

## Applied Research Delivers Technology Solutions for Minnesota Challenges

This funding promotes partnerships with state agencies and delivers real-world solutions for Minnesota to accelerate the adoption of technologies that address water and mineral challenges.

### MN Water Challenges

- Minnesota has the world's lowest sulfate standard to maintain the health of natural wild rice.
- Minnesota has severe nutrient (phosphate) burden in water bodies and PFAS (forever chemicals) in landfill leachates.

#### NRRI SOLUTIONS

*The following are currently included in the Governor's Budget MPCA Biennial Budget Change Item: Innovative Solutions for Managing Pollutants (\$2.1M)*

- **Meeting Minnesota's Sulfate Standards:** Reduce water sulfate levels in municipal and industrial facilities by piloting innovative, low-cost technologies. **Request: \$700,000**
- **Removing Phosphate Nutrients:** Remove phosphate from water bodies using a pilot-scale process that employs renewable biocarbon (biochar) and waste iron resources. **Request: \$600,000**
- **Removing 'Forever Chemicals':** Treat landfill leachate with application of engineered biocarbon materials to filter and remove PFAS chemicals. **Request: \$800,000**

### MN Mineral Challenges

- Since the 1960's, MN's iron mining industry has been based upon the state's taconite ore resources and process technology.
- Today's ores are finer, more complex and more oxidized – increasingly difficult for the taconite process.
- Legacy stockpiles, waste piles and tailings have ecosystem impacts but represent value opportunities.

#### NRRI SOLUTIONS

**Iron of the Future:** NRRI's critical long-term program to characterize MN's iron resources and develop next-generation process technologies for new iron products with reduced effluent to protect MN freshwater resources. **Request: \$900,000**



Developing sulfate solutions to meet Minnesota's water standards.



Helping the Iron Range develop next-gen iron technologies.

### Outcomes for Minnesota

1. Economically feasible water treatment options using MN resources.
2. A value-add portfolio of iron products including media for **Form Energy's** iron-air battery; *a disruptive technology opportunity for Minnesota.*
3. Derived value from legacy mineral resources.

# Introduction to NRRI

The Natural Resources Research Institute (NRRI), a nationally-unique entity, was established by the state in 1983. It delivers integrated research solutions to support the stewardship of Minnesota's natural resources via three strategic initiatives.

## NRRI Mission

Deliver integrated research solutions that value our resources, environment and economy for a sustainable and resilient future.



## Iron and Minerals of the Future

Developing carbon-neutral mineral resource extraction and processing strategies with reduced water, energy and effluent to support a portfolio of high-value products.

- Characterize remaining ore reserves; develop beneficiation strategies
- Reduce energy, water, effluent, and environmental impacts of our mineral activities
- Decarbonize production of iron, steel, other metals and related products



## Future Forest Industries

Demonstrating technologies to transform renewable biomass and organic waste streams into refined, engineered carbon materials.

- Model forest composition, function, harvest scenarios and climate change
- Develop hybrid plant species for biomass, biofuels and bioplastics
- Develop partnerships in engineered forest product opportunities
- Convert biomass into energy and value-add carbon products



## Ecosystem Resilience

Understanding relationships between water, land and mineral resources to manage societal needs and impacts.

- Measure and assess ecosystem disturbances
- Understand ecosystem integration and interactions regarding land use issues and climate change
- Demonstrate strategies and technologies to mitigate impacts to land and water ecosystems

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**NRRI develops and maintains long-term working relationships with our partners in industry, agencies, academia, NGO, tribal governments, and the public to carry out our mission.**

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