A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals

Response to Executive Order 13817
National Science and Technology Council
Subcommittee on Critical Minerals

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Critical Minerals

- Critical minerals are used in many products important to the U.S. economy and national security
- The U.S. is dependent on foreign sources of critical minerals
  - 14 lack domestic production
  - 29 are more than 50% import-reliant
  - Others lack downstream domestic processing and manufacturing capabilities
- The U.S. is vulnerable to supply disruption

A “critical mineral” is “(i) a non-fuel mineral or mineral material essential to the economic and national security of the United States, (ii) the supply chain of which is vulnerable to disruption, and (iii) that serves an essential function in the manufacturing of a product, the absence of which would have significant consequences for our economy or our national security.” (EO 13817)
Executive Order 13817

• The President issued Executive Order (EO) 13817, *A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals*, which seeks to address strategic vulnerabilities in critical minerals supply chains.

• EO 13817 directs:
  • The Secretary of Interior, in coordination with executive branch agencies and offices, to publish a list of critical minerals.
  • The Secretary of Commerce, in coordination with executive branch agencies and offices, to submit a report to the President that includes:
    (i) a strategy to reduce the Nation’s reliance on critical minerals
    (ii) assessment of progress toward developing recycling and reprocessing technologies, and technological alternatives
    (iii) options for investment and trade with our allies and partners
    (iv) improved topographic, geological, and geophysical mapping data and metadata, made electronically accessible to support private sector mineral exploration
    (v) recommendations to streamline permitting and review processes related to developing leases; enhancing access to critical mineral resources; and increasing discovery, production, and domestic refining of critical minerals.
The National Science & Technology Council (NSTC) Critical Minerals Subcommittee (CMS) has membership of more than a dozen agencies with a purpose to:

- ensure the U.S. has access to mineral resources needed for scientific, technological, economic, or military applications
- review, analyze, and develop policies, procedures, and plans that affect the supply of critical and strategic minerals; assess implications for the mineral supply chain; and evaluate potential strategies for risk mitigation
- implement and update the methodology developed by the subcommittee for assessing potential mineral criticality using the newest available data.

In response to EO 13817, the CMS facilitated:

- the publication of a list of 35 critical mineral commodities in the Federal Register by the U.S. Department of the Interior
- the development of an interagency Federal Strategy to reduce strategic vulnerabilities across the entire critical minerals supply chain
Federal Strategy

- The Federal Strategy identifies 6 calls to action, 24 goals, and 61 recommendations to:
  - help identify new sources of critical minerals
  - enhance activity, including research and development, at all levels of the supply chain, including exploration, mining, concentration, separation, alloying, recycling, and reprocessing
  - seek to stimulate private sector investment and growth of domestic downstream value-added processing and manufacturing
  - ensure that miners, producers, and land managers have access to the most advanced mapping data
  - outline a path to streamline leasing and permitting processes in a safe and environmentally responsible manner

These actions will reduce our Nation’s reliance on imports, preserve our leadership in technological innovation, support job creation, and improve our national security and balance of trade.
Executive Order Calls to Action (CTA)

1. Advance Transformational Research, Development, and Deployment Across Critical Mineral Supply Chains

2. Strengthen America’s Critical Mineral Supply Chains and Defense Industrial Base

3. Enhance International Trade and Cooperation Related to Critical Minerals

4. Improve Understanding of Domestic Critical Mineral Resources

5. Improve Access to Domestic Critical Mineral Resources on Federal Lands and Reduce Federal Permitting Timeframes

6. Grow the American Critical Minerals Workforce
CTA1: Advance Transformational Research, Development, and Deployment Across Critical Minerals Supply Chains

R&D Strategy Guiding Principles

- Diversify domestic critical mineral sources
- Use and reuse of critical minerals efficiently
- Develop alternatives to critical minerals
- Fundamental and crosscutting R&D

The U.S. will continue to pursue R&D investments that apply across critical mineral supply chains to promote adaptability, resilience, and competitiveness.

- utilize secondary and unconventional sources such as coal refuse materials, brines, seawater, and offshore mines

- reduce critical minerals content in products, minimize waste during manufacturing, reuse postproduction waste, and recycle at product end-of-life

- substitute abundant, less-expensive replacements at the elemental and material level, and develop new technologies

- advance our understanding of the critical minerals down to the atomic scale, leverage advanced computational and modeling capabilities, and improve environmental health and safety
**Goal I:** Develop an R&D strategy to enhance scientific and technical capabilities across critical mineral supply chains

**Summary of recommendations:**

- Develop a roadmap to identify key R&D needs and coordinate ongoing R&D activities

- Establish new public-private partnerships and leverage existing partnerships to efficiently address R&D challenges and validate/verify new materials and processes across the supply chain

- Complete technical and economic feasibility studies of production from secondary and unconventional sources

- Provide industry and external stakeholders access to computing capabilities, testing, and validation support facilities
Goal II: Increase U.S. private industry investment in innovation and improve technology transfer from federally funded science and technology

Summary of recommendations:

- Evaluate and provide recommendations to incentivize development and use of R&D innovations in private industry

- Support small and medium businesses by leveraging and expanding the existing coordination among research consortia, national laboratories, and universities
Developing robust domestic supply chains at all levels and establishing a resilient defense industrial base for critical minerals will:

- Help sustain domestic critical mineral resource development
- Reduce supply risks
- Improve U.S. industrial competitiveness
- Expand production capacity
- Spur job creation
- Support U.S. economic prosperity and national defense
Goal I: Leverage critical mineral expertise from stakeholders outside of the Federal Government

Summary of recommendations:

- Establish a National Critical Minerals and Supply Chains Council through the Federal Advisory Committee Act to seek advice from U.S. industry producers

- Convene stakeholders from across the critical mineral supply chain to increase collaboration with industry, academia, non-governmental and non-profit organizations, and State, local, and Tribal governments to leverage expertise

- Identify key needs and challenges related to the implementation of innovations at all stages of the critical mineral supply chain

Germanium Space Qualified Solar Cell Manufacturing Improvement Program at 5N Plus in St. George UT. Funded by Defense Production Act Title III Program.
CTA2: Strengthen America’s Critical Mineral Supply Chains and Defense Industrial Base

Goal II: Develop, expand, modernize, and sustain U.S. critical minerals downstream materials production capacity and supply chain resiliency

Summary of Recommendations

- Evaluate and provide recommendations to incentivize the U.S. private sector to address national defense critical mineral requirements
- Develop policies to stimulate increased private sector investment in domestic critical mineral production capabilities
- Strengthen the use of Federal Government domestic sourcing requirements, including the Buy American Act, to support domestic supply chain development

Beryllium Metal Pebble Plant at Materion in Elmore, OH. Funded by Defense Production Act Title III Program.
CTA2: Strengthen America’s Critical Mineral Supply Chains and Defense Industrial Base

**Goal III:** Stabilize and strengthen the National Defense Stockpile’s abilities to respond rapidly to urgent and unanticipated military and essential civilian requirements during U.S. wartime and other national emergencies

**Summary of Recommendations**

- Facilitate timely risk mitigation by using existing DoD authorities and practices to acquire strategic reserves.

- Seek funding methods to provide long-term financial stability of the National Defense Stockpile Transaction Fund.
Increasing trade and cooperation with allies and partners can help reduce our Nation’s reliance on sources of critical minerals at risk for disruption and mitigate strategic vulnerabilities.

- Competition is likely to increase over time
- Identify best practices used in other countries for risk mitigation
- Leverage U.S. – Japan – South Korea stockpile information sharing and cooperation
- Expand and strengthen ties with European Union partners and organizations
- Identify and develop targeted mineral / country specific mitigation strategies
CTA3: Enhance International Trade and Cooperation Related to Critical Minerals

**Goal I:** Increase international exchanges of information with partner nations to share best practices for trade and collaboration

**Summary of Recommendations**

- Continue and expand cooperation with interested partners such as Canada, Mexico, Australia, the European Union, Japan, and South Korea

- Complete a best practice report by evaluating other countries’ approaches to private industry critical mineral supply chain issues

- Establish accurate estimates of supply and demand of critical minerals through government to government cross-agency engagement

**Combined net import reliance for North America by commodity.**

North American net import reliance of mineral materials in 2014 for advanced technologies


Brainard, J.; Sinclair, R.G.; Stone, K.; Sangine, E.; Fortier, S.M.

DOI: [https://doi.org/10.19150/me.8365](https://doi.org/10.19150/me.8365)
CTA3: Enhance International Trade and Cooperation Related to Critical Minerals

Goal II: Secure access to critical minerals through trade and investment with international partners, while ensuring that foreign trade practices do not harm U.S. industries

Summary of Recommendations

- Leverage existing and future SOSA and RDP agreements to reduce U.S. critical mineral supply chain vulnerabilities
- Monitor barriers to critical mineral trade and investment and seek to remove such barriers when they arise
- Use international trade agreements to challenge unlawful or otherwise unfair trading practices of foreign countries, where applicable
Building a Domestic Critical Mineral Framework

Mineral Information:
- Collection, analysis, and publication of critical mineral supply, demand, consumption information
- Mineral criticality evaluation and modelling

Identify new domestic critical mineral resources:
- Mineral resource assessments
- Improved topographic, geologic mapping, and geophysical surveys

Mineral information, mineral resource assessments, and topographic, geologic, and geophysical data are the foundation for understanding U.S. domestic mineral potential

- Use critical mineral information to develop metrics to enable commodity specific mitigation strategies addressing strategic vulnerabilities
- Improve the geophysical, geological, topographic, and bathymetric mapping of the United States and associated coastal and ocean territory
- Conduct critical mineral resource assessments for byproducts, conventional, and unconventional sources
- Improve the discoverability, accessibility, and usability of geophysical, geological, topographic, and bathymetric data
CTA4: Improve Understanding of Domestic Critical Mineral Resources

Goal I: Use critical mineral supply and demand data to develop metric to enable commodity specific mitigation strategies

Summary of Recommendations

- Critical mineral list should be reviewed and updated every two years

- Categorize and prioritize the minerals on the critical minerals list to guide the efforts of other part of the EO response

- Continue development of mineral criticality models

- Evaluate the feasibility of developing natural capital accounts that could track the Nation’s natural resource wealth
Goal II: Conduct critical mineral resource assessments for byproducts, conventional, and unconventional sources

Summary of Recommendations

- Deliver at least one national or regional multi-commodity domestic critical mineral resource assessment every two years
- Develop critical mineral resource assessment methods; characterize and map critical mineral potential from secondary and unconventional sources
- Identify technological developments needed to improve recovery of byproduct, secondary, and unconventional critical mineral resources
- Support land management agency decision-making
Goal III: Improve the geophysical, geological, topographic, and bathymetric mapping of the United States and associated coastal and ocean territory

Summary of Recommendations

- Identify priority regions with significant critical mineral resource potential on land and in ocean regions
- Develop regional scoping studies to identify and prioritize critical mineral mapping projects
- Make geophysical, geological, geochemical, topographic, and bathymetrical survey data generated by Federal Government agencies publically available and easily accessible
- Improve government access to proprietary mapping datasets by building public-private partnerships
The U.S. possesses a wealth of mineral resources which could be developed to mitigate strategic vulnerabilities.

- U.S. mines produced an estimated $82.2 billion of mineral raw materials in 2018
- Value added to gross domestic product by major industries that consume processed mineral material was estimated to be >$3 trillion in 2018
- Complex and overlapping policy, regulatory, and social factors are significant barriers to the development of domestic critical mineral resources
- Timelines for permitting decisions are longer in the U.S. compared with other jurisdictions with similar environmental, health, and safety standards such as Canada and Australia
Federal Estate

Key Stats:

- BLM manages more than 700 million acres of onshore subsurface mineral estate and 245 million acres of surface estate.
- USFS manages 190 million acres of surface estate.
- More than 50% of the federal mineral estate is closed to mining.
- Mining impacts approximately 0.10% of the surface.

CTA5: Improve Access to Domestic Critical Mineral Resources on Federal Lands and Reduce Federal Permitting Timeframes
CTA5: Improve Access to Domestic Critical Mineral Resources on Federal Lands and Reduce Federal Permitting Timeframes

**Goals:** Revise land-use planning, review land withdrawals and travel management plans, evaluate NEPA and other regulations to improve timeliness

**Summary of Recommendations**

- Require resource inventory and assessment for land use plans; designate and classify lands based on mineral potential
- Review existing land withdrawals and land-use designations for impacts on mineral exploration and development
- Develop a publicly accessible online system to track milestones for mining projects
- Update agency NEPA processes to streamline analysis to provide improved timelines for processing mining Plans of Operations
Mineral Supply Chain Sector Workforce Challenges:

- Aging and retiring workforce and college faculty
- Decrease in mining, mineral engineering, and economic geology programs
- Negative perceptions of work in the sector
- Foreign competition for U.S. talent
- Reflects broader trends in R&D and manufacturing

The NSTC has begun to address workforce issues related to science, technology, engineering, and mathematics (STEM), as outlined in Charting a Course for Success: America’s Strategy for Stem Education, published in 2018

- Renewed interest by the Federal Government has contributed to the initiation of programs to address reductions in the mineral supply chain workforce. Examples include:
  - DOE’s Critical Materials Energy Innovation Hub
  - Centers of Excellence at U.S. universities
- Broader advances in education and training are needed to prepare U.S. students for jobs in exploration, mining, mineral processing, and manufacturing
Goal I: Bolster education in mining engineering, geology, and other fields related to critical materials manufacturing

Summary of Recommendations

- Develop partnerships with academia and private sector to support universities involved with mineral related education and research
- Develop opportunities to facilitate partnerships between industry and technical colleges to coordinate credentialing / skillset alignment
- Bolster the mineral supply chain sector workforce by leveraging provisions in the Strengthening Career and Technical Education for the 21st Century Act

Education Priorities

Comprehensive Local Needs Assessment:
Perkins V contains a new requirement within the local recipient application for funds, must be included in each local application and updated at least every two years. The law requires an analysis of how CTE programs are meeting workforce needs, and provides eligible recipients with multiple ways to demonstrate labor market demand.

Innovation & Modernization Grants:
Under this new discretionary grant program, the Department will award competitive grants to eligible entities, institutions, or recipients to identify, support and rigorously evaluate evidence-based and innovative strategies and activities to improve and modernize CTE and align workforce skills with labor market needs.

High School Pathways to STEM Apprenticeships:
This demonstration program is designed to support state efforts to expand and improve the transition of high school CTE Students to postsecondary education and employment through apprenticeships in science, technology, engineering, and mathematics (STEM) fields that begin during high school. $3,000,000 in Perkins funds were awarded to six states for a three-year project period.
Goal II: Cross-fertilize material science, computer science, and related disciplines to modernize the minerals supply sector industry and make the field more attractive to new talent

Summary of Recommendations

- Develop effective outreach efforts to the general public to convey the importance of critical minerals to the U.S. economy and national security
- Train individuals with the skill necessary to staff modern twenty-first century mining operations, including autonomous heavy equipment, drones, process automation, and bio-mediated refining processes and controls
- Implement personnel and management reform to ensure appropriate human capital to ensure support for land management agency decision-making

Education Priorities

**CyberCamps:**
CyberCamps were created through Perkins National Activities dollars with the objective of developing replicable models for providing intensive professional development for CTE teachers while preparing students for CTE Cybersecurity Programs of Study that begin in high school and matriculate to community and technical colleges. Currently, OCTAE plans to deliver five CyberCamps across the United States through Perkins National Activity funds.

**Secretary’s Investment in STEM:**
The Administration released the five-year STEM education strategic plan, so that all Americans have access to high-quality STEM education and to safeguard America’s place as a global leader in innovation and employment. In fall 2017, the President charged the Department with devoting at least $200 million in discretionary grant funds toward increasing access to high-quality STEM education, including Computer Science. For fiscal year 2018, we exceeded this goal, obligating $279 million in STEM grant funds.
A FEDERAL STRATEGY TO ENSURE SECURE AND RELIABLE SUPPLIES OF CRITICAL MINERALS

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