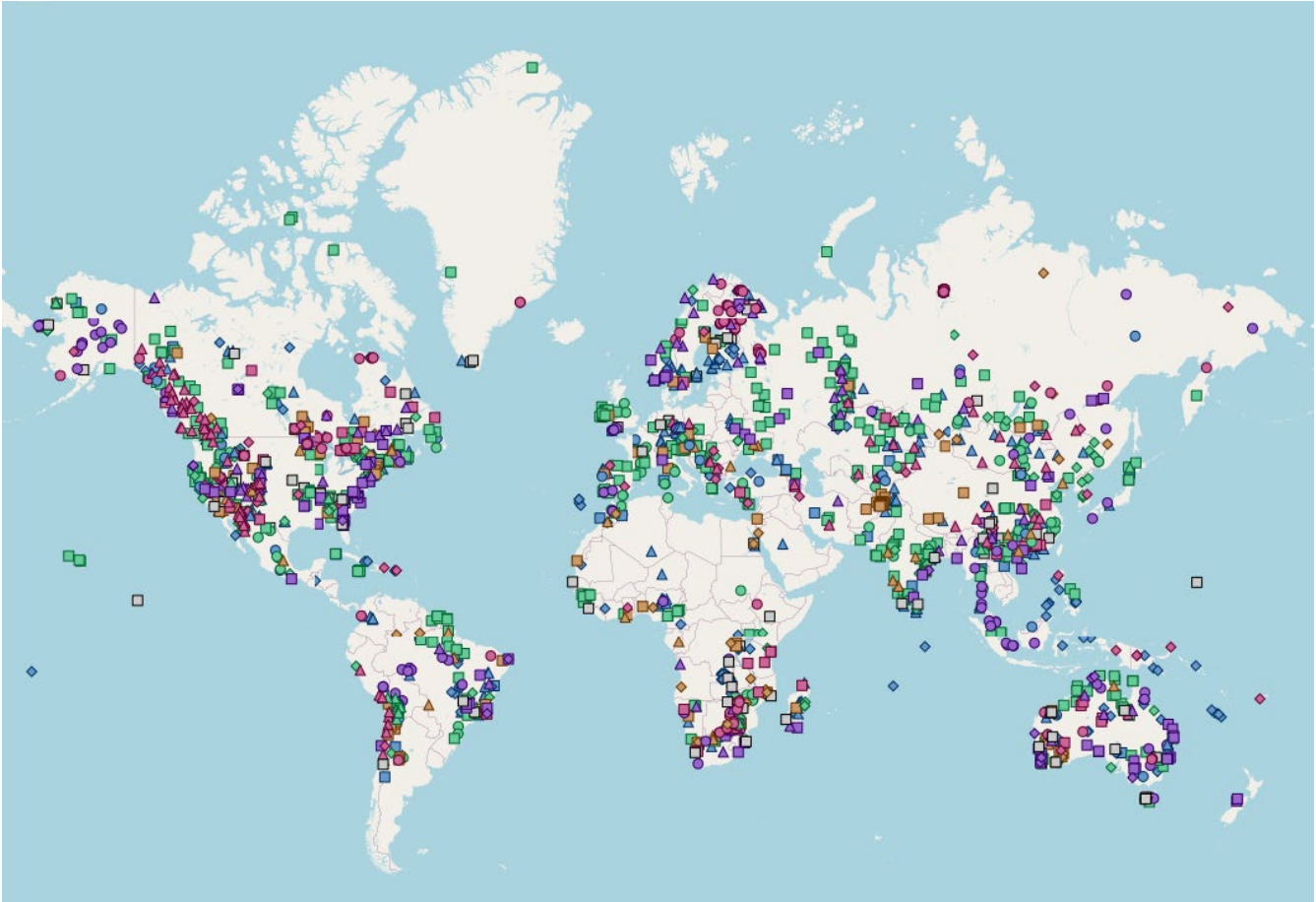
# EU CRM list 2020



- **Cobalt:** Rechargeable batteries and superalloys
- **Gallium:** Integrated circuits and optical devices like light-emitting diodes (LED)
- **Germanium:** Fiber optics and night vision applications
- **Graphite:** Major component of lithium-cobalt (Li-Co) oxide batteries
- **Indium:** Mostly used in liquid crystal display (LCD) screens
- **Lithium:** Primarily in batteries
- **Niobium:** Mostly in steel alloys
- **Platinum Group Elements:** Catalytic agents
- **Rare Earth Elements:** Batteries, electronics, magnets, communication, and medical technologies
- **Rhenium:** Lead-free gasoline or petrol and superalloys
- **Tellurium:** Steel-making and solar cells

<https://rmis.jrc.ec.europa.eu/?page=crm-list-2020-e294f6>  
<https://www.cesme-book.eu/book/2/2.1/2.1.9-green-raw-materials>

# World resources



## Critical Minerals Mapping Initiative

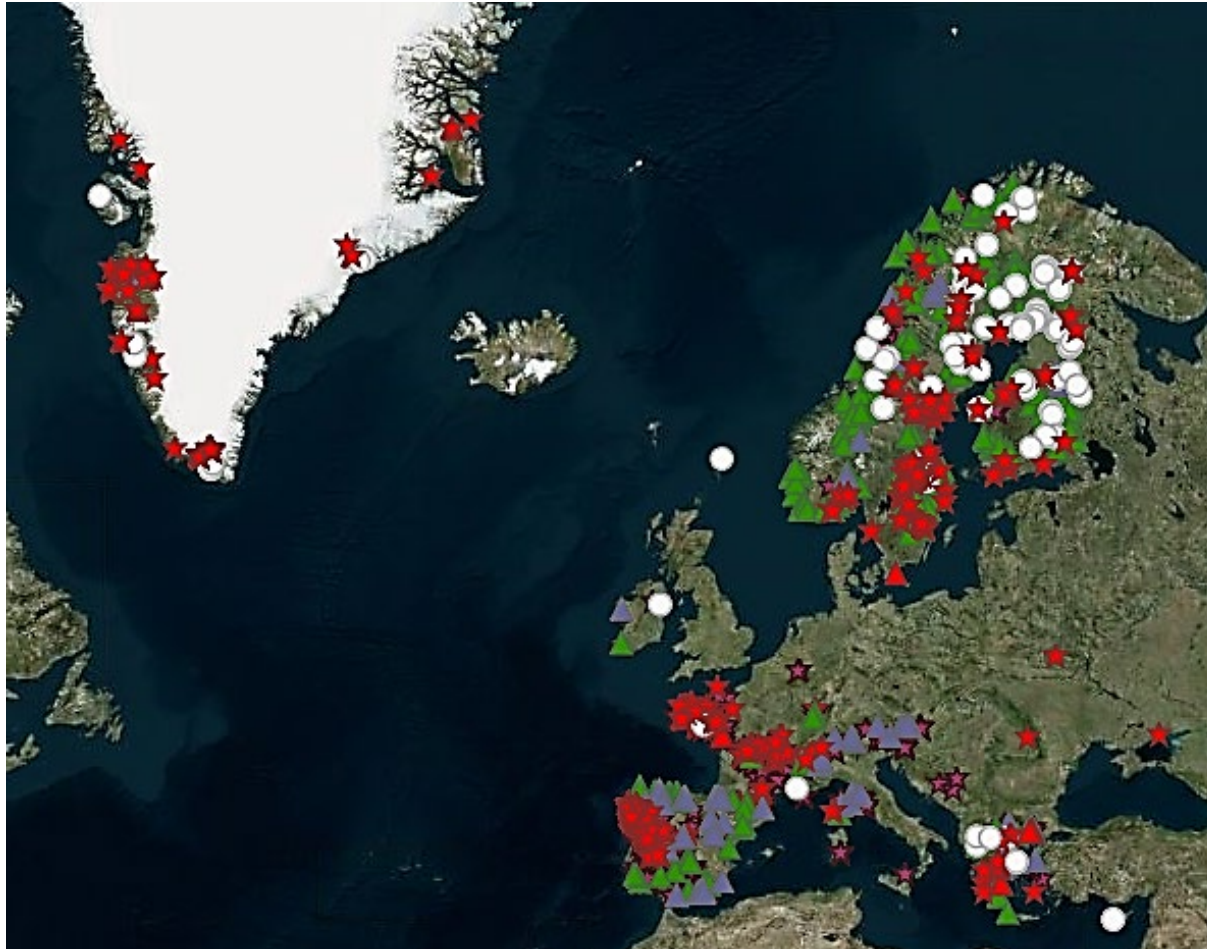
- Australia
- Canada
- USA

*“identifying new sources of supply”*

- Antimony
- Barite
- ▲ Beryllium
- ◆ Cobalt
- Fluorite
- Gallium
- ▲ Germanium
- ◆ Graphite
- Indium
- Lithium
- ▲ Manganese
- ◆ Niobium and Tantalum
- Platinum-Group Elements
- Rare-Earth Elements
- ▲ Rhenium
- ◆ Tellurium
- Tin
- Titanium
- ▲ Vanadium
- ◆ Zirconium and Hafnium
- Multiple critical minerals

<https://mrdata.usgs.gov/general/map-global.html>  
<https://www.usgs.gov/special-topic/earthmri>  
<https://pubs.usgs.gov/fs/2020/3035/fs20203035.pdf>

# European sources



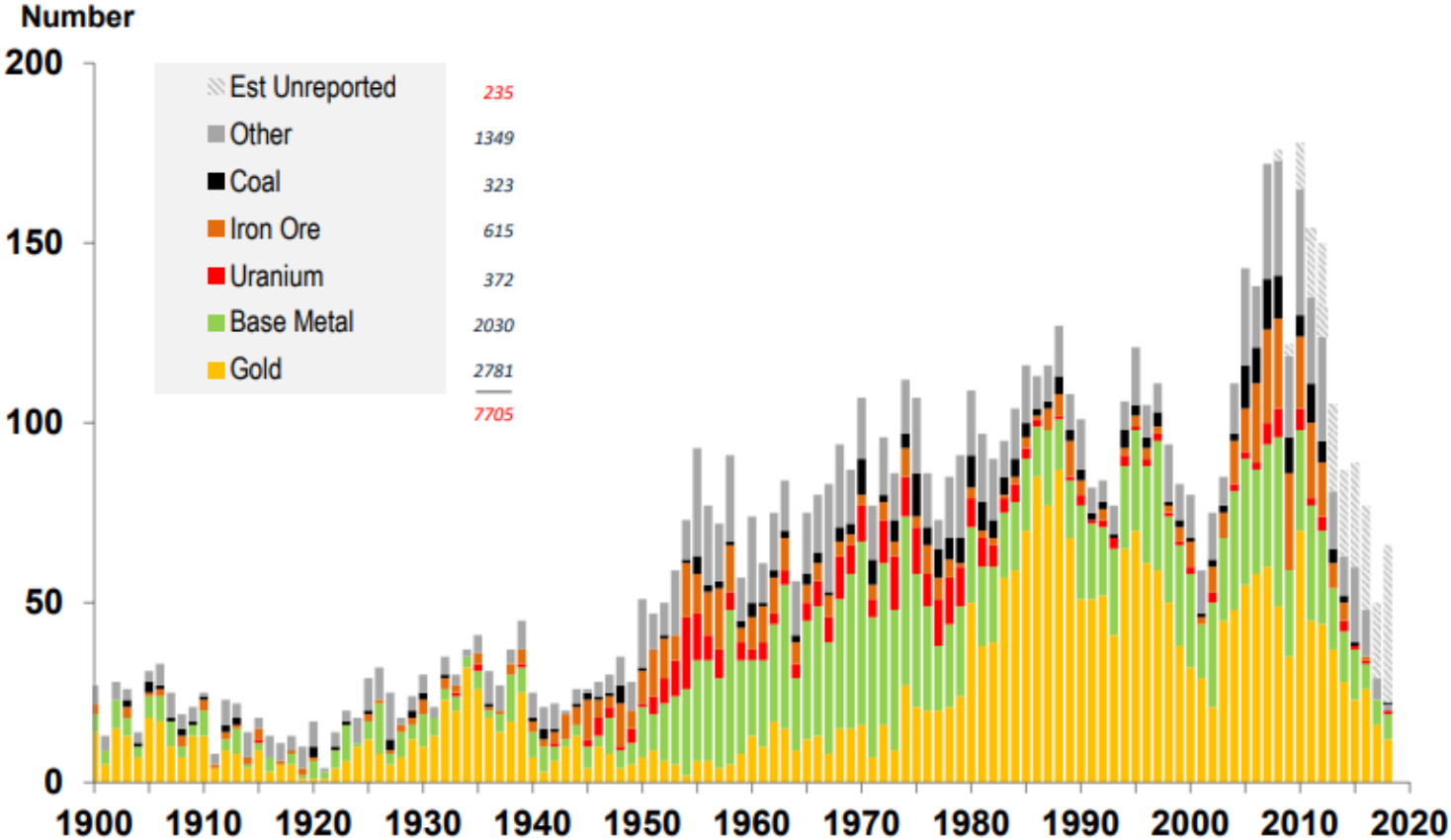
## European Raw Materials Alliance

*“ensuring reliable, secure and sustainable access to raw materials”*

- |            |             |
|------------|-------------|
| ▲ Wolfram  | ○ PGE       |
| ■ Wolfram  | □ PGE       |
| ★ Tantalum | ○ Platinum  |
| ■ Tantalum | □ Platinum  |
| ○ Rhodium  | ○ Palladium |
| □ Rhodium  | □ Palladium |
| ★ REO      | ▲ Niobium   |
| ■ REO      | ■ Niobium   |
| ★ REE      | ▲ Magnesite |
| ■ REE      | ■ Magnesite |
| ★ LREE     | ▲ Cobalt    |
| ■ LREE     | ■ Cobalt    |
| ★ HREE     | ★ Beryllium |
| ■ HREE     | ■ Beryllium |
|            | ★ Antimony  |
|            | ■ Antimony  |

<http://minerals4eu.brqm-rec.fr/minerals4EU/>

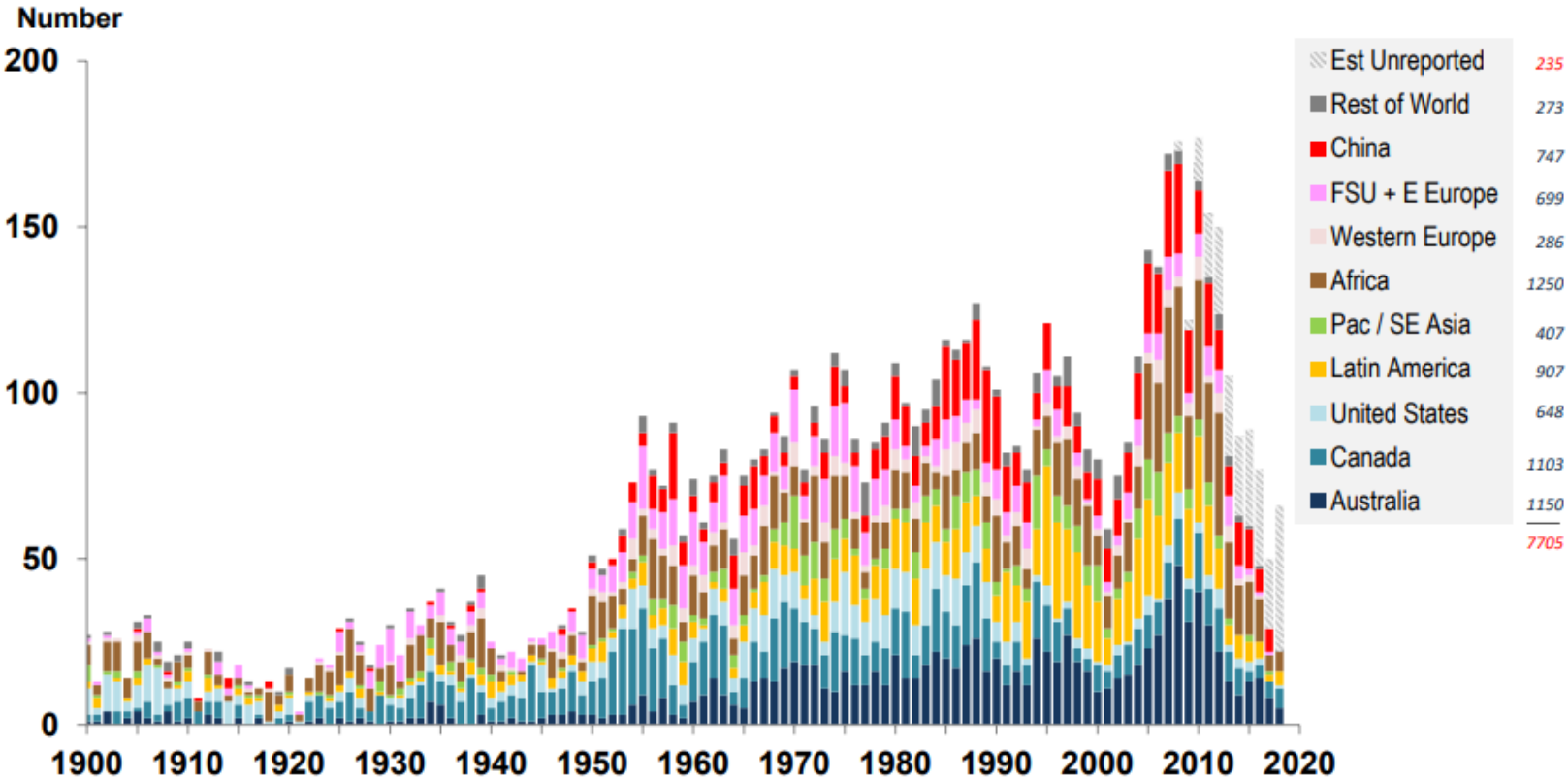
# Discoveries



<http://minexconsulting.com/wp-content/uploads/2019/12/IMARC-Presentation-27-Oct-2019-FINAL.pdf>

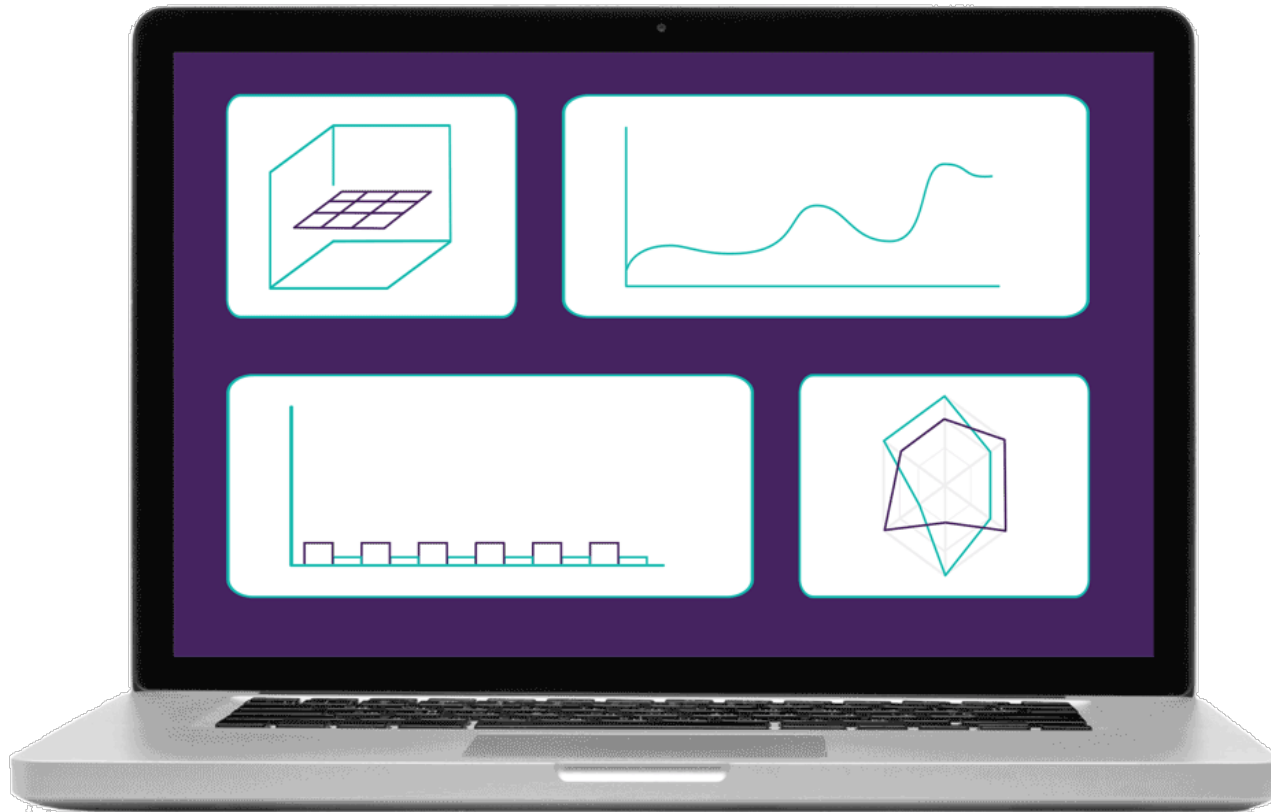


# Discovery location



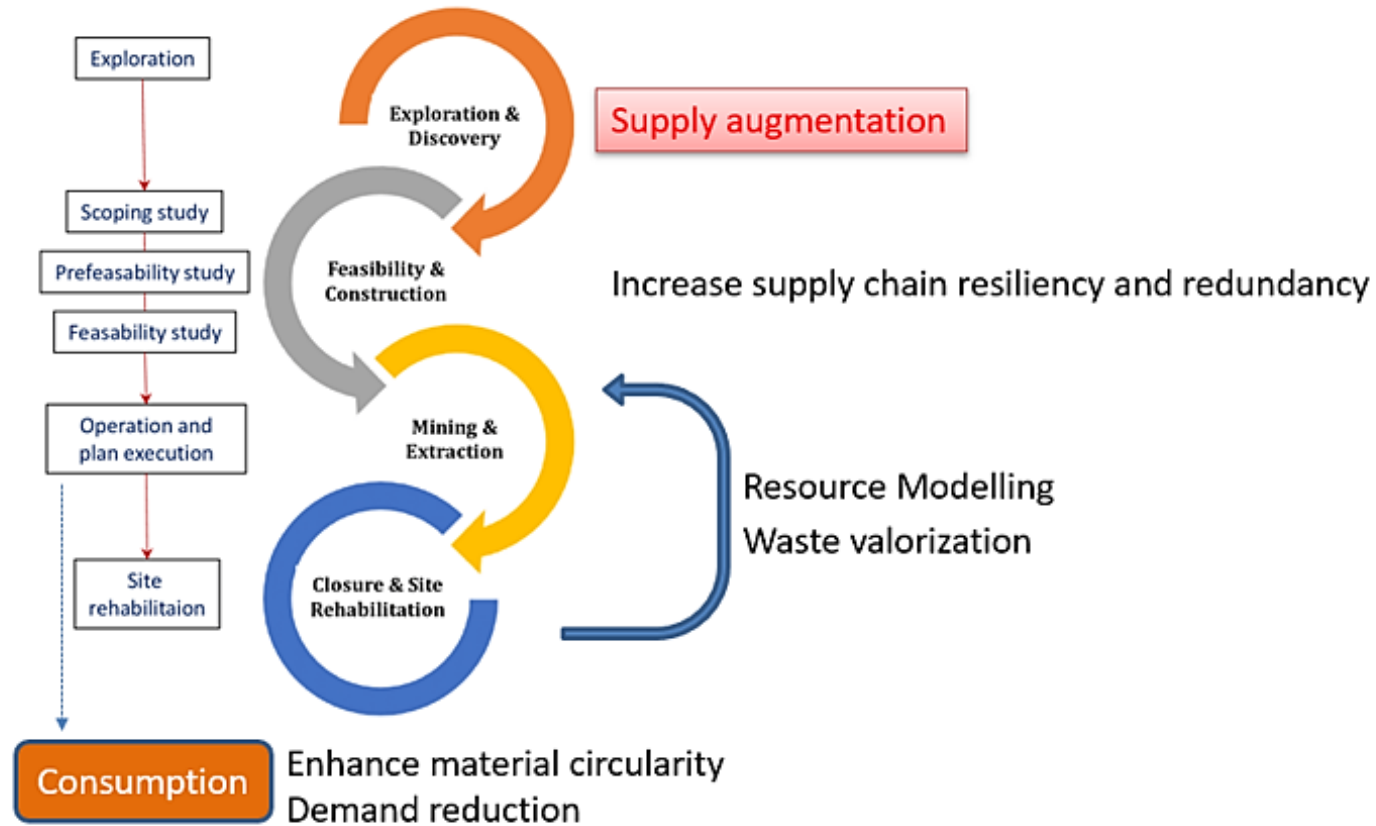
<http://minexconsulting.com/wp-content/uploads/2019/12/IMARC-Presentation-27-Oct-2019-FINAL.pdf>

# AMC's Smart Data System



- The largest site-sourced benchmarking data set in the world.
- Developed over the last 20 years by mining professionals.
- Helps us understand drivers of excellence in mine performance.
- Uses genuinely comparable or 'like-for-like' cost and productivities.

# Big data and AI



Source: Nwalia, Zhang and Ghorbani, 2020



# Infrastructure requirements



Concrete is used for 2/3 of construction. Of which 2/3 is sand



Average house

**200**

tons of sand



Hospital

**3,000**

tons of sand



1 mile highway

**45,000**

tons of sand

## Portland cement: secondary raw materials

- Slags
- Ash (fly ash)
- Flue-gas desulfurization (FGD) gypsum
- Used foundry sand
- Recycled building materials

<https://www.levinources.com/assets/pages/Responsible-sourcing-of-sand-Looking-ahead-Levin-Sources-White-paper.pdf>  
<https://www.extractiveshub.org/resource/view/id/9476>

# Infrastructure requirements



Slag



Grain Slag



Fly Ash



Industrial Tailing

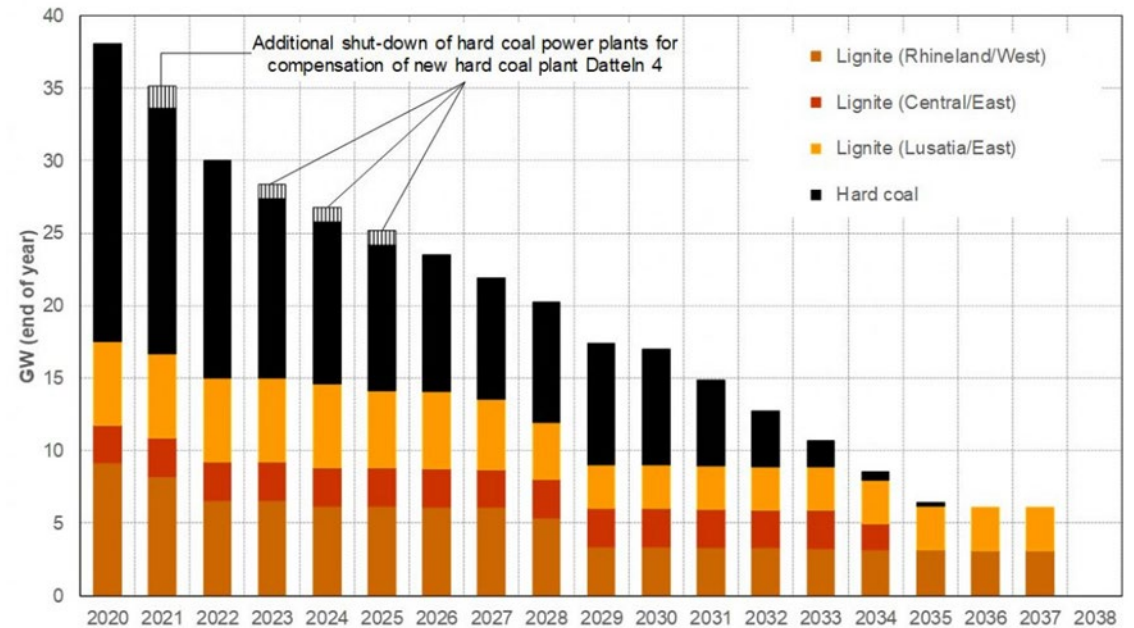


Coal Gangue



Ceramist

Coal phase-out in Germany.  
Capacity reduction path following the decision of the federal cabinet on 29 January 2020  
on the draft coal exit law (KVBG)



<https://www.block-machine.net/introduction-of-fly-ash/>  
<https://www.cleanenergywire.org/factsheets/spelling-out-coal-phase-out-germanys-exit-law-draft>

# The right to say no



*“Non-ferrous metals are absolutely essential to Europe’s low-carbon transition, because of their central use in breakthrough technologies including clean mobility, renewable energy and batteries.”*

Guy Thiran, Eurometeaux, 2018

*“The circular economy should really be about reducing the use of materials and the consumption of waste. If that’s the case, is that really where we’re going in Europe?”*

Jean-Pierre Schweitzer, European Environment Bureau (EEB), 2018

*“We cannot mine our way out of the climate crisis. To display true climate leadership, the EC needs to establish and put in place policies for a low-energy, low-material transition in Europe, with a far greater focus on demand reduction, recycling, and contributing a fair share of support to Global South nations to redress the relentless, centuries-long extraction of wealth from the South to Europe”.*

Hal Rhoades, Northern European Coordinator of the Yes to Life, No to Mining Network, 2020

<https://www.euractiv.com/section/circular-economy/news/metals-friend-or-foe-of-the-green-economy/>  
<https://seas-at-risk.org/27-deep-sea-mining/1097-we-cannot-mine-our-way-out-of-the-climate-crisis-open-letter-to-the-european-commission.html>



# Thank you!

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