Testimony of

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Chairman Weber and Ranking Member Ross, and Members of the Subcommittee, thank you for the opportunity to speak on the role of the Critical Materials Innovation Hub in strengthening the nation's scientific leadership, energy security, and supply chain resilience for critical materials.

My name is Thomas Lograsso and I serve as the Director of the U.S. Department of Energy (DOE)'s Critical Materials Innovation Hub (CMI). I am a senior leader at the U.S Department of Energy's Ames National Laboratory on the campus of Iowa State University, a single program Office of Science laboratory with the mission to deliver critical materials solutions to the nation. I am also an adjunct professor in the Department of Materials Science and Engineering at Iowa State University.

The Critical Materials Innovation Hub is one of the DOE Energy Innovation Hubs created to accelerate scientific discovery and address critical energy issues. The Critical Materials Innovation Hub was established in 2013 in response to growing vulnerabilities in U.S. supply chains for materials essential to energy generation and use, advanced manufacturing, and national security technologies. The Hub was created following DOE assessments identifying rare earth elements and other specialty materials as increasingly subject to supply disruption, price volatility, and geopolitical risk. Today, these concerns have intensified as demand for energy-related materials accelerates globally.

CMI is led by Ames National Laboratory. It operates as a coordinated national consortium of national laboratories, universities, and U.S. industry partners. This structure enables the Hub to integrate fundamental materials science, applied engineering, and manufacturing-relevant research within a single, sustained framework. In 2023, DOE renewed CMI for a third five-year phase of operation and formally redesignated it as the Critical Materials Innovation Hub, reflecting its maturity, its expanded mission to accelerate innovation and commercialization, and its status as a signature initiative in DOE's innovation pipeline.

Accelerating Solutions

The mission of the Critical Materials Innovation Hub is to accelerate scientific and technological solutions that enable secure, resilient, and diversified domestic supply chains for materials critical to U.S. energy technologies and manufacturing competitiveness. The Hub pursues this mission through four integrated technical pillars:

1. enhancing and diversifying supply;
2. developing substitutes;
3. unlocking secondary sources through recycling and reuse; and
4. conducting crosscutting research in thermodynamics, AI assisted predictive modeling and automated synthesis, technoeconomic and life cycle analyses, and supply chain analysis.

CMI focuses on four materials groups: rare earth elements, energy storage materials, platinum group metals, and electronic materials. Global supply chains for many of these materials remain highly concentrated. That is why long-term, coordinated federal investment is required to develop alternative sources as well as to develop new materials with fewer or no critical materials, and to develop new methods to process critical materials with enhanced efficiency. The CMI Hub provides that capability. The Hub serves as a national resource for reducing the criticality of materials across the materials life cycle.

Research, Innovation and Workforce Development

CMI's mission is pursued through a set of interrelated goals and objectives that span research, innovation, and workforce development.

A core objective is to **reduce material criticality across the life cycle** — to reduce dependence on fragile or concentrated supply chains by addressing criticality at multiple points in the materials life cycle. This includes advancing technologies for diversifying primary supply, improving extraction and separation processes, and converting critical minerals into high-value materials more efficiently and responsibly.

CMI is working to **develop substitutes and material-efficient processing**. We seek to develop substitutes that meet or exceed performance requirements while using less critical or more abundant elements. This includes reduced-rare-earth permanent magnets, alternative functional materials, and designs that use critical materials more efficiently without sacrificing performance.

Another major goal is **unlocking secondary sources of critical materials** through recycling, reuse, and recovery from manufacturing scrap, mine waste, and end-of-life products. By improving process economics and environmental performance, CMI supports a more circular and sustainable materials economy.

We are working to **advance crosscutting and predictive research**. CMI conducts crosscutting research in chemistry, materials physics, materials science, environmental sustainability, and supply chain and economic analysis. These efforts provide forecasting tools and decision frameworks to anticipate which materials may become critical in the future and to guide proactive technology development.

CMI places significant emphasis on **workforce development**. We train students, postdoctoral researchers, and early-career scientists in interdisciplinary critical materials research. To date, more than four hundred students and postdoctoral researchers have been trained through CMI, forming a national pipeline of scientists and engineers with expertise in critical materials. These products of the CMI Hub contribute to government, industry, national laboratories, and academia, strengthening long-term national capacity in this strategic area.

CMI places strong emphasis on accelerating progress for the benefit of the nation. A central management objective is to **accelerate innovation, shortening the transition from laboratory discovery to scalable technology and commercialization**. CMI emphasizes scalable processes, pilot-scale demonstrations, intellectual property generation, and close engagement with industrial partners to move technologies toward adoption in U.S. manufacturing. Through strong industry partnerships, cost-shared projects, and an active intellectual property program, the Hub advances technologies toward pilot-scale demonstration and early commercialization.

Since its inception, CMI has generated more than 225 invention disclosures, 72 U.S. patents, 45 licensed technologies, 17 R&D 100 Awards, and more than 750 scientific peer-reviewed publications. Furthermore, CMI has attracted more than $160 million of public and private investments to move technologies into practice. These results demonstrate a significant return on federal investment.

To fully appreciate the power of the collaborative innovation ecosystem DOE has established, allow me to provide three examples of technologies that have progressed toward deployment. Each relates to the rare earth material supply chain with emphasis on permanent magnet applications.

Success in Rare Earth Separation

Separating rare-earth elements to enable their use in many technologies and processes has been a persistent challenge. Sucessfully addressing this challenge demonstrates how sustained federal investment and coordination across the U.S. research ecosystem can translate basic scientific discovery into real-world deployment.

The effort began when scientists studying unusual microbes discovered that some bacteria naturally require rare earth elements to function. In 2018, researchers identified and characterized lanmodulin, a small protein with unprecedented affinity and selectivity for rare earth elements — an ability far surpassing conventional chemical extractants. This discovery was notable because rare earth elements are chemically similar and traditionally require hundreds of energy- and chemical-intensive solvent extraction steps to separate. Early research demonstrated that lanmodulin could selectively bind rare earths under harsh industrial conditions, confirming its relevance beyond basic science.

The technology advanced with support from CMI, where lanmodulin evolved from a single natural protein into a suite of engineered variants tailored to specific separation challenges. This accelerated evolution was enhanced with AI methodologies to predict new variants with specific attributes. Researchers showed for the first time that protein-based systems could separate closely related rare earth elements, achieving purities exceeding 98 to 99 percent in a single processing step. These results meet performance thresholds relevant for magnet production and defense applications. They also offer the potential for significantly lowering environmental impact compared to conventional solvent extraction.

Subsequent federal support emphasized robustness, manufacturability, and pilot scale demonstration. Research focused on recovering rare earths from domestic sources such as mine waste, coal byproducts, and recycled electronics—directly supporting supply chain resilience and national security priorities. Lanmodulin-based systems were integrated into continuous, all-aqueous workflows and tested well beyond laboratory scale, substantially reducing technical and commercial risk.

With scientific performance demonstrated and engineering risk mitigated, the technology transitioned to the private sector. Alta Resource Technologies licensed lanmodulin-based intellectual property and is deploying engineered protein systems for commercial and defense-relevant rare earth separations. This transition represents the final step of the innovation pipeline, converting federally funded research into domestic manufacturing capability that strengthens U.S. supply chains while offering environmental advantages over legacy methods.

Acid-Free Conversion of Rare Earth Compounds

A second example addresses a longstanding bottleneck in rare-earth metal production. Conventional methods for converting rare-earth compounds into metal rely on hydrofluoric acid to produce rare-earth fluorides, a step that poses serious safety and environmental concerns, as well as permitting obstacles. CMI researchers developed an alternative method that completely avoids hydrofluoric acid. This method uses sodium-based rare-earth fluoride salts that can be synthesized at room temperature from common upstream feedstocks, including oxides, chlorides, and nitrates. Using these alternative salts produce high purity rare-earth metals while improving safety, reducing energy use, and simplifying process integration. This example was made possible by the CMI and university collaboration model. The process progressed from laboratory proof-of-concept to scaled-up demonstrations that produced metals suitable for permanent magnet manufacturing. Importantly, Ames National Laboratory researchers demonstrated that metals produced via this new process performed equally to commercially produced materials in permanent magnets, confirming the technology's industrial relevance and reducing technical risk for adoption.

After only three years of development, the DOE's technology commercialization efforts transitioned the Rare Earth Metal Alternate Fluoride Salt (REMAFS) process out of the laboratory. Principal Mineral, a Texas-based company focused on strategic and advanced materials, licensed the technology, enabling commercial deployment of the hydrofluoric acid-free process. Again, it illustrates how public-private partnerships can rapidly convert federal R&D investments into domestic manufacturing capability.

Acid-Free Recycling of End-of-Life Permanent Magnets

My final example is the development of an acid-free recycling process to recover rare earth elements from end-of-life permanent magnets used in electric vehicles, wind turbines, and defense systems.

Recycling permanent magnets is particularly important because it represents one of the richest secondary sources of dysprosium, a critical element used to maintain magnet performance at high temperatures. Dysprosium is scarce, expensive, not present in extractable concentrations in U.S. mines, and vulnerable to disruptions. Importantly, dysprosium already is embedded at high concentrations in magnets currently circulating in the economy. That makes recycling far more efficient and responsible than extracting the element from newly mined ore.

The process we developed relies on surprisingly simple chemistry. Instead of using strong acids or high-temperature smelting, the method uses benign, recyclable reagents to selectively dissolve neodymium-iron-boron (Nd-Fe-B) magnets under modest conditions. Dysprosium and other rare earth elements are efficiently separated without generating hazardous waste streams. The approach is easy to implement, scalable, and compatible with existing industrial equipment, making it attractive for near-term adoption by private recyclers and manufacturers.

Commercialization of CMI's acid-free dissolution recycling technology has proceeded through licensing and close partnerships with private industry. Critical Materials Recycling, a company based in Boone, Iowa, licensed the patented process from Ames National Laboratory. The company operates a pilot-scale facility where the technology has been successfully demonstrated using real industrial feedstocks such as shredded hard disk drives, magnet filings, wind-turbine magnets, and other scrap, producing high-purity rare earth oxides, including dysprosium. The company's operation has attracted additional partners, including Western Digital, Microsoft, and PedalPoint Recycling. These partners have validated the process in multi-party demonstrations recovering rare earths from end-of-life data-center equipment at scale. These partnerships provide a clear commercialization pathway, moving federally developed technology from the lab to pilot production and toward domestic demonstration plants, while anchoring U.S. leadership in rare-earth recycling and secure supply chains. Once again, this technology emerged from federally supported research focused on reducing U.S. dependence on primary rare-earth mining and overseas supply chains, while lowering the environmental footprint of critical materials production.

Conclusion

In conclusion, these innovations taken together underscore the importance of a coordinated innovation ecosystem — one in which long-term Department of Energy investment, national laboratory expertise, university research, and industry partnership operate in accord rather than in isolation. CMI represents one element of a broader, highly integrated portfolio of DOE initiatives that collectively create an accelerated innovation pipeline, spanning discovery through deployment of advanced technologies necessary to establish robust and resilient supply chains.

The role of DOE — and the federal government more broadly — is to build and sustain the innovation ecosystem that makes critical materials technologies possible. These challenges are inherently long term, capital intensive, and high risk, placing them beyond the reach of private-sector investment alone. DOE must continue to play a central role by providing sustained support that enables fundamental science to integrate with engineering, scale-up, and manufacturing, while leveraging the nation's unique scientific capabilities. Just as important is the important role DOE plays as a convener, bringing together national laboratories, universities, and industry partners to accelerate promising technologies into domestic deployment—strengthening U.S. energy security, economic security, and national security.

As global competition for critical materials intensifies, the innovation pipeline made possible by these convened partners is essential to ensure that materials availability does not become a limiting factor for America's energy future or its national security.

Thank you again for this opportunity to speak on our work at the Critical Materials Innovation Hub, the Ames National Laboratory, and Iowa State University.