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SECURING AMERICA'S MINERAL FUTURE: UNLOCKING THE ECONOMIC VALUE BENEATH OUR FEET

HEARING

BEFORE THE

COMMITTEE ON SMALL BUSINESS
UNITED STATES
HOUSE OF REPRESENTATIVES

ONE HUNDRED NINETEENTH CONGRESS

FIRST SESSION

HEARING HELD
JUNE 24, 2025



Small Business Committee Document Number 119–015
Available via the GPO Website: www.govinfo.gov

U.S. GOVERNMENT PUBLISHING OFFICE
60–853 WASHINGTON : 2025

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TUESDAY, JUNE 24, 2025

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SMALL BUSINESS,
Washington, DC.

The Committee met, pursuant to call, at 10:08 a.m., in Room 2360, Rayburn House Office Building, Hon. Roger Williams [chairman of the Committee] presiding.

Present: Representatives Williams, Stauber, Meuser, Alford, Finstad, Bresnahan, Downing, Patronis, Scholten, McIver, Cisneros, Morrison, Tran, Simon, Olszewski, and Goodlander.

Chairman WILLIAMS. Good morning, everyone. I now call the Committee on Small Business to order. And without objection, the Chair is authorized to declare recess of the committee at any time. I recognize myself for my opening statement.

Welcome to today's hearing entitled Securing America's Mineral Future: Unlocking the Economic Value Beneath Our Feet. Thank you to all our witnesses for joining us today. We appreciate you taking time away from your busy businesses to participate in today's conversation. So today, we will examine how to secure our mineral supply chains against hostile foreign adversaries such as the Chinese Communist Party and how America's small businesses, national security, and ability to create new, innovative technologies rely on these essential materials.

Rare earth minerals and the broader category of critical minerals used in the manufacturing process of batteries, magnets, computers, and medical devices, to name a few, are vital to the functioning of the American economy. Unfortunately, far too long, burdensome regulations have made the production and refining of rare earth and critical minerals difficult in America, contributing to China's dominance in this market.

Now, to combat the CCP's monopoly, President Trump issued several executive orders aimed at bolstering domestic mineral production and reducing our reliance on foreign adversaries. Currently, the Mountain Pass Mine in California is the only active mine in the United States that extracts rare earth minerals. As a result, approximately 80 percent of the critical minerals used in America are supplied from foreign sources. The lack of domestic production undermines our national security and hinders small business innovation.

Thankfully, the Trump administration is working to unleash American energy production, safeguarding national security and allowing American small businesses to compete on a global stage. Small businesses are at the forefront of American innovation. The enhancement of the defense industry that provides our homeland relies on groundbreaking technology often developed by small businesses that need rare earth minerals to produce.

I want to thank our witnesses again for their contributions to end U.S. reliance on foreign rare earth elements and critical minerals. We look forward to your testimony.

With that, I will yield to the distinguished Ranking Member today from the great state of Michigan, Ms. Scholten, for her opening remarks.

Ms. SCHOLTEN. Thank you so much, Mr. Chairman. Thank you to our incredible witnesses and thank you for your patience. We had a very important caucus meeting this morning. It kept me tied up. I am so grateful, Mr. Chairman, that we are holding this hearing this morning. Critical minerals are pivotal to our nation's clean energy transition and national security. On this, we agree there is a lot of common ground. That is why I am so grateful that we are having this hearing.

These minerals are an essential component of our smartphones, electric vehicles, and, importantly, military hardware. Yet the supply chains for these 50 materials often run offshore and through the influence of our adversaries, most notably China, as you mentioned. That is why federal policy should redirect our critical mineral supply chains through our shores and the shores of our allies, not our enemies.

Every critical mineral is unique. Some, like aluminum, are relatively easy to extract and process into usable material. Others, like certain rare earth elements, are less concentrated in ore. Therefore, they require advanced, complex refinement methods that are developed by and accessible to only a handful of countries and companies. And crucially, some critical minerals just aren't deposited within U.S. territory, meaning they can't be mined here. The diversity of these materials, their properties, and extraction and refinement techniques means that the avenues to onshoring them must be equally diverse.

It is a complex problem, and we need a complex solution to make these minerals accessible. In other words, Mr. Chairman, we can't only mine our way out of our critical mineral needs. The federal government must prioritize and maintain investments in recycling, waste recovery, friend shoring, and industrial policy if our nation is to reclaim control over our critical mineral supplies.

In particular, I want to mention the invaluable boosts to domestic critical mineral sourcing, processing, and component manufacturing found in the Infrastructure Investment and Jobs Act and the Inflation Reduction Act, two landmark pieces of legislation signed under the previous administration. Democrats stand ready to defend and expand upon the massive long-term investments the federal government has already made in this space. We want to make it better.

I would also be remiss if I didn't highlight the downsides of mining when not done properly. When a new mine is opened, America

gains another source of minerals, yes, but it often loses unique pristine land that would have yielded far more economic activity and value through tourism, hunting, fishing, and other outdoor recreation business. In my family, we are avid outdoorsmen and women, year-round anglers. This matters deeply to us. Communities near mine often have to contend with new large competitors for wastewater resources and pollution of what remains with mining waste and byproducts. Sometimes, new mines even run roughshod over long-standing treaties and agreements with neighboring tribes. It is vital that we, as federal policymakers, consider the tradeoffs of expanding mining and the harm it can pose to nearby towns, tribes, and small businesses.

It is also important to remember that hard rock mining in America is not governed by an outdated law from the 1870s. You heard me right. Not the 1970s, but the 1870s. Nearly 150 years ago. Long before the concepts of land preservation and environmental protection and even consumer automobiles entered the mainstream.

Before we consider any changes to mining regulation, we have to reform the underpinning mining law to further balance the interests of miners and other industries and make mining activities more sustainable for the environment. To ensure that we can all continue to use these vital resources on shoring our critical mineral supply chain is a complicated issue intertwined with many other topics and policy areas. But I have trust in this committee, our witnesses here today, and our shared commitment to making sure that the vast majority of these critical earth minerals are not sourced only through our competitor.

I look forward to the hearing, Mr. Chairman, and I yield back.

Chairman WILLIAMS. Gentlelady yields back. And I will now introduce our witnesses.

Our first witness here with us today is Aaron Dowd. Mr. Dowd is the chief executive officer of Rare Earth Salts in Beatrice, Nebraska. Mr. Dowd has more than two decades of experience leading efforts at the intersection of global business strategy, government affairs, and national security. Mr. Dowd previously served as chief of staff in the U.S. Senate and supported high-level policy work at the Atlantic Council and Department of Energy. Mr. Dowd earned a Master's degree in Business Administration from Duke, Home of the Blue Devils, right, University, and Bachelor's degree in Political Science from Marquette University. Thank you for being with us today, and we look forward to our conversation.

Our next witness here with us today is Mr. Harvey Kaye. Mr. Kaye is the executive director of U.S. Critical Materials in Salt Lake City, Utah. Mr. Kaye has over 45 years experience in finance, strategic planning, and executive leadership across both public and private companies. Mr. Kaye has served as Founder, Chairman, and now Director of Zero Gravity Solutions, an agricultural biotechnology firm. Mr. Kaye also held various leadership roles at Latitude Solutions, a company specializing in water remediation and treatment. He received his Bachelor of Science degree in Marketing from Temple University. So we are glad you are here today and look forward to your testimony.

Our next witness is Mr. Ken Mushinski. Mr. Mushinski is the President and chief executive officer of Rare Element Resources in

Sundance, Wyoming. Mr. Mushinski has over 30 years experience in corporate development, mergers and acquisitions, and regulatory navigation across the mining and nuclear energy sectors. Mr. Mushinski previously served as vice president of corporate planning and acquisitions for General Atomics Technologies Corporation. Mr. Mushinski earned a Master's degree in Business Administration and Bachelor's of science in Mechanical Engineering from San Diego State University, where the Aztecs are. And we appreciate you being here today.

And I now recognize the Ranking Member Ms. Scholten from Michigan to briefly introduce our last witness.

Ms. SCHOLTEN. Thank you so much, Mr. Chairman.

Dr. Laura Stoy is an environmental engineer and the founder and CEO of Rivalia Chemical, an Illinois startup developing a novel method to chemically recover rare earth elements from coal ash and other mining waste. Rivalia Chemical patented the process and has been working on commercializing it since 2022. Additionally, the firm enjoys access to the Argonne National Laboratory in Lamont under the Department of Energy's Lab-Embedded Entrepreneurship Program, LEAP. Previously, Dr. Stoy served at the Environmental Protection Agency as a National Science Foundation intern fellow. At the EPA, Dr. Stoy worked on an environmental assessment of rare earth extraction from mining waste, precisely the process that she is developing and using now. While at school, Dr. Stoy also helped create an app named RocketJudge, which automates judge work for competitions such as fashion shows, barbecue festivals, and professional conferences. It is safe to say, Mr. Chairman, that Dr. Stoy is a serial innovator. Dr. Stoy holds a Bachelor's of Arts degree in Chemistry from Vanderbilt University and a Ph.D. in environmental engineering from Georgia Tech. Welcome, Dr. Stoy.

Chairman WILLIAMS. Welcome again to all of you. And then, before we begin to recognize the witnesses, we do have a few rules around here. Got to go over the rules, all right? And I would like to remind all of you that your oral testimony is restricted to 5 minutes in length. If you see the light turn red in front of you, it means your 5 minutes has concluded, and you should wrap up your testimony. If you keep talking, you will hear me do this. That is a kind way of saying, quit talking. Okay? And so, and also on another note, you periodically will recognize or will see some of our panel move in and out. That is because we got other hearings going on. It has nothing to do with whether you said the right thing or the wrong thing. We will be moving in and out, but you will see that.

So with that in mind, I now recognize Mr. Dowd for his 5-minute opening remarks.

STATEMENTS OF MR. AARON T. DOWD, CHIEF EXECUTIVE OFFICER, RARE EARTH SALTS; MR. HARVEY KAYE, EXECUTIVE DIRECTOR, U.S. CRITICAL MATERIALS; MR. KEN MUSHINSKI, PRESIDENT AND CHIEF EXECUTIVE OFFICER, RARE ELEMENT RESOURCES; AND DR. LAURA STOY, PHD., FOUNDER AND CHIEF EXECUTIVE OFFICER, RIVALIA CHEMICAL

STATEMENT OF AARON T. DOWD, CEO, RARE EARTH SALTS

Mr. DOWD. Chairman Williams, Congresswoman Scholten, and distinguished Members of the committee, thank you for the invitation to testify on the critical issue of securing America's mineral future. I appear before you today representing Rare Earth Salts, a Nebraska-based small business at the forefront of addressing one of our nation's challenges.

The United States confronts an unprecedented threat to our economic sovereignty and national security through China's control of the rare earth elements supply chain. Rare earths are a set of 17 elements in the periodic table that play a critical role in our national security, energy independence, environmental future, and economic prosperity. These elements are far more than mere commodities; they form the backbone of modern technological advancements. From powering batteries and electric vehicles to enabling medical equipment, military systems, smartphones, and wind turbines, rare earths are foundational to the innovation driving our technological civilization.

The age of technology is indeed the age of critical minerals with vast geopolitical implications. The need for securing both domestically sourced rare earth elements and domestic rare earth processing infrastructure is vital.

Today, China controls 90 percent of the global downstream rare earth market, impacting the rest of the world's supply chain and giving them significant control in restricting America's access to materials vital for manufacturing and defense capabilities. This was not always the case. From the 1960s until the 1990s, the U.S., specifically California's Mountain Pass mine, led global production. However, China's deliberate industrial policy systematically captured market control, creating the vulnerable supply chain we face today. Though China's dominance in the rare earth market has prompted global efforts to find alternative sources and processes to produce these critical compounds, producers outside of China continue to face formidable challenges, struggling to compete with the highly competitive pricing of China's domestic market.

The challenge extends beyond supply security to economic competitiveness. China's current market dominance stems from their large-scale use of Solvent Extraction, which were developed and implemented in the U.S. in the 1960s. These processes require hundreds of separation stages and generate excessive chemical waste. Western companies utilizing this proven method face higher production costs due to necessary environmental and worker protections. This cost differential has created a market failure where Western innovation cannot compete with Chinese production, despite superior technology and environmental stewardship. For small businesses like ours, this represents both a challenge and an extraordinary opportunity to innovate and lead.

Founded in 2012 by Dr. Joseph Brewer, Rare Earth Salts exemplifies how America's small business innovation can address strategic national challenges. Rare Earth Salts addresses the global need for a cost-effective, sustainable, and environmentally friendly rare earth separation process.

Prior to developing our proprietary processes, we evaluated the strengths and weaknesses of every separation process used since the 1940s. That allowed us to invent a revolutionary electrochemical process from the ground up based on sound basic chemistry. The separation process advancements by Rare Earth Salts represent industry-changing solutions demanded by the rare earth supply chain to profitably compete with Chinese production and maintain a low environmental footprint.

Rare Earth Salts has been working closely with the U.S. government and has received multiple grants and awards for its separation technologies from the Department of Defense and the Department of Energy. These private-public partnerships demonstrate how federal investment in small business innovation can yield strategic returns for national security while building defense industrial capacity. Rare Earth Salts recently received an award from the Department of Defense to increase production of heavy rare earth elements, specifically Terbium.

The rare earth challenge represents more than supply chain vulnerability; it is a defining opportunity for American small businesses to lead the next generation of critical mineral production. Companies like Rare Earth Salts exemplify how American innovation can compete globally.

Supporting domestic innovation in mineral processing can help ensure the United States does not merely secure its mineral future but leads the world in sustainable, competitive production of these essential materials. By supporting small businesses developing innovative separation technologies, we can reestablish America's leadership in this critical sector.

Rare Earth Salts stands ready to contribute to America's mineral independence. The mission requires collective effort. With a robust policy framework that acknowledges the strategic importance of domestic critical mineral production, American small businesses can help transform this challenge into a competitive advantage. The technology is ready. The market need is undeniable. The national security imperative is urgent. We need to now unlock the economic value beneath our feet and secure America's mineral future.

Chairman Williams, Congresswoman Scholten, and distinguished Members of the committee, thank you again for the invitation to testify, and I look forward to your questions.

Chairman WILLIAMS. Thank you.

I now recognize Mr. Kaye for his 5-minute opening remarks.

STATEMENT OF HARVEY KAYE, EXECUTIVE DIRECTOR, U.S. CRITICAL MATERIAL

Mr. KAYE. Thank you Mr. Chairman and Members of the Committee for allowing us to testify today. This is an issue that has taken 15 years to come to the point that we are at right now. We have all talked about Chinese dominance. It is actually 90 or 95 percent dominance in terms of its ability to process rare earths.

Their concerns about the environment are not the same as ours. It is no longer acceptable to spend 20 or 29 years to get a project online.

To that end, U.S. Critical Materials controls 339 claims covering approximately 11 square miles in a place called Sheep Creek, Montana. Montana in the past has been known as the Treasure State. Our objective is to make it the Treasure State again.

To that end we have a two-point point of our spear to accomplish those goals. First, is the rare earths that encompass our deposit have been considered now the highest-grade rare earths ever found in America, averaging 9 percent up. We also have a very robust deposit of gallium. Gallium is a mineral, a critical mineral that has 3,800 military applications. We now face a geopolitical situation that we are all aware of. It is in the front page news. To that end, we have expanded a great amount of the critical minerals and rare earths required for missiles, for radar, for advanced aircraft, the F47, et cetera. We cannot be dependent upon the Chinese to be our supply of these materials.

Therefore our focus and the focus I hope of this committee is to assist companies such as ourselves to accomplish those goals. What do we need to do that? We need help in accelerating permitting. Today, as the congresswoman stated, there is regulations that we are dealing with since 1870. Okay? We have made an attempt to fix that through Fast-41. Okay? Now, it requires cutting the red tape, unchaining the American entrepreneurial spirit in order to accomplish the goals. We have it here. It should be found in America.

We also have now entered into a venture with one of the prestigious American National labs called Idaho National Lab. Dr. Robert Fox is an acknowledged expert in the world of developing processes and technologies to process these kinds of minerals. We did a full-court press with them, and at the end of a year, they have accomplished the goal of setting forth the flow diagrams and the methodology for a process that we call an electrochemical membrane reactor. It is environmentally conscious. It has the ability to process rare earths in an efficient environmental manner.

To that end, therefore, we are working very hard to cooperate with the government. This committee can help us and the entire industry enormously. We need to do what we did with Sputnik. We need to do what we did with the Manhattan Project. This country can no longer have the Chinese knee on our neck. Therefore, as a group, we need to work together, government-private partnerships. And what is required? What is required is help in permitting. What is required is for us to establish a permanent market for the offtake so the Chinese can no longer utilize price manipulation to hurt our domestic marketplace. And we need to work together as a team in order to make the United States critically mineral independent and sovereign again. And so with that, I yield with 22 seconds left.

Chairman WILLIAMS. You are going to go far in this company. Thank you for the testimony.

I now recognize Mr. Mushinski for his 5-minute opening remarks.

STATEMENT OF KEN MUSHINSKI, PRESIDENT AND CEO, RARE ELEMENT RESOURCES

Mr. MUSHINSKI. Chairman Williams, Ranking Member Scholten, and esteemed Members of the committee, thank you for the opportunity to address this committee on issues of vital importance to this nation-securing critical minerals and, in my case specifically, rare earths, for our National defense and high-tech industries and supporting small businesses in meeting that need.

RAR is a publicly traded company with a critical rare earth deposit and state-of-the-art innovative rare earth processing and separation demonstration plant in Wyoming. We have invested over $170 million in developing our USGS-recognized world-class rare-earth deposit and proprietary separation technology.

I know you are all well-versed in why rare earths are critical components in our modern technology, essentially, in everything from smartphones, electric vehicles, wind turbines, and defense systems. Our rare earth elements are enablers to the evolution of our high-tech world and vital to our American defense system.

It is also widely known that China dominates the rare earth industry and is taking deliberate action to control the entire processing and manufacturing supply chains where rare earths are utilized for downstream products. This has created an untenable National and economic scenario. Chinese dominance and manipulation of the rare earth extraction, processing and separation, and permanent magnet production is an existential risk to our modern world. Further, this dominance allows China to influence global prices, making it risky for competitors to invest.

Small businesses like RER have unique technologies and the potential to innovate and contribute to domesticating the rare supply chain from mine to magnets. However, our small companies face challenges that have distinct needs and must be addressed to ensure a sustainable domestic rare earth supply chain.

As an example of the obstacles faced by RER, we have completed our resource confirmation and commenced the arduous NEPA permitting of the Bear Lodge Project in 2011. We spent over $30 million and many years progressing that effort, an effort that was ultimately derailed through Chinese market manipulation whereby rare earths supplied by the Chinese flooded the market, and prices bottomed out. As a result, RER's access to capital quickly disappeared and, ultimately, resulting in cessation of operation and almost bankrupting our company.

Realizing we could not compete with predatory Chinese market dominance, RER, in conjunction with its now majority shareholder and affiliate of General Atomics, pivoted to proving our novel and proprietary rare earth material separation technology so that we and potentially other domestic rare earth companies would not be reliant on China to economically and efficiently separate the rare earth concentrates produced here in the United States. Our goal is to compete with China in rare earth production and also create a path for processing and separation that is economically and environmentally superior—adhering to all U.S. Environmental regulations while supplanting the environmentally detrimental and costly steps in conventional Chinese technology.

With that challenge in front of us, RER, with partial funding from the Department of Energy and the state of Wyoming, have constructed and will soon begin operating our over $66 million demonstration plant that is intended to prove our separation technology on an industrial scale. Even with the expected success from this plant's operation, without additional support from the government, RER and other innovative small businesses face monumental hurdles. Specifically, access to capital requires a certain level of market stability that is thwarted by Chinese ability to manipulate the rare earth market.

Small businesses like RER, unfortunately, find themselves in a paradox whereby investors and potential industry supply chain partners require certainty in the markets, and yet this is not possible with the ongoing threat of Chinese market interference.

We believe addressing this nascent market's unique challenges, especially for small and innovative businesses, requires a multifaceted approach to market stabilization. RER encourages Congress to pursue policies and support funding to support small businesses that are innovating and progressing a secure domestic rare supply chain, including government purchasing to establish strategic stockpiles as potentially envisioned, but with the $2.5 billion critical minerals included in the recently passed reconciliation package, government grants to unlock industry innovation, government incentives and guarantees to encourage private investment in loans and permitting reform to bring surety to project timeliness.

We believe these types of initiatives will remove the significant market obstacles and barriers to progress for small businesses engaged in rare supply chain so that collectively, we can become a solution to a very real and present danger to our nation's defense and high-tech industries.

I am honored to be here today to share with you RER's unique experience as a small business in the rare earth industry, and I look forward to addressing your questions. Thank you very much.

Chairman WILLIAMS. Gentleman yields back.

And now recognize Dr. Stoy for her 5-minute opening remarks.

STATEMENT OF LAURA STOY, FOUNDER AND CEO, RIVALIA CHEMICAL CO.

Ms. STOY. Chairman Williams, esteemed Member Scholten, Members of the committee, thank you so much for the opportunity to speak today. It is an honor to discuss this issue that is critical to the future of U.S. mining and materials, securing our critical mineral supply chains for national defense, technological innovation, and manufacturing strength.

My name is Dr. Laura Stoy, and I am the CEO and founder of Rivalia Chemical Company. At Rivalia, we are pioneering new chemical extraction technologies to cover valuable rare earth elements from industrial wastes, including coal fly ash and other coal combustion byproducts, phosphogypsum, acid mine drainage, and mine tailings. Our patent-pending process extracts rare earths from these materials and separates them from their major elements in a single step. A significant challenge in traditional mining processing for rare earths. Using this method and by using wastes,

we can avoid the environmental and economic costs of mining while minimizing hazardous waste generation.

The U.S. has approximately 2 million metric tons of rare earths and reserves. However, there is far more locked in our waste materials. Researchers at UT Austin estimate that there are 11 million metric tons of rare earths and coal ash alone. Oak Ridge National Lab found millions of tons of rare earths in phosphogypsum. Duke University did research that found that abandoned mine drainage releases 500 to 3,400 tons of rare earths annually through acid mine drainage. These waste streams are often overlooked, but they present an opportunity to both recover rare earths and remediate environmental damage in local communities.

There are currently no companies producing rare earths from waste at scale in the U.S. right now, though I will note to this committee that there are many small businesses and startups addressing this opportunity space.

Rivalia's focus is on mining rare earths from waste, but I want to emphasize that it is likely that this is just one component of a broader rare earth element supply chain along with traditional mining. Building a broader, more diverse supply chain for rare earths will make our system overall more resilient to disruption and manipulation by our adversaries.

To achieve supply chain stabilization, the U.S. can't only mine. We can't mine our way out of this. We also need to separate, find, materialize, and produce the finished products—the permanent magnets.

China's dominance in rare earths comes from its control over this entire supply chain, which includes processing minerals both from its own mines and from international partners. To compete globally, U.S. rare earth producers must have robust midstream processing. This requires a skilled workforce, innovation, and efforts to derisk the market for private investors, especially given the price volatility caused by China's outsized market influence. Our market also must be cost competitive. China has subsidized their supply chains, enabling their businesses to offer products at significantly lower costs. Competing with that will require American ingenuity and innovation to lower our production costs and make U.S. rare earths attractive to both customers and investors.

I founded Rivalia after completing my PhD in environmental engineering at Georgia Tech, where I was fortunate enough to receive both government and private funding, the National Science Foundation's Graduate Research Fellowship, as well as funding from Georgia Power, one of the major utilities in the Southeast. This funding allowed me to develop the core technology behind Rivalia.

Since then, we participated in TechStars, a prestigious startup accelerator which included raising venture capital. This also allowed us to secure a future pilot with Southern Company. We have also raised non-dilutive funding through the National Science Foundation's SBIR program, which is helping us to de-risk our technology and validate it with other materials. We also have obtained funding through the Department of Energy EnergyWerx Vouchers Program as well as the Department of Energy Lab-Embedded Entrepreneurship Program called LEAP. And through that, we have gained access to critical expertise and facilities at Argonne

National Lab. This support has been crucial to scaling our technology and positioning it for high market impact.

For hard tech startups like Rivalia and my colleagues here, government funding is essential. It provides early-stage capital that is needed for high-risk project with immense potential but limited investor interest. Government funding acts as a third-party validation, attracting private capital and allowing us to make tangible progress on critical milestones. Hard tech ventures require significant upfront capital from prototyping, testing, and compliance, and without government support, companies like ours would face much greater challenges in bringing new game-changing technologies to market.

The U.S. is at a critical juncture in securing its mineral future. We need to embrace innovation, leverage public and private funding, and develop new technologies to ensure a robust and diverse critical supply chain here. Government support for startups like Rivalia are essential for maintaining U.S. leadership and technology, national security, and economic competitive—competitiveness.

Thank you, and I look forward to your questions.

Chairman WILLIAMS. Gentlelady yields back. We will now move to the Member questions under the 5-minute rule, and I will recognize myself for 5 minutes.

Throughout the Biden and Harris administration, the government has burdened small businesses with endless regulatory red tape. These regulations have slowed business-building projects and mining efforts. And I think we can all agree that we should get the government out of the way to let small businesses do what they do best. Now, Mr. Kaye, can you provide us with some examples of how the government has stood in your way?

Mr. KAYE. We have had these claims for better than 35 years. They—our approach is to do this with a great amount of environmental consciousness. Therefore, we deal with the U.S. Forest Service. The response many times is slow to get back. There has been a great amount of progress, however, recently with the advent of Fast-41. We have filed an application for that. And what it does is it holds the various agencies that are responsible for approvals to a very strict timetable.

Our plan is to be able to extract from our deposit literally this year, to be able to, in effect, stand on the steps of the White House and or Congress with a bag of gallium rare earths that were found in Montana, processed with American technology, and available for the defense of this country and indeed the free world. So it is starting to change. And we are seeing the effect of that because there is now a recognition that there is an issue, and we can't wait 15 or 20 years to bring a deposit online. So we feel that things are getting much better, and for that, we are grateful.

Chairman WILLIAMS. Good. Let's book that date, okay?

Mr. KAYE. Yep.

Chairman WILLIAMS. Domestic mining of rare earth elements and critical minerals faces numerous challenges, and one of which is that America has few known large deposits of pure rare earth elements. Despite these challenges, the United States is well positioned to quickly build its rare earth refining capacity. So, Mr.

Dowd, can you please explain the innovative approach your company has taken in the refining process and what impact those innovations have on the entire mining industry?

Mr. DOWD. Thank you, Sir. We believe the enormous demand for non-Chinese rare earth supply will only be met with the reimagining of innovative, nontraditional clean separation technologies. Our processes have a significant advantage over existing separation technologies in an industry that has not seen much viable refining innovation in more than three-quarters of a century. Our technology significantly reduces the cost of producing rare earths from concentrate, be it from recycled material, rare earth elements, specific mining operations, or as a byproduct of a mining operation. Our patented processed capital expenditure and operating expense are highly cost-competitive versus traditional rare earths refining. Our processing time from concentrate to first finished products is days with very limited separation steps versus months and dozens of steps with solvent extraction. Rare Earth Salts provides an immediate opportunity to reestablish domestic commercial production. The capability of our technologies has been thoroughly validated.

Chairman WILLIAMS. Okay, thank you. And now, quickly in the time I have got left, rare earth mining extraction is a heavily regulated industry that we have talked about today. Well, rare earth mines must comply with a substantial number of regulations intended for traditional mines. Rare earth mines also must navigate Nuclear Regulatory Commission requirements. So Mr. Mushinski, how is your business dealing with this complicated web of regulations? How can it be simplified?

Mr. MUSHINSKI. Thank you, Mr. Chairman. We do have a NRC possession license because as with most REE ore, it does have some naturally occurring thorium and uranium in it. So, we do have a license. That was quite a detailed and lengthy process. They, the NRC, did their own environmental assessment in addition to what is required by the EPA for a mine. It was costly, expensive and took a significant amount of time. We do have that license. That license is valid through 2027. However, we, like others, have a deposit that is on National Forest Service. We also have invested and had various meetings with the permitting council and are progressing toward Fast-41 permitting of our mine. That (Fast-41) is a much welcome improvement to the permitting process, and I will admit it is not a Trump administration policy, it is a previous administration that started Fast-41, but it is this administration that has advanced it into the mining sector. And we are very appreciative of that, and that is looked at as being helpful to our processing.

Chairman WILLIAMS. Gentleman yields back.

I now recognize the Ranking Member for her 5 minutes of questioning.

Ms. SCHOLTEN. Thank you, Mr. Chairman. Dr. Stoy, I am wondering if you could just start out and elaborate on the recovery process Rivalia is developing. Talk to us about how you are getting these minerals out of waste.

Ms. STOY. Absolutely. Thank you so much for the question. So Rivalia's patent pending technology employs a recyclable ionic liq-

uid in a closed-loop process that selectively extracts rare earths from the starting material. So again, this starting material might be coal ash, bauxite residue, phosphogypsum, mining tailings, acid mine drainage magnets, for really any rare earth element-rich waste is in our realm. So, we have some physical separation processes optimized to isolate higher rare earth element contained fractions within the original material. This helps improve our downstream efficiency. And depending on the material we also might have some chemical pretty treatment steps.

But our core innovation is that our method both extracts the rare earths from the starting material and does the separation from the bulk in one single step. We use this using—or we do this using proprietary chemistry to selectively bind with the rare earths while leaving most of the elements behind. This approach achieves higher selectivity than conventional acid leaching methods, reducing chemical consumption and waste generation. Following extraction, the chemical chemicals are recovered and recycled through the system, so they are ready for reuse, while the residuals are conditioned for beneficial use applications.

We generate two valuable rare earth element product streams. Scandium oxide product, which is a valuable rare earth used in solid oxide fuel cells, high-performance aluminum alloys, and specialized lighting applications. Second, we produce a mixed rare earth element concentrate containing multiple elements, including neodymium, cerium, lanthanum, terbium, europium, yttrium. All of these have significant roles in different applications that we have talked about already.

Ms. SCHOLTEN. Thank you. For my second question and sticking with you, Dr. Stoy, how much of the rare earth in existing products currently are we recycling?

Ms. STOY. Thank you for the question. To my knowledge, there is very limited recycling of rare earths in the U.S. I don't know of any companies doing this at scale right now. For some products, it is fundamentally challenging to extract rare earths from them. You know, consider consumer electronics, you know, your cell phone, your laptop is not designed to easily pull the rare earth elements out. You also have to collect them from the consumers. And that is not trivial. This is the same for EV motors. Permanent magnets in the motors will need to recover those. Industrial wastes don't have that kind of spatial distribution issue. In that way, they are almost more like a mine. But there is no one really recycling rare earths at this time.

Ms. SCHOLTEN. So, as a follow-up to that, can you describe the potential for recycling to add to the rare earths supply that we have here?

Ms. STOY. Yeah, absolutely.

Ms. SCHOLTEN. And be as specific as you can. I know it is not currently being done, so it is hard to sort of, you know, get into specifics. But in terms of percentages.

Ms. STOY. Yeah, there is a lot of potential here. It is hard to quantify and be forward-looking here. There is a researcher at Ames National Lab in Iowa, Dr. Kenneth Nlebedim, and one of the things he suggested was in the next 10 years, more than 25 percent of the demand for rare earths could come from recycling efforts.

Ms. SCHOLTEN. Okay, very good. I agree with your comments about, you know, the pressing nature of this problem requiring a bit of an all of the above approach. Traditional mining, as well as recycling. How would you characterize added returns created by new mines individually, but as well as opposed to recycling or in contrast to recycling?

Ms. STOY. Yeah, I think all of the above is really the answer here. You know, we, right now, we have one active mine. Would it be helpful if we had more? I can imagine so, but it is hard to say, right? Is five new mines the new—is the right answer. 50? 500? At a certain point, we do reach diminishing returns. Frankly, you know, what all of these minds do really need is refining. And I know some of my colleagues here are talking about integrating that into their processes. And that midstream or refining, in my opinion, is much more important and a higher priority than opening a new mine. Because if we don't have that refining capacity, we are sending our concentrate abroad for refining. And 99 percent of the time, that is going to be in China. We don't have—we won't have—you know, we could have dozens of mines, but if we are still sending the concentrate abroad, we haven't solved the problem.

Ms. SCHOLTEN. Okay, thank you. Very enlightening. I yield back.

Chairman WILLIAMS. Gentlelady yields back. I now recognize Mr. Stauber from the great state of Minnesota for 5 minutes.

Mr. STAUBER. Thank you very much, Mr. Chair. The development of America's abundance of resources is critical, and rare earth minerals are of deep importance to me in my district. The Minnesota's 8th Congressional District holds the biggest untapped copper-nickel find in the world. The previous administration banned 224,000 acres of it and took two leases away from a mining company that they had since 1966. Just last week, Talon Metals in Tamarack, Minnesota, brought an exploratory drill section: 28 percent nickel. The highest in the world. I don't know if you all knew that. Talon Metals, Northeastern Minnesota, drill hole, 28 percent nickel. Nowhere in the world can we do that? Northeastern Minnesota is ready, able, and willing to deliver these critical minerals to this great nation for our strategic national security.

I sit on the Natural Resources Committee. There was a Democrat witness when we were talking about mining. I said to her, I said, "You say it is too wet in Minnesota to mine. It is too dry in Arizona to mine. Where would you like us to mine?" And her answer, she said it out loud, "Nowhere." We have an anti-mining political agenda in this nation that is crippling our security, our strategic national security. Northeastern Minnesota mines the iron ore that makes 82 percent of this nation's steel that helped us win two world wars. And we continuously have to battle for these good union jobs in this town. The prior administration was the most anti-mining administration in the history of this country.

We will follow all environmental and labor standards. Allow us to do so. And when we do that, we will bring the economic engine to our communities. We will bring good-paying jobs to the iron range of Northern Minnesota, which jobs start at $90,000 a year without overtime, health benefits, et cetera. The median household income for the district that I represent is under $74,000. One min-

ing job can make up for that. This is how important domestic mining is to our nation, to our strategic national security, to our economy.

And, ma'am, you are right. Recycling is part of it. That is part of the concern. And bring it on. But we are—the demand is so much more right now.

There are 17 rare earth minerals, right? China just stopped selling six of their critical rare earth minerals to the world. 15 of the 19 industrial mines in the Congo are owned by the Chinese communist party, who use child slave labor. We can't accept that anymore. We should never enter into a memorandum of understanding with the communist country of China for our rare earths. Never. Yet the past administration did.

We have the opportunity to mine in this country. We can mine in Minnesota. We can mine in Alaska. We can mine in Utah. We can mine in Nevada. We can mine in California. We can mine in Washington. We can mine in Pennsylvania. And the list goes on and on. We have to have the political will to do it. It will be an economic boom for our communities. The jobs. What an opportunity do we have? Let's not miss it. And it starts with all of us understanding the importance of mining and the value that it can bring to our economy and our strategic national security, the state of Minnesota, and Northeastern Minnesota. I want you to understand the iron range and the Duluth complex, which is the copper, nickel, and cobalt—we have the opportunity to bring it to the nation.

I am so proud of each and every one of you here to talk about this opportunity. Mr. Chair, we cannot miss this opportunity. Our nation is depending on it. Our small businesses are depending on it. Our strategic national security is depending on it, and our communities and our minors need it. And I yield back.

Chairman WILLIAMS. Gentleman yields back. I now recognize Ms. McIver from the great state of New Jersey for 5 minutes.

Ms. MCIVER. Thank you. Thank you, Mr. Chairman, and thank you to our Ranking Member for convening this hearing today. I want to thank each witness for being here today with us.

Critical minerals are the foundation of our national security and economic resilience. And we must ensure that Congress supports the responsible development, processing, and reuse of these essential resources. Small businesses, from clean technology startups to equipment manufacturers to recycling innovators, are the engine of American creativity. They must be at the center of any National critical mineral strategy. That means leveling the playing field, ensuring fair access to capital, and providing consistent federal support to help them compete with larger and often state-subsidized global players. We must continue to build on the historic investments made through the Bipartisan Infrastructure Law and the Inflation Reduction Act, not roll them back. These programs support responsible development, promote environmental innovation, and empower the small businesses driving the next generation of American innovation. America's energy future, security, and economic leadership depend on it.

I have two questions, and these are both for Dr. Stoy. Some of my colleagues from across the aisle argued that repealing clean energy investments made under the Bipartisan Infrastructure Law

and Inflation Reduction Act will save money for our nation and its small business owners. Can you speak about how repealing the investments made under these laws will cost us in the critical mineral—minerals industry?

Ms. STOY. Absolutely. Thank you so much for the question. I will say I am not an expert on the Inflation Reduction Act. But my understanding is that, you know, as we seek to build out the entire supply chain in the U.S. as we seek to, you know, bolster manufacturing, we need to have incentives all the way down the line, especially given that we are dealing with a non-market player. The IRA includes many provisions that help bolster that. And if we cripple the end of the process by removing customer-consumer incentives, we are terminating the line. And ultimately, what that means is that our products will not end up being sold in the U.S. They won't end up being refined in the U.S. They will go abroad.

Ms. MCIVER. Thank you for that. Given how far behind we already are in securing critical mineral supply chains, wouldn't further funding rollbacks be a national security risk, in your opinion?

Ms. STOY. Yes, I would agree with that.

Ms. MCIVER. Thank you. With that, I yield back.

Mr. MEUSER. [Presiding.] Gentlelady Yields back. I now recognize myself for 5 minutes.

Folks, we have got a very serious discussion here. I think Mr. Kaye brought that out very well initially, and it is certainly being repeated over and over. So we got to figure out what we can do about it. Something tells me you all have some good ideas and perhaps a written plan, white paper, on what, not just what we need to do over the next 10 years, but even over the next 2 or 3 immediately, right? We have one mining company of rare earths elements in the United States, MP in Southern California, one processing refinery, I believe owned by MP. Now, China provides 70 percent of the world's rare earths. What are we doing, right? So this is a very important meeting, and hopefully, this is just the beginning.

I have a bill, and frankly, looking at it now, I think this just scratches the surface offering for rare earth elements production, tax credits $9 within a ton—on a ton of coal for refuse, $20 per kg on REEs extracted and sold from coal, $3 tax credit per barrel on brine water that we are about to introduce and et cetera, a couple of others. Now, I am not sure that is going to do the trick. It might be a step in the right direction. Mr. Kaye, what are your thoughts on some of my comments here?

Mr. KAYE. I think you hit the nail on the head. It goes this way. 15 years it has taken for us to do nothing while the Chinese have dominated. They and their government have been extremely supportive of their ability to create world dominance in this. And it was part of a strategy because they think in that context.

The first thing we need to think about is creating a stockpile. Why a stockpile? If we have a strategic oil reserve, then we need to have a strategic critical mineral reserve. What we intend to do, just to comment on it, is we intend to deliver a reasonable amount of gallium by the end of this year. That means that we will stockpile the other rare earths, perhaps on a military base, which is part of an executive order that said let's use the Pentagon, let's use

military bases. We are in discussions regarding a project such as that today.

Secondly, with a little bit of government support that Idaho National Labs has agreed that they can cut a year off the development of the plant that we are putting online. That will be a full-blown demonstration plant, at least 2 tons a day, and we can start delivering actual rare earths to our Defense Department, to various other. They talk about the Stargate project. We have allocated $500 billion artificial intelligence, medical applications. Nobody has ever talked about medical. Well, guess what? You can't have diagnostic equipment. You can't have the new technologies that are coming out without rare earths.

Mr. MEUSER. So let's hear now, Mr. Mushinski, I am going to ask you on the type of tax credits, incentives, and regulatory reform, some of your thoughts on what we need to do to springboard and blast off, if you will, or at least get off the ground.

Mr. MUSHINSKI. Thank you, Congressman. For me and for RER, and I assume the other businesses here, it is market stability that is important. We have tried to start up businesses before, and the Chinese are very aware. The Chinese are very smart people. They can flood the market and deplete prices and drive us out of business. You will recall that even MP, Mountain Pass, at the time, was driven into bankruptcy by that exact point. So, I agree a strategic stockpile is important. This is a nascent industry in the United States, and the companies here, mine included, need a foothold. We are not looking for the government to give us a complete handout. We need a foothold so that we can get investors. So that we can have bankable contracts. So that we can go to capital markets and have a business plan that they don't have to be concerned about market manipulation.

Mr. MEUSER. All right, quickly, Ms. Stoy, do you agree?

Ms. STOY. Yes, absolutely. The thing that I talk to when I talk to investors is they say, well, what about China? What about the market? Like for me to deliver a 5-year financial plan, I need to have pricing information, and we have an opaque market with non-market players on non-exchange traded metals.

Mr. MEUSER. Well, as I opened with, this is very, very important. Perhaps rather than call it the Manhattan Project, as I am from Pennsylvania, we will call it something other, maybe the Pennsylvania Project. But we look forward to continued conversations very much so. Thank you. I yield back.

I now recognize Mr. Tran from California for 5 minutes.

Mr. TRAN. Thank you so much, Chairman. Welcome, witnesses. Thank you for being here. Dr. Stoy, in 2024, the Select Committee on China released a bipartisan report revealing that the Chinese communist government supplies over 50 percent of the U.S. demand for 24 critical minerals, including 90 percent of rare earth elements. The report also emphasized that advanced recycling technologies offer a scalable solution to strengthen the domestic supply chain for these minerals and reduce our reliance on China. However, the Trump administration has reduced staffing in the Department of Energy's loan and R&D programs, the various resources needed to help reduce U.S. dependence on China for critical minerals. In fact, over 77 billion in funding at the Department of En-

ergy remains frozen. How does that affect their capacity to invest and award contracts to businesses like yours, Dr. Stoy?

Ms. STOY. Thank you so much for the question. This is something that I think about very often is how, you know, to fund, you know, the—the projects that we will be building, the projects that we will be financing. These will take high amounts of capital. The Department of Energy has been instrumental in putting together different loan offices, different programs for startups like mine and many others. Without staff at these agencies, they are not able to do their jobs. They are not able to evaluate loans. It is a huge problem for me, especially as I go out to investors, to say, here is my plan for building a facility. You know, I am going to use this contracting agency, this loan office. If they are not considered reliable, then my plan is no longer reliable. Thank you.

Mr. TRAN. And are you concerned that these cuts would cede America's global STEM leadership to the PRC?

Ms. STOY. Absolutely. I mean, one thing I also think about a lot is the training that comes from loans just like these. You know, China has, I think, 80 universities dedicated to mineral processing and mining. We don't have any. You know, if we are serious about building talent, the talent that we need to run our businesses, we need to have those funding agencies in place.

Mr. TRAN. Yeah. In fact, President Trump's proposed cutting of the National Science Foundation staff by half and reducing its grants awards, which would threaten the agency's ability to fund critical R&D nationwide and further advantage the PRC's technological competition with the U.S.

Mr. Chairman, I asked for unanimous consent to insert an R&D World article about the impacts of the proposal and existing Trump cuts into the record.

Chairman WILLIAMS. So moved.

Mr. TRAN. Thank you.

Next question goes to Mr. Dowd. In September 2024, your company received a 4.2 million contract from the Department of Defense to expand domestic production of rare earth element terbium, one of the most difficult to obtain rare earth elements from recycled fluorescent light bulbs. Can you explain how important government contract like this one are to your business?

Mr. DOWD. Yeah, absolutely. You know, when we talk about government support and kind of step back, big picture, you know, 35 years ago, the leader of China said that rare earths are going to be to China what oil is to the Middle East. And that is before this electrified world that we live in today, right? And so the government of China really instigated a deliberate industrial policy to systematically capture this market and the U.S. and the rest of the world now have to turn on all across the supply chain, mine to metal, so that we are no longer reliant upon China for the sources of material in any way. And that is not going to happen overnight. Obviously, that is going to take a decade or two or more. That is exactly what China has done. But it really needs necessary long-term policy that will transcend administrations, Republican and Democrat.

And specifically to us, terbium is only otherwise produced in China. We are the only other company in the world producing ter-

bium. The Department of Defense award allowed us to be able to scale up and produce what is necessary for military applications, for the U.S. government in the defense sector.

Mr. TRAN. That is amazing. And you would agree that it is important for us to continue federal investments in promoting recycling and a circular economy for these critical minerals, yes?

Mr. DOWD. I think turning on mining, recycling all sources of material is vital for the future of the country.

Mr. TRAN. Thank you so much, Mr. Chairman. I yield back.

Chairman WILLIAMS. The gentleman yields back.

I now recognize Mr. Finstad from the great state of Minnesota for 5 minutes.

Mr. FINSTAD. Thank you, Chairman Williams. Thank you for holding this important hearing today, and thank you to the witnesses for being here. As a Member of this Committee and then also on the House Armed Services Committee, I am excited to have you here today to discuss the important role critical minerals play in our national security interests and our overall economy in this country.

The state of Minnesota is home to a large majority of our nation's domestic critical mineral reserves, including nickel, cobalt, platinum, and copper. And after hearing Congressman Stauber's comments, I used to think his roads were paved in gold, but I guess they are going to be paved in nickel here now soon up in Northern Minnesota. Those Minnesota grown companies have been unable to renew their federal leases due to both the Obama and Biden administrations pulling the rug out from underneath them and putting up roadblocks.

So, with that being said, Mr. Kaye, the United States has the strictest environmental and labor standards in the world, yet we have become reliant on China and other adversarial nations to control a large majority of the world's global supply chain. In your experience, what environmental and labor standards do these countries have in place for their operations?

Mr. KAYE. They are very supportive of their homegrown industries and China particularly has been extremely robust in making it easy for it to happen. I believe that now it is an all-hands-on-deck approach for this. It is regulatory, it is, as my colleagues have said, support for the offtake agreements. We are in discussions with multiple country companies both in the defense industry and the automotive industry for supply even if it takes 3, 4, 5 years to come on stream.

So what we would need is, as everyone has said, we need support so that China cannot manipulate the price. We need fast tracking to permit. Even Mountain Pass is partially owned by the Chinese. Even some of their concentrate is shipped to China to be processed. That can't be good.

So it is, I believe, public-private partnerships. I believe it is regulatory relief. You know, as one of my colleagues said, unchain us and let American entrepreneurialship, let us do what we know how to do. And it is always now with an environmental concern because the environment is sensitive. But the pendulum has switched too far to that side. It can't take 29 years.

Mr. FINSTAD. So, Mr. Kaye, just as a follow up, just to be very clear, so our strictest in the world environmental standards, our state-of-the-art best that can be labor standards in this country, China isn't competing at that same level, correct?

Mr. KAYE. Absolutely not.

Mr. FINSTAD. Okay. So to my colleagues here, I mean, I guess the question we have to ask ourselves, are we content putting our head in the sand and pretending that they are playing by the same rules? And the answer is no. And so it is incumbent upon us and our government to do better in this area.

I would like to move on to Mr. Dowd. My constituents would rather rely on our neighbors in northern Minnesota, heck, even Nebraska, to extract and refine these minerals for our domestic supply chain. We trust our neighbors. We can have a healthy discussion about environmental standards, labor standards, and then we can, through our government and through our policy and through our process, make sure those standards are met. And we can do that face to face, neighbor to neighbor.

Given your experience operating and innovating in this space, what are the biggest challenges preventing American companies right now from leading the world in critical mineral development? And a lot of times we in this Committee, you know, people will come and say, well, it is the regulations or it is this or it is that. If you were to leave here today and say, I got this off my chest, here is the four or five things that this Committee and this Congress can help us do, what is it?

Mr. DOWD. Thank you, sir. You know, it is, as I said earlier, China, 35 years ago, said that rare earths are to China what oil is to the Middle East, and that is before this electrified world we live in today. We are literally in the infancy of this industry. It was referenced, perhaps a Rockefeller moment, where this is oil 100 years ago. I think that is absolutely to be true.

China controls this industry, one, because they made it a deliberate policy, but, two, the Chinese government subsidizes the industry, so there is no ability for this country to be able to compete on level ground if our government is not also part of that equation.

Mr. FINSTAD. My time is up here. I would just say this, we are ripe for critical minerals permitting reform 2.0 in our country. Let's reimagine the next 50 years and not try to fix broken policies of the last hundred.

Chairman WILLIAMS. The gentleman's time is up.

Mr. FINSTAD. I yield back.

Chairman WILLIAMS. The gentleman yields back.

I now recognize Mr. Olszewski from the great state of Maryland for 5 minutes.

Mr. OLSZEWSKI. Thank you very much, Mr. Chairman. Thank you to our witnesses for joining us today. I appreciate the opportunity to discuss America's economic and technological growth alongside the need for a stable supply of critical minerals.

In addition to my service here, I am honored to serve on the House Foreign Affairs Committee and in the Africa Subcommittee in particular, where we have recently also discussed the need to support Africa's critical mineral sector as a driver for economic growth. We know that this conversation must also include con-

versations about support for families, children, and local communities. These are groups that are often exploited through forced labor and small-scale informal mines across the continent, often in deadly work environments.

So I am concerned both about the action of this administration working to dismantle the National Institute of Occupational Health and Safety in terms of our own safety in that work here in America. I also know that we are currently facing a fairly chaotic landscape from a President who has unilaterally enacted tariffs on nearly every import from every country. These tariffs affect 35 of the 50 critical minerals that we discussed today, which raises prices for American businesses and consumers and causes higher prices for mining and for refinery equipment.

The reality is that this is an important conversation, but we cannot only mine our way out for reliable and ethical critical mineral supply chain. So I look forward to working with all of you in the years ahead, as well as my colleagues on this critical issue, while doing so not backtracking on issues like workers' rights and protections and removing some of the barriers to our success.

To that point, I have two quick questions. One is on tariffs and one is on grants. I will start with you, Dr. Stoy. According to the U.S. Geological Service, the U.S. has little to no reserves for many critical materials. So obviously, as we discussed, we are trading to acquire them. Can you talk a little bit about how tariffs affect our ability to buy them from abroad?

Ms. STOY. Absolutely. Thank you so much for the question.

I am not an expert on tariffs. I am not an economist. But what I can say is that when I look for investors, when mining companies globally look for investors, investors are looking for stable markets. They are looking for stable capital. Refiners that I think personally is the most important thing right now beyond just mining, you know, to build up these facilities, we need stable markets. And tariffs, I think, pose issues to that. And consistent pricing is important. We have talked about a lot of different levers that the government can use here, you know, stockpiles, ensuring price floors. There is different things we can use here, but all of them can be negatively impacted by tariffs.

Mr. OLSZEWSKI. I appreciate that, and I want to make sure I have it right. As a fellow "ski," is it Mr. Minishski?

Mr. MUSHINSKI. Mushinski.

Mr. OLSZEWSKI. Mushinski, Olszewski. We got it. Okay. I appreciated your testimony and your calls for unlocking grants for commercialization efforts. I think that is critically important as one way to increase capital access for this work. So I just want to, I guess, pose to you, would you be concerned if very large grant makers, and in particular, thinking about the federal government, right, if we froze our grants and other funding sources, that certainly would be a challenge to that and would erase some of the capital landscape? Is that a fair assessment?

Mr. MUSHINSKI. Of course.

Mr. OLSZEWSKI. Yeah. And so, yeah, just to that point, to my colleagues, we are seeing a lot of the dismantling of these kinds of programs, not just in this space, but across the government. And I think we want to try to work with our partners across the aisle

to find ways that here and in other spaces that I think the federal government actually does have a key role to play in spurring innovation, safety, and success in the private sector.

And so, again, I want to just thank our witnesses to today, Mr. Chairman, for their insights and their wisdom. Look forward to working with them and you and our colleagues in the years ahead.

And with that, I will yield back.

Chairman WILLIAMS. The gentlemen yields back.

I now recognize Mr. Bresnahan from the great state of Pennsylvania for 5 minutes.

Mr. BRESNAHAN. Thank you, Mr. Chairman and to the Ranking Member, for holding today's hearing, and especially to the witnesses for taking time out to come and testify today.

Securing our supply chains for rare earth minerals and other critical resources is not just an economic priority. It is a matter of national security. These materials are essential components in a wide range of technologies, from smartphones to electric vehicles and advanced defense systems. Yet, despite their importance, the United States has fallen behind over other nations, particularly China, in both the mining and refining of these vital resources. China's dominant position in these supply chains have given them significant leverage on the global stage, leverage that can threaten our economic competitiveness and our security. To address this challenge, we must bring about commonsense permitting reform that allows us to responsibly develop these resources here at home.

My district lies within the Marcellus Shale region in Pennsylvania. Fracking has been a key driver of our country's energy dominance and Pennsylvania's economic growth for the last 20 years. But fracking can potentially deliver more than just oil and gas. Recent studies by the National Energy Technology Laboratory have found that the water used in fracking can unlock up to 1,160 metric tons of lithium. That is almost 40 percent of the current demand for lithium, which is 3,000 metric tons per year. This is comparable to the lithium produced in the brine ponds in Chile, the world's second largest lithium producer.

In Wayne County in my district, there is roughly $1 billion of natural gas deposits that we cannot tap into because of governors in Pennsylvania, New York, New Jersey, and Delaware have banned it based on some science and under pressure from some environmental activists. If our country is going to reduce emissions and have a cleaner grid, we need these rare earth minerals like lithium to achieve these goals.

Sadly, the prior administration stifled their own green energy goals with overregulation by trying to ban natural gas exports, trying to ban fracking, the IRA's methane tax, and use of ESG's metrics and investments, and not approving pipelines quickly enough. Instead of American energy powered by clean American fuel sources and rare earth minerals processed under the American environmental standards, we have been forced to rely on Chinese imports, which are produced under horrendous environments and labor conditions.

Our goal must be to provide essential raw materials that fuel our economy, support our national defense, empower the innovative technologies of tomorrow. We can, we must, and uphold our com-

mitment to environmental stewardship while advancing economic growth. The false choice between economic progress and protecting our environment has held us back far too long.

With that, I am going to start with my first question to Mr. Dowd. I want to echo on Mr. Finstad's questions a little bit earlier. If you can point to just one specific action that Congress can deploy to help us in the progress, would it be towards workforce development? Would it be permitting? Would it be regulation? If you can point to just one thing, and you had mentioned China in the prior answer, but is there anything else beyond China that we can be of assistance with?

Mr. DOWD. Yeah, as a rare earth element separation company, at least the way we do, how we do our refining, there is no regulatory or regulation that is permitting us from doing what we are doing. The workforce is really not a challenge where we are, fortunately. I would say the big thing is continuing, as the government has through the Department of Defense and Department of Energy, funding companies like us to boost the defense industrial base to have the capability and the capacity in this country to compete with China.

Mr. BRESNAHAN. What do you mean "funding"? Is that through grant processes? Is that through R&D? What kind of funding do you reference?

Mr. DOWD. Yeah, sure. Our company has received a handful of grants and awards over the last handful of years, which have really furthered us to where we are today. The Congressman earlier mentioned we received a Defense Production Act through the Department of Defense for $8.67 million back in September. That really enabled us to be able to produce terbium, which cannot be found anywhere else in the world other than China.

Mr. BRESNAHAN. So why is that the responsibility of the American taxpayer to provide economic grants to a company like yours?

Mr. DOWD. Yeah, I think it is a real question for the Committee or for the country in terms of the responsibility of government to help fund what is necessary to be able to have this capability in this country. And I think if the government does not compete, given that the Chinese government is subsidizing the industry, we will be fully reliant on China for rare earths for a long period of time. And that is obviously a geopolitical supply chain issue.

Mr. BRESNAHAN. My time has expired. I yield.

Chairman WILLIAMS. The gentleman yields back.

I now recognize Ms. Goodlander from the great state of New Hampshire for 5 minutes.

Ms. GOODLANDER. Thank you, Mr. Chairman, and thank you to our witnesses for being here today for this important hearing.

You have each testified that the rare earth challenge is a really critical one to our national security. Our supply chain vulnerability is core to addressing, to keep our country safe. But it is also an extraordinary opportunity that small businesses across our country are seizing. And I am seeing it all across my home state of New Hampshire.

What I would say is our hearing today, the title of the hearing today, I note is "Securing America's Mineral Future: Unlocking the Economic Value Beneath Our Feet." The economic value I think is

more than just beneath our feet. And I saw this firsthand in visiting an extraordinary service-disabled, veteran-owned small business in the Monadnock Region of my state that more than 6 years ago predicted that we would have a germanium crisis in this country. Germanium is used, as many of you know, in high-speed computer chips, plastics, and a wide range of military applications from night vision devices to satellite imagery sensors.

My constituents started a company, they self-funded the research and development costs of a cost-effective, ecofriendly germanium recycling effort and they began production. They have encountered a lot of challenges in getting the support that they need for small businesses to actually tackle this. And I wanted to ask you, Mr. Dowd, can you speak to your experience?

I also serve on the Armed Services Committee and, knock on wood, we are going to have a National Defense Authorization Act this year where we have an opportunity to really take a look at ways in which we can improve the way that the Department of Defense does business with small businesses in our country. Can you speak to your experience contracting with the Department of Defense and what challenges you encountered?

Mr. DOWD. Yeah, our experience with the Department of Defense and, specifically, receiving funding through the Defense Production Act has really been incredibly positive. I really don't have a negative thing to say about that.

Ms. GOODLANDER. Really?

Mr. DOWD. I can only speak from the award that we are currently in and our experience in receiving that award in the last year.

Ms. GOODLANDER. Dr. Stoy, could you tell us a little bit about the challenges you have encountered in contracting with the federal government and getting the kind of investment that small businesses like yours need to bring us to the next generation of recycling critical minerals?

Ms. STOY. Absolutely. My experience has largely been very positive in applying for funding. I will say there were—there have been a handful of Department of Energy grants that required really an extensive amount of paperwork for small businesses to apply. As an example, I think there was a grant that was for $500,000, which is not—it is a sizable amount of money, but not huge, that I think I ended up writing, you know, 100 pages of content for on, you know, economic development. And, you know, 500K for a 3-year grant is not really enough money to have an outsized impact on, you know, your local community. So I think there are ways to streamline grant processes that would make it easier for small businesses to take advantage of.

Ms. GOODLANDER. Well, we welcome any and all ideas that you have on this front. We are all about cracking down on waste, fraud, and abuse, and making it easier for small businesses like yours. Just note that the funding cuts that we have seen across our federal government have made it very difficult for these important programs to reach their intended small business recipients.

I want to ask you about the impact of the President's unilateral trade wars, which have impacted 35 of 50 critical minerals, 10 of 16 rare earth elements. You have each spoken to just the time that

it takes to build up our domestic manufacturing base. Many on our Committee have supported an exemption for small businesses. But I wanted to ask you to the President's unilateral tariffs because they threatened to put so many essential small businesses out of business. I want to ask you about the uncertainty that you are seeing across the industry and the markets and the customers who you work with in this moment of absolute uncertainty for our country.

Ms. STOY. Yeah, you know, customers, investors, everyone is looking for stability and these tariffs add uncertainty. One of the big things—I have been a little bit insulated because I have been housed at Argonne National Lab, which has been a tremendous opportunity that—you know, it is a very small program. There is maybe five innovators per year. This is not—it is not a big enough program for many small businesses to benefit from that if they have to buy their own equipment. I mean, I am deeply impressed that someone from your state was able to self-fund a recycling project. So I think that that is something that we need to work on is adding that stability.

Ms. GOODLANDER. Thank you. I yield back.

Chairman WILLIAMS. The gentlelady yields back.

I now recognize Mr. Downing from the great state of Montana for 5 minutes.

Mr. DOWNING. Thank you, Mr. Chair, and thank you to the witnesses. I come from Montana, the Treasure State. If you want it, we can probably grow it or mine it or produce it. So we are blessed with incredible reserves in critical minerals.

So I am going to start in my backyard with Mr. Kaye. You are on the front lines of critical minerals discovery and extraction in Montana. Your company, U.S. Critical Materials, is set to develop the Sheep Creek site in Ravalli County into a major producer of rare earth elements. In your testimony, you note the remarkable nature of the mineral concentrations at the Sheep Creek site. Can you explain to us more about the unique abundance of rare earth elements at the site?

Mr. KAYE. Thank you for your question. We have concentrations that range about 9 percent and in some cases higher. That means as a comparative to Mountain Pass, they average about 5 percent. It literally, as confirmed by Activation Labs, the blue chip lab for evaluating purity of the product, and Idaho National Labs who did extensive work in our (phonetic 25:29) ore, which, by the way, is very low in thorium and very high in grade. That means we are below the standards required to seek nuclear regulatory authority, which is a boon to us in being able to get our product online quickly.

It is an extraordinary deposit because it is carbonatites. And carbonatites, geologically, 150 million years ago have come up from the earth, have penetrated through dikes and fissures and have extended above the surface within just three adits, which are horizontal tunnels that have been drilled into the side of the mountain 35 years ago, there are 62 carbonatites. We have sampled them all. They all show mineralization down at depth. And there is a theory going right now that we are working to prove this summer that there is a continuous source that lies below. So while——

Mr. DOWNING. Hey, just in the interest of time, the critical, and I appreciate that, the critical minerals mined at Sheep Creek support—how do they support the manufacturing of technologies critical to national security?

Mr. KAYE. The answer to that is samarium, which is not found in the United States. We have an abundant supply. Gallium, which, as mentioned earlier, has 3,800 military uses. The Chinese have banned it to export about a year ago. We have 180 to 380 parts per million. We are working with Idaho National Labs now. We expect that we will be able to extract gallium and be able to present it for the use of this country within this year.

Mr. DOWNING. So on that note, how are small businesses uniquely positioned to initiate American critical mineral independence from China?

Mr. KAYE. We have the entrepreneurial spirit that has grown this country. We are entrepreneurs. We understand risk-reward and we have the attitude of it has to happen, we will make it happen. And with the support of the regulatory authorities, state government, and the like, it will occur.

Mr. DOWNING. Thank you, sir. In my district, we have experienced firsthand the difficulties of competing with mineral dumping by foreign adversaries. The Sibanye Stillwater Mine in Stillwater County is the United States' only platinum and palladium mine. Unfortunately, Russia's dumping of cheap minerals into the international market forced the Sibanye Stillwater owners of the mine to scale back its operations and lay off 700 workers at the end of last year.

I am going to move to Mr. Mushinski. In your testimony, you outline how your company, Rare Element Resources, experienced similar hardships from Chinese dumping. Can you elaborate on to what degree you believe this dumping effort by Chinese producers was coordinated and deliberate?

Mr. MUSHINSKI. I think it was 100 percent coordinated and 100 percent deliberate. If you go back to the 2016 timeframe, when there were restrictions on—I am sorry, it may not be before 2016, the Chinese deliberately put restrictions on exports of rare earths. That spiked the price. As with any mining business, when the price goes up, the exploration goes up, the technology goes up, and it is a continuous curve.

The mining companies, Mountain Pass at the time, took off. Their stock went over $100 a share. A mere 4 years later, the Chinese absolutely flooded the market. The prices cratered, Mountain Pass went bankrupt. That is when our company almost went bankrupt in the middle of our permitting process.

Mr. DOWNING. Unfortunately, I have run out of time. Mr. Chair, I yield.

Chairman WILLIAMS. The gentleman yields back.

I recognize Mr. Cisneros from the great state of California for 5 minutes.

Mr. CISNEROS. Thank you, Mr. Chairman.

As a Member of the House Armed Services Committee and previously serving at the Department of Defense, I deeply care about our national security. And I understand and agree with the importance of securing our critical mineral supply chain and I support

the small businesses helping address this vital need. However, this hearing is not focused on what we can actually do to help these small businesses, but rather it is another attempt to infomercial the President's agenda to deregulate.

The House Natural Resource Committee already had a hearing on domestic mining for U.S. national security on February 6. The House Energy and Commerce Committee already had a hearing on enhancing our critical mineral supply chains on May 21. If we want to stretch the bounds of the House Small Business Committee to also talk about critical minerals, let's talk about federal funding opportunities like the small business research grants that help companies like Rivalia. This hearing is not talking about SBA programs to help these small businesses. It is not talking about funding from other agencies for these small businesses. It is not diving into federal contracting to support these businesses. I urge my colleagues to engage with us in meaningful discussions on how to better support small business, not just rubber stamp an agenda.

So, Ms. Stoy, could you kind of go into detail a little bit more about SBIR, how it helped you get started, and really the importance of programs like this to encourage investment in other businesses like yours that could help, like you said, recycle these minerals instead of them just going to waste after they have been used?

Ms. STOY. Absolutely. You know, I founded Rivalia using a blend of government funding, SBIR funding, and private venture capital. I think, you know, to prove that you should be a company in the market, you need to have that kind of buy-on from, you know, a private group. But, you know, programs like the SBIR help front load some of the high capital costs that come with hard tech startups. I mean, we are all in mining. You know, this requires equipment, this requires labs, this requires resources.

The SBIR program has been incredibly helpful to me. There is also some programs offered alongside the SBIR program, including a business boot camp where they help you do customer discovery, engage with your customers and the partners. You know, we are dealing with very complex supply chains here. And learning how to have those conversations was something I learned through the NSF SBIR program.

The Chain Reactions Innovations Program that I am a part of at Argonne National Lab, the LEAP program is also, I think, incredibly useful as a tool to help small businesses access resources that they otherwise wouldn't have access to.

Mr. CISNEROS. Thank you very much for that. And again, I think the importance of research and funding these grants in order to help small businesses like yours get started is of vital importance and something that we should be discussing today more than about how regulation is getting in the way.

Mr. Mushinski, hopefully I said that right, I hear your company is exploring training and education programs with universities in conjunction with the Bear Lodge Project. Can you speak to the importance of a strong STEM workforce in career and technical education programs for projects like that?

Mr. MUSHINSKI. Thank you for the question. We do, we currently have three interns from the University of Wyoming and

South Dakota, the School of Mines, which is dedicated to minerals and mining. And we live—our process and our facility is in a very small town of Upton, Wyoming, 800-and-something people. We are relatively close to other population centers. But the ability to recruit STEM employees is difficult in that area and that is a very important issue for us. Where do we locate our final plant because of those issues?

We fortunately live in a very pro mining state, which is Wyoming. And the governor and the University of Wyoming and all the Members within that legislation are very supportive to us. You know, it is junior colleges, it is colleges, it is technical trades. A mining and processing facility is not just STEM. You need all the blue collar work as well, and that is a very important concern.

Mr. CISNEROS. No, thank you for that answer. I am a big believer in education and training and everything that we need to put into it. You said this isn't a field that most people probably grow up thinking they are going to get into, but it is vital importance to make sure that we invest in the technology and the training for that.

So with that, I yield back, Mr. Chairman.

Chairman WILLIAMS. The gentleman yields back.

I now recognize Mr. Patronis from the great state of Florida for 5 minutes.

Mr. PATRONIS. Thank you, Mr. Chairman, and thank you all for participating in speed dating. It is kind of back and forth and, you know, the input that we are getting is really helpful.

For the last 8 years I regulated mining and blasting in the state of Florida. And I have learned of the proponents and the opponents and specifically understanding, at least in the case of the state of Florida, whenever we have what seems to be good policy or good proposed legislation, how it dramatically could potentially change your cost of business or where your customers may do their business. I look at what you are providing. You are providing quality jobs in a heavily regulated environment with a sensitivity to supply chain needs and also what you need to do to balance the environment. And I don't envy what you do, but I am glad you are able to find a margin to make you want to continue pursuing it.

I have always been a big proponent for predictability in the timelines when it comes to permitting. I don't want to belabor this because I know it was kind of touched on a little bit by you, Mr. Kaye, but I am going to ask you to elaborate more on it and maybe even a little bit of a comparison of the timeline of how China has the ability to bring goods to market versus the United States and how much of a difference there is in that timeline because does this create an advantage for China?

Mr. KAYE. I have a couple of comments that I think would be relevant. One of which is that to the former—the congressman over there who said, how do you attract young people? Okay, the answer is technology. Technology makes it a lot more glamorous than a pick and a shovel. We are using artificial intelligence, predictive analytics for fast tracking exploration. It brings a whole other kind of person to the table.

Secondly, today we made an announcement that retired four-star General Steven Townsend has become a senior advisor to us. He

testified in front of the Senate some years ago about the need for critical minerals. He told us that in Africa when he was running AFRICOM, he wanted to find out how many mines, rare earth and critical mineral mines, were owned by the United States versus China. He found none owned by the United States, all owned by China, except for one, a Canadian company, which turned out when he put his intelligence team to it, to be a front for the Chinese. So somebody asked earlier about Africa.

As to your question, fast tracking is everything right now. Okay. Speed and time. Speed is most important. Time is our enemy. And, therefore, the ability to have access to the decision-makers, to be able to have a meeting such as this, to be able to understand what their requirements are and how we can fast track application for DPA grants or Department of Defense or the movement of money from, you know, environment to defense is critically important. How can we manage the bureaucracy so that it makes it easier for us instead of cutting the red tape and drowning in the things that all my colleagues have just talked about, years and years of going through these things? It is getting better.

Mr. CISNEROS. And it is not—the technology's not going away and the demand is not shrinking. I guess my also concern is just, if you can just expand on it a little bit is the national security concerns we have about being beholden to China on our pipeline.

Mr. KAYE. Yeah. Thank you. The F-35 requires 920 pounds of rare earths. A submarine is 5,000. The new F-47, which is now being proposed, requires large amounts of rare earths. The newest radar that we are working on requires rare earths. The missiles, we expended a tremendous amount of our armaments with Israel, with the Ukraine war, et cetera. You got to rebuild the stockpiles, and yet they require rare earths.

So it is got to be domestic supply, and it is got to happen now. We don't have 5 more years. And so, therefore, that is why we are focused so hard on being able to deliver gallium by the end of this year, because it is required in 3,800 different defense systems that our government requires.

Chairman WILLIAMS. The gentleman's time is up.

Mr. CISNEROS. Thank you, Mr. Chairman.

Mr. KAYE. Thank you.

Chairman WILLIAMS. Next, I recognize Dr. Morrison from the great state of Minnesota for 5 minutes.

Ms. MORRISON. Thank you, Chairman Williams and Ranking Member Velázquez, for holding this hearing. And I want to thank our witnesses for being here and taking the time to testify and share your expertise about the critical mineral industry.

This is a topic we will return to again and again as demand for critical minerals continues to grow during the coming decades. The International Energy Agency projects that growing investments in clean energy will double global demand for minerals by 2040. Growing demand for electric vehicles could increase the need for minerals such as lithium and graphite by as much as 4,000 percent over the next few decades.

And by the way, I am thrilled by the enthusiasm for mining critical minerals I have heard here. So I assume that everyone on this

Committee will be voting against clawing back the IRA and clean energy tax credits.

One of the mines that my colleague from Minnesota, Mr. Stauber, referenced, is on public lands in the watershed of the Boundary Waters Canoe Area Wilderness, the most visited wilderness in the United States and a major economic engine in Northeastern Minnesota. One point I want to make regarding proposed hard rock mines in Minnesota is that this kind of mining has never been done in Minnesota before. We have a proud tradition of iron ore taconite mining. It is very different kind of mining that carries very different risks than copper, nickel, and other hard rock mining.

And the proposed mines, respectfully to my other colleague from Minnesota, are not Minnesota grown. They are owned by Glencore, Rio Tinto, and Antofagasta. These are not small businesses. These are not homegrown, and they are not American companies. They are international mining conglomerates with some of the worst labor and environmental records in the world.

I would like to point out a study that found that the proposed mine in the watershed of Minnesota's Boundary Waters Canoe Area Wilderness would cause a net economic loss in the long term, due in part to the job and revenue losses, for the thriving outdoor recreation industry that that area depends on.

So, Mr. Chairman, I request unanimous consent to insert the study into the record.

Chairman WILLIAMS. So moved.

Ms. MORRISON. Thank you, Mr. Chairman.

Dr. Stoy, can you comment on some of the tradeoffs of unrestricted, minimally regulated mining in terms of environment impacts? Are there any negatives or is it just all upside?

Ms. STOY. Thanks for the question. Wouldn't that be wonderful if there were only upsides? You know, as we discussed securing a domestic supply chain for rare earths, you know, we have to talk about these trade-offs. There are benefits. You know, we can increase our domestic supply long term. We can reduce our dependence on foreign sources. We can support national security. We might bring jobs and investment to rural areas that didn't have access to that before. But, of course, there are significant costs. You know, there is the timeline. We have to consider what is going to happen environmentally here.

The environmental impact, you know, we are talking about disturbing large areas of land. We are consuming water, we are producing hazardous tailings that include radioactive elements, like thorium, uranium. This is, you know, especially concerning and sensitive ecosystem or near indigenous lands or, frankly, anywhere where people live.

There is also, you know, community opposition. Many proposed mines face strong pushback from Tribal Nations, environmental groups, and local residents who are simply concerned about the place they live, you know, water quality, land access, the long-term plan for these sites. These projects carry legal, social, and reputational risks.

In contrast, recovering rare earths from existing industrial waste avoids new land disturbance. It leverages materials already above

the ground and offers a faster, cleaner pathway to supply security. So while I think new mining may play a role in the long term and, of course, in the entire economic picture, we have to be clear-eyed about the costs and pursue lower impact alternatives when they are available.

Ms. MORRISON. I appreciate that perspective. Thank you.

I want to just take a moment before my time expires to brag about a Minnesota company that is doing innovative work to reduce our dependence on critical minerals. Niron Magnetics is the world's only producer of high-performance rare earth-free permanent magnets, which are used in everything from cars to audio systems to medical devices. Niron Magnetics uses technology that was developed through research at the University of Minnesota and they received an SBIR award in 2024 to explore the use of their magnets in DOD applications, exemplifying, I think, how well-designed innovations system can support our small businesses and address pressing issues.

Mr. Dowd, we have talked a little bit about SBIR and STTR programs. Can you just speak to how federal grants and awards can be mutually beneficial to both small businesses and government agencies?

Mr. DOWD. Yeah. For my company, who has been in business for about a dozen years, we have had a handful of grants and awards with the Department of Defense and with the Department of Energy, which has really helped further us to where we are today. And I am not sure without the support of the government, we would have been able to achieve what we have achieved. Because what we do is not easy. If it was, we wouldn't be having this issue today, this conversation today. A lot of R&D goes into getting to where we are today. Thank you.

Ms. MORRISON. Thank you, Mr. Dowd. Thank you, Mr. Chairman.

Chairman WILLIAMS. The gentlelady yields back.

I recognize Mr. Alford from the great state of Missouri for 5 minutes.

Mr. ALFORD. Well, thank you, Mr. Chair, and thank you for our witnesses for being here today.

Rare earth minerals, elements like neodymium, cerium, lanthanum are critical for modern technology from smartphones to electric vehicles to defense systems. Missouri's role in their mining has a rich history and untapped potential, but government overreach is holding us back. In the mid-20th century, Missouri was a leader in rare earth exploration. The Pea ridge Mine in Washington County, operational since the 1960s, revealed significant deposits of rare earths alongside iron ore. And by the 1980s, studies confirmed Missouri's geological potential with deposits in the southeast region rivaling global hotspots.

However, low prices and foreign competition, mainly from China, stalled development. China now dominates, producing more than 60 percent of the world's rare earths, leaving the U.S. dependent on imports for more than 70 percent of our supply.

Today, Missouri stands at a crossroads. The Pea Ridge Mine, now dormant, holds an estimated 600,000 tons of rare earth oxides, enough to bolster domestic supply. This is just outside my district.

Private companies are eager to restart operations, but progress is slow. Why? Excessive regulation. Permitting for new mines can take over a decade in the United States of America compared to just a year in competitors' nations. Environmental reviews, while important, are often redundant, delaying projects without code clear benefits. Meantime, communist China tightens export controls, threatening our supply chains.

The government must act decisively. First, streamline permitting under the National Environmental Policy Act to cut timelines without sacrificing safety. Secondly, offer tax incentives for rare earth processing facilities as refining is a bottleneck. Third, fund research into cleaner extraction methods to address environmental concerns. These steps will unleash Missouri's potential, create jobs, and secure our national interest. Missouri's rare earths are a sleeping giant. It is my intent to help them wake up by getting government out of the way.

Mr. Kaye, critical minerals are not only essential for the long-term economic success of the U.S., but also for its national security. Could you please explain the importance of the resources in your minds to our national security, sir?

Mr. KAYE. Thank you for your question. We spoke about gallium. Gallium is critical. There is no supply here in the United States. The Chinese have embargoed it. Our gallium is in a very pure mineralized form found in the carbonatites themselves, which means it is relatively easy to bring them out and properly refine them.

Samarium, there is no supply here in the United States. And so we have the same situation with that.

Third is our government understands now, particularly the Department of Defense, and the reason that General Townshend has become an advisor to us is exactly that reason. He understands what the problems are. He understands what national defense means. And the Chinese are betting that we are going to keep slow like we have been. But that is not going to happen anymore.

And so we believe that the 17 rare earths and natural and critical minerals that are important to all aspects, artificial intelligence, chips, new radar, new aircraft, new ships, new technologies leading to the future, have to be domestically sourced. And we and our colleagues are determined to make that happen. Our attitude now these days is while we are all friendly competitors, we are all Americans. And whatever we can do to help each other, whether it is technology, whether it is cooperation, whether it is working together to make us critically mineral independent again and, therefore, critically mineral sovereign again, is our number one mission. And so we are all working toward accomplishing that goal. And thank you for your question.

Mr. ALFORD. Thank you, Mr. Kaye, Mr. Dowd, Mr. Mushinski, and our other witness, we really appreciate you being here today. This is a national security issue.

And with that, I yield back.

Chairman WILLIAMS. The gentlemen yields back.

I now recognize Ms. Simon from the great state of California for 5 minutes.

Ms. SIMON. Thank you, Mr. Chair. It is an honor to be sitting by you. And I do believe that you have the best tie in the room today, sir. It is amazing. Yes, sorry. I apologize.

I am so happy to be having this conversation with you all. In fact, as you all were talking, what came to me was a writing from Bernice Johnson Reagon, Dr. Bernice Johnson Reagon. And she was one of the leaders of the Student Nonviolent Coordinating Committee during the Civil Rights Movement. And one of her writings was called "Battered Earth." And one of the stanzas in the piece said, "If the earth could run away, she would be running for her life." And I really appreciate this very timely conversation.

I also appreciate, Dr. Stoy, you talked about being supported in your graduate studies as a young scientist. And it is not missed on me or anyone on this dais that you are the only woman on the panel. My daughter is in the biological sciences. My eldest, go Aggies at UC Davis, and she told me she was one of the few folks who crossed the stage an undergrad focused again on our earth, on biology.

I wonder what we would be talking about if, in fact, the United States paid homage to young scientists and fully supported their educations. And once they got out of grad school, fully nurtured their labs, fully nurtured your staffing process, provided support for your insurances. I wonder what we would be thinking about as we try to juxtapose where we are in terms of earthing rare minerals with our adversaries like China. It is hard to compare and contrast when you have countries around the world that fully support young people advancing in the sciences. But like Bernice Johnson Reagon says, our adversaries don't care about the earth. And if she could run away, she absolutely would.

You know, just a few months ago, I was able to visit an amazing small business in West Oakland, where I am from. A small company that has developed fascinating technology to extract lithium directly from brine using significantly less land and water than conventional evaporation methods. And in talking to the founders, young, brilliant, scrappy, they don't wear suits, they wear Converse, they are amazing and super smart and they have PhDs and they are physicians. That is crazy smart, amazing folks, right, again, in a low-income community in the Bay Area doing everything that they could to create a sustainable model moving forward. They talked to me about how difficult it was not just in the last administration, but also in this administration to acquire resources. In fact, they are waiting on money right now to keep their staffing levels up.

We are talking not just about rare minerals, we are talking about a finite Earth. And so when you have innovators, like some of you all on this panel, committed, committed to sustainable practices, committed to new opportunities and innovations that will literally save, save the lands of our dear country, you can't go in a gazillion times, right? The Earth is, in fact, finite.

I am curious, Dr. Stoy, when you talk about—well, you talked about, I would say in your testimony rather beautifully, how, in fact, it was difficult in this moment, and it has been, and a number of you have also repeated this, to receive the resources that you need and deserve to move forward. Dr. Stoy, can you talk to me

about, in the perfect world, how would, whether it is SBA or other government agencies, truly support young innovators like yourself? So that instead of sitting at a computer writing 100 pages for $500,000 divided by 3, and those of us who staffed institutions, we know that that is only a couple of staff with a little bit of health insurance and not for their kids, maybe just for them, what would it be like if you could truly be the scientist that you were trained to be? What would you need?

Ms. STOY. So I think I have talked about a lot of visions I have had. You know, in a dream world I am running a team of a dozen people. We are all in the lab. We have folks dedicated on building out the rest of the supply chain, talking to all the partners, building out the network. You know, this is something that I, instead of using government funding, I will go out and fundraise later this summer, you know, a couple million dollars to start building out that team. And I am trading that for equity, and I am trading that for, you know—that is betting against the money I will need in the future to build a plant. You know, there is—for startups, you know, you can be scrappy, but you can only do so much with so little money.

So I appreciate your question and I think, you know, betting on young innovators is a win for us.

Ms. SIMON. I appreciate you and I appreciate all those who came out today to listen, and those are folks who came to testify.

Thank you, Mr. Chair. I yield back.

Chairman WILLIAMS. The gentlelady yields back.

I would like to thank our witnesses for their testimony and for appearing before us today. Without objection, Members have 5 legislative days to submit additional materials and written questions for the witnesses to the Chair, which will be forwarded to the witnesses. I ask the witnesses to please respond promptly.

So if there is no further business, without objection, this Committee is adjourned.

[Whereupon, at 12:02 p.m., the committee was adjourned.]

APPENDIX

RARE EARTH SALTS

June 24, 2025

Aaron T. Dowd
Chief Executive Officer
Rare Earth Salts Separations and Refining, LLC
Beatrice, Nebraska

WRITTEN TESTIMONY TO THE U.S. HOUSE SMALL BUSINESS COMMITTEE

"Securing America's Mineral Future:
Unlocking the Economic Value Beneath Our Feet"

Chairman Williams, Ranking Member Velazquez, and distinguished members of the Committee, thank you for the invitation to testify on the critical issue of securing America's mineral future. I appear before you today representing Rare Earth Salts, a Nebraska-based small business at the forefront of addressing one of our nation's challenges.

The United States confronts an unprecedented threat to our economic sovereignty and national security through China's control of the rare earth elements supply chain. Rare earths are a set of 17 elements in the periodic table that play a critical role in our national security, energy independence, environmental future, and economic prosperity. These elements are far more than mere commodities; they form the backbone of modern technological advancements. From powering batteries and electric vehicles to enabling medical equipment, military systems, smartphones, and wind turbines, rare earths are foundational to the innovation driving our technological civilization.

The age of technology is indeed the age of critical minerals with vast geopolitical implications. The need for securing both domestically sourced rare earth elements and domestic rare earth processing infrastructure is vital.

Today, China controls 90% of the global downstream rare earth market, impacting the rest of the world's supply chain and giving them significant control in restricting America's access to materials vital for manufacturing and defense capabilities. This was not always the case. From the 1960s until the 1990s, the U.S., specifically California's Mountain Pass mine, led global production. However, China's deliberate industrial policy systematically captured market control, creating the vulnerable supply chain we face today. Though China's dominance in the rare earth market has prompted global efforts to find alternative sources and processes to produce these critical compounds, producers

outside of China continue to face formidable challenges, struggling to compete with the highly competitive pricing of China's domestic market.

The challenge extends beyond supply security to economic competitiveness. China's current market dominance stems from their large-scale use of Solvent Extraction (SX) methods, which were developed and implemented in the U.S. in the 1960s. These processes require hundreds of separation stages and generate excessive chemical waste. Western companies, utilizing this proven method, face higher production costs due to necessary environmental and worker protections. This cost differential has created a market failure where Western innovation cannot compete with Chinese production, despite superior technology and environmental stewardship. For small businesses like ours, this represents both a challenge and an extraordinary opportunity to innovate and lead.

The global technology race to develop next-generation rare earth separation solutions highlights the urgent market demand that Rare Earth Salts addresses. By delivering advanced separation technologies, we meaningfully contribute to enabling cost-competitive domestic production, positioning ourselves as a leader in meeting this critical need.

Founded in 2012 by Dr. Joseph Brewer, Rare Earth Salts exemplifies how America's small business innovation can address strategic national challenges. Rare Earth Salts addresses the global need for a cost-effective, sustainable, and environmentally friendly rare earth separation process.

We have developed patented technologies for the refining of rare earth elements to high purity from various feedstocks worldwide, including both ore-based and recycled material.

Prior to developing our proprietary processes, we evaluated the strengths and weaknesses of every separation process used since the 1940s. That allowed us to invent a revolutionary electrochemical process from the ground up based on sound basic chemistry. The separation process advancements by Rare Earth Salts represent industry-changing solutions demanded by the rare earth supply chain to profitably compete with Chinese production and maintain a low environmental footprint.

Rare Earth Salts has been working closely with the U.S. government and has received multiple grants and awards for its separation technologies from the Department of Defense (DOD) and Department of Energy (DOE). The DOD and DOE are working to further establish a domestic rare earth supply chain given the well-documented national security risks arising from the foreign reliance on critical materials. These partnerships demonstrate how federal investment in small business innovation can yield strategic returns for national security while building domestic industrial capacity. Rare Earth Salts recently received an award from the DOD to increase production of heavy rare earth

elements, specifically Terbium.

The rare earth challenge represents more than supply chain vulnerability—it is a defining opportunity for American small businesses to lead the next generation of critical mineral production. Companies like Rare Earth Salts exemplify how American innovation can compete globally.

Supporting domestic innovation in mineral processing can help ensure the United States does not merely secure its mineral future but leads the world in sustainable, competitive production of these essential materials. The permanent magnet industry, which represents the predominant end use for rare earth elements, is essential to our energy independence, environmental future, and economic prosperity. By supporting small businesses developing innovative separation technologies, we can reestablish American leadership in this critical sector.

Rare Earth Salts stands ready to contribute to America's mineral independence. But this mission requires collective effort. With a robust policy framework that acknowledges the strategic importance of domestic critical mineral production, American small businesses can help transform this challenge into a competitive advantage. The technology is ready. The market need is undeniable. The national security imperative is urgent. We need to now unlock the economic value beneath our feet and secure America's mineral future.

Chairman Williams, Ranking Member Velazquez, and distinguished members of the Committee, thank you again for the invitation to testify, and I look forward to your questions.

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Submission of Testimony:
House Committee on Small Business

"Securing America's Mineral Future: Unlocking the Economic Value Beneath Our Feet"

US Critical Materials – June 24, 2025
Harvey Kaye, Executive Chairman

Thank you for the opportunity to speak with you today about a matter of growing urgency for the United States—our near-total dependence on foreign adversaries, particularly China, for the rare earth elements essential to our modern economy, energy systems, medical safety, and national defense.

We find ourselves, quite frankly, in a precarious position. The United States—once a global leader in rare earth element production—has fallen far behind. While China accounts for more than 80% of global REE processing, the U.S. lacks both sufficient upstream mining capacity and the downstream processing infrastructure to support a resilient, secure, and independent supply chain. This is not merely a trade issue; it is a national security imperative.

Fortunately, there are real-time solutions here at home. One of the most promising is the Sheep Creek deposit in Montana, operated by U.S. Critical Materials Corp. This is not a speculative play or a minor resource—Sheep Creek represents a world-class deposit with extremely high concentrations of critical heavy rare earth elements like neodymium, praseodymium, dysprosium, and terbium—elements that are indispensable for permanent magnets used in electric vehicles, wind turbines, precision-guided munitions, and advanced medical technologies.

What makes Sheep Creek especially remarkable is that it shows some of the highest total rare earth oxide (TREO) grades discovered in the U.S. to date, with favorable geology for low-impact extraction. This is the kind of domestic resource we must prioritize if we are to reassert our leadership and reduce dependency on foreign-controlled supply chains that do not align with our values or strategic interests. The site also contains a significant amount of gallium and samarium, which are critical minerals essential for technologies such as semiconductors, permanent magnets, and nuclear control rods - and unfortunately - the marketplace for these mineral elements are also dominated by China.

Historically when confronted with similar challenges, the United States has responded with bold industrial policy when our future was at stake. We invested massively in the nuclear enterprise, in our aerospace programs, and in defense innovation—all because we understood the stakes of falling behind in strategic sectors. Businesses large and small fit into this matrix in a wide-scale effort to demonstrate America's greatness.

Current day solutions to fortifying a rare earth element supply chain are constrained to say the least. Our increasing tensions with China over trade and geopolitics can reduce the flow of rare earths to the United States in a heartbeat - impacting smaller scale projects more adversely. There are no near term or even short term solutions in Greenland or Ukraine, and frankly, before we see any commercial quantities of critical minerals from these two locations, it could be decades - time we as a country do not have.

In closing, let me remind this committee of one of the most pivotal moments in that history: when the Soviet Union beat us to space with the launch of Sputnik in 1957. It was a global wake-up call, a technological and psychological shock. But it was also a catalyst. The United States responded with urgency and vision—rallying public-private partnerships, dedicating substantial resources,

and ultimately leapfrogging the Soviet Union to not only win the space race, but to unlock decades of technological and economic leadership.

We now face a similar Sputnik moment—this time not in orbit, but in the ground beneath our feet. We must treat rare earth elements with the same seriousness we once gave to satellites and rockets. If we do, if we match our ambition with investment, coordination, and smart policy, we can build a resilient domestic REE supply chain that not only supports our clean energy transition and national defense but also reclaims U.S. leadership in critical material technology.

I strongly urge this committee to support legislative and regulatory frameworks that accelerate domestic permitting, incentivize investment in U.S.-based projects like Sheep Creek, strengthen our ability to process and refine rare earths here at home, mitigate red tape challenges to producing and processing these critical minerals, and implement the full support and backing of the United States Government in these important endeavors..

Let's not wait for another wake-up call. The time to act is now. Thank you.



Executive Chairman
US Critical Materials

RER
RARE ELEMENT RESOURCES

Testimony of Ken Mushinski
President and Chief Executive Officer
Rare Element Resources (RER)
before the
House Committee on Small Business
"Securing America's Mineral Future: Unlocking the Economic Value Beneath Our Feet"
June 24, 2025

Introduction

Chairman Williams, ranking Member Velazquez, and esteemed members of the Committee. Thank you for the opportunity to address the Committee on an issue of vital importance to our nation and world today, securing critical minerals, specifically rare earths, for our nation's defense and high-tech industries and supporting small business in meeting that need.

My name is Ken Mushinski, and I am the President and Chief Executive Officer of Rare Element Resources. We are a Wyoming-based publicly traded company with a critical rare earth deposit and a state-of-art innovative rare earth processing and separation demonstration plant in Wyoming. Since our founding in 1999, we've invested over $170M in developing our USGS recognized[1] world-class rare earth deposit and proprietary separation technology.

Executive Summary

I believe you are all well-versed in why Rare Earth Elements (REEs) are critical components in modern technology, essential in everything from smartphones and electric vehicles to wind turbines and defense systems. REEs are enablers to the evolution of our high-tech world, and vital to our American defense systems. It is also widely known that China dominates rare earth mining and processing and is taking deliberate actions to control the entire manufacturing space for all systems and components that utilize rare earths for downstream products. This has created an untenable national economic and security scenario.

Small businesses like Rare Element Resources (RER), including the other companies testifying before you today, have unique technologies and the potential to innovate and contribute to domesticating the REE supply chain; from mine to magnets. However, our small companies face specific challenges and have distinct needs that must be addressed to ensure a sustainable domestic REE supply chain.

The rare earth market is a niche market that presently has very limited domestic capability and capacity. RER has been and is currently working to correct this longstanding strategic issue

[1] The U.S. Geological Survey (2010) mineral resource map located at https://www.usgs.gov/centers/gggsc/science/airborne-geophysics-rare-earth-element-deposits-agreed

affecting our defense, energy, technology and transportation sectors that has left our country at the mercy of Chinese market dominance and manipulation.

As an example of the obstacles faced by RER and others in the critical minerals industry, RER completed its resource confirmation and commenced National Environmental Policy Act (NEPA) permitting of the Bear Lodge Project, located within the Black Hills National Forest, in 2011 and spent over $30 million progressing our NEPA assessment. This long and tedious process, which was protracted and often delayed due to red tape and lack of government resources, culminated in the publication of a draft EIS in January 2016. This multi-year, millions of dollar effort was ultimately derailed through Chinese market manipulation whereby the supply market was flooded with Chinese mined and processed REE products such that the prices of rare earths worldwide bottomed out. As a result, RER's, as well as other REE development companies', access to capital quickly disappeared, ultimately resulting in cessation of operations – due solely to a lack of funds and project economics.

Realizing we could not compete with the predatory Chinese market dominance, RER, in conjunction with its now majority shareholder (an affiliate of General Atomics), pivoted to proving and demonstrating our novel and proprietary REE separation technology so that we, and potentially other domestic rare earth companies, would not be reliant on China to separate the rare earth concentrates produced here in the U.S. Our goal is to not only compete with China in rare earth production, but to also create a path for processing and separation that is economically and environmentally superior- adhering to all U.S. environmental regulations while supplanting the environmentally detrimental and costly steps in conventional Chinese technology.

With that challenge in front of us, RER, with partial funding from the Department of Energy (DOE) and the state of Wyoming and supported by the Wyoming state and Federal delegations, has constructed and will soon begin operating our $66M+ demonstration plant that is intended to prove RER's separation technology, already confirmed in pilot scale testing, on an industrial scale.

Even with the expected success from the demonstration plant operations, without additional support and funding from the government, RER and other innovative small businesses face monumental hurdles. Being a small business attempting to establish a first-of-its-kind commercial business in a niche market, that is unattractive to larger established mining enterprises, access to capital is paramount. Access to capital requires a certain level of market stability, a stability that is thwarted by Chinese influence. RER and our peers cannot afford to invest hundreds of millions of dollars to commercialize our projects only to have our efforts and investment undermined by Chinese adversarial market manipulation.

Small businesses like RER unfortunately find themselves in a paradox whereby investors, and potential industry supply chain partners, require certainty in the markets and yet this is not possible with the ongoing threat of Chinese market interference.

We believe that addressing this nascent market's unique challenges requires a multi-faceted approach involving market stabilization through engaging in government offtake agreements, creating incentives for private capital, unlocking grants for commercialization efforts, and regulatory streamlining. By meeting these needs, policymakers and industry stakeholders can unlock the potential of small business and create a secure, resilient and sustainable REE supply chain, right here in America.

Chinese Dominance of the REE Market Impedes Market Entry

As many now realize, China's dominance and manipulation of the rare earth extraction, processing and separation, and permanent magnet production is an existential risk to our modern world. It is estimated that Chain controls 60–70% of global REE mining and over 85–90% of processing capacity including 99% of Heavy REE processing. Heavy rare earths, including dysprosium, are a small market, but of the utmost importance to our modern defense systems.

This dominance allows China to influence global prices, making it risky for competitors to invest, and as we have seen just recently, export controls by China strains the U.S. and its allies' ability to produce and progress our technology. Just last week, a report was published on the extent to which Beijing's curb on rare-earth magnet exports furthered chocked off supplies to the world. This report confirmed that exports of RE magnets from China fell 74% in May from a year earlier, a move that was felt throughout the automotive, electronics and the defense industries[2]. Even if China determined in its sole judgment that they would commence exports again, the Chinese REE prices can be, and have before been, set artificially low due to subsidies, state support, or strategic dumping, which undercuts new entrants, and prevents global market competition.

Permitting Obstacles Further Impede a Diversified REE Market

Because REEs are typically found in low concentrations, mining them often requires large-scale operations and complex chemical processing. With these challenges, environmental regulations make REE projects costly and slow to permit due to the stringent and often inefficient U.S. permitting framework. These are realities that China is simply immune to as they are not held to these same environmental standards. It is noteworthy that over the prior few months, however, several initiatives for more efficient permitting paths for critical mineral projects have been designed and/or advanced here in the U.S. Those programs include FAST-41 and Transparency Project designation through the Permitting Council. We are appreciative of these efforts driven by the current Administrations' executive orders, and we believe it is a step in the right direction to bring critical mineral projects, like our Bear Lodge Rare Earth Project, online in a more reasonable timeframe. However, these actions alone will not allow a project like Bear Lodge to

[2] Miao and Feng (2025, June 19) *"China Flexes Chokehold on Rare Earth Magnets as Exports Plunged in May"* Wall Street Journal.

reach commercialization due to lack of financing options, influenced by the opaque Chinese led rare earth market.

Rare Earth Supply and Demand Uncertainty Discourages Investment

While highly strategic, REE markets are relatively small in volume when compared to mainstream commodities such as iron, copper, or precious metals (thousands of tons per year vs. millions of tons per year) and therefore of less interest to major mining companies, which prefer to focus on lower-risk, high-volume commodities. As a result, REEs are seen as too small and too high of a market risk, and better suited for specialized nimble and innovative small companies.

Further, demand for REEs is largely concentrated in the high-tech industries, which makes growth projections speculative. Unlike other commodities, there is no transparent market and trading system, which results in investor concern about demand growth. Combined with the risk and cost of a new supply or the inherent impact on that supply by Chinese dominance and predatory practices, these factors make investments riskier for public companies focused on stable returns – especially small business in need of capital investment.

These market challenges are worsened by high capital needs and long payback periods for critical minerals projects. REE projects often require hundreds of millions to over a billion dollars to become sustainable, covering exploration, development, mining, processing, separation, and sometimes downstream manufacturing. The uncertain offtake pricing adds to the risk. Most critical minerals projects take 10–15 years from exploration to production, tying up investor capital with uncertain returns and complicating offtake agreements. Customers like EV makers or magnet manufacturers are hesitant to commit to unproven suppliers, increasing investor risk without confirmed agreements.

Recommendations to Support a Domestic Secure REE Industry

This begs the question, how does America protect its interest in these *seeds of technology*?

The key to progressing a domestic rare earth supply chain, from mine to magnets requires market certainty. We believe that certainty can be obtained through government-backed, bankable, long-term contracts, possibly to establish a strategic reserve of critical REEs. Additionally, government grants or guarantees tailored to small businesses in the REE sector to progress a project are vital. RER would not be in our current position today, with our processing and separation demonstration plant, without the support of the DOE and the state of Wyoming, all of which we are extremely appreciative. However, the leap from demonstration to commercialization is perilous for small businesses given the increased financial burden in technology and commercial advancement.

Additional low-interest loans aimed at resource exploration and technological innovation should also be supported and backstopped by the government; as well as creating tax incentives during development and operations to reduce the financial pressures of capital-intensive development projects.

On the regulation side of the process, compliance with the environmental permitting process creates another challenge for small businesses. Although critical to protecting our environment, mining and permitting processes have become overly burdensome with layers of scrutiny and multiplication of efforts between agencies. The U.S. must streamline permitting processes to reduce costly bureaucratic delays and create a regulatory framework that balances environmental concerns with economic viability, an issue that we appreciate has not gone unnoticed by this Administration.

Further, due to the global REE market China domination, small businesses struggle to find buyers for their products or to secure long-term contracts with large manufacturers. It is imperative that market access programs to connect small businesses with international buyers be encouraged, and U.S. suppliers be showcased not only to our internal market but also to our allied nations.

Finally, in a sector where efficiency and sustainability are paramount, small businesses must adopt cutting-edge technologies for REE extraction and, as RER has, separation. We believe additional funding for the development of cost-effective and eco-friendly technologies must be urgently progressed. RER knows first-hand, that although open calls for funding opportunities are released quite consistently, and responsive white papers are being submitted by us and other like companies, the years pass, and letters are then received stating there is "strong interest" by agencies like the Department of Defense and the DOE, but we are told in those letter that there is "no funding". The drive to invest seems to be there, yet the fuel to get it done doesn't seem to exist.

Conclusion

In conclusion, RER encourages Congress to pursue policies and support funding to support small businesses that are innovating and progressing a secure, domestic rare earth supply chain:

- **Government purchasing to establish strategic stockpiles**. Government purchasing through long-term contracts with price stability mechanisms will bring clarity to the investment community on not only demand but also pricing that supports commercial economics. This will drive private investment into the REE small business sector.
- **Government grants unlocked for industry innovation.** DOD and DOE funding is limited, even though open calls for projects are being released. The funding to progress small business innovation and progress on REE projects should be supported such that those initiatives can come to fruition. Unlocking the funding through the

DOD and DOE grant and financial assistance award programs that are backlogged can meaningfully move small businesses toward commercialization.

- **Government guarantees to encourage private investment and loans**. Similar to purchasing agreements, government guarantees will entice private investment and unlock capital to small businesses.
- **Permitting reform to bring surety to project timeliness.** Permitting reform to streamline duplication and red tape will bring certainty to the permitting and licensing process for small REE companies which in turn will drive investment, while reducing the extraordinary cost of permitting.

We believe these types of initiatives will help to remove the significant market obstacles and barriers to progress for small businesses engaged in the REE supply chain so that collectively, we become the solution to the very real and present danger to our nation's defense and high-tech industries.

I am honored to be here today to share with you RER's unique and intimate experience as a small business in the rare earth industry and I look forward to addressing any questions. Thank you.

Securing America's Mineral Future: Unlocking the Economic Value Beneath Our Feet

House Small Business Committee

Tuesday, June 24, 2025 | 10:00 AM

Written Testimony of Laura Stoy, Ph.D., CEO and Founder of Rivalia Chemical Co.

Chairman Roger Williams, Ranking Member Nydia Velázquez, and Members of this Committee, thank you for this opportunity to speak before you today. It's an honor to speak on a topic so vital to the future of U.S. mining and materials. Securing critical mineral supply chains is essential, particularly for our national defense, technological innovation, and manufacturing strength.

My name is Dr. Laura Stoy, and I am the CEO and Founder of Rivalia Chemical Co. Rivalia is pioneering new chemical extraction technologies to recover valuable rare earth elements from industrial wastes. These wastes include coal fly ash and other coal combustion byproducts, phosphogypsum, acid mine drainage sludges, and mine tailings, and from them we produce a rare earth element rich concentrate. Rivalia's patent-pending method both extracts the rare earths from the bulk material and separate them from major elements- major challenges in rare earth processing. Using this method and by targeting secondary materials, Rivalia avoids the high economic and environmental costs of mining and minimizes chemical consumption and hazardous waste generation.

"Mining" Alternative Sources of Rare Earth Elements

The U.S. has 1.9 million tons of rare earth elements in reserves, according to the 2025 U.S.G.S. Mineral Commodities Report. There are even more rare earths in our wastes. Last year, researchers at U.T. Austin estimated that there were 11 million tons of rare earth elements in accessible coal ash in the United States, nearly eight times the amount that the U.S. currently has in domestic reserves. Researchers at Oak Ridge National Laboratory identified phosphogypsum supplies in the U.S. containing another 680,000 tons to several million tons of rare earths. At Duke University, scientists found that hundreds of abandoned coal mines collectively release 500–3400 tons of rare earths each year through acid mine drainage. Mine tailings, another type of waste generated from mine activity, may also be a source of rare earths. While typically considered wastes by the mining industry, tailings often contain 5-10% of the target minerals or metal in the parent ore body. In all these applications, we have an

opportunity to not just harvest the rare earths we need, but to also remediate sites where environmental damage may have been done and improve the area for local communities.

I would be remiss if I did not mention electronic wastes as sources of rare earths. While Rivalia does not focus on recycling electronics, recycling magnets are an important contribution to rare earth element sourcing, especially for powerful magnets: neodymium, praseodymium, and dysprosium.

There are no companies currently producing rare earth elements from any of these wastes in the U.S. at scale- though I will note to this committee that there are many small businesses and startups addressing this opportunity space. Rivalia's focus is on mining rare earths from wastes, but it is likely that this will only be one component of a broader rare earth supply chain. It is my opinion that building a broader, more diverse supply chain for rare earths will make the system overall more resilient to disruption.

Beyond what we can mine domestically, the U.S. should strategically ally with countries with growing and active mining operations, including Australia, Canada, and Brazil, among others. This 'friendshoring' will also contribute to a stronger value chain in the West.

Securing the Midstream

To build a stable rare earth element supply chain independent of China, the U.S. cannot only mine rare earths: we must **also** separate, refine, metallize, and produce finished products. China's dominance in rare earths comes from their leverage over the entire supply chain; for some other critical minerals, China mines less minerals domestically than other large nations, but it processes minerals not only from its own mines, but from mining partners abroad.

Up until very recently, this has included MP Materials, one of the leading U.S. rare earth element mining companies. This has only changed as of January 2025, when the company began a 'mine-to-manufacturing' program, taking their mined ore all the way to finished NdPr magnets.

To solve rare earth value chain and bring it back to the West, domestic rare earth producers must have robust mid-stream processing available. There are significant challenges here, from developing a skilled workforce to fostering innovation, to ultimately de-risking the rare earth market for private capital. The rare earth market is opaque, in large part due to heavily controlled processing and production in China. This makes it vulnerable to price manipulation, making investing anywhere along the rare

earth supply chain less appealing to many forms of private capital due to the added price volatility and risk.

Ultimately, domestically produced rare earth elements must be cost competitive in a global market. China has strategically subsidized domestic mineral supply chains, enabling their businesses to offer products and services at significantly lower costs than their American counterparts. It will be challenging to attract customers, not to mention private capital, without comparable pricing. **It is here that I believe American ingenuity and innovation must be nurtured, to develop new technologies to achieve cost competitive rare earth element production.**

Building New Technologies for Securing Critical Minerals: The Role of Government and Private Funding for Rivalia

I founded Rivalia after completing my Ph.D. in environmental engineering at the Georgia Institute of Technology, where I was privileged to be funded with both government and private funding. Government funding through Georgia Tech's President's Fellowship and the National Science Foundation Graduate Research Fellowship Program; private funding through Georgia Power. I developed Rivalia's core technology during my program through the help of these programs.

I've leveraged a similar combination for Rivalia. I've raised venture capital and participated in Techstars, a prestigious startup accelerator program that, on my site, is partnered with Alabama Power. Through our participation, we have secured a pilot with Southern Company to demonstrate our technology.

I have also raised nondilutive capital. I have been awarded a National Science Foundation Phase 1 Small Business Research Grant, which has helped to derisk the technology and validate our method for additional materials. I've also been awarded several Department of Energy EnergyWerx Vouchers, which have helped us to identify and prioritize technical process improvements as well as improve our positioning the market. Finally, I am embedded at Argonne National Laboratory for two years as an awardee of the DOE Lab-Embedded Entrepreneurship Program (LEEP), Chain Reaction Innovations. Chain Reaction Innovations and LEEP support scientific founders like me so that our technologies have a chance to achieve market impact, to make our nation more secure and prosperous. Having access to the deep expertise, world-class facilities, and science environment at Argonne has been pivotal to Rivalia's development. Specifically, we'll be scaling our technology, going from "grams on the bench to tons in the trench." LEEP and the national labs are incredible resources for launching significant and serious scientific and technical innovations for the nation.

Government funding is invaluable for hardtech startups because it provides early capital to high-risk, long-horizon ideas that, while they have immense impact potential, are often too risky for investors. To these investors, a nondilutive funding award offers both third-party validation as well as an opportunity for the founders to make meaningful progress on milestones. Investment then becomes more attractive for all parties. Additionally, unlike software businesses, hardtech startups have upfront capital-intensive needs, including prototyping, lab infrastructure, testing, compliance, and technical hiring.

Without the DOE LEEP and NSF, Rivalia would have had a much harder path. Government funding can and should be used to launch breakthrough advancements that will lead America into prosperity as a global science and technology leader – especially in critical minerals.

ALLIANCE FOR MINERAL SECURITY

Testimony for the Record

Nicole Rodgers
President
Alliance for Mineral Security
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June 24, 2025

To:
Chairman Roger Williams
Ranking Member Galton
House Committee on Small Business
Washington, D.C.

Subject: Testimony for the Record – Strengthening the U.S. Rare Earth Supply Chain

Dear Chairman Williams, Ranking Member Galton, & Members of the Committee,

Thank you for the opportunity to submit this testimony for the record on an issue of growing strategic urgency: the vulnerability of the United States' rare earth and critical mineral supply chains. We are in the throes of a five-alarm fire of supply chain vulnerabilities, and we ignored all of the previous warnings and fire drills from the rare earth embargo in 2010 and the market manipulation of 2016 to the 2023 export bans from China on gallium, germanium, graphite, and antimony. As President of the Alliance for Mineral Security with almost three decades of experience in federal appropriations, national security policy, and industrial base resilience, I offer the following observations and recommendations:

A. The United States Must Treat Critical Mineral and Rare Earth Independence as National Security Imperative

Critical minerals are not just the foundation of clean energy technologies—they are embedded in nearly every defense and advanced system we rely on. From the F-35's 920 pounds of rare earths to missile guidance systems and secure communications, these inputs are non-negotiable. China's 90% control over downstream processing—and its recent embargo on gallium and other critical materials—puts our military readiness and economic sovereignty at unacceptable risk.

B. Funding Alone Is Not Enough Without Procurement Certainty

While programs such as the Defense Production Act (DPA) and Small Business Innovation Research (SBIR) are essential, the federal government must go further. It should issue bankable off-take agreements and long-term contracts to American producers. The absence of market guarantees is preventing private capital from flowing into this space, particularly for mid-stage and scaling technologies. We must stabilize the market by acting as a first buyer and anchoring industrial demand.

C. Appropriations and Authorizations Should Be Synchronized

The federal government has committed over $300 billion across agencies to strengthen supply chains for critical minerals, rare earths, and essential components. But much of that funding remains unallocated—and where dollars have been designated, they've often been deployed in a fragmented way, missing the mark on full value chain coverage. To secure real resilience for our industrial base, Congress must ensure that authorizations are backed by timely, targeted appropriations—with clear directives that prioritize commercial deployment and supply chain buildout, not just academic research.

Alliance for Mineral Security Policy Recommendations to Strengthen U.S. Critical Mineral Security

1. Treat Rare Earth and Critical Mineral Independence as a National Security Imperative

- Recognize rare earths and critical minerals as strategic defense assets, vital to missile systems, communications, space platforms, and advanced manufacturing.
- Develop legislative mandates that tie mineral security to defense readiness, codifying supply chain independence as a core national interest.

2. Establish a U.S. Strategic Critical Mineral Reserve and Commercial Access Mechanism

- Create a Strategic Critical Mineral Reserve modeled after the Strategic Petroleum Reserve.
- Integrate a Defense Logistics Agency (DLA)-administered right-of-first-refusal program for domestically warehoused commercial materials, allowing the government to access pre-positioned supply during crises without distorting markets or assuming storage costs.
- Focus acquisition on minerals with immediate strategic vulnerability, such as neodymium, dysprosium, terbium, gallium, and graphite.
- Require rotation strategies, blending national security goals with market stability.

3. Expand the Defense Price Index Across All Strategic Inputs

- Create a Defense Price Index for all critical minerals, materials, and components procured, contracted for, or stockpiled by the U.S. government.
- The index should establish allowable price premiums over spot market rates to reflect geopolitical risk, procurement urgency, and compliance with DFARS non-China sourcing mandates.
- Use the index to streamline contracting, increase transparency, and give suppliers and investors clear economic expectations.

4. Provide Procurement Certainty Through Long-Term Government Offtake Agreements

- Direct federal agencies to issue long-term offtake agreements and first-buyer contracts to American producers.
- Prioritize bankable, milestone-driven agreements that unlock private capital for midstream and refining capacity, not just raw extraction.
- Coordinate between DOD, DOE, and GSA to align procurement pipelines with U.S. industrial base needs.

5. Streamline Permitting for Critical Minerals Through Congressional Modernization

- Enact a permitting modernization bill for strategic materials with enforceable timelines, interagency coordination mandates, and judicial review limitations.
- Expand FAST-41 eligibility to cover all Critical Supply Chain Sectors.
- Require agencies to balance environmental stewardship with national security imperatives.

6. Launch a Critical Supply Chain Sectors Designation Program

- Establish a formal federal designation for qualifying sectors such as rare earths, battery metals, defense alloys, and semiconductor materials.
- Provide designated projects with:
    - Tax credits
    - Workforce and STEM education support
    - Accelerated permitting
    - Coordinated interagency reviews
    - Access to DOD, DOE, and DOC industrial base programs

7. Leverage Waste Recovery and Urban Mining as Strategic Resources

- Treat recycling of coal ash, mine tailings, and e-waste as strategic mineral recovery operations.
- Fund proven recovery methods (e.g., ionic liquid extraction, supercritical CO_2 separation) with commercialization grants and DOE pilot project support.
- Require federal agencies to assess recovery potential in federal and tribal lands before approving new foreign-sourced procurement.

8. Harmonize Appropriations with Industrial Deployment Goals

- Ensure that Congressional authorizations (e.g., DPA Title III, IRA, IIJA) are backed by timely and accessible appropriations.
- Include statutory guidance requiring at least 40% of mineral-related funding to be allocated for near-term industrial deployment, not just research.

9. Support Small Business Participation in Mineral and Material Innovation

- Create a simplified federal grant application pathway for awards under $100 million focused on critical mineral innovation and scale-up.
- Establish a "Small Business Advantage" clause in DOE, DOD, and NSF mineral-related solicitations to ensure equity in access.

10. Expand EB-5 Immigrant Investor Expedited Status for Strategic Industrial Base Projects

- Grant automatic USCIS expedited status for EB-5 investments in domestic mining, refining, processing, and strategic materials manufacturing projects.
- Reduce immigration-related delays for investors supporting critical U.S. infrastructure.

In conclusion, the United States is at a strategic inflection point. We must rapidly de-risk our supply chains—not through rhetoric, but through contracts, permits, education, and procurement policy. I urge this Committee to continue its strong bipartisan leadership on this issue and to work with appropriators, defense officials, and technology leaders to drive meaningful, timely change.

Respectfully submitted,

Nicole Rodgers

President

Alliance for Mineral Security

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Biography:

Nicole deSibour Rodgers

President, Alliance for Mineral Security

Nicole Rodgers is a nationally recognized leader in industrial base strategy, critical mineral policy, and supply chain security. She serves as the founding President and Executive Director of the Alliance for Mineral Security (AMS), an organization she was asked to establish by leading industry stakeholders seeking a focused voice to advocate for U.S. mineral independence and industrial resilience.

In addition to her role at AMS, Nicole is a Senior Director at Clark Hill Public Strategies, where she advises clients in the defense, energy, transportation, and technology sectors. She previously served as Chief Government and External Affairs Officer for an investment and advisory firm specializing in the critical mineral sector.

With nearly three decades of experience in advocacy, strategic communications, and public affairs, Nicole brings a unique blend of sectoral depth and cross-industry insight. Her background includes over ten years of direct lobbying and more than a decade of senior-level association leadership. She has worked extensively across the energy, transportation, financial services, and government contracting landscapes—leveraging her policy expertise to craft innovative solutions that advance American competitiveness.

Nicole holds an MBA from George Washington University and a BA from Duke University. She serves on the Executive Committee of the Rare Earth Industry Association (REIA) and remains an active thought leader in U.S. industrial policy circles.

Ecological Economics 174 (2020) 106663

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

Analysis of proposed 20-year mineral leasing withdrawal in Superior National Forest☆

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ARTICLE INFO

Keywords:
Economic impact analysis
Resource extraction
Recreation economy
Mining economy

ABSTRACT

The Rainy River Watershed on the Superior National Forest is home to the Boundary Waters Canoe Area Wilderness (BWCAW). It also contains deposits of copper, nickel, and trace metals, and copper-nickel mining has been proposed adjacent to and upstream of the BWCAW. In 2017, the US Department of Agriculture proposed withdrawing land in the Rainy River Watershed within the Superior National Forest from mineral leasing, a position it reversed in 2018. These developments highlight the potential tradeoff between economic benefits from mining and concerns about its negative economic consequences for the local recreational and amenity-based economy. Previous studies of mining in the Superior National Forest focus on static effects on a single industry (e.g., mining) at some unspecified point over a medium-run horizon. We draw on these studies and the economics literature to provide a unified analysis of the effect of the proposed mining development on income and employment over time. Our results suggest that the proposed mining would lead to a boom-bust cycle that is typical of resource extraction economies, exacerbated by the likely negative effect on the recreation industry.

1. Introduction

The Boundary Waters Canoe Area Wilderness (BWCAW), located within the Superior National Forest in northeastern Minnesota along the Canadian border, consists of more than one million acres of connected lakes and rivers. The BWCAW is one of the most visited wilderness areas in the United States, with 150,000 visitors in 2015 (US Forest Service, 2016). Those visitors support a varied outdoor recreation industry in gateway communities, primarily Ely, Minnesota (Hjerpe, 2018). The lakes and rivers outside the BWCAW also attract recreational visits and both seasonal and permanent residents who locate there for the outdoor and lakes amenities.

The region also has rich mineral deposits. The Mesabi Iron Range, the largest iron mining district in North America, extends for nearly 100 miles to the southwest of the BWCAW, with its most northeasterly portion within ten miles of the wilderness boundary (Minnesota

☆ An earlier draft of this study was submitted on August 6, 2018, in letter form, as a comment on the U.S. Forest Service's proposed withdrawal of Superior National Forest land within the Rainy River Watershed from mineral leasing. This revision reflects several updates to the 2018 letter. The most significant of these is that the 2018 letter considered only direct and indirect employment and income. In response to comments received on the original letter, the current revision now includes estimates of induced (spillover) employment and income. This revision also incorporates several other changes. For internal consistency, multipliers are now taken solely from University of Minnesota-Duluth, (2012) for mining and from Hjerpe (2018) for recreation. Additionally, wage rates are all for the Arrowhead county region whereas, in the 2018 letter, some wage rates were statewide. The discussion of related academic literature has been expanded, and procedural recommendations to the US Forest Service made in the 2018 letter have been removed from this version. Taken together, the revisions affect numerical values in the 2018 letter but do not change the conclusions. We thank Steve Polasky, Cathy Kling, John Hinderaker, Tom Landwehr, and two referees for their comments.

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https://doi.org/10.1016/j.ecolecon.2020.106663
Received 25 June 2019; Received in revised form 21 February 2020; Accepted 25 March 2020
Available online 06 May 2020
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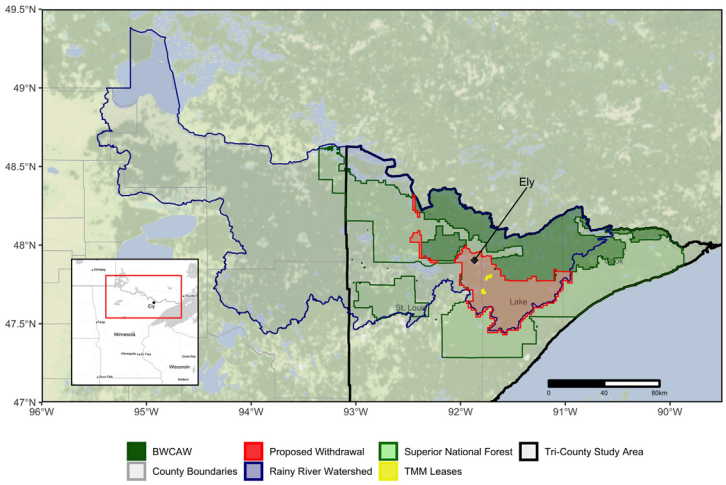


Fig. 1. Map of key hydrological and administrative features of the study area. The area of the proposed withdrawal of mineral rights within the Superior National Forest drains north into the BWCAW and encompasses the TMM mineral leases.
Sources: U.S. Forest Service, 2017, Minnesota Geospatial Information Office, 2020.

Department of Natural Resources, 2017). Although its high-grade iron ore (hematite) has been mined out, taconite mining continues, and taconite mining operations employed 3440 workers in 2016 (Minnesota Department of Natural Resources, 2017). In addition, there is commercial interest in developing copper-nickel mines in deposits both in and out of the Superior National Forest.

In particular, a copper-nickel mine, the proposed Twin Metals Mine (TMM), would be located in a site bordering and immediately upstream of the BWCAW (see Fig. 1).[2] The legal and jurisdictional setting is complex. The proposed site, along with much of the copper-nickel deposit, is on federal land for which mineral leasing rights are administered by the Bureau of Land Management (BLM), though the project also includes several state leases administered by the Minnesota Department of Natural Resources (DNR). The land is within the Superior National Forest, the surface of which is administered by the U.S. Department of Agriculture (USDA), and the USDA must consent to discretionary mineral leasing to ensure compatibility with the resource management objectives of the National Forest System. The USDA also administers the BWCAW, where federal law prohibits mining. Federal mining rights for the TMM project were originally granted in 1966 for a 20-year period with up to three 10-year renewals. The first two of these renewals were granted by the federal government. However, in December 2016 the USDA withheld its consent to renewal, citing concerns about negative impacts on the BWCAW, so the BLM denied the third renewal request.[3] In January 2017 under the Obama Administration, the U.S. Forest Service further proposed to withdraw from mineral leasing approximately 234,000 acres of federal lands within the Rainy River Watershed, which flows north into the BWCAW and which contains the TMM project, and it also initiated the preparation of an environmental impact statement (EIS) to assess the proposed withdrawal.[4]

In September 2018, the Trump Administration cancelled the withdrawal application and EIS,[5] and in May 2019 the BLM reversed its 2016 denial and renewed the TMM leases. TMM submitted its mine application to regulatory agencies in December 2019. The mine now awaits federal and state permitting, even as the federal lease renewal is currently being litigated.[6] Despite its cancellation, the proposed withdrawal remains a key part of the debate over mining near the BWCAW, and legislation that would permanently enact the Obama

[2] The Twin Metals Mine is a copper-nickel mine proposed by Twin Metals Minnesota, a subsidiary of Antofagasta PLC, one of the top ten copper producers by volume in the world. The project is located approximately nine miles southeast of the city of Ely, MN and proposes to mine sulfide-ore from the Maturi deposit of the Duluth Complex geologic formation. The Duluth Complex is one of the world's largest polymetallic deposits and in addition to copper and nickel includes cobalt and platinum group metals. Twin Metals Minnesota anticipates processing 20,000 tons of ore per day from the proposed sub-surface mining operation at the Twin Metals Mine (TMM, 2019a).

[3] Thomas Tidwell, Chief, BLM, Memorandum "Lease Renewal Application Rejected," December 15, 2016 at https://www.blm.gov/download/file/fid/7652.

[4] 82 FR 4282.

[5] https://www.usda.gov/media/press-releases/2018/09/06/usda-removes-roadblock-mineral-exploration-rainy-river-watershed.

[6] The TMM project is subject to multiple regulatory requirements. The project is subject to an environmental review process under the National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA). In December 2019, TMM submitted its Mining Plan of Operations to state and federal agencies for review, thereby initiating the formal NEPA/MEPA Environmental Impact Statement process (TMM, 2019c) (see https://www.dnr.state.mn.us/input/environmentalreview/twinmetals/index.html). Following completion of the EIS, the TMM project must receive permits by various federal, state, and local regulatory agencies to commence construction and operation. These permitting requirements regulate various aspects of the project construction and operation, including hazardous waste management, the disposal of wastewater, and maintenance of air quality standards (TMM, 2019b).

Administration's withdrawal has been introduced in the House of Representatives.[7]

The proposed TMM mine raises a classic conflict between recreational use and conservation on the one hand and mining development on the other, a conflict made more stark by the unique attributes and wilderness status of the BWCAW. Proponents of the mine point to the jobs and income it will create (University of Minnesota-Duluth, 2012; Orr et al., 2018). Opponents point to the risks to the watershed because of potential acid mine drainage and toxin release (Myers, 2016; Pearson et al., 2019), noise and light pollution that would disrupt the wilderness experience and negatively impact the local recreational industry (US Forest Service, 2016), and potential reductions in amenity-based in-migration (Sungur et al., 2014).[8]

The environmental risks associated with sulfide-ore copper mining within the watershed of the BWCAW are potentially economically consequential. Mining and beneficiation processes for underground copper ore generate large volumes of tailings. In a watershed hydrology model of possible mining locations in northeastern Minnesota, Myers (2016) finds that even relatively short-term leaks of tailing materials on the surface at mining locations in the region could cause substantial loads of sulfate, a major product of acid mine drainage, in the rivers and downstream resources of the BWCAW. The economics literature provides some insights concerning the economic costs associated with these adverse environmental impacts. In a study of acid mine drainage-impaired lakes in rural Ohio, Mishra et al. (2012) find a negative relationship between sulfate levels in impaired lakes and recreational use. The literature (reviewed below) documenting the transition of amenity-rich communities from reliance on extractive industries to tourism-based growth suggests a link between the two: were sulfide-ore copper mining to proceed at the TMM site, a contraction in tourism and recreation-based economic activity could plausibly occur, depending on the extent of mining disamenities that diminish the wilderness experience as well as on the severity of spills, breaches, and/or drainage.

While there have been reports issued on both sides of the issue,[9] those reports tend to look at snapshots in time, use different assumptions, and do not provide an integrated comparison of the economic costs and benefits of the proposed withdrawal.

Our study aims to fill this gap by providing an accounting of the impacts over time of the potential development of copper-nickel mining adjacent to the BWCAW on regional employment and income. We focus on the proposed TMM project because it is the sole copper-nickel mine currently proposed for the Rainy River watershed. We consider a 20-year horizon, which is the horizon of the Obama Administration's proposed mineral rights withdrawal. Because the focus is on the TMM project, the economic analysis focuses on the greater Ely region including usage of the Boundary Waters Canoe Area Wilderness (BWCAW) and nearby non-BWCAW lakes and forests. The study area is shown in Fig. 1. Our analysis draws on relevant regional and industry data, modeling in previous economic studies of the withdrawal, and the related economics literature. Our employment concept is employment in industries directly affected by the project (so-called direct employment), plus employment in the directly affected industry's supply chain (indirect employment), plus employment created by spending the earnings from direct and indirect employment (induced employment). Our income concept is total earnings from those direct, indirect, and induced jobs, taking into account differences in wages across sectors.

One of the challenges in this undertaking is the uncertainty around each of the many assumptions needed for this calculation. Although historical data inform distributions for some of our parameters, for others there is no evident way to calibrate a distribution, and moreover some of the parameters could covary and no data are available to quantify those covariances. As a result, a textbook treatment of uncertainty, for example Bayesian or Monte Carlo methods, is not practical in this situation. We therefore use a multiple scenario approach, which (as we explain) results in 72 different scenarios which in turn generate 72 different time paths for income and employment over the 20 years.

We find that, in all our scenarios, mining would produce an initial but temporary net growth of employment and income. Over time, however, the economic benefits of mining tend to be outweighed by the negative impact of mining on the recreational industry and on in-migration, leading to a boom-bust cycle. The preponderance of our scenarios indicates negative net present values of income resulting from the mining project. The primary drivers of the longer-run decline in incomes are increasing productivity in mining (estimated using historical data), reduced amenity-based in-migration, and reduced recreational demand. This boom-bust finding is consistent with recent papers on boom-bust cycles in extractive resource development.

The scope of this study – incomes and employment – is intentionally narrow, and we have omitted multiple factors which are likely important. These omitted factors include: effects on real estate values in the region; proprietors' income and profits; the value of the BWCAW and Superior National Forest as a regional attractor of talent in the Duluth area and elsewhere; and the employment and income driven by the BWCAW and Superior National Forest elsewhere in the state. We also do not consider non-market benefits such as non-market ecosystem services and wilderness existence values.

Although our focus is on the proposed TMM project, our impression is that the challenges confronting our study arise more generally in other natural resource extraction cases. These challenges include competing advocacy studies based on input-output models (or no models) that focus on a specific, unspecified date in the future and which potentially make mutually inconsistent assumptions; a lack of dynamic analysis that incorporates (for example) productivity growth and economic trends; a relative paucity of local data; and considerable uncertainty about key parameters. We hope that the methods used here for reconciling studies and estimating a range of dynamic impacts might be useful in other applications.

We first develop our scenarios and present the net present value calculations. We then discuss factors omitted from this analysis and discuss our results in the context of the relevant academic literature.

2. Computing costs and benefits over a 20-year horizon

We compute annual employment and income for the 20 years of the proposed withdrawal under two cases: the base case of the status quo in which there is no mining, which corresponds to a withdrawal of mineral rights, and the alternative in which the TMM mine is developed. In addition, we compute the net present values of the differences in income between the two cases.

We consider direct, indirect, and induced employment and income effects of the TMM case, relative to the base case. Direct employment is in the industries under study (mining and recreation). Indirect employment is in industries that serve the industry or project under study, for example in the case of mining, the change in employment in industries that provide mining services such as equipment repair. Induced

[7] Boundary Waters Wilderness Protection and Pollution Prevention Act, H.R. 5598, 116th Cong. (2020), https://www.congress.gov/116/bills/hr5598/BILLS-116hr5598ih.pdf.

[8] The conflict over the proposed TMM project is but the latest phase in a history of tension between mining and environmental concerns in Northern Minnesota, which has generated scholarly as well as public interest. Baeten et al. (2016) document the waste footprint of iron ore and taconite mining in the Mesabi Iron Range. Sutherland (2015) catalogs the challenges of economic transition from mining to tourism faced on the Cuyuna Iron Range, just south of the Mesabi, where production peaked in the 1950s. Bergstrom (2019) examines media coverage of copper-nickel mining in northern Minnesota. Liesch and Keweenaw, (2016) and Thistle and Langston (2016).

[9] University of Minnesota-Duluth (2012), Hjerpe and Phillips (2013), Sungur et al. (2014), Barber et al. (2014), Minnesota DNR (2015), Phillips and Alkire (2017), Helmberger (2017), Hjerpe (2018), Ward (2018), and Orr et al. (2018).

employment is the employment resulting from the spending of direct and indirect income on local goods and services. The direct and indirect income effects of the TMM counterfactual in a given year are the net effect on incomes from direct and indirect employment in mining and recreation of the TMM project, relative to the withdrawal case, plus the net direct effect on income from those attracted to the region by amenity values. This latter term captures the income spent in the region by those who choose to live in the region because of its amenity effects, and whose decision to live in the region might be affected by the withdrawal/no withdrawal decision.[10]

Induced income and employment are "spillover" effects of direct and indirect earnings which operate through a Keynesian multiplier channel.[11] Because mining jobs are better-paying than recreation jobs, a job in mining will result in more induced employment and income than a job in recreation. Whether induced employment and income effects actually materialize depends on the availability of unemployed or underemployed resources locally. If there is economic slack, then the direct and indirect earnings can create new local jobs. If, however, the economy is already at full employment, then what is calculated as induced employment either substitutes for other employment as workers change jobs or creates local jobs by expanding the work force as out-of-region workers move into the area. Recent empirical evidence in Auerbach et al. (2019) suggests that on average over periods of recession and expansion, there are nonzero induced local income and employment multipliers. The induced multipliers we use, which are taken from the IMPLAN studies of the Arrowhead economy, fall in the range estimated by Auerbach et al. (2019).[12]

The construction of our scenarios entails developing benchmark assumptions for employment and income under the case of the withdrawal, then considering alternative assumptions under the TMM counterfactual. To capture uncertainty, we vary key parameters to generate a total of 72 scenarios.

For our employment calculations, we make the following assumptions. For the case of the withdrawal, absent extant third-party growth forecasts of recreational employment in the greater Ely area, we rely on two sources of growth in employment related to recreation. In the Arrowhead region (St. Louis, Lake, and Cook counties), employment in the tourism and hospitality industries from 2012 to 2016 grew by 1.4% per year (Minnesota Department of Employment and Economic Development, 2017). USDA (2016) provides projections of increased recreational usage by category for 2008–2030; for the category "Backcountry/challenge" the annualized growth rate of user-days is 1.2%. We use this latter, lower value as the baseline in the withdrawal scenario because it is more directly relevant to BWCAW usage rather than outdoor recreation generally. Although Arrowhead region employment in recreational industries is available, we are unaware of data on the recreational employment base potentially specifically affected by the TMM project. Full Arrowhead region recreational employment (tourism and hospitality) in 2016 was 13,616, however that includes activity not likely to be directly impacted by the mining, such as hotels and restaurants serving University of Minnesota-Duluth and Duluth hospitals. Using the IMPLAN model and a survey of actual user expenditures, Hjerpe (2018) estimates that BWCAW visits from in-season out-of-region overnight visitors alone supports 879 direct jobs. Canoe camping in the BWCAW is just one way that recreational users take advantage of the outdoors in the region, so jobs potentially affected include more than just those supported by BWCAW out-of-region users. We therefore approximate the narrow direct employment definition from Hjerpe (2018) as accounting for one-fourth of potentially affected jobs. The full Superior National Forest area extends well to the east of Ely (see Fig. 1). For this reason, the assumption of 3516 (= 879 × 4) affected direct jobs could be an underestimate. We therefore consider an alternative case in which the number of affected direct jobs in tourism and recreational is 50% greater, 5274, which is still less than two-fifths the number of recreational and tourism jobs in the tri-county area.

Under the TMM counterfactual, in our high-mining scenario, we assume that TMM direct employment starts at 650 jobs, a figure taken from TMM materials (Twin Metals Minnesota, 2019a; Barber et al., 2014). We consider this estimate to reflect the high end of direct mining employment. The UMD-Duluth (2012) study projected 427 direct employment jobs in non-ferrous mining. In addition, in May 2018 TMM announced that it would scale back the planned mining from 50,000 tons per day to 20,000 tons per day, the figure in its December 2019 proposed Mining Plan of Operations. A proportional employment reduction of the TMM 650 jobs at 50,000 tons/day yields 260 direct employment jobs. We therefore consider two additional mining scenarios, intermediate, at 427 direct jobs, and low, at 260 direct jobs.

As shown in Fig. 2, non-ferrous mining generally, and copper mining specifically in the US, has exhibited substantial gains in productivity. Using the data in Fig. 2, we consider three mining productivity growth scenarios.[13] In all, this generates nine paths for annual

[10] We compute indirect employment from direct employment using indirect/direct proportionality factors from the IMPLAN model results reported for non-ferrous mining by UMD-Duluth (2012, Table 25) (Arrowhead region plus Douglas County, Wisconsin) and for recreation/hospitality by Hjerpe (2018, Table 5) (northeast Minnesota). Direct and indirect labor incomes are computed from direct and indirect employment using wage rates for 2016 for the Arrowhead region as discussed below.

[11] Of the four studies related to the withdrawal that use the IMPLAN model (UMD (2012), Minnesota DNR (2015), Hjerpe (2018), and Orr et al. (2018)), only Hjerpe (2018) and Orr et al. (2018) report labor income. The labor income multipliers (induced/(direct + indirect)) computed from results in Hjerpe (2018) and Orr et al. (2018) are respectively 0.214 and 0.347. With constant marginal propensities to consume out of labor income, the induced income multiplier should be the same for income earned regardless of its source (e.g., mining or recreation). One difference between the two studies that could account for these different multipliers is that Orr et al. (2018) consider state-wide effects whereas Hjerpe (2018) restricts effects to the northeast Minnesota region. Because the focus of our analysis is regional, not state-wide, we use the multiplier 0.214. This induced income multiplier is in line with the (induced/(direct + indirect)) value added multiplier of 0.18 in University of Minnesota-Duluth (2012), which is for the Arrowhead region plus Douglas County, Wisconsin. We compute induced employment from induced labor income using Arrowhead tri-county average wages for 2016. If the larger, state-wide induced multiplier of 0.347 is used, the numerical results change but the qualitative results, both for incomes and employment, do not.

[12] Auerbach et al. (2019) use US Department of Defense spending at the local region level and find that, for each $1 of US DOD spending in a locality, GDP in that state goes up by $1.50, so that the GDP multiplier ((indirect + induced)/direct) is 0.50. Their data covers 1997–2016 so includes both the strong labor markets of the late 1990s and mid-2000s and the long period of slack during and recovering from the financial crisis recession. Their estimate of an induced GDP multiplier of 0.50 is consistent with IMPLAN output multipliers. Hjerpe's (2018, Table 5) IMPLAN output multiplier ((indirect + induced)/direct) is 0.59 regionally (not state-wide) for recreation income. UMD's (2012, Table 25) regional GDP IMPLAN multiplier ((indirect + induced)/direct) is 0.43 for non-ferrous mining. The PolyMet FEIS (2015, Table 5.2.10-2) output multiplier is ((indirect + induced)/direct) is 0.55. Orr et al.'s (2018, Table 1) state-wide GDP IMPLAN multiplier ((indirect + induced)/direct) is 0.48.

[13] Fig. 2 shows an overall positive trend in output per employee in the Arizona copper industry from 1970 to 2016, across all hard rock metal mining from 1987 to 2017, and in underground coal mining separately in the three major U.S. coal producing regions from 2001 to 2016. The declines in copper mining output per employee in the mid- to late-2000's are associated with temporary changes in global commodity prices, and the decline in Appalachian underground coal productivity reflects the contraction in the industry and depletion of the higher productivity mines. The average growth rate of output per employee in the Arizona copper industry, 1970–2016, is 2.1% per year. We incorporate uncertainty using low and high productivity growth scenarios of 1.4%, and 2.7%, which are the end points of a 95% confidence interval for productivity growth estimated from the Arizona data. We assume a constant

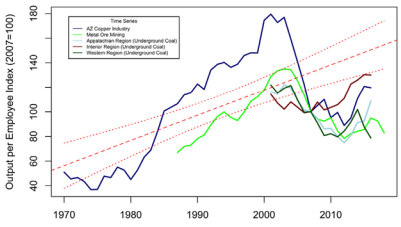


Fig. 2. Output per employee in copper, metal ore, and underground coal mining (index, 2007 = 100).
Sources: Energy Information Administration, 2016, Arizona Department of Mines and Mineral Resources, 1970, U.S. Geological Survey, 2015, Bureau of Economic Analysis, 1970-2017, Bureau of Labor Statistics, 1987-2016.

mining employment (three initial levels, three productivity growth rates).

Under the TMM counterfactual, we consider two paths for recreational employment, a low-impact path and a high-impact path. Because we are not aware of a directly comparable project (large-scale copper-sulfide-ore mining proximate to a water-based wilderness area) for which there are historical data, we consider a scenario in which recreational employment contracts at the rate of 1.2% per year and another in which it contracts at the rate of 2.4% per year. The first of these rates reverses the growth projected under the USDA baseline (USDA, 2016). The second of these rates is a reversal of twice the growth projected under the USDA baseline (USDA, 2016).[14] These counterfactuals are in line with previous studies of growth of other US amenity-based regional economies.[15]

We consider the high-impact scenario conservative in the sense that the impact on tourism over the long run of a major spill or acid mine drainage event are plausibly substantially more consequential.

For the income scenarios, the incomes associated with direct mining and recreational employment are computed using average local wage rates in those industries (Bureau of Labor Statistics, 2018; Minnesota Department of Employment and Economic Development, 2017). Employment in indirect and induced jobs are assumed to earn the average wage for the tri-county region in 2016 (Bureau of Labor Statistics, 2018; Minnesota Department of Employment and Economic Development, 2017).

The remaining component of income is the direct effect from those who move away from the region because of the mining and the related direct effect of those deterred from moving to, or retiring in, the region because of the mining (the "in-migration direct income"). To estimate this component, we used as a baseline the 2016 Census Bureau American Community Survey (U.S. Census Bureau, 2016) total income of the five-township Ely region (Ely, Eagles Nest, Fall Lake, Morse, and Stony River). We projected withdrawal baseline income growth as the sum of per-capita income growth and population growth. Our per-capita income growth projection is the historical per-capita income growth from 1970 to 2016 for the Arrowhead counties (Headwaters Economics, Economic Profile System, 2018). There is a large literature that documents increased population growth in amenities-rich areas (see Rickman and Rickman (2011) and Holmes et al. (2016) for surveys). We adopt the population growth rate from Rickman and Rickman (2011) for counties with USDA amenity rank equal to the average Arrowhead amenities rank (McGranahan, 1999). For the TMM counterfactual, we considered two scenarios for in-migration direct income. Polling by Sungur et al. (2014) found that 23% of residents would consider moving from the region in the event that the TMM project were undertaken. This estimate strikes us as high and many of those who would consider moving might not actually move. We therefore consider two scenarios one in which population growth slows to zero and a second in which in-migration population for amenity values declines by 10% over the 20-year period, less than half of the estimate in (Sungur et al., 2014).[16]

3. Results

In all, these assumptions generated 72 employment and income paths under the various scenarios. The employment paths are plotted in Fig. 3, and the income paths are plotted in Fig. 4.

All the scenarios in Figs. 3 and 4 show a similar pattern. Initially, mining is economically beneficial because of the new mining jobs, the income they produce, and their spillovers to the local economy. Over time, however, the net effect of the mining jobs erodes because of the growth of productivity in mining, the stagnation or decline of amenity-based in-migration, and the decline in wilderness-based recreation as a result of impacts of mining on the recreation industry. The magnitude and timing of the effect on employment and incomes varies across scenarios.

We computed the net present value for each of the income paths, using a 3% real discount rate (Office of Management and Budget, 2003). A histogram of these net present values is presented in Fig. 5. In 89% of the cases, the net present value of the TMM counterfactual is negative, that is, the income benefits of mining are outweighed by the income costs on recreation and in-migration. The cases for which the net present value of the TMM project are positive are those in which mining employment starts at the highest level (650 jobs, despite the

(footnote continued)
annual extraction rate, so that employment falls by the rate of growth of productivity for the three productivity scenarios.

[14] Rasker and Hackman (1996) examine employment and income trends in northwestern Montana and find that from 1969 to 1992, employment in counties characterized by pristine wilderness grew by 93%, an annualized rate of 2.9%. In contrast, resource-extractive counties observed employment growth of 15% over the same period, an annualized rate of 0.6%, a difference of roughly 2.3 percentage points. The scenario in which recreational employment contracts at the rate of 1.2% represents a difference of roughly 2.4 percentage points with respect to the withdrawal scenario. Thus, our rate of a 1.2% contraction in hospitality employment is reasonable assuming a reversal of Rasker and Hackman's (1996) estimate and is perhaps conservative given the degree to which hospitality and tourism employment is amenity-dependent.

[15] Rasker and Hansen (2000) examine rural counties in Idaho, Montana, and Wyoming and find that ecological and natural amenity variables are correlated with population growth in these areas. Deller et al. (2001) find similar results, finding a positive relationship between population growth and publicly owned land resources related to tourism. Winkler et al. (2007), find that "New West" communities, areas typically characterized by amenity migration, see anywhere from 38% to 195% higher employment in the tourism industry when compared to "Old West" communities. According to Winkler et al. (2007), this transition from "Old" to "New West" economic models has occurred over a 30-year period, which would imply an annual growth rate of between 1.2% and 6.5%. Empirical evidence supports the assertion that amenity-driven growth has supplanted extractive industries as the foundation of many amenity-rich, rural western counties (Lorah and Southwick, 2003). Rasker et al. (2013) find a positive relationship between growth in employment and proximity to protected public lands using data on federal lands in non-metropolitan Western counties. Henderson and McDaniel (2005) study sector-level employment growth and USDA natural amenity indices in more than 2000 rural U.S. counties, and find a statistically significant, positive relationship between landscape amenities and service sector employment growth.

[16] In-migrants are treated as bringing income to the economy but are not a business so do not undertake direct hiring, so there is no direct or indirect employment from this channel. That income is spent in part in the community, so it does generate induced employment and income, which are computed in the same way as induced employment and income from mining and recreation.

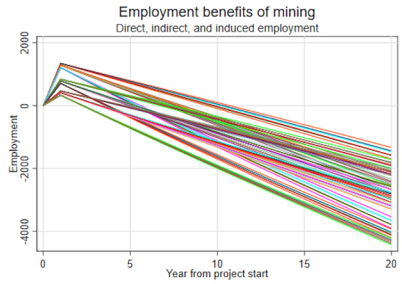


Fig. 3. Net annual employment effects (direct, indirect, and induced) of the TMM counterfactual over time on the Arrowhead economy. A positive employment value means that, under that scenario, the number of jobs in the TMM mining case exceeds the number of jobs in the no-mining baseline.
Notes: the horizontal axis denotes time, starting with the commencement of production at the TMM site.
Source: Authors' calculations.

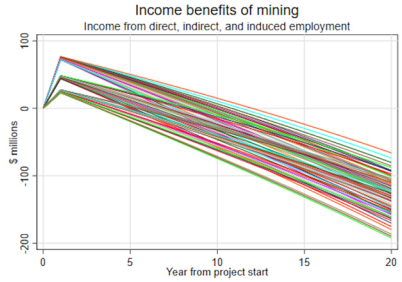


Fig. 4. Net annual income effects (direct, indirect, and induced) of withdrawal over time on the Arrowhead economy. A positive income value means that, under that scenario, the annual income in the TMM mining case exceeds the annual income in the no-mining baseline.
Notes: the horizontal axis denotes time, starting with the commencement of production at the TMM site.
Source: Authors' calculations.

2018 announcement and 2019 Mining Plan of Operations in which the project is scaled back) and impacts to tourism jobs and amenity-based in-migration are low.

4. Our estimates in the context of other studies

4.1. Other studies of rural economic growth and amenities

Multiple studies conclude that outdoor recreation and recreational amenities, especially wilderness amenities, have been the basis for strong and sustainable economic growth in rural communities with those attributes over the past two decades. This literature looks at a variety of measures including income, job growth, population growth in wilderness-abutting regions, willingness-to-pay, and property values. In early influential research, Deller et al. (2001) studied rural U.S. counties and concluded that "the empirical results provide strong evidence

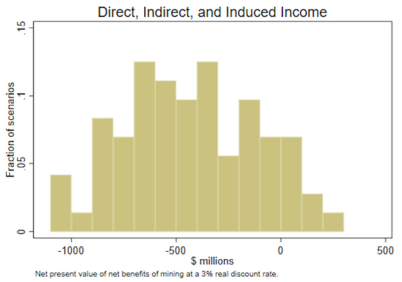


Fig. 5. Histogram of the net present value (NPV) of income in the 72 scenarios. Source: Authors' calculations.

that rural areas which can be characterized as endowed with high levels of key natural resource amenity endowments and overall quality of life experience higher overall levels of growth" (p. 363). Rickman and Rickman (2011) examine population trends and measures of outdoor and recreational amenity in nonmetropolitan counties across the U.S.; they establish a positive relationship between amenity values and population growth. Lorah and Southwick (2003) look at the role of protected federal lands, which hold an intrinsic natural amenity value, on rural population growth in western counties and find that counties with protected federal lands within 50 miles of their center grew approximately 12 times faster than nonmetropolitan western counties without protected federal lands within 50 miles of their center. Poudayal et al. (2008) analyze nationwide county-level data on the role of natural resource amenities in attracting retiree in-migration; they find that the percentage of a county under forest, the quantity of high-quality water resources, and the presence of federally-protected National Parks are all statistically significant drivers of retiree in-migration. Winkler et al. (2007) finds similar demographic trends. McGranahan et al. (2011) study the underlying mechanism whereby sustainable growth is linked to amenity values and find that this growth has an endogenous element through the channel of entrepreneurs being attracted to rural locations with high outdoor amenity value.

Holmes et al. (2016) provide a recent survey of the literature on valuation of proximity to wilderness areas. In addition to reviewing estimates of the local economic effects (or "onsite" values) examined here, they include a discussion of "offsite" values on which we have not relied. These "offsite" values include both "use" values (e.g., residential property values; see below) and three so-called "passive use" values: existence value, option value, and bequest value. They argue that these passive use values can be large, a point that is relevant to the withdrawal proposal because they attempt to estimate directly the value of pristine wilderness.

These studies validate the inclusion of in-migration effects that are supported by the withdrawal and are potentially at risk if the withdrawal does not occur. In addition, these studies support a broader interpretation of the value of the BWCAW and Superior National Forest as an attractor of non-tourism, non-retirement jobs to the area because of the proximate wilderness. This latter category of job is not included in our study, and by excluding such jobs our study is conservative and understates the economic benefits of the withdrawal.

4.2. Resource extraction and sustainable growth

The question of resource extraction and economic growth has long been of interest in the economics literature at the country level (e.g., oil export economies), regional level, and local level. Although we are not

aware of any recent hard-rock mining studies on sustainable local growth, the boom in nonconventional oil and gas development has stimulated recent research on extractive resource growth cycles.

Jacobsen and Parker, (2016) study county-level data for the American West and examine the consequences of oil and gas well drilling arising from the oil price increases of the 1970s and early 1980s. They find "that the boom created substantial short-term economic benefits, but also longer-term hardships that persisted in the form of joblessness and depressed local incomes.... In the longer run, after the full boom-and-bust cycle had concluded, we find that local per capita income was about 6% lower than it would have been if the boom had never occurred." (p. 1093).

Allcott and Keniston, (2018) study US county-level manufacturing data in connection with oil and gas booms and conclude that "while county-level population, employment, wages, and revenue productivity are all procyclical [i.e. all go up in the initial extractive stage], the booms are cancelled out by the busts. By the end of the 1990s, we see no significant remaining long-term effects of the boom and bust cycle of the 1970s and 1980s (p. 697)".

There is also some work on the economic impacts of nonconventional oil and gas extraction, however the scope for dynamic analysis is limited because that development is new and insufficient time has elapsed to observe a full cycle. One set of limited dynamic estimates is provided, however, by Feyrer et al. (2017). They use local geographic data to provide some estimates of the dynamic effect of nonconventional oil and gas extraction in the 2000s; they find that it has large employment effects, but that those employment effects are transitory at the local level. They only estimate dynamics over the first two years following the initial local extraction shock and find that wage income gains, including direct, indirect, and induced, dissipate by 1/3 within two years (the dissipation is faster if only direct and indirect wages are considered, see their Fig. 4). Because the technology for nonconventional oil and gas extraction has a shorter life cycle than hard rock mining or conventional oil and gas extraction, the findings of these studies are all qualitatively consistent with an extractive boom-bust cycle.

These studies are designed to estimate the effects of these booms on counties with average amenity values. Thus, these estimates capture the boom-bust effect on resource extraction and related jobs but do not include any special effects that resource extraction disamenities or environmental damage would have on employment and in-migration related to high-amenity regions like the area surrounding the BWCAW. Such effects would exacerbate the boom-bust nature because of the deterioration in environmental conditions and amenity values that would reduce non-mining amenity-related incomes.

4.3. Property values and mining disamenities

There is substantial evidence that mining disamenities reduce housing values. In their study of acid mine drainage (AMD) from coal mining in the Cheat River Watershed of West Virginia, Williamson et al. (2008) find that location near an AMD-impaired stream has an implicit marginal cost of $4783 on housing, or nearly 12.2% of a home's value. Kim and Harris (1996) examine the broader suite of possible mining disamenities and their effect on property values near a copper mine in Green Valley, AZ and find that parcels closest to the mining site lost 5.74% of their value with homes further away losing 0.66% of their value. In their study of sulfide-ore copper mining in the Arrowhead region, Phillips and Alkire (2017) use Kim and Harris' (1996) findings to estimate that the total loss in property value due to sulfide-ore copper mining would be approximately $508 million (2016 USD), or roughly 1.9% of the total property value of the three Arrowhead region counties. This is a large value which, if added to the NPVs in Fig. 5, would make all the NPVs negative.

Phillips and Alkire's (2017) estimate of a decline of 1.9% is in the range of those in related studies. Boxall et al. (2005) examine the impact of oil and gas facilities on rural residential property values in central Alberta, Canada using hedonic regression methods for property valuation.[17] They find that location within four km. of industry facilities leads to a four to 8% decrease in property value. Leggett and Bockstael (2000) use a hedonic property model to show that water quality has a significant effect on property values along the Chesapeake Bay, an amenity-rich, non-metropolitan setting with high recreational value. Poor et al. (2007) find a similar result in the Chesapeake Bay watershed examining non-point source pollutants, including suspended solids and nitrogen. In a study of the impact of lake water clarity on New Hampshire lakefront properties, Gibbs et al. (2002) find that water clarity—a measure of the degree of eutrophication—has a significant effect on prices paid for residential properties. More recent research linking local water quality to higher property values includes Keiser and Shapiro (2019) and Kuwayama et al. (2019).

In the case of the proposed withdrawal, these negative effects on housing values would be compounded by the downward pressure on housing values from reduced in-migration or, possibly, out-migration. Consistent with the boom-bust literature, one could see an initial rise in housing values as mine and associated industry workers buy or rent in the greater Ely area, however that increase would be temporary as mining employment, recreational employment, and in-migration housing demand subsequently decline. By omitting this effect, our analysis is conservative and likely understates the benefits of the proposed withdrawal.

5. Conclusion

We find that, over the 20-year time horizon of the proposed withdrawal, introducing copper-nickel mining in the Superior National Forest is likely to have a negative effect on the regional economy. Our calculations omit some factors, notably the negative effect of mining on real estate values, that would strengthen this conclusion. We reviewed the relevant literature and conclude that our findings are consistent with the literature, most notably the history of boom-bust economies associated with resource extraction that leave the local economy worse off.

In addition to adding to the debate over copper-nickel mining in the Superior National Forest, our study contributes to the broader literature on the tradeoffs between resource extraction and natural amenity-based economic growth. Our findings highlight the importance of considering the long-term effects of resource extraction in natural amenity rich areas. While estimates of the employment effects of the TMM project are positive in the short run, accounting for the well-documented boom-bust cycle that characterizes resource extraction results in negative estimates of the overall effect of allowing mining in the Superior National Forest. This analysis also demonstrates the importance of modeling dynamic responses to resource extraction in amenity-based income, for example through decreased in-migration and reduced demand for amenity-driven recreation.

Our study points to opportunities for future research. As noted previously, we omit several factors which are likely important to fully understand the impacts of allowing mining near the BWCAW, including both market values (such as housing) and non-market values (ecological services). Future work examining the effects of copper-nickel mining in this region should examine the long-run effects of mining on these additional values. More broadly, the prospective modeling approach of our study, which is shared by many other studies in this field, would ideally be complemented by empirical analysis of historical data. Additional work is needed on ex-post evaluation of the economic effects

[17] Hedonic regression is a method for estimating the value of a characteristic of a good when that characteristic is not sold separately but instead is part of a bundle of characteristics embodied in the good; see for example Haab and McConnell, 2002.

of resource extraction in comparable, ideally quasi-experimental, settings.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Allcott, H., Keniston, D., 2018. Dutch disease or agglomeration? The local economic effects of natural resource booms in modern America. Rev. Econ. Stud. 85, 695–731.

Arizona Department of Mines and Mineral Resources, 1970-1990. Average Number of Covered Employees in Primary Copper Industry. Primary Copper Industry of Arizona - Annual Reports. http://repository.azgs.az.gov/collection/AzMMR.

Auerbach, A., Gorodnichenko, Y., Murphy, D., 2019. Local fiscal multipliers and fiscal spillovers in the United States. In: NBER Working Paper 25457.

Baeten, Langston, J.N., Lafreniere, D., 2016. A geospatial approach to uncovering the hidden waste footprint of Lake Superior's Mesabi Iron Range. The Extractive Industries and Society 3 (4), 1031–1045.

Barber, John, Parker, Harry, Frost, David, Hartley, Janine, White, Trey, Martin, Chris, Sterrett, Robert, Poeck, Joanna, Eggleston, Ted, Gormely, Lynton, Allard, Simon, Annavarapu, Srikant, Radue, Tom, Malgesini, Matthew, Pierce, Matthew, 2014. Twin Metals Minnesota Project: Technical Report on Pre-feasibility Study. Prepared for Duluth Metals Corp. 6 October 2014.

Bergstrom, R.D., 2019. Community development in the face of resource extraction in northern Minnesota, USA. The Extractive Industries and Society 6 (3), 831–841.

Boxall, P.C., Chan, W.H., McMillan, M.L., 2005. The impact of oil and natural gas facilities on rural residential property values: a spatial hedonic analysis. Resour. Energy Econ. 27 (3), 248–269.

Bureau of Economic Analysis, 1970-2017. Regional Data. https://www.bea.gov/index.htm (retrieved 14 July 2018).

Bureau of Labor Statistics, 1987-2016. Labor and Multifactor Productivity Data by Industry: Four Digit Industry Data. U.S. Department of Labor. https://www.bls.gov/lpc/tables_by_sector_and_industry.htm (retrieved 14 July 2018).

Bureau of Labor Statistics, 2018. Occupational Employment Statistics: May 2017 State Occupational Employment and Wage Estimates. U.S. Department of Laborhttps://www.bls.gov/oes/current/oessrcst.htm (retrieved on 14 July 2018).

Deller, Steven C., Tsai, Tsung Hsiu (Sue), Marcouiller, David W., English, Donald B.I., 2001. The role of amenities and quality of life in rural economic growth. Am. J. Agric. Econ. 83 (2), 352–365.

Energy Information Administration, 2016. Coal Data Browser. U.S. Department of Energy. https://www.eia.gov/coal/data/browser/#/topic/36?agg=2,0,1&geo=nvg1qag9vvlpg&mntp=4&freq=A&start=2001&end=2016&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0 (retrieved 14 July 2018).

Feyrer, J., Mansur, E.T., Sacerdote, B., 2017. Geographic dispersion of economic shocks: evidence from the Fracking revolution. Am. Econ. Rev. 107 (1313-1224).

Gibbs, Julie P., Halstead, John M., Boyle, Kevin J., Huang, Ju-Chin, 2002. An hedonic analysis of the effects of lake water clarity on New Hampshire lakefront properties. Agricultural and Resource Economics Review 31 (1), 39–46.

Haab, T.C., McConnell, K.E., 2002. Valuing Environmental and Natural Resources: The Econometrics of Non-market Valuation. Edward Elgar Publishing, Inc, Northampton, MA.

Headwaters Economics, 2018. A Profile of Socioeconomic Measures: St. Louis County, MN; Cook County, MN; and Lake County, MN. Headwaters Economics and U.S. Census Bureauhttps://headwaterseconomics.org/tools/economic-profile-system/about/, Accessed date: 19 July 2018.

Helmberger, Marshall, 2017. Ely's golden goose. In: The Timberjay, 3 August 2017. http://timberjay.com/stories/elys-golden-goose,13540.

Henderson, J.R., McDaniel, K., 2005. Natural amenities and rural employment growth: a sector analysis. Rev. Reg. Stud. 35 (1), 80–96.

Hjerpe, Evan, 2018. Outdoor recreation as a sustainable export industry: a case study of the boundary waters wilderness. Ecol. Econ. 146, 60–68.

Hjerpe, Evan, Phillips, Spencer, 2013. A Review of 'The Economic Impact of Ferrous and Non-ferrous Mining on the State of Minnesota and the Arrowhead Region'. Report prepared by Conservation Economics Institute and Key-Log Economics (30 December 2013).

Holmes, Thomas P., Bowker, J.M., Englin, J., Hjerpe, E., Loomis, John B., Phillips, Spencer, Richardson, Robert, 2016. A synthesis of the economic values of wilderness. J. For. 114 (3), 320–328.

Jacobsen, Grant D., Parker, Dominic P., 2016. The economic aftermath of resource booms: evidence from boomtowns in the American West. Econ. J. 126 (593), 1092–1128.

Keiser, D.A., Shapiro, J.S., 2019. Consequences of the clean water act and the demand for water quality. Q. J. Econ. 134 (1), 349–396.

Kim, H.S., Harris, D., 1996. Air quality and view degradations due to copper mining and milling: preliminary analysis and cost estimates for Green Valley, Arizona. Nonrenewable Resources 5 (2), 91–102.

Kuwayama, Y., Olmstead, S., Zheng, J., 2019. The Value of Water Quality: Estimating Amenity and Recreational Benefits. Manuscript. LBJ School, University of Texas – Austin.

Leggett, Christopher G., Bockstael, Nancy E., 2000. Evidence of the effects of water quality on residential land prices. J. Environ. Econ. Manag. 39 (2), 121–144.

Liesch, Matthew, Keweenaw, Creating, 2016. Parkmaking as response to post-mining economic decline. The Extractive Industries and Society 3 (2), 527–538.

Lorah, Paul, Southwick, Rob, 2003. Environmental protection, population change, and economic development in the rural western United States. Popul. Environ. 24 (3), 255–272.

McGranahan, David, 1999. Natural Amenities Drive Rural Population Change. AER-781. Economic Research Service, U.S. Department of Agriculture.

McGranahan, David A., Wojan, Timothy R., Labert, Dayton M., 2011. The rural growth trifecta: outdoor amenities, creative class and entrepreneurial context. J. Econ. Geogr. 11, 529–557.

Minnesota Department of Employment and Economic Development, 2017. Current Employment Statistics Data Tool. https://mn.gov/deed/data/data-tools/current-employment-statistics/ (retrieved on 14 July 2018).

Minnesota Department of Natural Resources, 2017. The Mesabi Iron Range (Map) at. https://files.dnr.state.mn.us/lands_minerals/mpes_projects/mnmin2017_mesabi.pdf.

Minnesota Department of Natural Resources, US Army Corps of Engineers, and US Forest Service, 2015. NorthMet Mining Project and Land Exchange: Final Environmental Impact Statement.

Minnesota Department of Natural Resources, U.S. Army Corps of Engineers, U.S. Forest Service, 2015. Final Environmental Impact Statement: Polymet Mining, Inc. - NorthMet Mining Project and Land Exchange. MDNR Division of Ecological and Water Resources, St. Paul, MN.

Minnesota Geospatial Information Office, 2020. Minnesota Geospatial Commons. https://gisdata.mn.gov/.

Mishra, Shruti K., Hitzhusen, Frederick J., Sohngen, Brent L., Guldmann, Jean-Michel, 2012. Costs of abandoned coal mine reclamation and associated recreation benefits in Ohio. J. Environ. Manag. 100, 52–58.

Myers, Tom, 2016. Acid mine drainage risks – a modeling approach to siting mine facilities in Northern Minnesota USA. J. Hydrol. 533, 277–290.

Office of Management and Budget, 2003. OMB Circular A-4: Regulatory Analysis. Executive Office of the Presidenthttps://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf.

Orr, Isaac M., Struhsacker, Debra W., Phelan, John, 2018. Unearthing Prosperity: How Environmentally Responsible Mining Will Boost Minnesota's Economy. Center of the American Experiment.

Pearson, Jennifer, Ipsen, John, Sutherland, Steven, Wegerson, Kristan, Onello, Emily, 2019. Risks and costs to human health of sulfide-ore mining near the boundary waters canoe area wilderness. Human and Ecological Risk Assessment: An International Journal. https://doi.org/10.1080/10807039.2019.1576026.

Phillips, Spencer, Alkire, Carolyn, 2017. Sulfide-ore copper mining and/or a sustainable boundary waters economy: the need to consider real tradeoffs. In: Key-Log Economics LLC. Report Prepared for Northeastern Minnesotans for Wilderness.

Poor, P. Joan, Psagno, Keri L., Paul, Robert W., 2007. Exploring the hedonic value of ambient water quality: a local watershed-based study. Ecol. Econ. 60 (4), 797–806.

Poudayal, Neelam C., Hodges, Donald G., Ken Cordell, H., 2008. The role of natural resource amenities in attracting retirees: implications for economic growth policy. Ecol. Econ. 68 (1–2), 240–248.

Rasker, Ray, Hackman, Arlin, 1996. Economic development and the conservation of large carnivores. Conserv. Biol. 10 (4), 991–1002.

Rasker, Ray, Hansen, Andrew, 2000. Natural amenities and population growth in the Greater Yellowstone Region. Hum. Ecol. Rev. 7 (2 (winter 2000)), 30–40.

Rasker, Ray, Gude, Patricia H., Delorey, Mark, 2013. The effect of protected federal lands on economic prosperity in the non-metropolitan west. Journal of Regional Analysis & Policy 43 (2), 110–122.

Rickman, Dan S., Rickman, Shane D., 2011. Population growth in high amenity non-metropolitan areas: What's the prognosis? J. Reg. Sci. 51, 863–879.

Sungur, Engin, Asche, Kelly, Fluegel, David, Ronnader, Reid, Bibeau, Jacob, 2014. The Four Townships Area Economic, Housing Development Survey. Center for Small Towns and Data Services Center, University of Minnesota at Morris.

Sutherland, F., 2015. Community-driven mining heritage in the Cuyuna Iron Mining District: past, present, and future projects. The Extractive Industries and Society 2 (3), 519–530.

Thistle, H., Langston, N., 2016. Entangled histories: iron ore mining in Canada and the United States. The Extractive Industries and Society 3 (2), 269–277.

Twin Metals Minnesota, 2019a. About Twin Metals Minnesota. http://www.twin-metals.com/wp-content/uploads/2019/12/TMM_FactSheet_December2019.pdf.

Twin Metals Minnesota, 2019b. Mine Plan of Operations: Twin Metals Minnesota Project – Environmental Review Support Document. Doc. no. TMM-ES-115-0001. http://www.twin-metals.com/wp-content/uploads/2019/12/TMM-Mine-Plan-of-Operations_2019-1218-R.pdf.

Twin Metals Minnesota, 2019c. Press Release: Twin Metals Minnesota Submits Mine Plan to State and Federal Agencies for Review. http://www.twin-metals.com/twin-metals-minnesota-submits-mine-plan-to-state-and-federal-agencies-for-review/.

U.S. Census Bureau, 2016. American Community Survey. U.S. Department of Commerce. https://www.census.gov/programs-surveys/acs/ (retrieved 18 July 2018).

U.S. Department of Agriculture, 2016. Federal Outdoor Recreation Trends: Effects on Economic Opportunities. U.S. Forest Service, Pacific Northwest Research Station General Technical Report (PNW-GTR-945).

U.S. Forest Service, 2017. Northern Minnesota Federal Withdrawal: Supporting Documents at https://www.fs.usda.gov/project/?project=50938. U.S. Department of Agriculture.

U.S. Forest Service, 2016. Letter From Thomas Tidwell, Chief, US Forest Service to Neil Kornze, Director, BLM, Dec. 14, 2016. at. https://www.blm.gov/download/file/fid/7645.

U.S. Geological Survey. 2015. Copper statistics through 2015, *in* Kelly, T.D., and Matos, G. R., comps., Historical Statistics for Mineral and Material Commodities in the United States (2016 Version): U.S. Geological Survey Data Series vol. 140. https://minerals.usgs.gov/minerals/pubs/historical-statistics/.

University of Minnesota-Duluth, 2012. The Economic Impact of Ferrous and Non-ferrous Mining on the State of Minnesota and the Arrowhead Region, Including Douglas County, Wisconsin. University of Minnesota, Duluth, Labovitz School of Business and Economics, Duluth, MN.

Ward, Fabrizio, 2018. Save the boundary waters survey: Minnesota registered voter telephone survey. In: Report for Save the Boundary Waters, (13 April 2018).

Williamson, J.M., Thurston, H.W., Heberling, M.T., 2008. Valuing acid mine drainage remediation in West Virginia: a hedonic modeling approach. Ann. Reg. Sci. 42 (4), 987–999.

Winkler, Richelle, Field, Donald R., Luloff, A.E., Krannich, Richard S., Williams, Tracy, 2007. Social landscapes of the Inter-Mountain West: a comparison of 'old west' and 'new west' communities. Rural. Sociol. 72 (3), 478–501.

NSF layoffs in 2025: Deep budget cuts headed for U.S. research sector

[Updated on April 10, 2025 with additional details]

The **2025 National Science Foundation (NSF) layoffs**—stemming from budget freezes and aggressive federal downsizing—could reduce National Science Foundation staff by up to half, threatening the agency's ability to fund critical research nationwide. Amid projections of a multibillion-dollar shortfall under the CHIPS and Science Act and a new executive order pushing rapid workforce reductions.

As of February 21, the agency remained under a short-term continuing resolution that expires on March 14, according to COSSA.org, leaving the NSF budget in limbo. Yet in mid-March, Congress passed and the President signed a Full-Year Continuing Resolution (CR) for Fiscal Year 2025. That move secured topline funding through September 30, 2025, and averted a government shutdown. The CR, however, lacks detailed programmatic guidance. It thus grants significant discretionary power over internal fund allocation to agency leadership operating under White House influence. Additionally, the administration removed the "emergency spending" designation for NSF's $234 million FY25 Major Research Equipment and Facilities Construction (MREFC) budget appropriated by Congress. That development potentially jeopardizes funding for large-scale infrastructure projects. In a February 11 statement, Sen. Ted Cruz (R-TX) alleged that over $2 billion had been "diverted" to DEI-related programs, lauding the White House for "taking a sledgehammer to the radical left's woke nonsense," as noted on the Senate Commerce Committee website. This scrutiny has continued, with Senator Cruz launching a follow-up investigation into the Future of Privacy Forum (FPF) in early April over alleged misuse of NSF/DOE funds for "woke AI" advocacy. Meanwhile, The Guardian reported that layoffs targeting probationary NSF employees have already begun, with some workers given only minutes to clear out their offices.

In a newly disclosed wave on February 18, NSF reportedly fired about 168 employees—roughly 10% of its workforce—in a single morning, many via a Zoom call, with some permanent staff included after retroactive probationary status changes, as Wired reported. In a reversal following court challenges and updated OPM guidance in early March, NSF reinstated nearly all (reportedly 84 out of 86) of the terminated probationary employees with backpay.

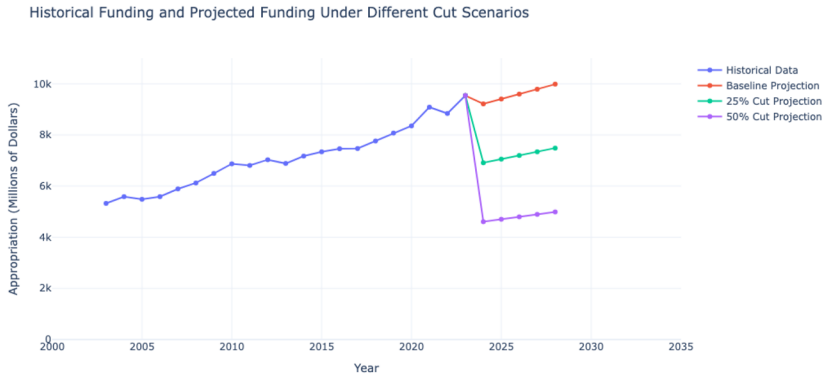
Outside of NSF, some terminated employees at various science-focused agencies were later asked to return to work, such as the National Nuclear Security Administration and United States Department of Agriculture (employees focused on bird flu). For instance, approximately 300 NNSA employees were initially let go, but all but 28 were ultimately reinstated upon discovery that critical staff had been mistakenly terminated, according to AIP.org.

The development comes as *Nature* and others have noted that, while the U.S. remains the world's research superpower, that China is quickly catching up and could be the world's top R&D spender by 2030.

Trimming or halting grant awards

In the face of the cuts, NSF, a major funder of basic research in the U.S., would be forced to considerably reduce or halt grant awards, potentially impacting thousands of researchers, universities, and projects. NPR indicates that the grant payment system is still experiencing delays. While NSF officially resumed proposal processing, review activities, and payment systems (like ACM$) after initial pauses, the grant system operates under considerable strain. Factors weight it down include reduced staffing (loss of experts, buyouts, planned RIFs) and ongoing compliance reviews mandated by executive orders. In total, such factors could lead to expected delays despite official continuity. Actions at sister agencies like NIH, NASA, DOD, and USAID, which saw active grant/contract terminations linked to EO compliance, contribute to uncertainty. Widespread NSF grant terminations, however, have not been confirmed post-Feb 21.

In 2024, the Fiscal Responsibility Act's spending caps resulted in an 8% cut to NSF's budget compared to the prior year, leaving NSF roughly $6.6 billion below the funding targets Congress had set in the 2022 CHIPS and Science Act.



Charting NSF Funding: Historical appropriations vs. future scenarios
Historical data sourced directly from the National Science Foundation establishes the historical funding baseline. Using a linear regression model, we extend this trend to project future funding—and overlay widely reported 25% and 50% cut scenarios.

The 2025 NSF layoffs—stemming from budget freezes and aggressive federal downsizing—did not emerge in a vacuum. Early in 2025, a series of executive orders from the White House placed multiple science agencies under a funding freeze while also directing them to reduce staffing within short timeframes. In particular, the newly formed "Department of Government Efficiency" (DOGE) issued a mandate instructing agencies such as the National Science Foundation (NSF) to cut staff by 25–50% to meet strict budget targets. This directive went beyond routine belt-tightening: the Office of Personnel Management (OPM) began compiling lists of staff on probation (who can be more easily dismissed) and rolling out buyout programs offering "incentives" for employees to resign.

According to internal communications in early February 2025, NSF leadership confirmed that the agency may lay off roughly 375 to 750 employees—over the next several months. OPM has characterized these reductions as part of a government-wide push to downsize federal agencies, describing the buyout offers as a "once-in-a-lifetime opportunity" for employees to leave voluntarily before forced cuts. A federal judge, however, issued a temporary restraining order on February 6 blocking the administration's "deferred resignation" program. Consequently, that delayed immediate layoffs until legal challenges were resolved. Despite the initial TRO, the voluntary "fork in the road" deferred resignation/buyout program proceeded, with union sources indicating roughly120 NSF employees accepted the offer. Furthermore, a February 26 memo from OMB/OPM mandated that all agencies, including NSF, develop formal, multi-phase Agency Reorganization Plans (ARPs) specifically aimed at initiating large-scale Reductions in Force (RIFs). Phase 2 ARPs, detailing planned cuts and restructuring, are due by April 14, 2025, signifying that substantial, formally planned workforce reductions are imminent, replacing earlier ad-hoc methods.

The administration is also reportedly considering slashing NSF's annual budget from approximately $9 billion down to about $3–4 billion. Such a drop would significantly impact the agency's capacity to manage current and future research grants. **T**hese drastic cuts remain unconfirmed rumors, likely pertaining to future fiscal years (FY26 and beyond) rather than the enacted FY25 CR funding level. NSF has not officially commented on these reports. While NSF has not officially commented on the precise scale of layoffs or budget cuts, lawmakers, including Rep. Zoe Lofgren (D-CA), have sought for clarification regarding reports involving staff reductions as high as 50%. In addition, federal employee unions have also filed lawsuits to halt the buyout program.

Universities and state governments also secured a temporary injunction on February 10 against a proposed 15% overhead cost cap for research grants, according to CalMatters.org. A follow-up hearing on February 21 will determine whether that cap remains blocked. University leaders claim that such cuts would lead to widespread layoffs and lab closures, echoing reporting from The Guardian and other outlets. Today's hearing on the 15% overhead cost cap is underway, with stakeholders awaiting the judge's decision which could have significant implications for research funding. It has become clear this controversial 15% mandatory cap on Facilities and Administration (F&A)/indirect costs was an NIH-specific policy proposal. Following the February 21 hearing, the temporary block was extended and later converted in early March into a nationwide preliminary injunction, preventing NIH from enforcing the cap while legal challenges proceed. This issue does not apply to NSF's standard indirect cost policies, which allow negotiated rates or an optional 15% *de minimis* rate for certain organizations without a negotiated rate.

Key administration figures of the current administration have criticized NSF's support for diversity, equity, and inclusion (DEI) initiatives. The NSF has scrubbed multiple DEI references from its website, including a 2022 announcement of the appointment of a chief diversity officer. NSF continues to face intense political pressure regarding DEI, primarily through Senator Cruz's ongoing

investigation and database targeting specific grants. Such pressures have prompted internal compliance reviews mandated by executive orders. NSF has acknowledged awareness but has not issued a specific public rebuttal to the Cruz database methodology or findings.

Operational disruptions within NSF

Suspension of grants and salary payments: NSF leadership responded by pausing new grant awards and, in some cases, temporarily delaying salary payments to scientists and administrative staff. Researchers whose grants were already in progress suddenly found themselves in limbo—uncertain whether they could continue paying their students, postdocs, or lab technicians. While grant processing has officially resumed, the backlog from the January freeze caused delays in disbursements. As noted earlier, official processes have resumed, but significant strain and potential delays persist due to staffing reductions and compliance activities.

Targeted workforce reductions: The Office of Personnel Management first targeted probationary employees as they were deemed easier to remove. Some were offered a buyout, a program that was temporarily put on pause, according to The Washington Post. As detailed above, the targeting of probationary staff was largely reversed via reinstatements following legal challenges. Yet intermittent experts were permanently terminated, approximately 120 staff accepted voluntary buyouts, and the agency is now under mandate to develop formal plans for large-scale RIFs via the ARP process, indicating further significant reductions are planned. Sources within NSF indicate that further rounds of layoffs may target specific departments or programs deemed lower priority by the administration, as Wired has noted.

With an annual budget of $9–10 billion (prior to 2025 cuts), the NSF has historically funded roughly 25% of federally supported basic research at 1,800 institutions in the United States. In FY2023 alone, NSF provided some 11,000 awards that supported more than 350,000 researchers, postdoctoral fellows, teachers, and students nationwide.

Prior FY 2025 budget request from NSF

Abbreviation	Directorate / Account	FY 2024 Enacted Budget ($ millions)	FY 2025 Request ($ millions)	Change ($ millions)	Change (%)
BIO	Directorate for Biological Sciences	844.91	862.93	18.02	2.1%
CISE	Directorate for Computer and Information Science and Engineering	1,035.90	1,067.58	31.68	3.1%
ENG	Directorate for Engineering	797.57	808.14	10.57	1.3%

Abbreviation	Directorate / Account	FY 2024 Enacted Budget ($ millions)	FY 2025 Request ($ millions)	Change ($ millions)	Change (%)
GEO	Directorate for Geosciences	1,591.79	1,662.50	70.71	4.4%
GEO: OPP	Office of Polar Programs (within GEO)	538.62	588.83	50.21	9.3%
U.S. Antarctic Logistics Activities	U.S. Antarctic Logistics Activities	94.20	106.00	11.80	12.5%
MPS	Directorate for Mathematical and Physical Sciences	1,659.95	1,681.63	21.68	1.3%
SBE	Directorate for Social, Behavioral, and Economic Sciences	309.06	320.41	11.35	3.7%
TIP	Directorate for Technology, Innovation, and Partnerships	664.15	900.00	235.85	35.5%
SBIR/STTR	Small Business Innovation Research/Small Business Technology Transfer programs	266.54	279.21	12.67	4.8%
OCRSSP	Office of the Chief of Research Security Strategy and Policy	9.85	15.52	5.67	57.6%
OISE	Office of International Science and Engineering	68.43	68.43	0.00	0.0%
IA	Integrative Activities	531.39	518.69	-12.70	-2.4%

Abbreviation	Directorate / Account	FY 2024 Enacted Budget ($ millions)	FY 2025 Request ($ millions)	Change ($ millions)	Change (%)
U.S. Arctic Research Commission	U.S. Arctic Research Commission	1.75	1.78	0.03	1.7%
Mission Support Services	Mission Support Services	116.27	137.71	21.44	18.4%
Research & Related Activities[2]	Research & Related Activities	7,631.02	8,045.32	414.30	5.4%
STEM Education[2]	STEM Education	1,229.28	1,300.00	70.72	5.8%
Major Res. Equip. & Facil. Construction	Major Research Equipment & Facilities Construction	187.23	300.00	112.77	60.2%
Agency Operations & Award Mgmt.	Agency Operations & Award Management	463.00	504.00	41.00	8.9%
Office of Inspector General	Office of Inspector General	23.39	28.46	5.07	21.7%
National Science Board	National Science Board	5.09	5.22	0.13	2.6%
Total, NSF Discretionary Funding	Total, NSF Discretionary Funding	9,539.01	10,183.00	643.99	6.8%
Advancing Scientific Discovery: Artificial Intelligence	Advancing Scientific Discovery: Artificial Intelligence	–	50.00	50.00	N/A

Abbreviation	Directorate / Account	FY 2024 Enacted Budget ($ millions)	FY 2025 Request ($ millions)	Change ($ millions)	Change (%)
STEM Education – H-1B Visa	STEM Education – H-1B Visa	192.54	138.93	-53.61	-27.8%
Donations	Donations	40.00	40.00	–	–
Total, NSF Mandatory Funding	Total, NSF Mandatory Funding	232.54	228.93	-3.61	-1.6%
Total, NSF Budgetary Resources	Total, NSF Budgetary Resources	9,771.55	10,411.93	640.37	6.6%

OUTDOOR ALLIANCE

June 23, 2025

Rep. Roger Williams
Chair, Committee on Small Business
2336 Rayburn HOB
Washington, DC 20515

Rep. Nydia Velázquez
Ranking Member, Committee on Small Business
2302 Rayburn House Office Building
Washington, DC 20515

RE: June 24 Full Committee Hearing on America's Mineral Future.

Chair Williams, Ranking Member Velázquez, and Committee Members,

On behalf of the human-powered outdoor recreation community, we write to provide our perspectives on critical minerals and hardrock mining ahead of June 24th's hearing on America's mineral future. Our community recognizes the need to increase domestic mining for critical minerals to support a clean energy economy; however, significant reforms to America's mining laws are needed to ensure that new mining occurs in a manner that sustains the numerous small businesses across the country that rely on safe access to healthy public lands and waters. To achieve this balance, we recommend advancing comprehensive hardrock mining reform in line with the Mining Waste, Fraud, and Abuse Prevention Act (S. 859).

Outdoor Alliance is a coalition of ten member-based organizations representing the human powered outdoor recreation community. The coalition includes Access Fund, American Canoe Association, American Whitewater, International Mountain Bicycling Association, Winter Wildlands Alliance, The Mountaineers, the American Alpine Club, the Mazamas, Colorado Mountain Club, and Surfrider Foundation and represents the interests of the millions of Americans who climb, paddle, mountain bike, backcountry ski and snowshoe, and enjoy coastal recreation on our nation's public lands, waters, and snowscapes.

Outdoor recreation pursuits are deeply meaningful in the lives of Americans for a wide range of personal reasons. They also support nearly $1.2 trillion in gross

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economic output, 2.3 percent of GDP, and nearly 5 million American jobs—many at small businesses—according to the Bureau of Economic Analysis.[1] Beyond those numbers, outdoor recreation amenities and access to public lands and waters play a huge role in attracting a wide array of businesses and workers to rural communities across a range of industries and support vibrant and diversified local economies.

The outdoor recreation community and the outdoor economy are profoundly affected by hardrock mining. Improperly sited mines have the potential to irreversibly degrade outdoor recreation resources like rivers, trails, and climbing areas, as well as important cultural sites and conservation lands—often areas that our community considers irreplaceable. Recreationists are also affected by legacy mining pollution, which the EPA estimates has polluted 40% of headwaters in western U.S. watersheds.[2] At least 140,000 abandoned hardrock mine features exist across federal public lands, many of which pose physical hazards to people, as well as environmental hazards that threaten public health, wildlife, and aquatic ecosystems.[3]

The lack of protections for recreation and other public lands values in the 1872 Mining Law—the outdated law that still governs hardrock mining on western public lands today—poses a major barrier for our community to support mining projects that might be needed for clean energy and other purposes, leading to controversy, uncertainty, and delay around mining projects. As a result, outdoor recreationists are currently engaged in multiple campaigns across the country to protect highly valued recreation landscapes from degradation through mining, including the Boundary Waters in Minnesota, Oak Flat in Arizona, and the South Fork Salmon River in Idaho.

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[1] U.S. Bureau of Economic Analysis, BEA 24-53, Outdoor Recreation Satellite Account, U.S. and States, 2023 (2024).

[2] U.S. Environmental Protection Agency, EPA-840-B-00-001, Liquid Assets 2000: America's Water Resources at a Turning Point (2000).

[3] Abandoned Hardrock Mines: Information on Number of Mines, Expenditures, and Factors that Limit Efforts to Address Hazards. United States Government Accountability Office. March 2020. Report to the Ranking Member, Subcommittee on Interior, Environment, and Related Agencies, Committee on Appropriations, U.S. Senate, https://www.gao.gov/products/gao-20-238.

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As Congress considers how best to accelerate domestic mineral production, it is imperative that these policies be paired with significant reforms to the 1872 law that reflect modern uses of public lands, cultural values, and local economies. At a minimum, these reforms should:

- Provide clearer discretion for land managers to approve or deny mining projects based on foreseeable impacts to ecological, cultural, or recreational resources;
- Ensure adequate funding for hardrock mine remediation;
- Provide a fair return for taxpayers;
- Protect sensitive areas and cultural sites; and
- Strengthen tribal consultation.

The Mining Waste, Fraud, and Abuse Prevention Act of 2025 (S. 859) introduced in the Senate earlier this year would make a number of these reforms and would help ensure that critical mineral production does not pose unnecessary risk to outdoor recreation and tourism-related small businesses that rely on sustainable access to public lands and waters. We recommend that this bill, or similar legislation, be advanced in any legislative package aimed at boosting critical mineral production.

Thank you for considering our community's input. We look forward to working with you to support small businesses that make up America's outdoor recreation economy.

Best regards,

Louis Geltman
Vice President for Policy and Government Relations
Outdoor Alliance

cc: Adam Cramer, Chief Executive Officer, Outdoor Alliance
Heather Thorne, Executive Director, Access Fund
Beth Spilman, Executive Director, American Canoe Association
Clinton Begley, Executive Director, American Whitewater
Kent McNeill, CEO, International Mountain Bicycling Association

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David Page, Executive Director, Winter Wildlands Alliance
Tom Vogl, Chief Executive Officer, The Mountaineers
Ben Gabriel, Executive Director, American Alpine Club
Rebekah Phillips, Executive Director, the Mazamas
Madeline Bachner Lane, Chief Executive Officer, Colorado Mountain Club
Chad Nelsen, Chief Executive Officer, Surfrider Foundation

Statement for the Record

ReElement Technologies

Hearing: "Securing America's Mineral Future: Unlocking the Economic Value Beneath Our Feet" on June 20, 2025

Date: June 30, 2025

To:

The Honorable Roger Williams, Chairman

The Honorable Nydia Velázquez, Ranking Member

Committee on Small Business

U.S. House of Representatives

Introduction

Thank you for the opportunity to submit this statement for the record. ReElement Technologies is a small business headquartered in Indiana. We applaud the Committee's focus on securing America's mineral future and welcome the chance to demonstrate how domestic refining can drive economic growth, strengthen national security, and protect our environment.

Company Overview

ReElement Technologies recycles end-of-life permanent magnets and purifies rare earth elements (REEs) from those materials using chromatographic separation technology developed at Purdue University. Today, we supply 99.5%-plus pure oxides of Neodymium, Praseodymium, Dysprosium, and Terbium. We are today supplying these directly to U.S. magnet manufacturers and other companies in the defense supply chain—including multiple small businesses—at prices competitive with the Chinese market, while sustaining strong margins.

Capabilities & Impact

- **Rare Earth Separation:** Our modular, scalable platform produces ultra-pure REE oxides in-state. This prevents export of U.S.-sourced REEs back to China—avoiding "buying these materials twice."

- **Critical Mineral Refining:** Beyond REEs, we recover and purify Antimony, Gallium, Germanium, and additional rare earths needed for specialized defense applications. Feedstocks include:
    - Recycled electronics and magnets
    - Mining tailings and waste streams
    - Concentrated domestic ores
- **Economic & Security Benefits:**
    - **Supply-Chain Resilience:** Domestic refining eliminates reliance on foreign-controlled midstream processes.
    - **Small-Business Leverage:** Indiana-based operations create skilled jobs and foster a network of downstream manufacturers.
    - **Low Environmental Impact:** Our process is water-efficient, energy-lean, and permit-friendly.

Invitation to Visit

We invite Chairman Williams, Ranking Member Velázquez, and Committee staff to tour our Indiana facility. You will see firsthand how U.S. technology and entrepreneurship are already derisking critical-mineral supply chains.

Conclusion

ReElement Technologies stands ready to partner with policymakers to expand domestic refining capacity, protect American jobs, and secure critical-mineral supplies for industry and defense. We appreciate the Committee's support and look forward to working together to unlock the economic value beneath our feet.

Respectfully submitted,



Mark C. Jensen

Chief Executive Officer

ReElement Technologies

www.reelementtech.com

Testimony for the Record

Date: June 24, 2025

To:
The Honorable Chairman Roger Williams
The Honorable Ranking Member Galton
House Committee on Small Business
Washington, D.C.

Subject: Testimony for the Record – Ensuring Small Business Access to Critical Minerals for U.S. Innovation and Security

Dear Chairman Williams, Ranking Member Galton, and Members of the Committee,

Thank you for the opportunity to submit this testimony. As President of Blue Stone Delta and an advisor to small businesses advancing frontier technologies—from photonic processors at Strike Photonics to secure communications at Open Droids—I offer this testimony from the perspective of someone actively building and navigating the innovation economy. My work has also included engagements with national laboratories, defense industrial base suppliers, and early-stage mineral development projects.

This hearing could not be more timely. We stand at a pivotal moment. Small businesses across the U.S. are on the frontlines of advanced manufacturing, robotics, and AI-driven systems, yet the inputs that power these breakthroughs—gallium, dysprosium, neodymium, graphite, cobalt, lithium—remain largely sourced from unstable or adversarial foreign supply chains. These are not niche materials; they are foundational to everything from photonics to electric motors, satellite systems, and beyond.

China controls 90% of the global downstream rare earth market, along with critical portions of the supply chain for other strategic materials. The reality is simple: the future of American innovation depends on secure, domestic access to these materials. This is not just a mining challenge—it's a permitting, financing, and procurement problem.

In parallel, I am also working on building a blockchain framework to track rare earth elements and critical minerals through a commodities exchange. This initiative is designed to ensure transparency, provenance, and supply chain security from source to strategic application, and may ultimately serve a global or U.S.-anchored structure depending on the final design.

In my role as an advisor to the Alliance for Mineral Security, I've worked closely on policy concepts that appear throughout this testimony. These recommendations align with AMS

initiatives to support domestic capacity, reduce permitting friction, and ensure the future of critical supply chains.

Small businesses cannot wait 20 years for permits or compete with state-subsidized Chinese firms without a stable domestic framework. They need a pathway to scale. Here are key recommendations that would directly strengthen small business access and national supply chain resilience:

Policy Recommendations

- Authorize the Defense Logistics Agency (DLA) to take options on commercially warehoused critical minerals. This mechanism allows for flexible, cost-efficient access to material without distorting domestic commercial markets, ensuring that both small businesses and the defense industrial base can meet urgent material needs.
- Establish a Department of Defense Price Index for ex-China materials and components—gallium, dysprosium, neodymium, graphite, cobalt, lithium, and others. This would set a predictable acquisition ceiling, enabling government and small business procurement to proceed without fear of Chinese market manipulation.
- Create a streamlined, dedicated application process for small businesses applying for federal grants under $100 million. This should include an explicit 'small business advantage' analogous to federal contracting rules, ensuring startups and SMEs can access federal funding on fair terms.
- Grant automatic expedited status under the EB-5 immigrant investor program for critical mineral and industrial base projects. By reducing immigration and capital deployment risk, this pathway would unlock funding for innovative supply chain development and expansion.
- Establish and implement a Critical Supply Chain Sectors designation. Projects operating within designated sectors (minerals, magnets, semiconductors, advanced manufacturing) would receive targeted tax incentives, FAST-41 permitting, and coordinated interagency support through DOD and the Office of Industrial Base Policy.

The solution is not just to mine more. It is to support and scale the processing, recycling, component manufacturing, and systems integration led by U.S. companies—particularly small businesses that move fast and innovate faster.

We must ensure the future of U.S. photonics, robotics, and precision manufacturing is not lost due to dependence on materials processed overseas. If we fail to support these early-stage efforts now, we will continue to lag behind where we should lead.

America can't lead in advanced tech if it begs for the materials to build it.

Supply chains win wars—startups build them.

We either build the foundation now, or we buy it back later at ten times the price.

We stand at a precipice, a cliff if you will, and like Icarus, without the critical minerals and rare earths that form the very magnets holding our wings together, we will not soar. Instead, we will plummet.

Thank you for your leadership on this issue. I look forward to supporting further actions that prioritize American capability, security, and ingenuity.

Respectfully submitted,
Robert Anderson
President, Blue Stone Delta
randerson@bluestonedelta.com

Biography – Robert Anderson

Robert Anderson (known in national security and technical circles as 'Ghost') is the founder and president of Blue Stone Delta, a strategic advisory firm working with companies across advanced manufacturing, space systems, blockchain, photonics, and national security technology. He has worked with federal agencies, defense contractors, and emerging startups to help align innovation with critical mineral access and industrial resilience. Robert's background includes technical work in satellite control and RF systems, support roles in national laboratories, and participation in secure policy environments involving spaceport development and strategic materials planning. He has been a trusted voice in both public and private sector forums focused on critical supply chains.