NASEO
National Association of State Energy Officials

Critical Minerals: State Planning and Policy Considerations

NCSL Task Force on Energy Supply

Indianapolis, IN
August 18, 2023

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Photo Courtesy of RL Martin

Overview

- A bit about NASEO and State Energy Offices
- Critical minerals contexts and concerns
- Key strategies, options, and opportunities
- State planning and policy considerations
- Resources

NASEO
National Association of State Energy Officials

About NASEO

- The only national non-profit association for the governor-designated energy officials from each of the 56 states and territories
- Serves as a resource for and about the State Energy Offices through topical committees, regional dialogues, and informational events that facilitate peer learning, best practice sharing, and consensus building
- Advances the interests of the State and Territory Energy Offices before Congress and the Administration
- Learn more at www.naseo.org

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NASEO Programs and Priorities

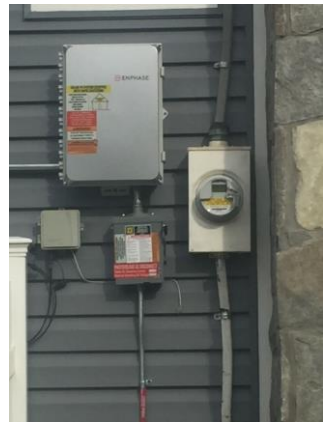
Buildings Electricity Climate Financing Workforce Resilience

Equity Planning Innovation Transportation Solar Policy Security

Also, Industry/Manufacturing, Hydrogen, CCUS, Critical Minerals and Supply Chain

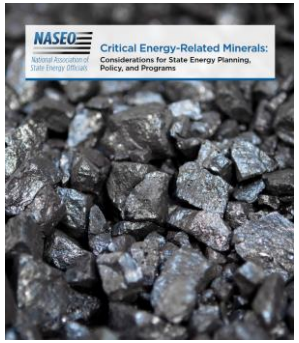
State Energy Offices

- Diverse
  - Governor's/Executive Office, Commerce/Economic Development, Environmental Agency, Utility Commission, Independent Agency
  - Large and small
- Multiple Roles and Objectives
  - Advise governors and legislatures
  - Policy development and implementation
  - State energy planning
  - Program development and implementation
  - Regulation (sometimes)
  - Energy emergency planning and operations (ESF #12), reliability and resilience
  - Technology advancement; economic development
  - Energy affordability, equity
  - Environmental stewardship
- Federal and State funding
- IIJA/BIL and IRA are critically important opportunities – numerous SEO roles and opportunities

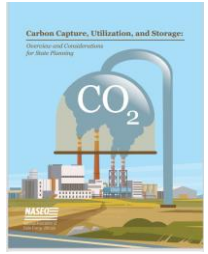


NASEO Work and Resources

- [Critical Energy-Related Minerals: Considerations for State Energy Planning, Policy, and Programs]
  - https://www.naseo.org/data/sites/1/documents/publications/NASEO_Critical%20Minerals%20September%202022%20Final.pdf
  - U.S. DOE Fossil Energy and Carbon Management (FECM) support



- Also of possible interest:
  - **NASEO State Industrial Working Group**
    - https://www.naseo.org/naseo-state-industrial-working-group
  - **Hydrogen: Critical Decarbonization Element for the Grid, Manufacturing, and Transportation**
    - Resources https://www.naseo.org/issues/energy-environment-climate/hydrogen
  - **Carbon Capture, Utilization, and Storage: Overview and Considerations for State Planning**
    - Resources https://www.naseo.org/issues/energy-environment-climate/ccus



The Challenge

- Energy transition will be a materials transition: from fuel intensive to materials intensive.
- Fast growing demand expected for certain minerals, materials, elements for energy transition technologies.
  - Renewables, nuclear, EVs, energy storage, cleaner fossil (incl. carbon management), high efficiency uses (motors, lighting, industrial processes, building systems, etc.), sensors, controls, computing
  - IEA: typical EV 6x mineral content of ICE car; wind generation 9x mineral content as natural gas capacity
- Supply may struggle to meet demand
  - Need to grow production and processing
  - Supply chain vulnerabilities

Table 2. Matching Minerals with Relevant Low-Carbon Technologies

	Wind	Solar Photovoltaics	Concentrated Solar Power	Hydro	Geothermal	Energy Storage	Nuclear	Coal	Gas	Carbon Capture and Storage
Aluminum	X	X				X	X	X	X	
Chromium	X		X	X	X	X	X	X	X	X
Cobalt						X		X	X	X
Copper	X	X	X	X	X	X	X	X	X	X
Graphite						X				
Indium		X					X			
Iron	X					X				
Lead	X	X		X		X	X			
Lithium						X				
Manganese	X			X	X	X		X	X	X
Molybdenum	X	X		X	X		X	X	X	X
Neodymium	X									
Nickel	X	X		X	X	X	X	X	X	X
Silver		X	X				X			
Titanium				X	X		X	X	X	
Vanadium						X	X	X		
Zinc	X	X		X		X	X			
	10	8	2	8	6	11	11	9	8	6

Source: Derived from Hund et al. (2020), Table 3.1. https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf

The Challenge

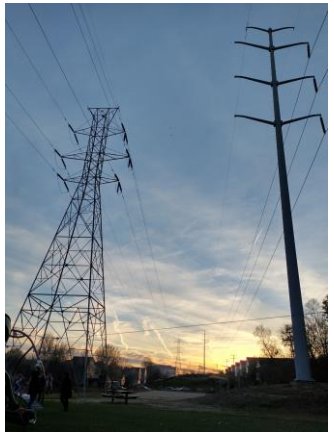
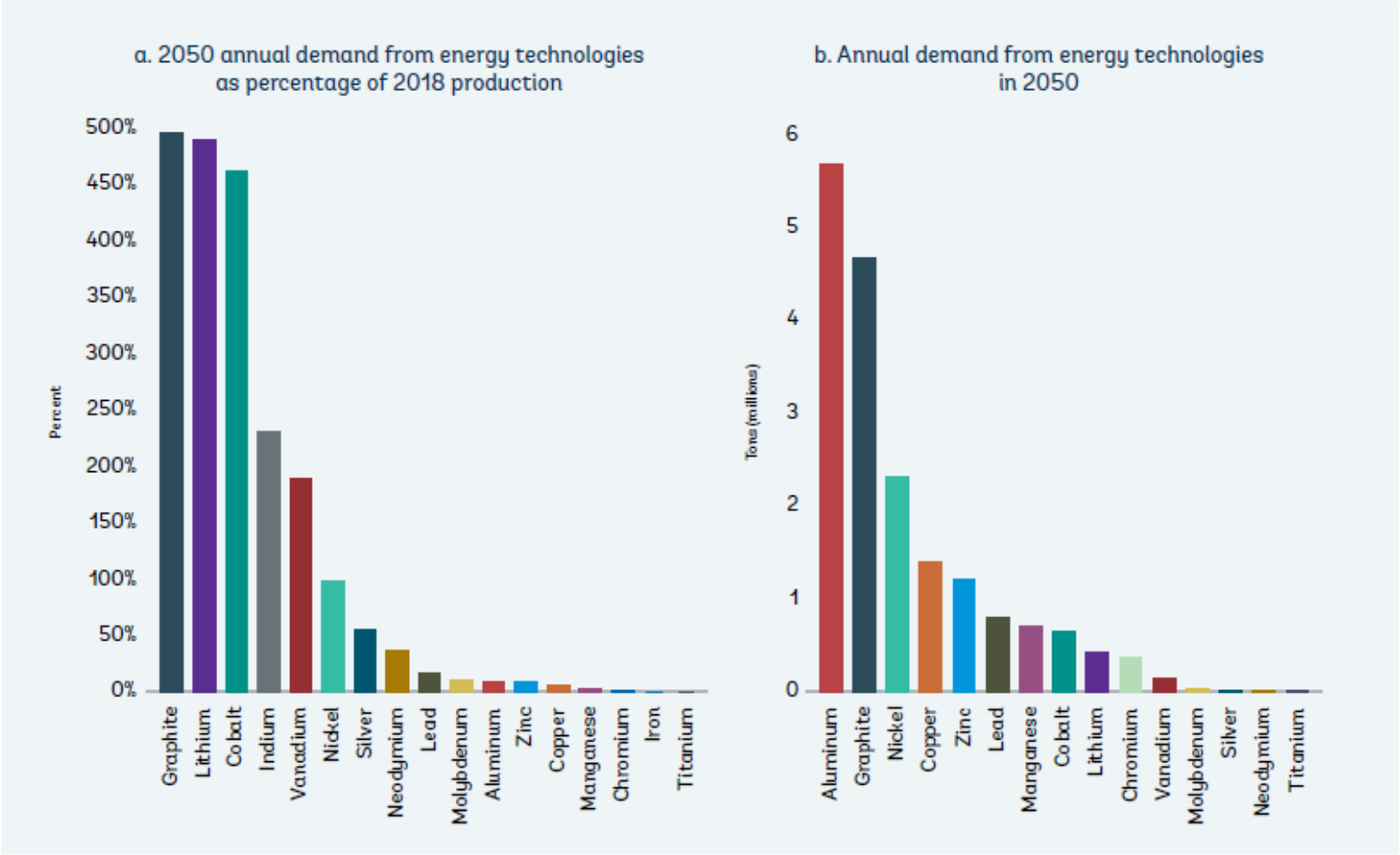


Figure 1. Projected World Annual Mineral Demand under 2°C. Scenario



Source: Hund et al. (2020), Figure 4.3. https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf

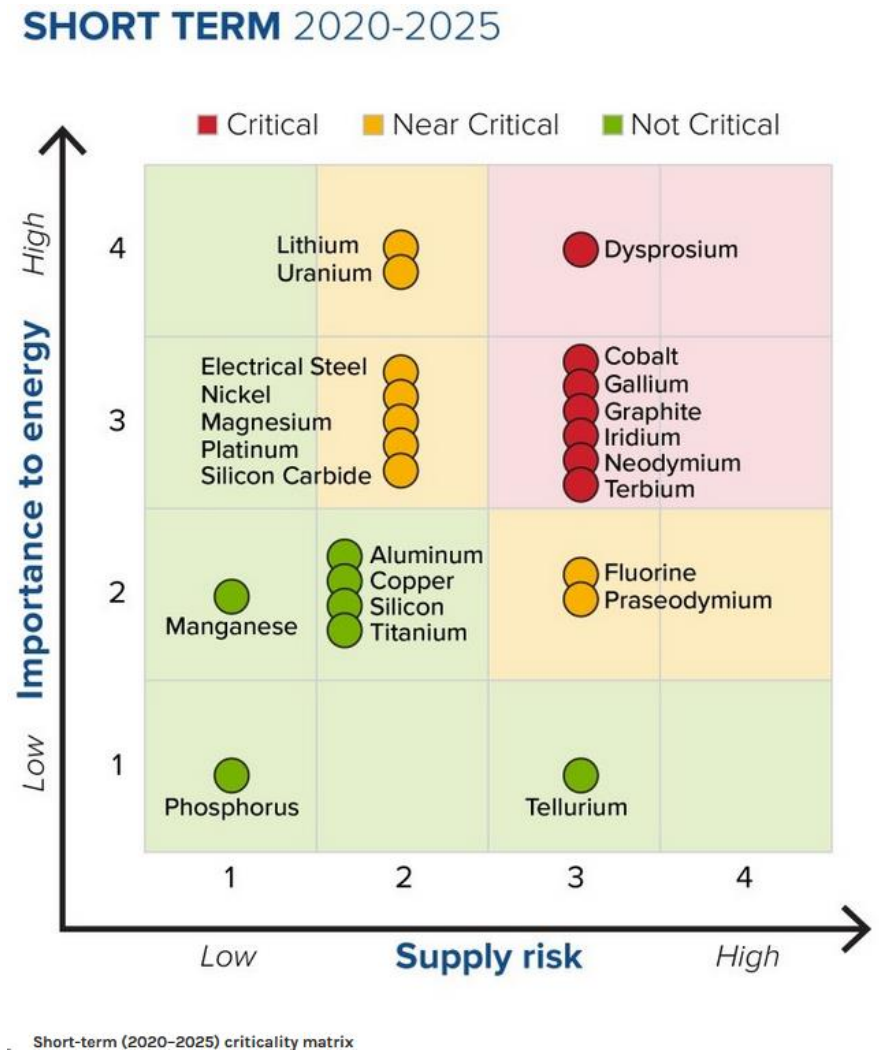
The Challenge

- Current non-diverse supply chains vulnerable to disruption
  - International tension, war, civil strife, labor disputes, pandemic, natural disasters
  - Cobalt (Co): 71% mined DR Congo; 80% processing China
  - China: 82% natural graphite production; 60% rare earth elements (REE) production, 85% processing
  - U.S. imports: 76% Co, 100% natural graphite, 90% REE
- Environmental, social, and governance (ESG) concerns and “conflict minerals”
- Impacts, cost, time to increase supply and processing – and reduce vulnerabilities
  - Conventional and unconventional resource availability
  - Environmental, social impacts
  - Siting and permitting
  - Diversity, reliability of supply – domestic, “friend-shoring”

Figure 2. Demand Risk Matrix

Source: Hund et al. (2020), Figure 4.7. https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf

The Challenge



Short-term (2020–2025) criticality matrix

Medium-term (2025–2035) criticality matrix

https://www.energy.gov/cmm/what-are-critical-materials-and-critical-minerals

Questions for States

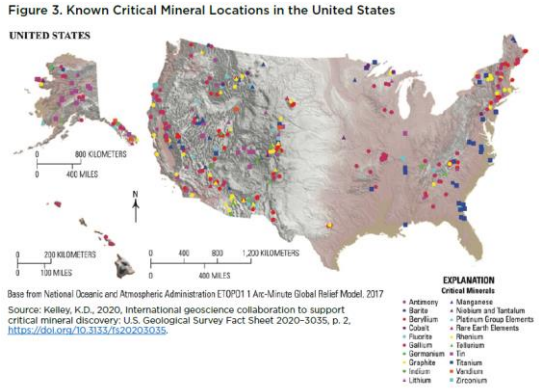
- **What economic opportunities may be available to develop critical minerals resources and supply chains in one's state?**
  - Conventional and unconventional resources; mining, extraction, processing, reuse, recycling
  - Environmental and socioeconomic impacts, positive and negative, on localities and vulnerable communities
  - Potential remediation of brownfields; energy community opportunities
- **How will critical mineral supply chain reliability or uncertainties affect production industries in one's state?**
  - Supply and price trends and vulnerabilities for industrial production
  - Be attuned to supply chain policies and to technological changes, including new tech, alternatives, substitutes
- **How will critical mineral availability, price, and supply chain affect deployment of energy technologies?**
  - Potential effects on availability and cost of technologies and products states looking to meet energy, economic, and environmental goals.

Key Strategies

- **Diversify supply through new production and processing, including from unconventional resources.**

- **Moderate demand growth through efficient designs that conserve materials, use of alternatives and substitutes, and reuse and recycling.**

Options and Opportunities

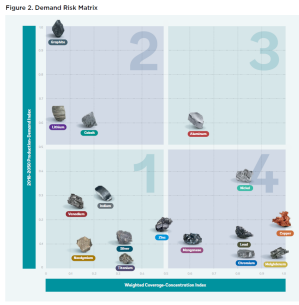


- **Conventional Mining, Extraction, and Processing**
  - Developing and expanding mining, extraction, and processing
  - Time and cost of siting and permitting facilities; environmental and social concerns; community engagement
  - New technologies and markets may open previously uneconomic and unviable options
    - Can revive or grow economic opportunity
    - Complementarities – e.g., geothermal power and Li from brines (Salton Sea)
  - Some critical minerals are secondary products of other minerals
- **Unconventional Resources**
  - Recovery from wastes and by-products – mining/processing, industrial wastes/byproducts
    - E.g., Rio Tinto pilot Li from California boron mine
    - Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Initiative – “carbon ore” high value products from coal, plus mineral recovery from coal-related wastes (acid mine drainage [AMD], wastes, ash)
    - Produced water from oil and gas operations
    - Industrial byproducts and wastes—e.g., REE from garnet sand (abrasive) or red mud (bauxite processing)
  - May help remediate and treat environmental damage (e.g., AMD, coal wastes, mine tailings treatment) and revive jobs, economic opportunity
  - But can also impose environmental risk (pollution, wastes)
  - Thus, can also face siting and permitting hurdles

Options and Opportunities

- **Mineral-Efficient Design, Alternatives, and Substitutes**
  - More efficient, material conserving processes
  - Designs and technologies to reduce or eliminate some critical mineral use
  - Alternatives and substitute materials and designs
  - Battery examples—
    - Reduce Co in Li-ion batteries;
    - Avoid Co, Ni in lithium-iron-phosphate batteries
    - Solid state batteries
    - Silicon instead of graphite anodes
    - Other chemistries for some applications: flow batteries, metal-air, aluminum-sulfur, etc.
  - Can have tradeoffs in performance and cost
- **Reuse and Recycling**
  - Reduces need for primary production and disposal
    - But with growing demand, won't obviate need for new production
  - Reuse, "second use" (e.g., old EV batteries for stationary use)
    - Evaluation, refurbishment, specifications, warranties, liabilities
  - Recycling
    - New, nascent for some products (EV batteries, PVs, wind turbines)
    - Existing bulk recycling may not recover critical elements (e.g., REE from motors)
  - Need system to collect, process, distribute – and a value stream to incite participation

State Planning and Policy Considerations



Source: Hund et al. (2020), Figure 4.7. https://pubdocs.worldbank.org/en/961711588875536364/Mineral-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf

- **Resource Identification and Characterization**
  - States can take stock of mineral endowments – conventional and unconventional
  - Unconventional: coal-related, tailings, produced waters, industrial byproducts
  - Recycling potential – current and prospective
  - Collaboration: DOI (USGS, OSMRE), DOE, state geologic surveys, environment dept, natural resources dept., academia, industry, NGOs,…
    - GIS: resources, environmental features, brownfields, economic development, zoning, utility access, transport, etc.
- **RD&D and Commercialization Assistance**
  - Direct funding of RD&D
  - Tax incentives for RD&D
  - Direct and indirect (incentives) support of tech incubators, business assistance
  - Support access to federal funding

State Planning and Policy Considerations

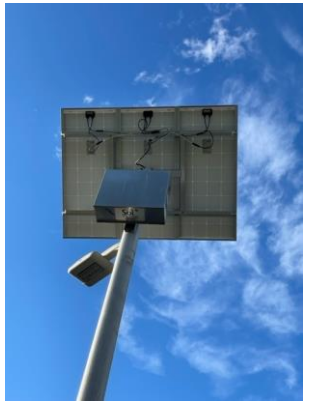
- **Siting, Permitting, and Facility Regulation**
  - Try to streamline reviews and permitting, but with attention to communities and environmental protection
    - Permitting one-stop shops
    - Model/template local ordinances and technical assistance
  - Community engagement, community benefit agreements
  - Opportunities for "energy communities," brownfields, site reuse, remediation
- **Financing, Taxes, and Fiscal Incentives**
  - Consider tax incentives (credits, deductions, incentives)
  - Grants, loans, credit enhancements in accord with economic development funding
    - Including infrastructure authorities, green banks
  - Funding supportive infrastructure improvements
  - Support access to federal funding, financing, and tax incentives
    - IRA, IIJA/BIL—DOE, EPA, USDA, …
    - DOE Loan Program Office
    - DOC Economic Development Administration
    - Regional Development Commissions (e.g., Appalachian Regional Commission, Delta Regional Authority)

State Planning and Policy Considerations

- **Stewardship, Reuse, and Recycling**
  - Collection, refurbishment, recycling need not be near mines/primary sources
  - Thus, wider economic development opportunity but also environmental, health, and safety (EHS) concerns – regulation, standards, permitting, siting
  - Technical/quality standards for reuse and recycled products; warranties, liabilities
  - Incentives – disposal fees and restrictions; tax incentives for reuse, recycling
    - E.g., and analogies: lead-acid battery "core charge," tire fees, Calif. charge on certain electronic displays
  - Reuse/recycling infrastructure and workforce support
- **Procurement Policies**
  - Public procurement preferences for reuse and recycled products
  - Policy for reuse and recycling for end-of-life public property disposition
  - PUC preference or direction to utilities to favor reuse (e.g., "second life" batteries) and recycled content where practicable

State Planning and Policy Considerations

- **Stakeholder Engagement and Equity Concerns**
  - Community engagement and transparency, technical and financial assistance to support community engagement
    - State Energy Office tradition of stakeholder convenings, engagement
  - Community benefit agreements
  - E.g., Calif. Legislation -> Calif Energy Commission set up Lithium Valley Commission
- **Workforce Development**
  - Assess potential workforce needs and skill requirements
    - Needs across the supply chain: mining/extraction, processing, manufacturing, system for reuse and recycling (collection, refurbishment) – plus site/facility development
    - From equipment operators and technicians to scientists and engineers
    - New, existing, and transitioning workers
  - Support development and delivery of training and education
    - Vocational institutions, community colleges, unions, corporate training, universities…



Resources

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