

NRRI Now

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February News from NRRI

There was a time in the 1980s when the economy of northeastern Minnesota was so depressed, a local business person put up a billboard that said: "Will the last one leaving Duluth please turn out the light."

But that downturn spurred a lot of economic development energy, including the formation of NRRI by the Minnesota State Legislature. Today, the lights are on and the Arrowhead is attracting talent and technology with a vibrant entrepreneurial ecosystem. Read about it below.

Thanks for staying in touch. Please share this newsletter with friends and colleagues.



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Our Mission

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

**Natural Resources
Research Institute**

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NRRI finds unique niche in NE MN entrepreneurial ecosystem



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June Breneman

Entrepreneurs find support organizations working together on their behalf in Northeast Minnesota to drive success.

“The region’s success is dependent on our collaboration.” Michael Colclough, Northland SBDC Regional Director

When a key piece of equipment quit on potter/artist Karin Kraemer, the manufacturer estimated it would take 8 to 10 weeks to repair.

“And that was devastating. I use this every single day,” said Kraemer. “It’s critical to my business.”

But when she looked in her own community for solutions – a local millwright, a manufacturer of parts – they took the machine apart and put it back together, operational once more, in just two days.

“And they showed me how the machine works and how to fix it myself!” she exclaimed.

Kraemer, owner of [Duluth Pottery](#) in the now-thriving Lincoln Park neighborhood, is a cheerleader for the entrepreneurial team spirit in Duluth. She has leaned on support from some of the many organizations in the Arrowhead region that each have a niche in helping entrepreneurs – from idea to development to funding to startup to (hopefully) success.

“Not only do we have a great network between our businesses, we have the [Entrepreneur Fund](#), and [Ecolibrium3](#) and [NRRI](#),” said Kraemer. “I don’t know of any other place with all the resources I have right here in town.”

She received financial and ongoing consulting assistance from the Entrepreneur Fund. Ecolibrium3 organized revitalization of the Lincoln Park Craft District to attract small, local businesses. And Kraemer is now engaging with NRRI to develop an idea she has for a new product.

Wide, Deep Base of Support

In all, there are an estimated 60-plus organizations that – in their unique way – make up the Arrowhead’s “entrepreneurial ecosystem.” And this, on top of the neighborly business network.



Left: Business owner and artist, Karin Kraemer, stands in front of her pottery studio in the Lincoln Park Craft District.

“If you think about a healthy ecosystem in nature, it’s balanced and sustainable. And with our entrepreneur ecosystem, each organization fills a unique niche and they work together,” said Tim White, NRRI Business Development manager. “That’s a model for what a good support system looks like.”

And now the State is solidifying that model to understand the overlaps, the gaps and how to measure success with an umbrella initiative called [Launch Minnesota](#). Now one year old, the state-wide, collaborative effort has catalyzed conversations with entrepreneurial support organizations, streamlined access to capital and mapped the resources available.

The program recently provided grant funding to the [Itasca Economic Development Corporation](#) (IEDC) to build that hub of support for Northeast Minnesota. And Tamara Lowney has big plans for the program.

“That means we’ll get state funding for education and outreach to entrepreneurs,” explained Lowney, IEDC president and CEO. “We’ll put a heavy focus on tech, incorporate training and develop a speaker series... We’ll build a strategic plan to welcome entrepreneurs to the area.”

The IEDC hosts one of six regional Small Business Development Center sites which allows it to provide hands on business consulting throughout Itasca County at no cost to the client.

“We’ve been really busy with a loan program to help businesses during the COVID pandemic,” said Lowney. “Our challenge is to find the entrepreneurs, pull them out of the woodwork and engage for their success.”

The Entrepreneur Fund – specifically created in the late 1980s to spur entrepreneurship in the Arrowhead region – also has two Women’s Business Center programs to support women entrepreneurs. Sandi Larson is the Director of the Women’s Business Alliance North and provides business advising directly with women. One of the hurdles women are still working to overcome is the fact that up until the 1980s, a woman couldn’t get a bank loan without a co-signer.

“There’s a lingering perception that women might be more likely to fail at business. It’s harder for them to get a loan,” said Larson. “We have programming focused on things they care about, like how to access capital, strategic planning, and networking with other women business owners.”

But more than just removing barriers to accessing financing, the Entrepreneur Fund advises, reviews business plans, provides access to capital, and connects business owners to the resources they need.

The [Northland SBDC](#) is also laser-focused on building small business success, with access to flexible capital. They have 23 consultants and provide accounting and marketing expertise. But it doesn’t try to go it alone.

“The region’s success is dependent on our collaboration,” said Michael Colclough, Northland SBDC regional director. “We have a really healthy lending ecosystem and healthy technical assistance available, like what NRRI provides.”

The Iron Range has its own economic engine in the [Department of Iron Range Resources and Rehabilitation](#). Commissioner Mark Phillips describes their niche as “bringing together the funding and partnerships that form the economic landscape of the region -- industry, technology, workforce, education and communities.”

Phillips, a NRRI Advisory Board member, keeps the ties between Iron Range Resources & Rehabilitation and NRRI strong. “We like the NRRI model because it brings the university

resources to the table, good scientists and professors who might have an innovation,” he said. “NRRI’s technical expertise in natural resources is critical.”

NRRI Prepares for Lift-Off

And now a new program at NRRI will address the challenges innovations face on the path to commercialization. The LaunchPad, modeled after a similar program in the Twin Cities, will help startups and new business initiatives reach commercialization.

“The LaunchPad concept provides hands-on assessment, training and consulting, increasing the chances for the innovation to reach commercial success,” added NRRI’s Tim White. “We’re hoping to reach people needing technical assistance and can help get them on the right path to move their idea forward.”

Advisory Board Spotlight: Q&A with Al Rudeck



February 3, 2021

What are the challenges and opportunities facing Minnesota and how can NRRI help? Advisory Board Member Al Rudeck answers our questions.

NRRI: In your opinion, what challenges face Minnesota’s natural resource-based economies and how does NRRI play a role in addressing those challenges?

Al Rudeck: I believe Minnesota’s vast forests, mineral resources, agriculture and economy are at a serious crossroads. I fear there is a widening societal gap lack for understanding where things come from that underpin our daily lives. Physical things in our world are either grown and harvested or mined and processed. At the same time, there’s a growing value in society for sustainability in all of its forms. Technology and innovation are the best way to enable responsible natural resource development and ways to create more economic and environmental value. This is where I believe NRRI plays an important role, providing leadership to help solve these serious state and national raw material sourcing needs that underpin our nation’s clean energy and decarbonization objectives including renewables, EV’s, battery storage and beneficial electrification.

NRRI: What opportunities have caught your attention as bringing value to Minnesota and the region?

AR: A couple of things NRRI is working on really get me excited. First, I believe we have, and can continue to have, both economic growth and environmental protection. NRRI’s ability to provide independent, data-driven insights to inform resource management and development can help bring diverse viewpoints together for the common good of Minnesotans.

Second, policymakers, agency partners and private industry must work together to responsibly develop and protect our natural resources and environment. This can be achieved by characterizing our state’s flora, fauna, water and mineral resources and providing digital access to things like forest makeup, bird populations and trends as well as mineral resource discovery, deposit characterization and economic development feasibility. These are areas where NRRI is well positioned.

NRRI: What role could the Minnesota Legislature play in NRRI’s success in 2021?

AR: That’s a great question. Of course, the most pressing issues we have in the moment include the response to the global pandemic and support to spur economic recovery. Longer term, three major things come to mind: healthy forests, advanced mineral development and reduced carbon emissions. This requires long term, sustainable funding for applied research institutes like NRRI to support the State’s policy objectives.

Minnesota’s forests need a long-term management strategy. Year over year declines in demand for paper and related forest products has essentially removed an important private sector forest management tool for the Dept. of Natural Resources. Legislative leadership to develop a comprehensive strategy could include large scale demonstrations for novel forest product-based projects (energy conversion, material science, consumer products, etc.). I also envision an

intensive State Forestry Works program to put unemployed Minnesotans to work harvesting and replanting our forests.

Advanced mineral development includes working with private industry to position Minnesota's resources to create more value in the marketplace. The state could supply a large demonstration project fund to spur private-public investment. Rather than exporting mined raw materials to other states for further refining, Minnesota could invest in a plant to convert iron units to steel or copper units to finished metal products, all produced responsibly and efficiently.

Finally, NRRI is well positioned to inform legislative initiatives that support our state's leadership in the transition to a lower carbon economy. There are several legislative initiatives moving this session that could foster innovation in energy efficiency, energy storage and renewable energy conversion, beneficial use of electricity in transportation or building climate control.

Each of these priorities requires foundational applied science investments and funding to encourage and support the brightest minds to drive discovery and innovation that will move the State's natural resource-based economy forward.

NRRI: What might NRRI achieve in 2021 that you'll be especially proud to promote?

AI: I think dispelling the false premise that sustainable and responsible natural resource development is an "either/or" conversation. We have proven time and time again, across many industries and over many decades, that through innovation and technology advancement, we can drive economic growth and environmental protection in a sustainable manner. Taking this balanced stakeholder approach, building upon a data driven foundation, is a way NRRI can advance this message.

NRRI: You have been on NRRI's Advisory Board for more than six years. How has your participation helped you grow professionally or personally? How has your advice to NRRI evolved?

AI: The NRRI's mission and purpose is more relevant and important than ever. In my time on the NRRI Board, in a variety of iterations, has given me a broader perspective, and built many relationships with a broad cross section of talented and committed Minnesotans. Over time, I've learned the value of patience and the need to leverage historical context while staying open to new ideas with an ability to apply them in new ways.

The NRRI is a state and national treasure -- created with a great vision nearly 40 years ago -- with a renewed energy to discover Minnesota's economy of the future.

NRRI tests alternative binders for next-gen pellets



February 8, 2021

June Breneman

NRRI Coleraine has a unique niche for small batch testing of alternative binders for iron of the future.

"We are helping industry evaluate naturally derived and synthetic chemicals as a substitute for traditional bentonite." - Shashi Rao

As the steel industry continues its transition away from blast furnaces to electric arc furnaces -- now 70 percent of steel production -- Minnesota's Iron Range must continue to expand its offerings to include higher value iron products. Today, Minnesota has one producer of direct reduced grade pellets to address the electric arc market.

When pellets are manufactured, iron concentrate is mixed with binder materials which hold the product together for shipping and introduction into the next steel manufacturing step. Direct reduced grade pellets (further processed into direct reduced iron) differ from traditional taconite pellets in having higher iron content and reduced impurities, like silica and alumina. Bentonite clay is an effective binder for taconite blast furnace pellets, but is composed of those same impurities. Alternative binders are needed.

Binders of the future

NRRI has carved out a unique niche with its bench-to-pilot scale testing capabilities to evaluate how alternative binders perform for Minnesota’s specific iron ore concentrates. The testing data will help Minnesota’s iron industry select the best binders for their ore bodies and end products.

“We are helping industry evaluate naturally derived and synthetic chemicals as a substitute for traditional bentonite,” explained Shashi Rao, NRRI metallurgical engineer. “We can test the alternative binders for companies that don’t have internal capabilities to test at the lab and pilot scale.”

Binders 101

Bentonite clay is largely mined domestically in Wyoming, South Dakota and Montana. Its unique properties hold the fine iron ore particles together during taconite high-temperature processing, hardening the pellets for shipping. However, aside from introducing silica and alumina incompatible with electric arc furnaces, use of bentonite faces escalating transportation costs and depleting U.S. reserves.

“The low-grade iron deposits are significantly more challenging to process, which can be seen by increasing levels of unwanted elements such as silica, alumina, alkali and phosphorus in the iron ore concentrate,” explained Rao.

Demand for direct reduced iron is escalating and a suitable binder is key for making quality pellets without increasing costs. Alternative binders being tested are often derived from organic compounds or agricultural or bio-based products that do not contain mineral impurities.

Iron pellet products -- whether direct reduced grade or traditional -- need to be very hard to withstand shipment by rail and cargo ship to the steel mills.

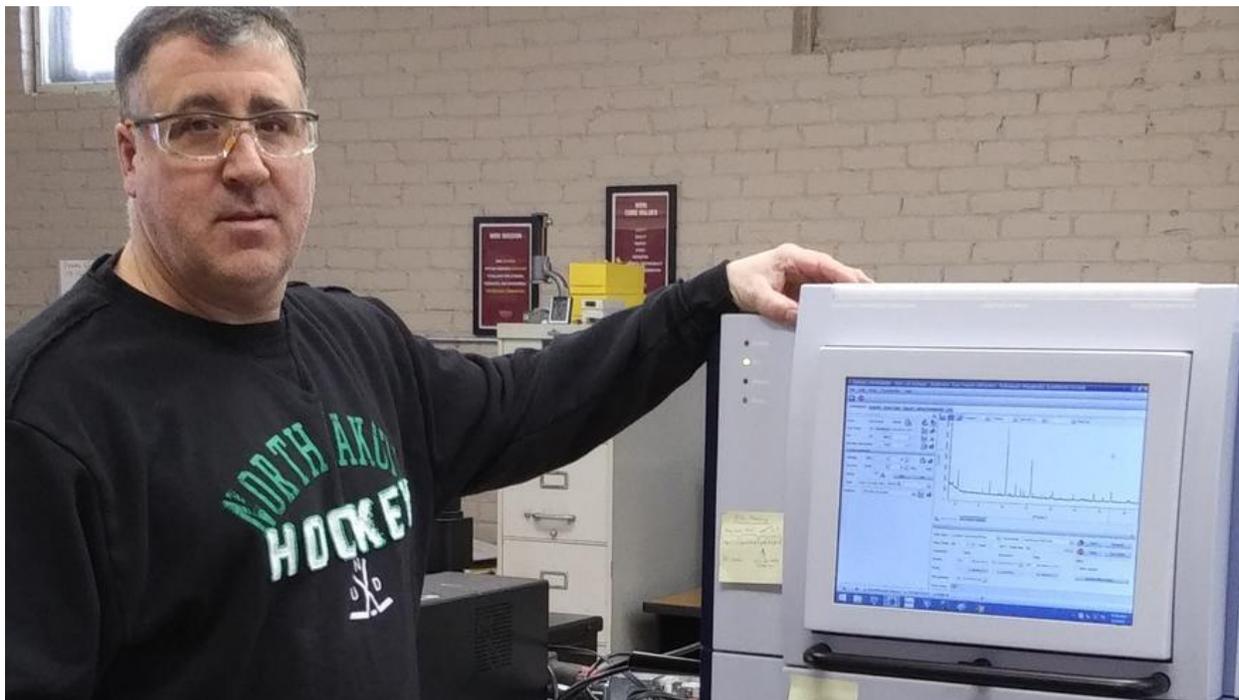
Poor quality pellets will turn to wasteful dust during shipment and downstream processing. Rao and the research team test the binders’ ability to facilitate the balling of the fine iron ore particles and document its improved mechanical properties and the metallurgical performance of fired pellets.

NRRI Expertise

Rao has studied metallurgical engineering in India and Australia, and has been NRRI’s lead researcher in alternative binders for nearly seven years.

“As demand for direct-reduced-grade pellets increases for electric arc furnace steelmaking, the demand for alternative binders will increase,” said Rao. “This transition is happening in Minnesota. Blast furnace grade pellets can be produced with or without alternate binders.”

Meet the Technician - Greg Gargano



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June Breneman

Rocks from all over the world are shipped to NRRI's Minerals Laboratory in Coleraine. Mining companies want to know what's in their materials so they know how to process them.

But before NRRI researchers get to work on the samples, they need to know if the rock is safe to handle. Greg Gargano is NRRI's Iron Analysis Coordinator and Lab Technician for the new Minerals Safety Screening Program.

The first step is to stand 100 feet away and scan it with a hand unit (scintillometer) that checks for radiation.

"If it's a sample we've never run before, we need to screen it for hazardous materials," explained Gargano. "We don't want to contaminate our labs with these hazardous materials which can become airborne once they are crushed."

If there's no radiation, the next step is to screen it for asbestos minerals using X-ray Diffraction (XRD). The sample is also checked for heavy metals, such as chromium or lead, using Energy Dispersive X-ray Fluorescence (XRF).

Gargano was trained to use the XRD instrument to do the initial asbestos screening, and the EDXRF instrument that identifies the chemical signature of these unknown samples. The EDXRF wasn't completely new to Gargano. Prior to coming to NRRI in 2007 he worked at Cleveland Cliffs, in which he worked with the company's EDXRF in their lab.

"But back then, it was a huge unit," he laughed. "Now we have a desktop model. So I had to get comfortable with the new tools."

Gargano generates raw data from the samples and sends it to NRRI Senior Research Geologist Steve Monson Geerts to identify the content.

Gargano is also kept busy with NRRI's Iron of the Future project, funded by the Legislative-Citizen Commission for Minnesota Resources (LCCMR). Rock samples come in from all over the Iron Range that he crushes and binds with epoxy into mounts that are polished for microscope analysis by NRRI geologists in Duluth.

"In July we started working on a new calibration curve on the EDXRF Instrument for the LCCMR project samples," said Gargano. "The researchers need to know the concentration of silica, iron, calcium and aluminum and with the new calibration, we'll be able to process them faster."

LCCMR is the Legislative-Citizens Commission for Minnesota Resources that is funding the Iron of the Future project.

Pandemic Paperwork

The lock-down in March and through the summer afforded time to document processes, which kept Gargano busy at home. Now, with all the samples that need processing, he's in the lab three to five days a week.

He worked with NRRI Quality Manager Lisa Estepp to write the lab procedures. "Whatever paperwork needed to get done, that was a nice break to concentrate on that," said Gargano.