

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

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.
