



Update on Commercialization of Critical Minerals Production from Lignite

July 22, 2026

North Dakota has an opportunity to become a national leader in strategic materials production and value-added manufacturing

Critical Minerals – What are They?

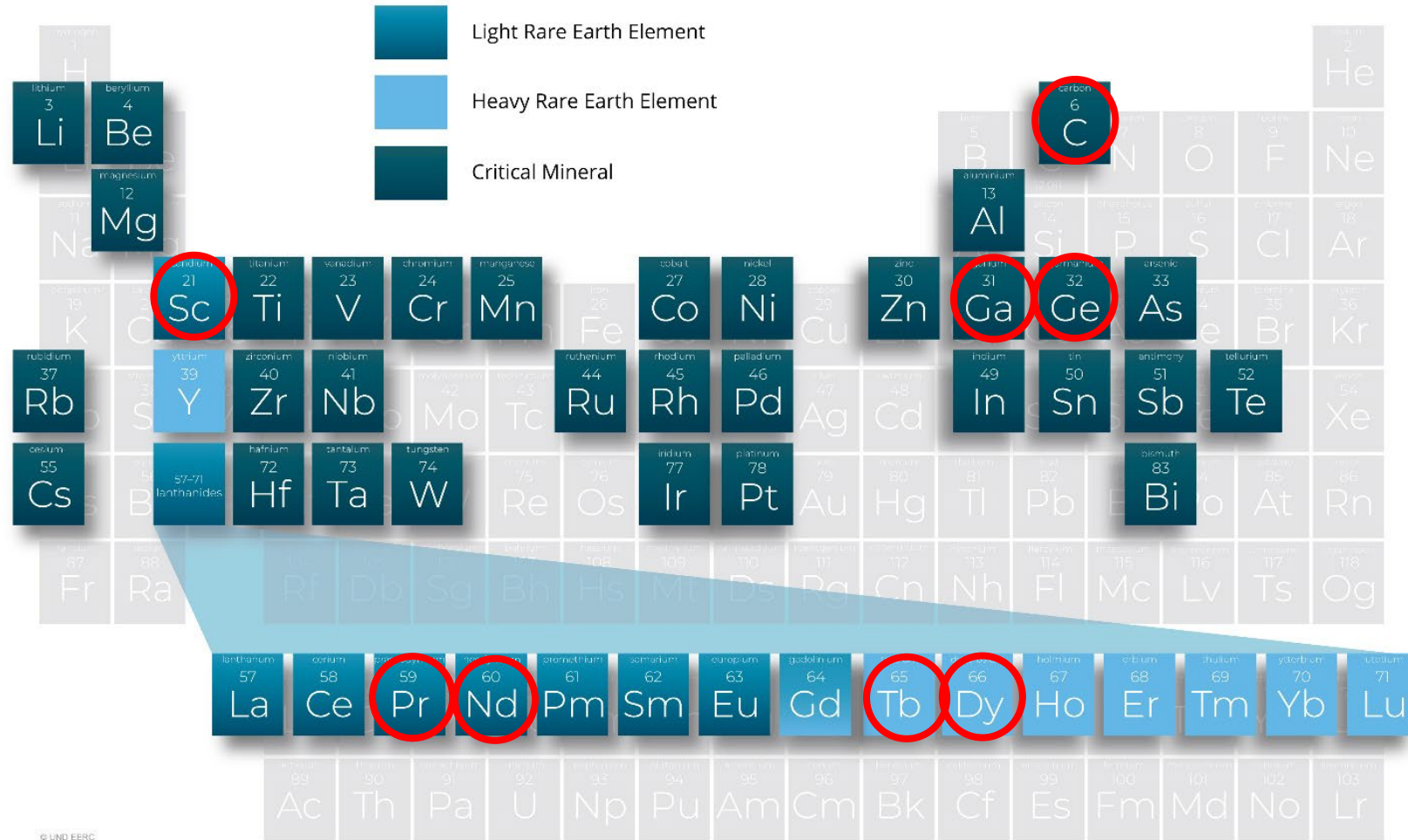


Critical Minerals

Defined by the Dept. of Interior

Critical Because of:

- 1) Importance to U.S. Economy
- 2) Risk to Supply Chain Disruption

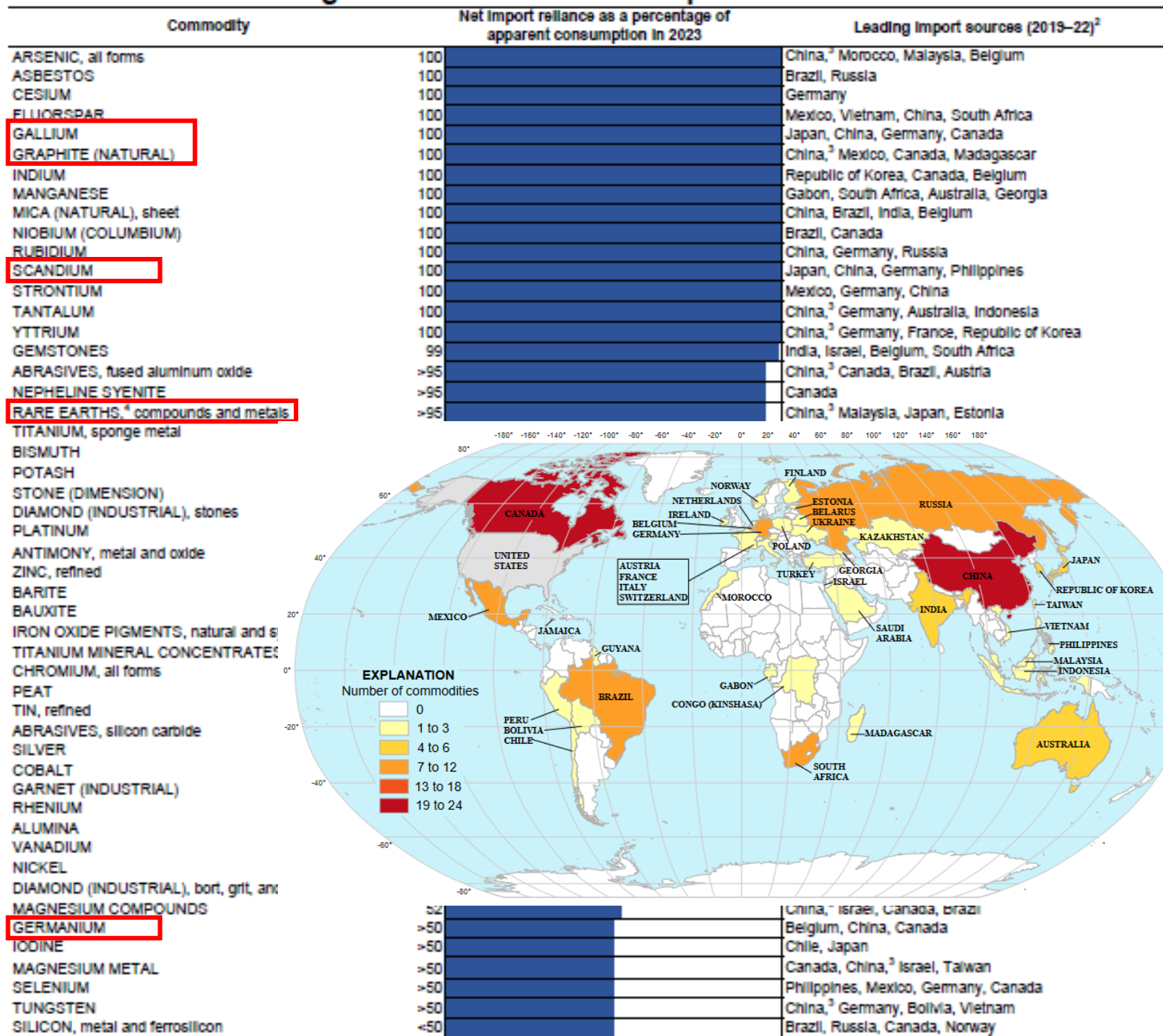


○ Primary economic drivers
for UND technology/project

Net Import Reliance

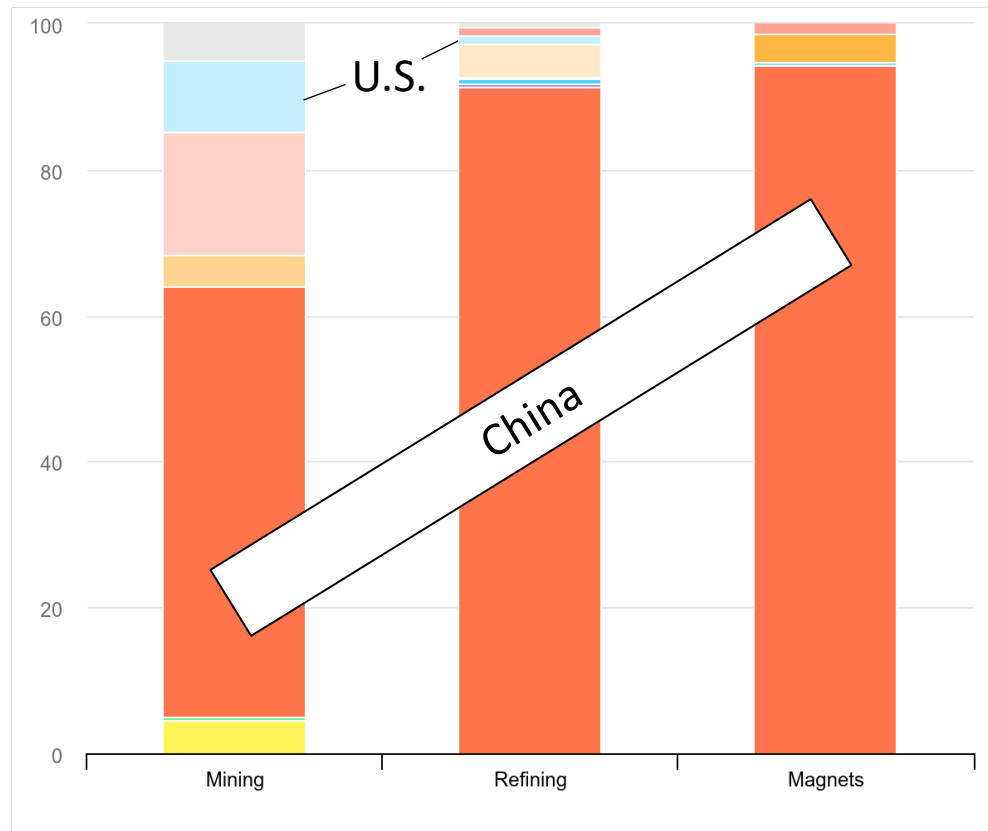
*2024 USGS Mineral Commodity Summary Reports – Minerals with >50% net import reliance

Figure 2.—2023 U.S. Net Import Reliance¹



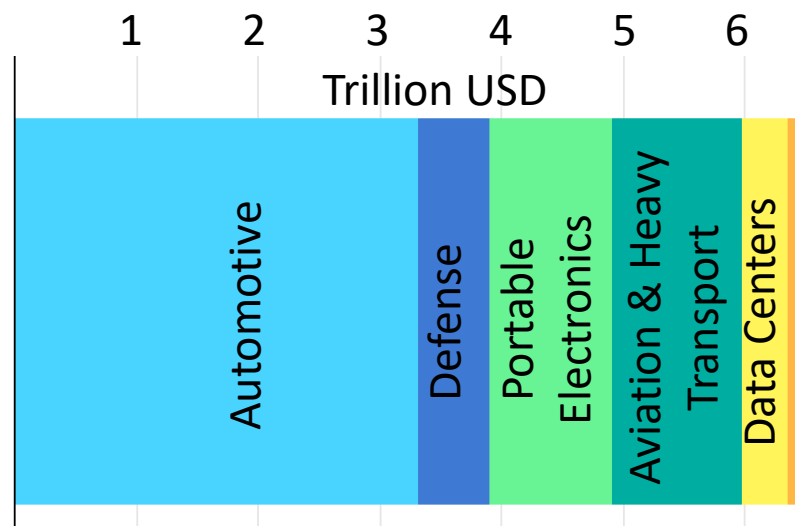
Rare Earth Elements

- Not actually rare, but very evenly dispersed in earth's crust – economic deposits are rare
- 17 individual metals with unique properties and dramatically different economic values
- Rare earth permanent magnets drive the REE markets



Share of Global Supply of Magnet REE and Magnet Manufacturing, 2024

- IEA (2026)



Economic Value of Downstream Production at Risk from Chinese Export Controls, 2025

-IEA (2026)

Germanium and Gallium

- Semiconductors
- Chip manufacturing
- Fiber optics
- LEDs

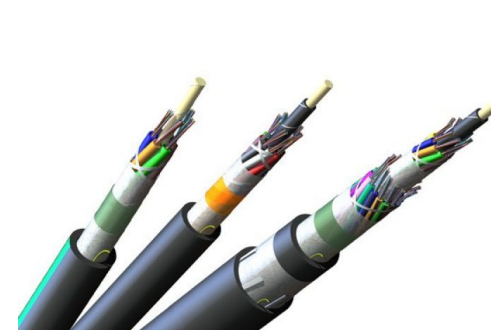
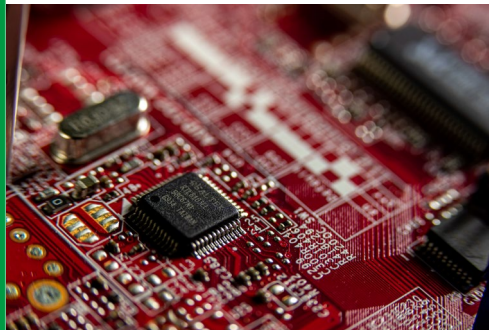
China export curbs choke off shipments of gallium, germanium for second month

By Reuters

October 19, 2023 10:16 PM CDT · Updated a year ago



Aa



Graphite

- Dramatic increases in demand projected with EV market

China's Jan-Feb graphite exports plunge amid export controls

China's graphite exports continued to fall in the first two months of 2024 after the implementation of the export controls on certain graphite-related products on December 1, 2023

March 25, 2024

By Sybil Pan

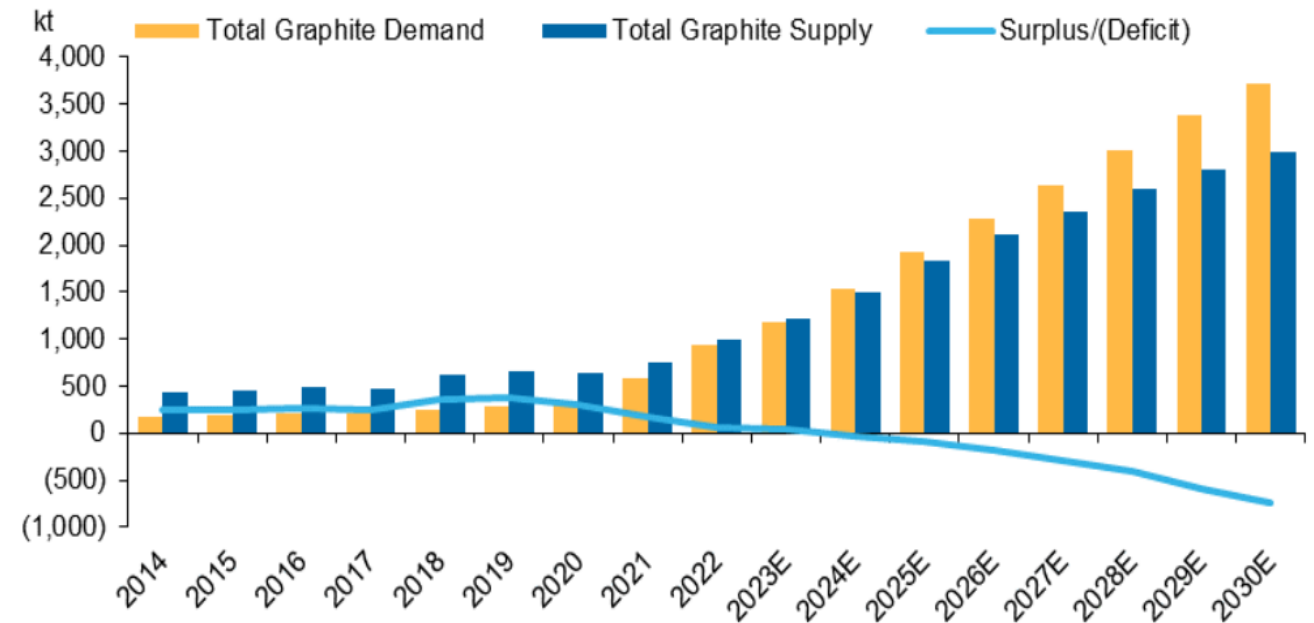


Image: <https://www.marketindex.com.au/news/macquarie-says-graphite-supply-needs-to-triple-to-meet-demand-3-asx-players>

Technology Development



Our Approach to Maximizing the Value of Both the Inorganic and Organic Fractions of Lignite

Lignite's unique high proportion of organically associated inorganic elements makes critical minerals recovery easier while purifying the carbon structure

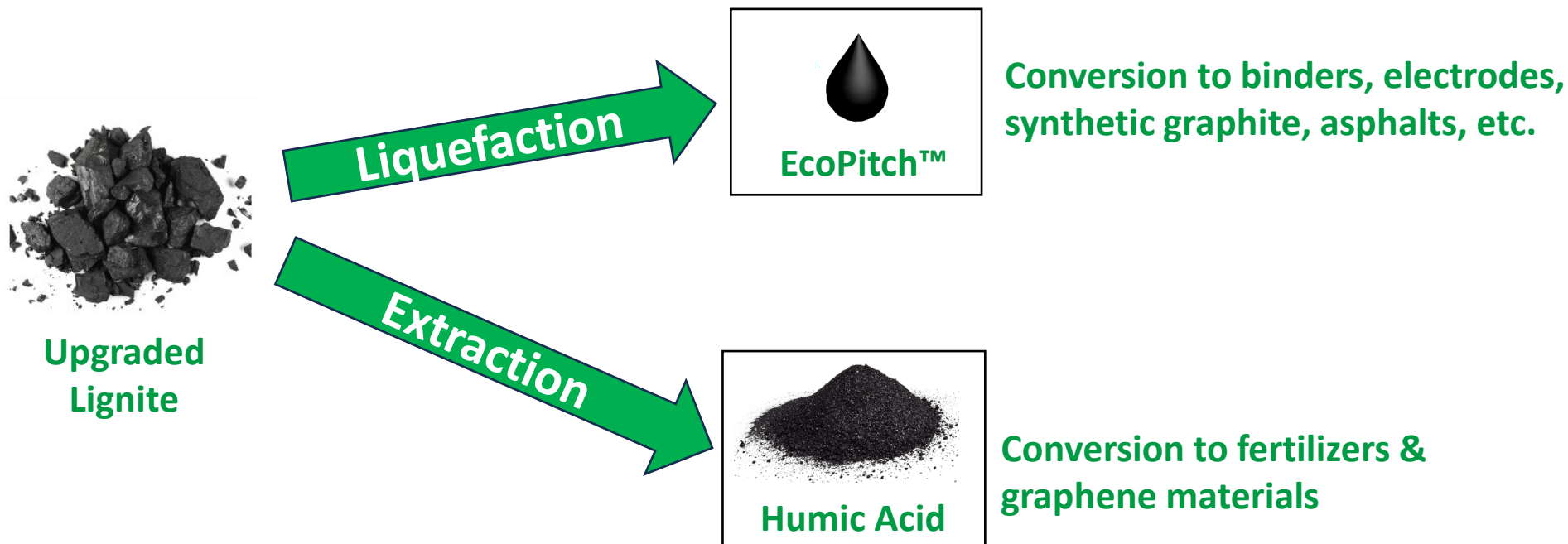


Easy to Extract!

High Purity Made Easy!

Two Complementary Carbon Products Pathways Being Developed

UND's REE technology is also "carbon upgrading" – monetizing the carbon is essential for economics



Our Technology Development



2016-2017: Lab-scale (60 g batches)

- **Key result:** Unique properties of lignite make it a valuable resource for REE recovery; patented UND REE extraction and concentration technology

2017-2020: Bench-scale (50 kg batches)

- **Key result:** High purity REE mixtures can be economically generated from ND lignite coal



2020-2025: Pilot-scale (500 kg/hour)

- **Key result:** Demonstrated technology at commercially-relevant scale in a continuous process & validated economic feasibility



U.S. DEPARTMENT OF
ENERGY



MICROBEAM
TECHNOLOGIES, INC.



AN ALLETE COMPANY

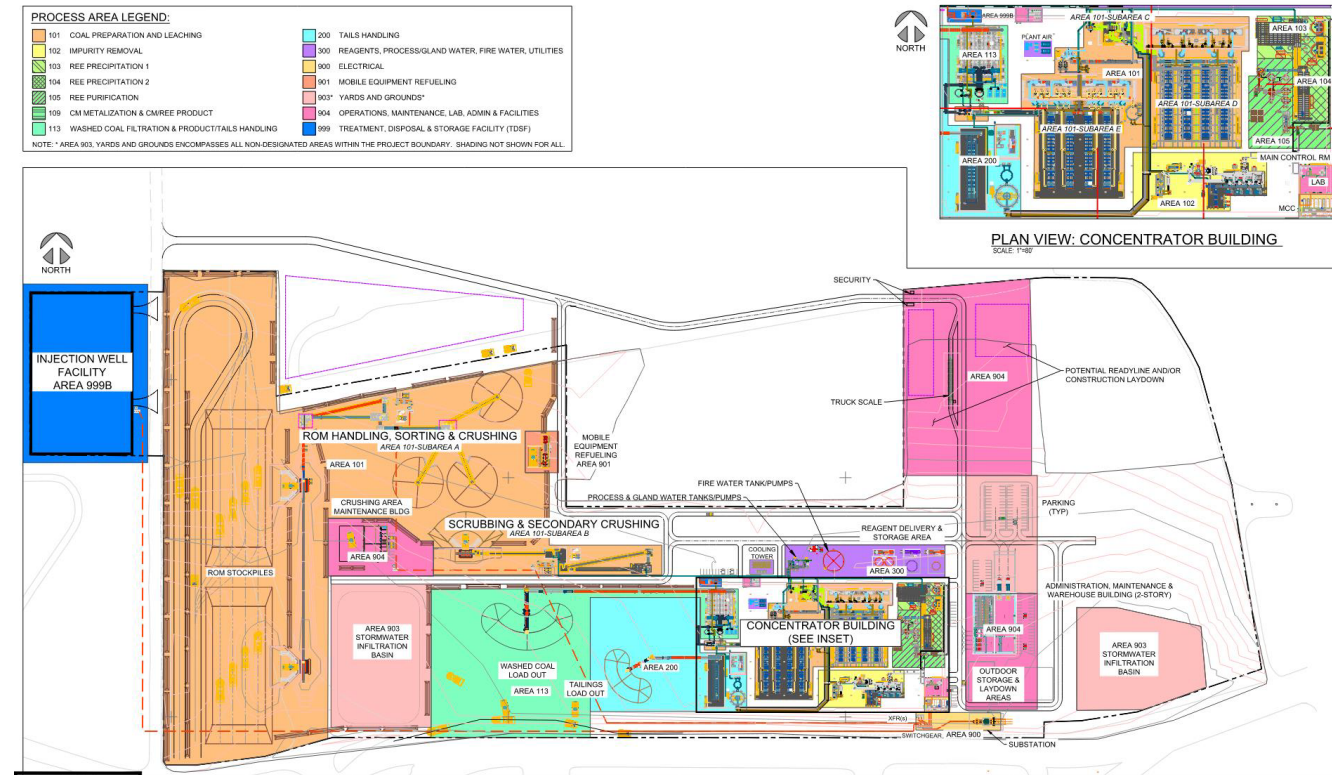


Front-End Engineering & Design (FEED) Study

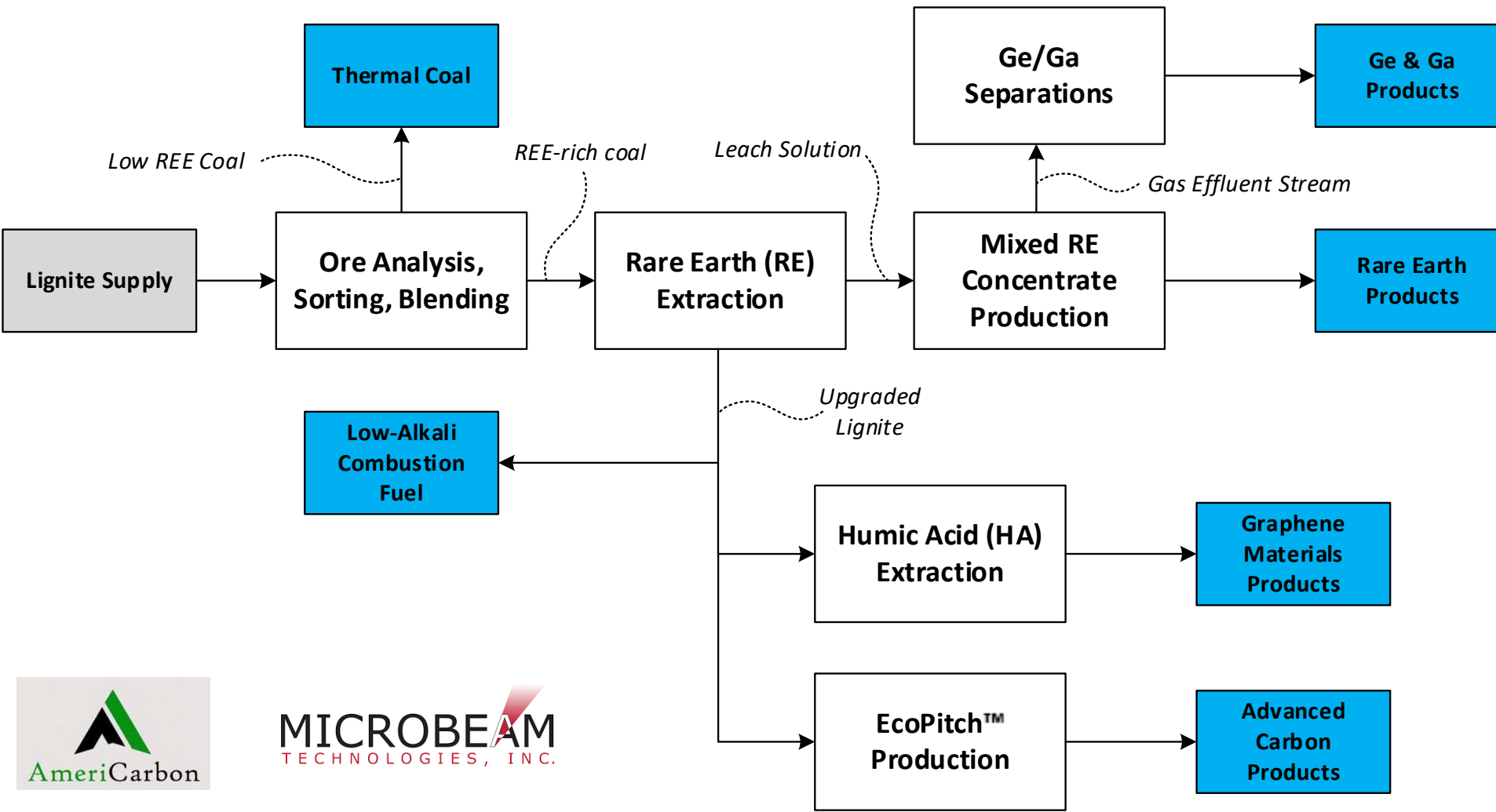
2023-2025: \$10M FEED focused on upstream concentration and downstream refining

Key results:

- Identified major technical and economic risk drivers
- Identified methods to reduce capital and operating costs and improve technology performance
- Developed commercialization plan



How This All Fits Together



Commercialization Plans

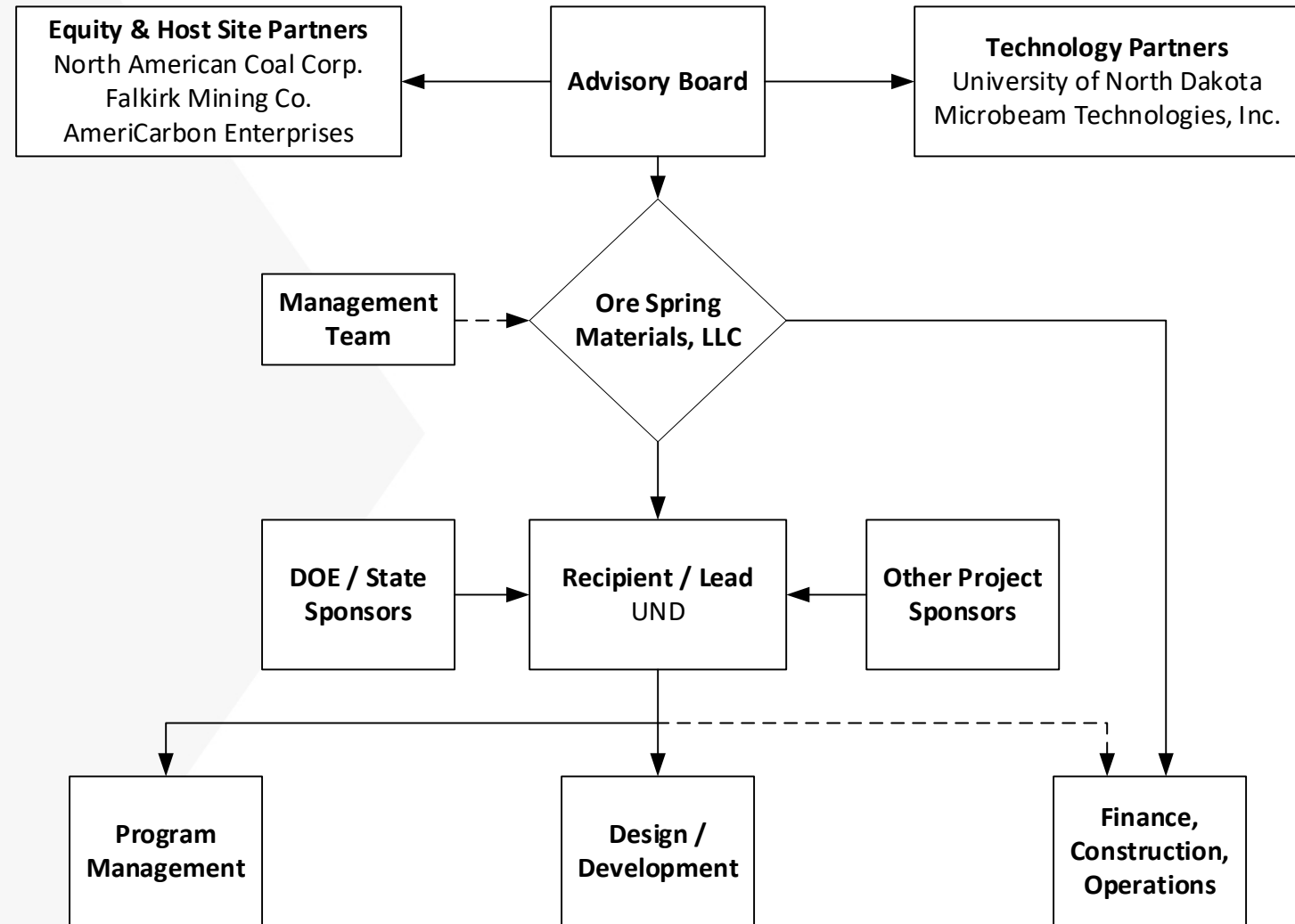


Commercial Demo at Falkirk Mine

- June 25, 2026 – selected for award negotiations by the Dept. of Energy
- Original DOE request was \$50 million for a \$100 million total project
- State date likely around Jan. 2027

Project Goals:

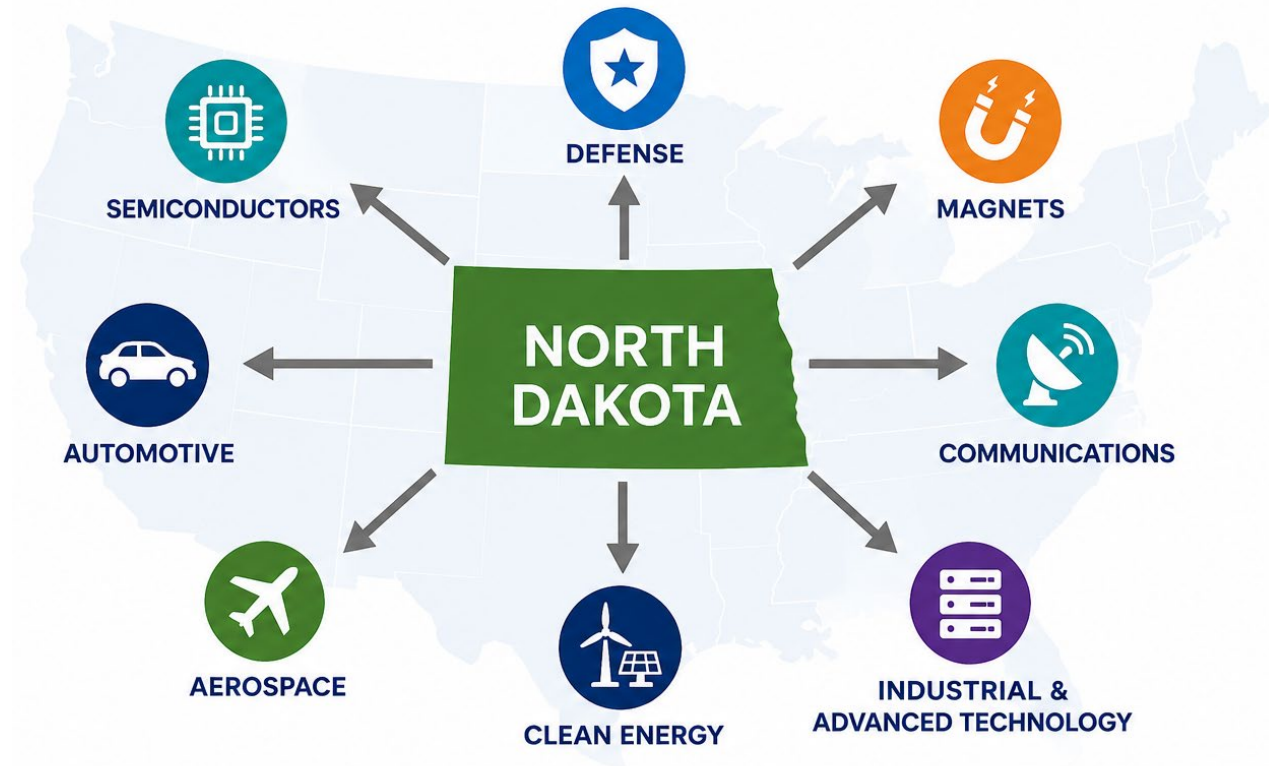
- De-risk underlying technologies – operating continuously over long periods at commercially relevant scale
- Validate engineering & economic assumptions
- Produce and sell products, generating cash flow positive net revenue and creating customer confidence
- Prepare the technology platform for future full-scale projects at multiple sites



Why this Matters to North Dakota

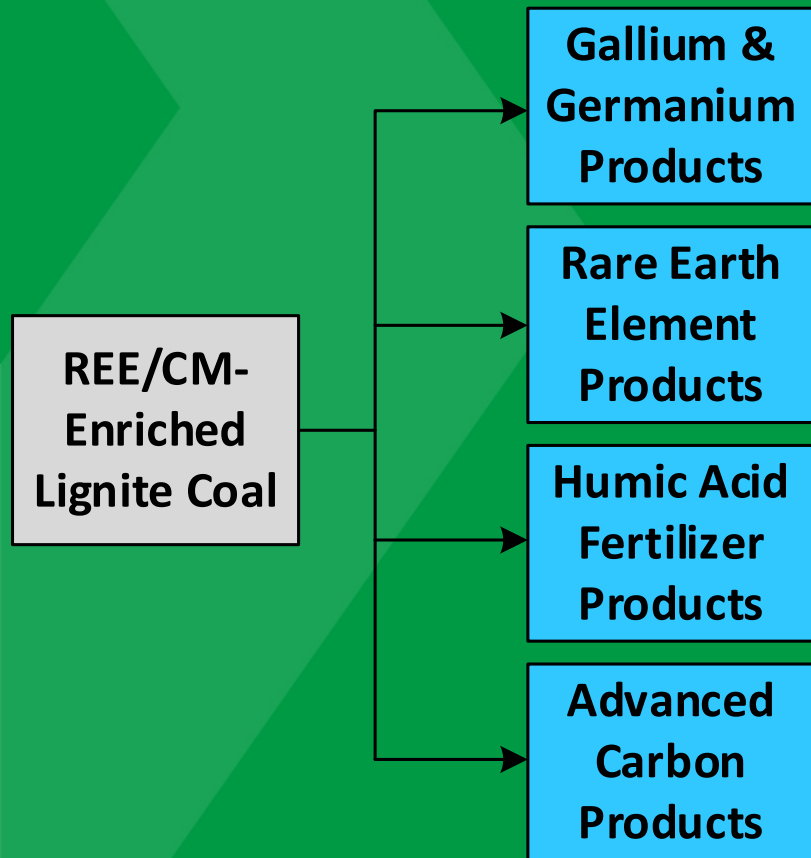
- First commercial-scale critical minerals demonstration in the State
- New value-added use for lignite – monetizing the full resource
- New fertilizer manufacturing
- New strategic materials supply for defense, energy & semiconductor industries
- Platform for future manufacturing investment
- Potential scaling and replication at additional ND sites

Positioning North Dakota as a National Critical Minerals Hub



Supplying Critical Minerals for America's Most Important Industries

Demonstration Project Details

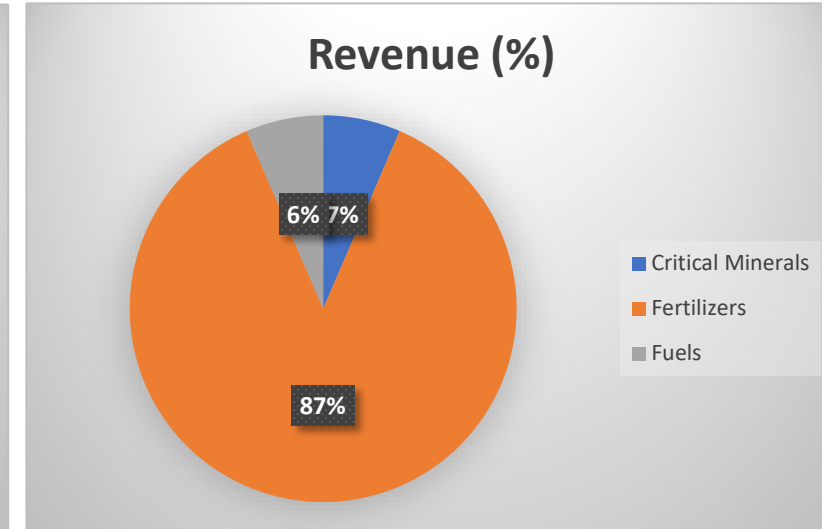
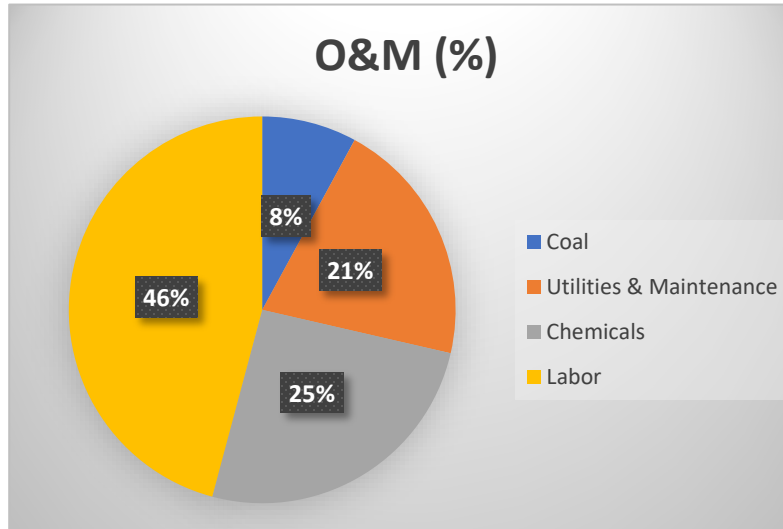


Current Planning Basis*

Capital Cost: ~\$60M (including engineering)

Operating Cost: ~\$13 million / year

Total Revenue: ~\$14 million / year



Illustrative Project Specs*: ~30k tpy lignite feed

- 5 tpy REE products
- 0.4 tpy Ga and Ge products
- 11k tpy fertilizer products
- ~20k tpy fuel products

** Project scope and cost will not be finalized until DOE award is finalized*

Demonstration Project Scope

Design / Development Phase: 15 months

- Pilot testing at UND and Microbeam: Finalize design parameters & advance product quality information
- Detailed engineering: ready-to-bid design package & Class 2 cost estimate
- Regulatory approvals / permitting
- Financing: final commitments for capital
- Business planning: Ore Spring Materials management and ownership structure

Construction Phase: 24 months

- Construct and commission the demo facilities
- Hire and train operations workforce
- Demonstrate production meeting customer requirements

Operations Phase: 21 months

- Long-term operations: Optimize plant and develop detailed performance and cost data
- Execute offtake agreements or establish spot-price agreements with customers for all products
- Update engineering and economics for full-scale projects – Sufficient to de-risk further investment

Plans After the DOE Funding Period

Falkirk Facility Continues to Operate

- Ongoing fertilizer production
- REE/CM facility remains operating continuously or periodically:
 - Long-term R&D
 - Product development (e.g., carbon products)
 - Customer qualifications
 - Operator training
 - Workforce development

Full-scale Deployment

- North Dakota – evaluate scaling opportunities at existing mines or new mines
- U.S. – evaluate other low-rank coal basins
- Outside U.S. – evaluate low-rank coals in allied nations (e.g. Bulgaria MOU signed)

Market Impact (each full-scale project)

Product	Full-scale Production (tonnes/yr)	% of U.S. Demand at Full-scale
REE Concentrate	90-350	1-2%
Ge Concentrate	3-7	10-21%
Ga Concentrate	2-5	20-50%
Humic Acid (fertilizer)	100,000-200,000	10-20%
Synthetic Graphite	10,000-30,000	2-7%

The Aspirational Opportunity for North Dakota

How can the State Help?

- Non-federal cost share for the DOE demonstration
- Continue support of R&D for technologies and resource exploration
- Support workforce development across the full value chain
- Position ND to attract downstream manufacturing industries

THE RARE EARTH VALUE CHAIN

Small volumes of rare earths create extraordinary value.



**NORTH DAKOTA IS AT THE BEGINNING OF ONE OF
THE WORLD'S HIGHEST-VALUE MANUFACTURING SUPPLY CHAINS.**

Dan Laudal, Ph.D.

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