

Expert Dialogue on

# Critical Minerals: The Achilles Heel of America’s Clean Energy Future?



OurEnergyPolicy (OEP) held a discussion November–December 2019 on the United States’ critical mineral import dependency and potential policy solutions. OEP’s community of energy professionals provided recommendations on the best ways to address this issue, and this document provides excerpts from that discussion. Access this document online at <http://bit.ly/2ucNZ3D>.

**Context** - from Morgan D. Bazilian, Colorado School of Mines



“Of the 35 critical minerals designated in a 2018 Department of Interior (DOI) report, the United States is 75-100% reliant on 24 of them. Many of these are **essential inputs to clean energy technologies** such as lithium-ion batteries, solar modules, and wind turbines....

This has **important implications** for geopolitical dynamics, industrial growth, innovation in high-tech sectors, and responsible consumption and production.... If the future of the critical minerals market is not addressed with effective policy and innovation it could negatively impact the **economic and national security of the United States.**”

**Policy Recommendations** - *These recommendations are the individual views of discussion participants and are not the positions of OEP, which is nonpartisan. See page 8 for more about participants.*

1. Best ways to address the United States’ dependency on foreign sources for critical minerals: *(pages 3–5)*
  - 1) Build a thriving U.S. domestic minerals industry with robust environmental practices.
  - 2) Invest in research and development (R&D) for clean and efficient mining and processing.
  - 3) Diversify our mineral trade regime so as to not depend on on only one or two countries.
  - 4) Apply the lessons learned from oil markets to practice responsible resource diplomacy.
  - 5) Continue to give attention to the current risks of foreign critical mineral dependency, but do not relax regulations or hastily expedite permits.
  - 6) Consolidate efforts among agencies and create a long-term federal strategy to promote security of supply. Create industrial policies and promote responsible domestic supply.

*continued on page 2*

- 7) Consider policies that improve how we obtain strategic minerals now while reducing the United States' long-term dependency on rare minerals.
- 8) Be intentional about how we use imported minerals and rare minerals. Take a long-term view as to whether uses for supply-constrained minerals serve the public's energy needs.
- 9) Consider China's competitive advantage in processing minerals from African mineral markets and address its significant competitive advantage.

### **Perspectives & Considerations** – *from individual OEP discussion participants (see page 8)*

2. More on understanding and responding to China's dominance: *(pages 5–6)*
  - The U.S. has higher environmental standards than China and should keep those standards.
  - Unsafe conditions for workers in China are part of why their critical mineral prices are low.
  - China's mineral advantage includes cheap energy and cheap financing.
  - China processes rare earths with fewer regulations on the production and handling of nuclear source materials.
3. Bottlenecks in critical minerals supply: *(pages 6–7)*
  - Cobalt is the largest bottleneck in critical minerals supply.
  - Lithium is not a supply bottleneck, and its best use is for transportation—not for the grid.
4. Do supply chain risks pose a barrier to climate change goals? *(page 7)*
  - We don't know yet to what extent they affect climate change goals. We would need further analysis of all potential mineral sources and carbon tradeoffs of different technologies.

### **Administration Actions & Active Legislation**

- [Executive Order 13817](#) - U.S. is reliant on minerals imports vital to national security.
- [Department of Interior](#) list of 35 critical minerals deemed critical to U.S. national security
- [Department of Commerce](#), *A Federal Strategy to Ensure Secure & Reliable Supplies of Critical Minerals* - six "calls to action": speed permitting, improve workforce, supply chains, etc.
- [American Mineral Security Act](#) (S.1317), Senators Lisa Murkowski (R-AK), Joe Manchin (D-WV), Martha McSally (R-AZ), Dan Sullivan (R-AK) & eight other cosponsors: Would include nationwide resource assessments for every critical mineral, common sense permitting reforms, R&D for mineral recycling & replacements, study of minerals workforce.

### **Related Resources**

- **Brief:** *Critical Minerals and the Role of U.S. Mining in a Low-Carbon Future*, Center for Strategic and International Studies and BlueGreen Alliance, December 18, 2019. (Available in the OurEnergyLibrary: <https://www.ourenergypolicy.org/resources/critical-minerals-and-the-role-of-u-s-mining-in-a-low-carbon-future>)
- **Event Recording:** *Minerals: The Overlooked Foundation of Our Future*, RealClearPolitics, November 20, 2019. (<http://bit.ly/202N4cw>)
- **Hearing:** *Full Committee Hearing on Mineral Security and Related Legislation*, U.S. Senate Committee on Energy & Natural Resources, May 14, 2019. (<http://bit.ly/2U4otYP>)

## 1. What is the Best Way to Address our Dependency on Foreign Sources for Critical Minerals?

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**Morgan Bazilian**  
Colorado School of  
Mines

### Build a Thriving Domestic Industry & Robust Environmental Practices

“The United States’ approach to addressing these issues should **focus on issues across the supply chains**, as well as building a **thriving domestic industry with robust regulations and environmental practices**. As each of the individual minerals have their own set of supply chain conditions, they will require a suite of thoughtful policy prescriptions.” [Full Comment \(Intro\)](#)

– [Morgan D. Bazilian](#), Colorado School of Mines, Director of the Payne Institute

(See page 8 for more information about discussion participants.)

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### Invest in R&D for Clean & Efficient Mining & Processing

“The United States and other potential producers should be **investing in R&D in how to mine more efficiently, cleanly, and safely**. ...It’s not just digging the rocks out of the ground that’s the problem—the rock also has to be crushed, heated, and bathed in toxic chemicals to get the right minerals into a useable form. **That processing or smelting is a dirty business—and that’s also where China has a strong advantage**, again, because as an authoritarian government, they can get away with the pollution. Of course, advanced economies have willingly offshored this pollution to China and looked the other way because it wasn’t our problem. **We should be investing in research for better, cleaner processing**.” [Full Comment](#)



**Sharon Burke**  
Resource Security  
Group, New America

### Diversify Our Mineral Trade Regime; Include Some Domestic Supply

“Being dependent on foreign sources to some degree is not necessarily a bad thing; it’s just the **concentration of supply on one or two countries that’s a big problem**, especially when one of them is a country the U.S. has explicitly called out as an adversary. **A more diversified and responsible mineral trade regime would be better for our security of supply, better geopolitically, and in the long-term, more stable economically**. That can and should include some responsible **domestic supply**.” [Full Comment](#)

### Practice Resource Diplomacy with Lessons Learned

“The United States should be **practicing resource diplomacy**, [and] helping and incentivizing new producers on the way to stable, responsible mineral governance. Allowing expediency of supply to come first will only guarantee disrupted supplies later—we should **apply the lessons of turbulent oil markets** and the economic and geopolitical price they’ve exacted over the last 40 years.” [Full Comment](#)

– [Sharon Burke](#), Director, Resource Security Group, New America

**Continue to Give Attention to Current Risks, But Do Not Relax Regulations or Hastily Expedite Permits**

“The Trump Administration **deserves credit for recognizing the growing importance of non-fuel minerals for high tech, military, and clean energy applications**, and the risks inherent in the current concentration of supply. On the other hand, I am **skeptical that this administration will actually address U.S. reliance on foreign sources of critical minerals in the best possible way**. This can’t just be a give away to domestic mining interests, with national security as a fig leaf for hastily expedited permits, relaxed regulations, and auctioned public lands....” [Full Comment](#)



**Sharon Burke**  
Resource Security  
Group, New America

**Create Industrial Policy & Long-Term Federal Strategy to Promote Security of Supply & to Promote Responsible Domestic Supply**

“As for the **key points in the supply chain that require policy interventions**, the biggest glaring gap is that **the United States has no industrial policy**. At this point, we shouldn’t assume the free market will take care of itself; China is making global investments in production, infrastructure, and processing to ensure its supply (and dominance) of critical minerals. They’re cornering the market in a way that might ultimately undermine global markets.

That doesn’t mean the solution is to emulate them and turn to statism, but **we should definitely have a long-term strategy to support security of supply**. That should include **policy to promote domestic supply in a way that is thoughtful and lawful, not hasty and regrettable** and reliant on long-term government subsidies. For that matter, critical minerals policy has no real home in the national government—the Departments of Commerce, Energy, Interior, Defense, and State all have some responsibility, but no one has a clear lead.” [Full Comment](#)

– [Sharon Burke](#), Director, Resource Security Group, New America

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**Charles Forsberg**  
MIT Nuclear Science

**Consider Policies That Improve How We Obtain Materials Now While Reducing Our Long-Term Dependency**

“In the near-term, the policies... can **help obtain strategic materials**. In the long term, with the goal of 10 billion people with a higher standard of living, **we need to develop technologies not dependent upon strategic materials....**” [Full Comment](#)

– [Charles W. Forsberg](#), MIT Nuclear Fuel Cycle Project, Massachusetts Institute of Technology (MIT) Department of Science & Engineering

## Addressing Dependency on Foreign Sources for Minerals (cont.)

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**Charles Forsberg**  
MIT Nuclear Science

### Be Intentional About Uses for Imported and/or Rare Minerals

“The other need is to develop specific technologies for specific applications [e.g., lithium is better used in automobiles than in stationary applications].... That requires **research & development programs to focus on specific markets, recognizing different markets have different requirements**—and ask whether if what they are developing can really be deployed at scale....” [Full Comment](#)

– [Charles W. Forsberg](#), MIT Nuclear Fuel Cycle Project

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**Dipesh Dipu**  
Jenissi Management  
Consultants

### Consider China’s Competitive Advantage in African Mineral Markets

“Among the strategies for critical minerals outlined in the U.S. government document, **acquisition of assets abroad may perhaps be the most critical** one. I believe that **Africa has a significant role to play** in satiating mineral needs of the world. From analysis of mineral asset acquisitions in a few resource-rich African countries, it can be safely concluded that the Chinese have become a formidable force in [the] resources sector in Africa already.... In a nutshell, U.S. strategies for critical minerals need to **take into account the African potential and address significant competitive advantage that the Chinese already have there.**” [Full Comment](#)

– [Dipesh Dipu](#), Managing Partner, Jenissi Management Consultants

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## 2. More on Understanding & Responding to China’s Dominance

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**Sharon Burke**  
New America

### The United States Has Higher Environmental Standards Than China and Should Keep Those Standards

“One of the reasons China is hard to beat on minerals is that **they have poor environmental protections**. The solution should not be to race them to the bottom and devalue the health of our own citizens and quality of our land, air, and water in the process.” [Full Comment](#)

– [Sharon Burke](#), Director, Resource Security Group, New America

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**Emily Hersh**  
DCDB Group

### Unsafe Conditions for Workers are Part of Why Prices Are Low

“As I understand the issue, **China’s rare earth dominance has resulted from a willingness to endure environmental contamination and unsafe working conditions** and then turn around and supply the product at a low price. Rare earths aren’t ‘rare’ in the sense that deposits are difficult to find, but they wouldn’t be available close to the price that China sells them without the existence of these factors.” [Full Comment](#)

– [Emily Hersh](#), Managing Partner, DCDB Group

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## More on Understanding & Responding to China's Dominance (cont.)

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### China's Mineral Advantage Includes Cheap Energy & Cheap Financing

"China's dominance in rare earths does not stem from some geological accident that left it uniquely endowed with good ore bodies. Raw source minerals for rare earth elements (REE's) are actually relatively common and widely distributed around the world.... The problem with the **rare earths elements** is not that they are particularly rare (they aren't) but that they are **hard to separate from one another**....

Industrial processing of rare earth minerals in China starts with **two major advantages: cheap financing for plant construction**, and the country's **willingness to burn coal for cheap electricity**...." [Full Comment](#)



**Roger Arnold**  
Silverthorn  
Engineering

### China Processes Rare Earths with Fewer Regulations

"There's a third and even more decisive advantage that the Chinese rare earths industry enjoys: **freedom from stringent regulations on the production and handling of 'nuclear source materials.'**...No ordinary mining company wants to have anything to do with production of nuclear source materials. It exposes them to regulatory issues and liabilities they are not prepared to handle. So when they mine an ore body for other metals that happens to include workable concentrations of REEs and thorium, they make no effort to extract them....

There is a loose coalition of players who want very much to change that situation. Some are primarily motivated by the **strategic need to revive a U.S. REE industry** and break the nation's dependence of China. Others are **advocates of thorium power** reactors who see them as a safer and cleaner approach to nuclear energy. They have been **pursuing federal legislation that would charter companies able to responsibly deal with the non-proliferation issues of nuclear source materials**.... They are seeking authorization to process the rich supply of mine tailings holding high concentrations of thorium and REE's...." [Full Comment](#)

- [Roger Arnold](#), *Systems Architect, Silverthorn Engineering*

## 3. Bottlenecks in Critical Minerals Supply

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**Emily Hersh**  
DCDB Group

### Cobalt is the Largest Bottleneck in Critical Minerals Supply

"Looking only at the minerals in the cathode, the biggest bottleneck is the **cobalt**.... It complicates the economic question, as well, that the majority of cobalt is extracted as a **by-product or co-product with copper or nickel**, so the cobalt supply depends to some extent on those prices." [Full Comment](#)

- [Emily Hersh](#), *Managing Partner, DCDB Group*

## Bottlenecks in Critical Minerals Supply (cont.)

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**Emily Hersh**  
Managing Partner,  
DCDB Group

### Lithium is Not a Supply Chain Bottleneck; Its Best Use Not For the Grid

“Lithium isn’t a bottleneck...” [Full Comment](#) “Lithium also isn’t the major cost determinant of the battery, so the price of lithium chemicals aren’t the biggest impact on vehicle electrification.” [Full Comment](#)

“I am of the opinion (and there are smart people who disagree) that in the medium and long run, **the case for lithium batteries as part of grid-scale storage doesn’t make too much sense**. For home storage, the case for lithium is a bit stronger, but the reason lithium batteries are [valued] is the fact that you can move them around. Mobility applications are well suited for lithium. Stationary applications—you *could* use lithium, but you don’t *have* to for space or weight considerations.” [Full Comment](#)

“**Geothermal co-production** [of lithium], as well as oilfield production, is very interesting because we’re talking about producing lithium chemicals from a brine that alone would not be economically feasible....” [Full Comment](#)

– [Emily Hersh](#), Managing Partner, DCDB Group

## 4. Do Supply Chain Risks Pose a Barrier to Climate Change Goals?

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### We Don’t Know Yet; Analysis Needed

“I don’t believe we actually know to what extent the supply chain security risks of these minerals represent a barrier to climate change targets and goals. There **needs to be thorough analysis of the mineral implications of a clean energy transition**, of what the total requirement will be....



**Sharon Burke**  
Resource Security  
Group, New America

We also need a **serious study of all the potential sources of minerals**.

There are some sources that are simply not possible with fossil fuels, such as recycling—most of these minerals are not expended when they’re used, the way fossil fuels are. For some of these minerals, the demand is effectively only a decade or two old, so no one was explicitly looking for them in the past. There may be more new discoveries out there, but there’s also old mine waste or tailings, which are currently an environmental hazard, that contain some of these specialty minerals and could be repurposed. I recently saw a technology that can extract lithium and rare earth elements from fracking wastewater.... The United States and other advanced economies **could be incentivizing these sources of supply, including by investing in R&D to improve these processes** and help move them to market.

Finally, **there needs to be some study of the tradeoffs**—we don’t want to just swap carbon pollution for a different kind of chemical pollution. We need to know what we’re really getting into.” [Full Comment](#)

– [Sharon Burke](#), Director, Resource Security Group, New America

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## Discussion Participants



**Morgan D. Bazilian** - *Director, Payne Institute; Professor, Colorado School of Mines*

[Bazilian](#) has more than two decades of experience in the energy sector and is regarded as a leading expert in international affairs, policy, & investment. He is director of the Payne Institute and a member of the Council on Foreign Relations and two global advisory councils.



**Sharon Burke** - *Director, Resource Security Group, and Senior Advisor, New America*

[Burke](#) directs the Resource Security group at New America, which works in the intersection of security, prosperity, & natural resources. Burke served as the Assistant Secretary of Defense for Operational Energy and in several other senior U.S. government positions.



**Charles W. Forsberg** - *Executive Director, MIT Nuclear Fuel Cycle Project*

[Forsberg](#) is the Executive Director for the Nuclear Fuel Cycle Project at the Massachusetts Institute of Technology (MIT) Department of Nuclear Science & Engineering. He is a licensed professional engineer & was a corporate fellow at Oak Ridge National Laboratory.



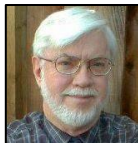
**Emily Hersh** - *Managing Partner, DCDB Group*

[Hersh](#) is a well-known lithium industry expert & co-hosts the Global Lithium Podcast. She manages projects in South America for companies in the mining, energy, oil, and gas industries, and manages a fund dedicated to raw materials in the battery supply chain.



**Dipesh Dipu** - *Managing Partner, Jenissi Management Consultants*

[Dipu](#) is Managing Partner and Principal Consultant at Jenissi Management Consultants, an energy and resources consulting firm in India that helps its clients optimize resources. He was previously Director of Energy and Resources Consulting at Deloitte.



**Roger Arnold** - *Systems Architect, Silverthorn Engineering*

[Arnold](#) now directs the Silverthorn Institute, after 30 years as a software engineer, systems architect, and technology consultant. The institute serves as a clearing house for ideas and tools supporting local sufficiency in energy and resources.

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The quotes in this document are excerpts from comments posted November 4–December 8, 2019, in the online discussion, “[Critical Minerals: The Achilles Heel of America’s Clean Energy Future?](#)” by registered members of OurEnergyPolicy’s energy professionals community. Bold added for emphasis. Access this document online at <http://bit.ly/2ucNZ3D>.



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