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NRRI Update

MVP Meeting
Chisholm, MN

21 October 2026





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Topics

JRA-IMPACT

Highlights

- State & Regional
- Federal
- Industry
- New Opportunities





Joint Research Alliance IMPACT

Partnership Between:

National Laboratory of the Rockies

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Joint Research Alliance for
Innovative **M**aterials and **P**rocessing for **A**dvanced **C**ritical **T**echnologies

Complementary Capabilities to Solve BIG Things

National Laboratory of the Rockies

Energy systems

AI modeling

Materials

Grid-interactive Testbed

Partnerships

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Pilot-scale processing

Geology/Metallurgy

Feedstock Evaluation
(mineral, biomass)

Ecosystem Resilience

Partnerships

JRA IMPACT

Technology Demonstration at Industrial Pilot Scale


AI/Digital Twin, Validation, and Scale-up
Water, Byproduct, and Waste Management
Processing, Comminution and Liberation System
Feedstock and Materials Characterization
Thermal Processing and Management
Integrated IMPACT Platform
NRRI NLR ESNet
Partnerships and commercialization
Electrochemical and Metallurgical Recovery
Separation and Concentration Process
Integrated Energy Systems and Controls

Emerging Mineral Resources Paradigm

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Integrated Approach

- Process trains
- LCA

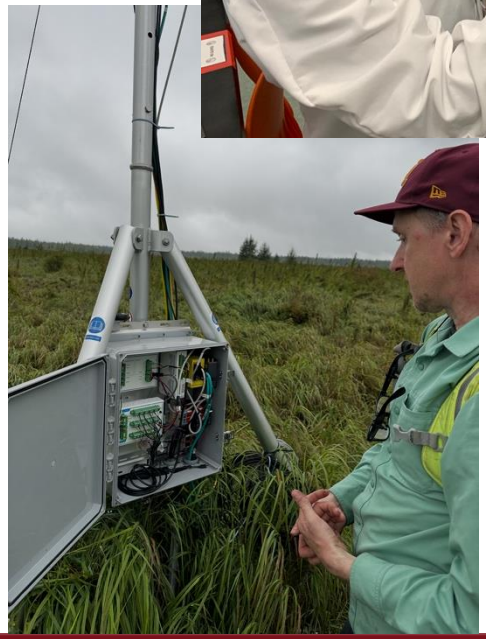
Expanded Definition

- Ores
- Lean Ores
- Tails
- Reclamation
- Water

“Get it all”

- Metallics
- Byproducts







State & Regional Highlights

Minnesota Industrial Transformation Roadmap

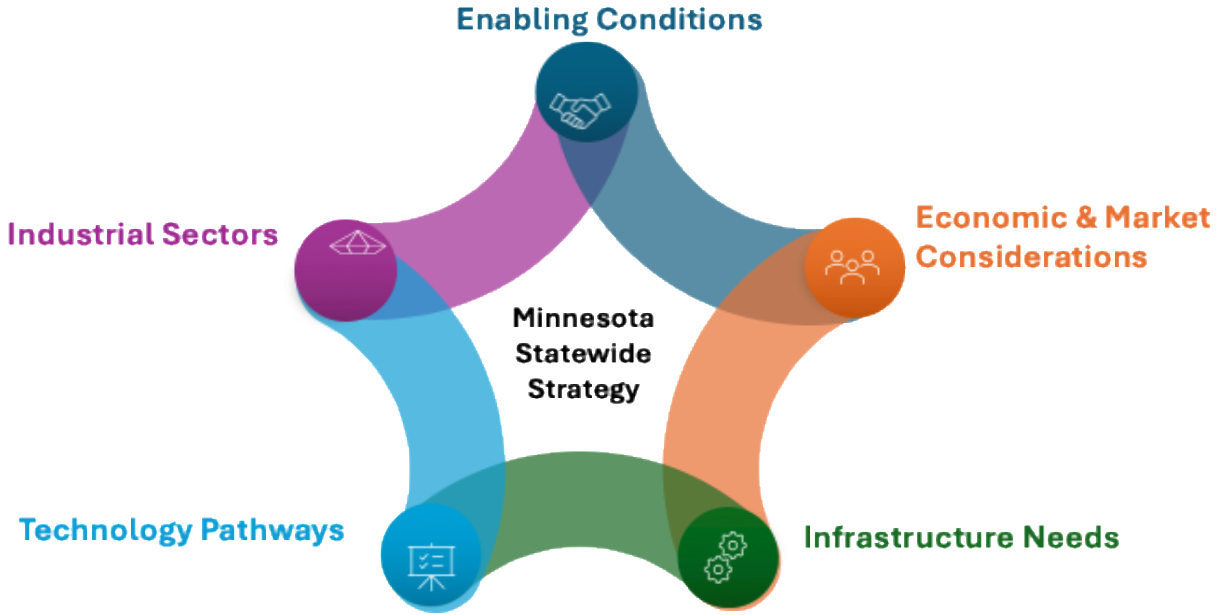
*A practical **framework** to help Minnesota identify, prioritize, and guide industrial transformation opportunities*

MINNESOTA POLLUTION CONTROL AGENCY

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5lakes energy

GREAT PLAINS INSTITUTE



Food & Beverage
Mining
Energy
Bioeconomy/Fuels

Other State Efforts

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Water Treatment Technologies (MPCA)

- Sulfate (+ Phosphate, Nitrate, Mercury, Copper, Magnesium, Sulfur)
- PFAS materials

Geologic Hydrogen Evaluation (state & federal)

- Understand the resource and technologies
- Determine feasibility, safety

NRRI DRI Simulator Ribbon-Cutting

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July 30, 2026

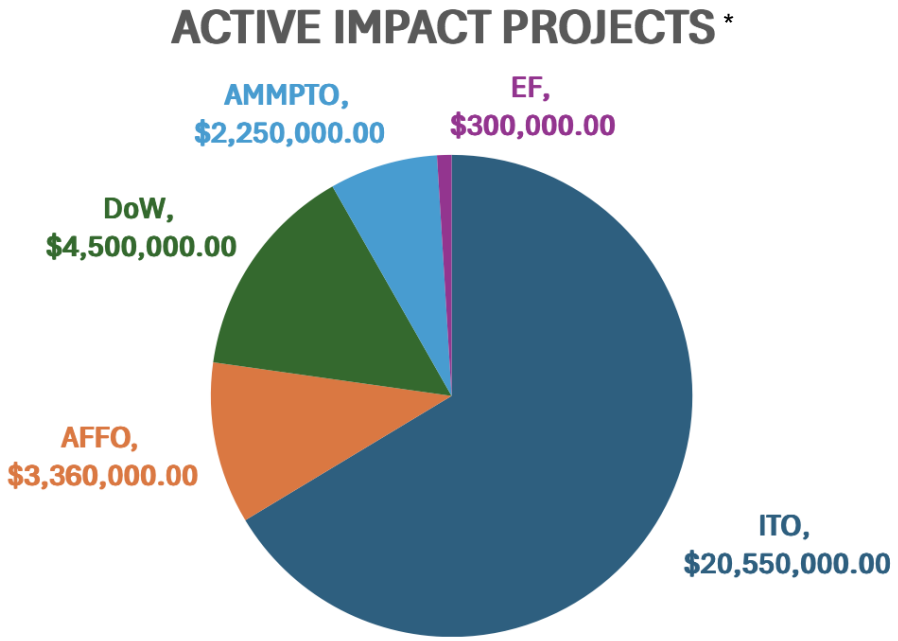




Federal Highlights

Overview of Portfolio

- Current projects
  - 12 current projects
  - ~$30M
  - ITO, AMMPTO, AFFO, DoW
- Featured projects
  - **TERI (Tramp Element Removal Incubator)** – ITO Center of Excellence, ($5M)
  - **Critical Material Recovery from High Performance Alloy Waste Streams** – DoW (ESTCP), $4.5M
  - **Mines of the Future - Reducing Energy Demand in U.S. Sulfide Ore Processing through Advanced Chemical and Comminution Techniques –** AMMPTO, $1.75M



* (as of 9/2026)

US DOE - ITO Projects

Sponsor	ITO	ITO	ITO	ITO	ITO	ITO
Abbrev. Title	Engineered Biocarbon for EAF	Enhanced Pellet Chemistry	Graphite Core Induction Smelting (GCIS)	Transformative Iron Flowsheet of the Future	Incubator for Critical Steel Technologies (TERI)	Library for Iron Ore and Steel Scrap (LIOS)
Lead (Partners)	**NRRI** (Nucor, Metcovery)	**NRRI** (NLR, Nucor, ArcelorMittal U.S. Steel)	**NRRI** (NLR, Metcovery)	**NRRI** (NLR, UM-Duluth)	**NLR** (NRRI, MS&T, CMU CSM, ASU, MIT)	**INL** (NLR, ORNL, NRRI, Vale, ArcelorMittal, Mesabi Metallics, DJJ Nucor, SSAB, Fortescue, CMP, NIST)
Federal Budget Duration	$2.9M 3 years	$2.1M 5 years	$3.0M 3 years	$3.1M 3 years	$1.0M (NRRI) 3 years	$1.2M (NRRI) 3 years

RD&D

Center of Excellence – Enhanced Scrap Steel Recycling

Recovery of copper, nickel, and other critical materials from scrap streams will help domestic critical mineral supply chains and enhance recycled steel quality.

- DOE funded program – JRA-IMPACT
- Recycled steel scrap primarily used for low-value products like rebar
- Reclaiming tramp elements (e.g. copper, nickel) will also increase quality of recycled steel

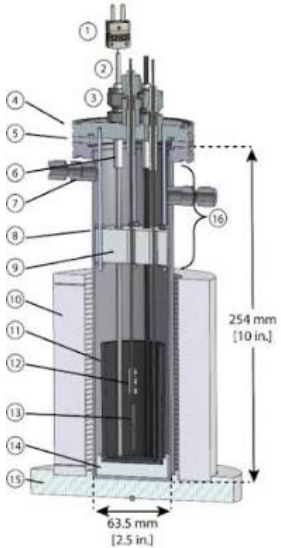


RD&D

US DOW ESTPC Project: Demonstration Center for Critical Material Recapture

Molten salt electrochemical recovery of critical minerals (Scandium, Lithium) from high-temperature, aerospace aluminum alloys







ScienceDirect

Industry Highlights

Emerging Industry

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Tailings Processing

- Retrieve base metals, trace critical minerals
- Remove tailings hazards

Advanced Iron Products; New Processing Technologies

- New iron units
- Batteries, magnets
- Semiconductors

CO2 Electrochemical Recycling

Emerging Industry

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Engineered Biocarbon for Metallurgical Applications

Retrieval of Resources from Copper Slags

Critical Material Separations – Ores, Alloys

New Opportunities

New Opportunities

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Philanthropic Interest

- Community engagement
- Tribal opportunities
- Emerging technology investment; *fast demonstration capacity*

International Partnerships

Tribal Economic Development

Feasibility study for tribally owned solar on-site at large industrial facility. (Aug 2026)

- 9.9-megawatt solar array, build behind the meter at a Northern Minnesota-based iron pellet plant.
- Solar array owned, operated, and controlled by a consortium of tribal entities.





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