Wyoming Minerals Initiative: From Mining to Advanced Technologies

Wyoming’s mineral industry plays a pivotal role in the state’s economy and the nation’s strategic resource landscape. Of the [$3.8 billion in tax revenue](https://www.wyoleg.gov/2023/Databook/Operations/Revenue/a%20Revenue%20Introduction.pdf) collected by the state last year, $1.34 billion came directly from resource extraction via severance taxes and mineral royalties. Wyoming contains abundant reserves of trona, uranium, and critical minerals which include rare earth elements (REEs). The state produces over 90% of the nation’s trona, essential for manufacturing glass, paper, and chemicals, and is a major producer of uranium, vital for nuclear energy. Increasingly, Wyoming is gaining recognition for its deposits of rare earth elements and other critical minerals necessary for advanced technologies, energy innovations, and national defense. However, Wyoming’s critical mineral deposits have not been adequately developed, and much of this potential resource remains in the ground. Because global markets for processing and refining many of these minerals are highly concentrated (e.g., China refines 80% of rare-earth oxides), Wyoming’s development of extraction, processing, refining, and use of these resources takes on additional strategic importance to reduce the reliance on other countries. In short, supporting resource extraction is essential to maintaining both the state’s financial health and national security.

Complementing these natural resources is a growing ecosystem of research and development, including the University's specialized technical expertise, geosciences, engineering and computing facilities, expertise in environmental assessments, and legal policies. To best serve the state, UW now needs to support interdisciplinary initiatives focused on sustainable extraction, refining, materials science, and supply chain innovation. This requires UW to strengthen its facilities and enhance its expertise in key areas of the mineral supply chain, including mineral deposit characterization, mineral processing and mine engineering, environmental remediation, supply-chain policy, and more. Building upon our strengths will position Wyoming as a key player in advancing the secure and responsible development of mineral resources for the 21st century.

The Denver metro area is known for its strong presence in the quantum industry and aerospace defense industry. Both industries use end products of critical minerals supply chains that Wyoming could provide. The United States leadership in these areas will be maintained if we can innovate self-sufficient critical minerals supply chain (particularly REEs) along the I-25 corridor. Quantum computing and quantum materials/devices depend on REEs, superconducting metals, and ultra-pure semiconductors—all of which Wyoming currently has in the ground and has the potential to process. Wyoming's geological wealth, infrastructure, and pro-mining policies make it a promising candidate to support and attract investment in this growing tech sector. Another important region is along the I-80 corridor with Idaho and Wyoming working together on nuclear energy. Recognizing these regional strengths, the Department of Commerce has recognized ID-WY as the Nuclear Technology Hub and NM-CO-WY as the Quantum Technology Hub. Maintaining U.S. leadership in these fields will require not only technological innovation but also policy frameworks that neutralize external market power and keep prices stable enough for domestic investors.

**Trona:** Wyoming’s abundant trona reserves present a unique opportunity to support the growing sodium-ion battery industry by serving as a domestic source of key sodium compounds. These compounds form the basis of cathodes, electrolytes, and other components in sodium-ion batteries, which are gaining traction as a low-cost, scalable solution for energy storage. The University of Wyoming can play a critical role in this emerging supply chain by advancing research in chemical processing, materials synthesis, and battery prototyping, helping to position the state as a strategic hub for energy storage innovation.

### **Uranium:** UW has significant opportunities to contribute across the uranium-to-advanced nuclear reactor value chain, supporting both the state’s uranium industry and the growing modular and microreactor energy sector. The university can also play a key role in materials science, safety modeling, digital twins, and workforce development, while partnering with industry and national labs to support reactor deployment, regulatory frameworks, and grid integration. These efforts position UW as a strategic hub for innovation in the new generation of nuclear energy.

**Critical Minerals, particularly Rare Earth Elements:** The U.S. is highly dependent on foreign sources for processing and refining critical minerals, with China dominating the critical minerals and REE supply chains. A profitable, sustainable, and resilient domestic supply chain for critical minerals requires major investments in R&D across the entire value chain and carefully crafted public policy mechanisms that blunt foreign price manipulation. Wyoming has readily available REE resources and deposits of many other critical minerals. Current Wyoming companies have some ability to mine and process critical minerals, but Wyoming lacks the infrastructure for a complete critical mineral supply chain and a need for improved and adapted approaches for environmental remediation. For this industry to grow, both additional facilities and workforce development are needed in areas such as ore characterization, mine planning, mineral processing and separation of the REEs into individual elements, material fabrication, and device production/integration. The supply chain, from REE to advanced technologies such as magnets for quantum materials and defense technologies, offer immediate opportunities for diversifying and strengthening Wyoming economy. UW can play a pivotal role in the growth of this sector by providing needed catalytic support in technology innovations, business analytics, legal and policy reforms, and workforce development.

## Current Assets at UW

Wyoming is home to an important research, innovation, and education environment because of UW, the state’s nationally recognized, research-intensive university. UW’s School of Energy Resources and College of Engineering and Physical Sciences are actively engaged in critical mineral mapping, extraction technologies, quantum and energy materials, quantum computing, and agile responsiveness to the industry’s needs for an appropriately trained workforce. In addition, UW’s School of Computing’s growing strength provides a critical foundation for digital innovation in mineral exploration, processing, and supply chain resilience. UW has a strong record of partnerships with DOE labs (e.g., Idaho National Lab, Ames Lab and Argonne National Lab), which can be expanded to the DOE-organized Critical Materials Innovation Hub. Eight community colleges across the state provide associate-level education for training and retraining the workforce. Governor Gordon’s WIP initiative has strengthened the collaborations among Wyoming’s IHEs. These collaborations place UW in a unique position to couple scientific advances with forward-looking policy analysis aimed at neutralizing concentrated foreign market power. With these funds, UW has laid groundwork for collaboratively meeting the needs of new and existing Wyoming industries serving the minerals supply chain.

Here is a summary of existing assets and activities at UW that are already serving the minerals industry.

**School of Energy Resources:** SER serves as the central hub for interdisciplinary research, education, and industry collaboration focused on trona, nuclear energy, REEs and other critical minerals.

* SER has received extramural grants from DOE, private foundations, and industry; CEPS and College of Law are collaborating on these projects.
* SER developed the critical minerals [leadership academy](https://www.uwyo.edu/ser/research/critical-mineral-leadership-academy/index.html), with participation from National Labs, industry and many units across the campus which is being offered in August 2025.In FY2025, they received state funding to fill in key gaps in expertise including two faculty positions being recruited in CEPS.
* They also received funding for supporting projects to launch industry-relevant research. CEPS and SER faculty are involved in these projects.
* SER’s Center for Economic Geology Research and Nuclear Energy Research Center are working with faculty across colleges to implement projects in minerals research, particularly on uranium and critical minerals.

**College of Engineering and Physical Sciences:** It brings together expertise in materials science, chemical engineering, quantum materials and computing, and process engineering to support the development of efficient extraction and processing methods for critical minerals. The Department of Geology & Geophysics works closely with SER on geological mapping, mineral characterization, and exploration strategies to identify and assess critical mineral resources. The Departments of Chemical and Biomedical Engineering and Energy and Petroleum Engineering also serve as key hubs of expertise, supporting collaborative projects—funded by SER and federal agencies—focused on the characterization and sustainable use of technologies and resources for energy and critical mineral extraction and processing. The Department of Chemistry works closely with SER and INL on separations and purification of REEs. The Department of Physics & Astronomy has expertise in downstream applications of carbon and REEs (permanent magnets, catalysts and quantum materials) as well as hydrogen storage and detection.

**Haub School of Environment and Natural Resources**: It addresses environmental and social dimensions of critical mineral development, including community engagement, environmental impact assessments, and policy frameworks. Haub School has organized a critical minerals workshop, in collaboration with SER and looks forward to advancing discussions through future Wyoming Resource Policy Fora.

**College of Law:** Recently, SER and the College of Law received a [grant](https://www.uwyo.edu/news/2024/07/uw-ser-receives-sloan-foundation-award-for-circular-economies-and-critical-minerals-study.html) from Sloan Foundation to conduct interdisciplinary research exploring the legal, policy and social considerations associated with the buildout of a domestic U.S. supply chain for critical minerals and rare earth elements.

**College of Agriculture, Life Sciences, and Natural Resources**: It provides research expertise and workforce development in areas of environmental assessment and management, including a focus on restoration and reclamation of drastically disturbed lands and ecological and hydrological impact.

**UW Science Institute:** Two centers started by UW Science Institute, Center for Quantum Information Science and Engineering as well as Energy Materials Center have research projects that address various steps in the minerals-to-advanced technology supply chains. A current priority of CEM is to contribute to and lead the R&D effort in rare earth separations and purifications, the development of REE permanent magnets and catalysts.

In addition to the existing activities above, the following units can add to UW’s efforts in supporting the growth of minerals industry and of advanced technologies that will use Wyoming minerals.

**School of Computing:** The University of Wyoming’s new School of Computing brings an important, computing-focused dimension to Wyoming’s mineral strategy. As extraction, processing, and manufacturing become increasingly digitized, computing enables smarter exploration through AI-enhanced geospatial analytics leveraging satellite and UAV remote sensing, safer and more efficient operations using digital twins and industrial IoT, and more resilient supply chains through real-time monitoring, simulation, and optimization. Advanced computing also plays a vital role in environmental modeling—supporting land and water impact assessment, remediation planning, and lifecycle analysis to ensure that mineral development is not only economically viable but also ecologically responsible. The School of Computing is committed to developing these capabilities not only as research initiatives, but as embedded support across the full mineral value chain. By partnering across disciplines and industries, the School of Computing can serve as a hub for digital innovation, environmental intelligence, workforce training, and computational infrastructure, helping Wyoming translate its geological wealth into national leadership in secure, sustainable, and tech-enabled mineral development.

**College of Engineering and Physical Sciences:** Department of Electrical Engineering and Computer Science has expertise in AI and robotics. Both technologies are critical in automating industrial processing to make them economically competitive with labor-intensive and environmentally risky technologies processes used in other countries.

**Office of Industry and Strategic Partnerships:** This office strengthens and coordinates UW’s interactions and collaborations with industry. Currently the office is deeply engaged with minerals industry through the support and facilitation of their interactions with CEPS and SER. With additional resources, the office can expand its impacts both with industries and with other units on the campus.

**Computing resources at UW:** Advanced Research Computing Center at UW, UW’s participation in the Argonne National Lab’s Lighthouse Program, and UW’s collaboration in operating the NCAR-Wyoming Supercomputer allows UW researchers to use high end computing resources for supporting industry needs in computing and AI applications in their functions.

## Resources needed at UW

Despite the strong record of UW’s commitment to the mining industry, it can serve the state even more and help support Wyoming’s aspirations to be the catalyst for Wyoming’s mining renaissance by fostering development of much of the post-mining supply chain in Wyoming. An equally important objective is to identify and prototype policy tools (e.g., market-stability contracts, targeted tax incentives, or price-risk bonds) that make downstream investment bankable in the face of foreign policy interventions. To achieve this, UW is launching the Wyoming Minerals Initiative - from Mining to Advanced Technologies. Current Wyoming companies focus on mining, extraction, and sometimes initial separation at their pilot plants. For these companies to grow and spur the downstream processing and manufacturing industry, both additional innovations and workforce development are needed in areas such as ultra-purification, material fabrication, and device production/integration industries. This will enable the local, regional, and national supply chain and value chain development. To support these aspirations, UW can frame its strengths and needs around the following four components (Table 1).

## Table 1. Wyoming Minerals Initiative Components

|  |  |  |
| --- | --- | --- |
| Component | Description | Campus-wide Needs |
| People | * Build expertise through recruiting top faculty, researchers, and developing a skilled workforce trained in mining innovations, critical minerals and quantum materials science. * Promote workforce development and transition programs to meet local industry needs | * Faculty expertise available/needed in geosciences, chemical engineering, quantum physics, EECS, battery technologies, supply chain analytics, law and policy, environmental management, remediation, community expertise |
| Places | * Invest in state-of-the-art research facilities and laboratories dedicated to REE extraction, processing, and quantum materials development. * Upgrade existing infrastructure to support pilot projects and scalable processing | * Physical Sciences and Engineering renovations for clean rooms and critical mineral user facilities * A place for Critical Minerals Innovation Collaboratory as a part of the UW-Laramie research park (potentially including some production facilities in Laramie) to be developed separately |
| Programs | * Develop programs to stimulate innovative research * Evaluate policy needs in these areas, such as environmental and socioeconomic assessment * Introduce new micro-credentials, certificates and degree programs focused on critical minerals, sustainable mining, materials science, and quantum engineering to meet industry needs * Expand reclamation and restoration research and instruction into hardrock mining as well evaporites. | * Wyoming Minerals Quasi-endowment for seed grants * Matching funds for DOE grants and industry partnerships through SER * Additional programmatic investments through SER * Added programmatic investments through CALSNR, SER, and HENR |
| Partnerships | * Establish formal collaborations with industry leaders, other universities, DOE National Labs (e.g., Idaho National Lab), and federal agencies. * Foster joint research projects, technology transfer, and workforce development initiatives | * A joint venture with National Labs, potentially leading to the Critical Minerals Collaboratory on the campus (to be developed separately) * Increased personnel to focus on partnerships with the mining and mineral-based technologies industry |

## Critical Investments needed through State Appropriations in the UW budget request

In FY2027-28 state appropriations, UW is seeking $XXX one-time addition and $XXX recurring supplement to the UW block grant to complement the request by Energy Resource Council for SER. These funds will not only expand laboratory capacity but also support research into supply-chain risk mitigation and mineral-market policy, ensuring that Wyoming’s technical edge is matched by a strategic policy edge. In addition, UW seeks $XXX for major maintenance for improving facilities needed to develop advanced technologies using Wyoming minerals.

One-time funds in UW’s budget request: UW requests $XXX to invest in

* $XXM for equipment needed to start the research in innovations in mineral purification and their use in advanced technologies.
* $1.9M for start-up and initial operational costs of the Minerals Assay Facility including supplies and one scientist or staff member for the first two years. In the subsequent years, the user fees from the laboratory will pay for lab technicians.
* $10-17M for a Critical Materials Facility which also includes a clean room for QISE, pulsed high magnetic field and AI-enabled experimental labs. Total cost can run from $10M to $17M, and some equipment items can be added later on.

Recurring funds in UW’s budget request: UW requests $XXX to invest in

* XX faculty/staff positions to address critical expertise gaps in support of the Wyoming minerals and advanced materials industry.
  + Director of the Minerals Assay Facility: Tenure-track Professor or Research Scientist line dedicated to keeping the facility running, stable, and responsive to the needs of the state. This position needs to be tenure-track to attract qualified candidates.
  + Chemical separation of critical minerals (CEPS -- Chemistry; ): Design and synthesis of new solvent systems, ligands, and transport-based separations schemes to displace existing technologies based on solvent extraction, which are infeasible for domestic implementation.
  + AI-enabled material design and synthesis (CEPS – Physics, Electrical Enginering, and/or SoC) one faculty position
  + Process development with emphasis on mineral extraction/separation (CEPS – Chemical Engineering): Implementation of new separations technologies into practical unit operations and their economically-effective integration into critical material production workflows.
  + Small pilot-scale facility to take Technology Readiness (TRL) Level processes beyond the TRL 3-4 range. Such a facility could serve as a UW-industry collaboration hub that includes participation of industry fellow.
  + Two technicians to run the clean room and pulsed high magnetic field facilities (1.5 and 0.5 split).
  + Two faculty positions in Phys and EECS for QISE.
* $300K per biennium for an Industry Relations Manager in the UW’s Office of Industry and Strategic Partnership to focus on initiating, coordinating, and strengthening partnerships between UW and mining and mining-related technology industry. This person will facilitate interactions for research projects as well as for placement of UW students as interns in the Wyoming businesses relevant to mining and advanced technologies.

Funds for renovating space in the existing old buildings to house facilities related to minerals research

* $XXXM for the biennium: Physical Sciences and Engineering buildings have space available for housing facilities for serving the current minerals industry as well as for spurring the advanced materials industry. However, since these buildings were constructed 50 or more years ago, the space is not suited for modern research that requires ‘clean’ dust-free conditions to process minerals to high purity or to synthesize materials. Therefore, major maintenance funds are requested to support renovation of laboratory spaces that will house Minerals Assay Facility and Critical Materials Facility. Availability of these facilities will enable UW to undertake projects in support of industry and to obtain funding from external sources. It will allow training of UW students in highly sophisticated technologies that are now commonplace in the advanced technology industry.

**Table 2. Resources available and needed for reaching UW’s potential in supporting Wyoming’s quest to foster critical minerals mining industry and supply chain.**

|  |  |  |  |
| --- | --- | --- | --- |
| Unit | Available (currently available or committed for FY25-26) | One-time needs (FY27-28) | Recurring needs |
| SER | Research scientists, SER faculty being recruited in CEPS | -Matching funds for DOE and industrial grants  -Research support to make UW competitive for Federal grants |  |
| CoB | Expertise in business and natural resource economics as well as supply chain management |  |  |
| CoL | Faculty (Tara Righetti) |  |  |
| SoC |  |  |  |
| HSENR | Natural resources scientists, natural resource economists, andcommunity-engagementexpertise | Funds for a FY 27-28 Wyoming Resource Policy Forum (ideally recurring funds) | Faculty position working at the science-policy interface at state and national levels; funds to convene the Wyoming Resource Policy Forum annually with a session in this area |
| CEPS | Strong geosciences expertise SER funded projects  Life cycle analysis expertise  Chemistry/Chemical Engineering - Strong faculty base in Separations, particularly REEs. Several faculty have a strong track record of success with **external** funding from the DOE/National Labs to support these projects. UW-affiliated startups pursuing commercialization of REE separation technologies.  Physics, materials and EECS faculty expertise in quantum information science and engineering as well as in some areas of materials and product development of critical materials (rare earth magnets and catalysis, and Na-based batteries). | Critical Minerals Analytics Facility (GEO)  Cleanroom facilities for quantum materials and devices and for critical materials research(PHY/Chem/Mechanical Eng./Chemical Eng.)  Pulsed high magnetic field facilities (if not supported separately)  AI-enabled experimental labs | Scientist position in GEO  Cost-matching support to pursue larger opportunities through DOE FOAs  Two technicians to run the cleanroom facilities and Pulsed high magnetic fields  Two faculty position in Phys and EECS for QISE |
| CALSNR | Small but active reclamation and restoration, hydrology, ecology and natural resource economics. | Expanding expertise in hardrock and evaporate mining reclamation | Scientist positions in Soil science, and hydrology, as well as social sciences |
| CAS |  |  |  |
| OMV | Seed funding through BoT quasi endowment (REDD?) and the NSF ART grant (REDD) | (Operations) Major maintenance funds for clean laboratory and Minerals Assay Lab | (REDD) A staff position in OISP for focused on industry collaborations in mining and energy |