WHY DO CRITICAL MINERAL BUSINESS IN THE BASIN?
OUR STRENGTHS, OUR ASSETS, OUR NEEDS
January 11, 2023
THANK YOU TO OUR SPONSORS
PRESENTERS

Jason Laumb, Director
Advanced Energy Systems, EERC

David Flynn, Research Director
Institute for Policy & Business Analytics
Nistler College of Business & Public Administration
Webinar Series Events

Last Year

- Critical Minerals: What, How, Why All the Hype?
  September 21, 2022

- Today’s Critical Mineral Technologies and How to Move Forward
  November 30, 2022

www.undeerc.org/wb-corecm
(or scan the QR code)

Today

- Why Do Critical Mineral Business in the Williston Basin?
  Our Strengths, Our Assets, Our Needs
  January 11, 2023

- Securing the Williston Basin’s Critical Mineral Future:
  Findings and Next Steps

POSTPONED
Defining Critical Minerals

Critical Minerals

Rare-Earth Elements (REEs)
- Not rare but found together
- Chemically similar and difficult to separate
- Each with a different use

Critical Minerals (CMs)
- Catch-all term for the critical minerals that are not REEs
- No other common factor
Critical Minerals Play a Vital Role in Our Modern Economy and National Security
More than 80% of U.S. critical minerals are imported.
Elements with Greatest Potential to Contribute to the Williston Basin Market
Developing New Sources and Innovative Ways to Extract CMs and REEs

Existing Lignite Coal Mines

Produced Water

ND Shales: Pierre, Niobrara, Upper and Lower Bakken

Deep Unminable Coal Seams by In Situ Extraction

Coal Ash
How Do We Move Forward?

Evaluate technologies with:
• Ore and reserve in mind
• Current technology scale
• Market needs
JASON LAUMB

Director, Advanced Energy Systems
Energy & Environmental Research Center
University of North Dakota
Business Boundary Timeline and Team

STAGE 01: Existing Infrastructure
STAGE 02: Businesses and Industries
STAGE 03: Market Assessment
STAGE 04: Infrastructure and Supply Chain Gaps

Jason Laumb, Angie Morgan, and others
David Flynn
UND Nistler School
Dean Bangsund
Ag Economics
Strategy – Our Strengths, Our Opportunities

- Identify basin infrastructure, businesses/industries, and economic challenges.
- Identify markets, barriers to market penetration, size, distribution, and needs.
  - Competitive environment
    - What is the competition?
    - How is this product superior?
      - Lower CO₂ footprint?
      - Cheaper?
      - Available?
Advantageous Transportation Infrastructure

- Rail
- Truck
- Port in Duluth
Strategy – Our Products

Raw REEs/CM?

Final Products?

- Magnets
- Aggregate
- Computer components
- Graphite/graphene
- Batteries
Strategy – Our Needs

- Additional infrastructure and resources
- Ideas to spur economic growth
- Logistical needs to fill supply chain gaps
International Energy Agency 2040 Demand Scenarios

Production increasing
- Meet climate goals
- Meet computer and electrification needs

Production for some elements will need to increase by many times the current rate.
NEAR-TERM OPPORTUNITY

• Synthetic graphite: $22,000 per ton
• Expected new market over 1 million tons per year by 2025
Recycling

- Magnet elements are near-term target:
  - Neodymium
  - Praseodymium
  - Dysprosium
  - Terbium
- Turbine motors
- MRI machines
- Hard drives

Image Credit: Mart Production/Pexels
Barriers: Limited Market Penetration and Price Control

Market Assessment
• Key barrier – market penetration
  – Large purchase agreement
  – China controls the price!
• Use of CMs in our region?
DAVID FLYNN

Research Director
Institute for Policy & Business Analytics
Nistler College of Business & Public Administration
University of North Dakota
Opportunities Exist to Enter

• Most research suggests the cost structure of firms in the supply chain and the nature of demand do not favor monopoly.

• This depends crucially on access to infrastructure:
  – Transportation
  – Energy
  – Water
  – Labor

• Production and reserves are currently highly concentrated globally.

Photo: Mo Eid
2020 Annual Production of Rare-Earth Elements

Source: U.S. Geological Survey
2020 Annual Reserves of Rare-Earth Elements

Source: U.S. Geological Survey
Demand for products using rare-earth elements is high.
Cellular Subscriptions per 100 People

Source: World Bank Indicators
Price Factors Are Vital to Business Growth

• Within extractive industries, the price level is an important factor determining firm entry, exit, and profitability.

• Equally important from the perspective of risk mitigation is the variability of prices and the inflation rate.

• These prices displayed significant volatility over the last several years.
Understanding Price Fluctuations

• Right now, there is no singular price series for rare earths.
  – Mining Producer Price Index shown as something that might be comparable
• Not all the rare earths move the same, although overall the pattern is pretty clear.
Rare-Earth Inflation and Mining PPI

- Yttrium
- Lanthanum
- Cerium
- Praseodymium
- Neodymium
- Samarium
- Europium
- Gadolinium
- Terbium
- Dysprosium
- Mining PPI
Not All Rare Earths Are Created Equal

- At different times, the demand, supply, and innovation factors influence price fluctuations.
- We highlight a few of the current key ones right now.
- Notice they experienced some of the highest inflation volatility.
Select Rare Earths

Source: U.S. Geological Survey
What Is Unknown?

• Innovation is difficult to predict; equally difficult to determine are the economic consequences of any innovation.

• Broader economic circumstances and policy, such as interest rates, matter and can impact the benefit-cost calculations at the firms.

• Is the U.S. government going to engage in policy actions to support the industry?
  – National security and interest
  – Economic security
Williston Basin as a Business Hub

• Williston Basin possesses natural risk mitigation attributes:
  – Transportation
  – Water availability
  – Energy
• These factors contribute to the protection of capital investment.
David Flynn
Research Director, Institute for Policy & Business Analytics
Nistler College of Business & Public Administration
david.flynn@und.edu
701.777.3356 (phone)
Key Findings

• Regional industries
  – End users of final products
  – Defining business model
Key Takeaways

1. Critical mineral users and markets are influenced globally.
3. Key market barrier is the buyer.
Jason Laumb
Director of Advanced Energy Systems Initiatives
jlaumb@undeerc.org
701.777.5114 (phone)
Carbon Ore, Rare Earth, and Critical Minerals Initiative (CORE-CM)

U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL)-Led Program

- Catalyze economic growth.
- Job creation in energy communities.
- Energy communities not to be left behind.
- Domestic production of REEs and CMs.
- Strengthen our national economy and security.
13 CORE-CM Initiative Teams

US BASINS
1. Appalachian Basin, North
2. Appalachian Basin, Central
3. Appalachian Basin, South
4. San Juan River-Raton Basin
5. Illinois Basin
6. Williston Basin
7. Powder River Basin
8. Uinta Basin
9. Green River-Wind River Basin
10. Gulf Coast Basin
11. Alaska Basin
12. Cherokee-Forest City Basin
13. Mid-Appalachian Basin

Source: NETL
Williston Basin CORE-CM Project Team

UND Energy & Environmental Research Center
UND Institute for Energy Studies
UND Nistler College of Business & Public Administration
Pacific Northwest National Laboratory
North Dakota State University
Montana Tech University
Critical Materials Institute (Ames)
Basin Electric Cooperative
BNI Energy
Current Lighting Solutions
General Atomics
Illinois Geological Survey CORE-CM Team
Lignite Energy Council
Minnkota Power Cooperative
North American Coal
North Dakota Department of Commerce
North Dakota Geological Survey
North Dakota Governor’s Office
Northrup Grumman
Semplastics
South Dakota Geological Survey
U.S. Geological Survey
University of Alaska CORE-CM Team
University of Utah CORE-CM Team
Western Dakota Energy Association
Wyoming School of Energy Resources CORE-CM Team
THANK YOU TO OUR SPONSORS
ACKNOWLEDGMENT

This material is based upon work supported by the U.S. Department of Energy National Energy Technology Laboratory under Award No. DE-FC26-05NT42592.

DISCLAIMER

This presentation was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government, nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
NDIC DISCLAIMER

This report was prepared by the EERC pursuant to an agreement partially funded by the Industrial Commission of North Dakota, and neither the EERC nor any of its subcontractors nor the North Dakota Industrial Commission nor any person acting on behalf of either:

(A) Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

(B) Assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this report.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the North Dakota Industrial Commission. The views and opinions of authors expressed herein do not necessarily state or reflect those of the North Dakota Industrial Commission.
Webinar Series Events – Watch Your Email for Future Invites!

Securing the Williston Basin’s Critical Mineral Future: Findings and Next Steps

Because of recent and unexpected new opportunities for the Williston Basin CORE-CM Initiative, we are postponing the fourth webinar until we can fully incorporate our findings into an update.

Visit us online!
• Learn more about the Williston Basin CORE-CM Initiative.
• Listen to past webinars and presentations.

www.undeerc.org/wb-corecm (or scan the QR code)
Questions?