Written Testimony of Reed Blakemore
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Ranking Member Westerman and distinguished members of the Subcommittee, thank you for the invitation to appear before you today. My name is Reed Blakemore and I serve as deputy director at the Global Energy Center of the Atlantic Council. The Atlantic Council is a non-partisan, non-profit organization headquartered in Washington, DC. Before I begin, I should note that my remarks and written testimony represent my observations, and do not necessarily represent the views of my colleagues or institution.

As recently underscored by studies from both the World Bank and the International Energy Agency, a projected six-fold increase in demand for key minerals in renewable and advanced energy technologies between now and 2040 warrants the close attention of the United States.[1,2]

Given the breadth of expertise on this panel, I will focus my remarks on three observations of the global mineral supply chain: the complex economics and interdependency within steps of the supply chain; the impact of "lowest common denominator" barriers to entry for new participants; and how the scale of the minerals challenge bears upon policy options for supply chain resiliency and security.

1) **Economic Interdependency Within Mineral Supply Chains:** In the upstream and midstream, most critical minerals are found as sub-deposits during extraction or found as byproducts of processing and therefore need appropriate market conditions in place to be retrieved in addition to (or at the expense of) other co-located materials. Most minerals also often need to be sent elsewhere in order to continue to pass through the value chain, frequently resulting in small physical amounts of key minerals being aggregated from multiple sources. A good example here is tellurium, which is most frequently found as a byproduct of copper refining but is only retrieved at a rate of .9 grams per ton of refined copper ore.[3]

   The result is a highly interdependent value chain, wherein the market conditions necessary to incentivize the retrieval of minerals as byproducts at a mine might vary from those necessary for a refiner to process those ores into concentrate and sell finished material to a component manufacturer. These issues are compounded by a lack of strong market governance structures and price volatility, which together create obstacles for operators seeking certainty around sourcing and offtake, inhibits decisions regarding production volumes, and increases overall business risk. This has maligned previous attempts at 'patching' vulnerabilities in single segments of the supply chain, such as the 2015 bankruptcy of Mountain Pass Mine in California.[4]

   Overcoming the uncertainty related to supply chain interdependency is why there is growing attention to more integrated approaches to the supply chain which ensure input and offtake

[1] http://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf
[2] https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary
[3] https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Modules_and_Websites_(Inorganic_Chemistry)/Descriptive_Chemistry/Elements_Organized_by_Block/2_p-Block_Elements/Group_16%3A_The_Oxygen_Family_(The_Chalcogens)/Z052_Chemistry_of_Tellurium_(Z52)
[4] https://www.defensenews.com/opinion/commentary/2019/11/12/the-collapse-of-american-rare-earth-mining-and-lessons-learned/

certainty, though the scale of financial and operational commitment necessary to achieve a fully integrated supply chain is beyond the reach of many single companies or countries.

This leads to my second observation.

2) **"Lowest Common Denominator" Barriers to Supply Chain Entry:** Though generally abundant, most critical mineral production is currently limited to a few key countries or geographies, with one country often holding a significant amount of market share in each supply chain. New components of a minerals supply chain need to manage cost-intensive factors, ranging from geology of the mine and associated mineral extraction, to political and environmental risk, to price volatility and market uncertainty.[5]

   China has seen considerable success in limiting or circumventing these factors through an integrated industrial strategy that includes subsidized investment, limited regulation, as well as production quotas and direct offtake support.[6,7,8] This advantages Chinese producers with significantly lower overhead costs, improved tolerance to price volatility, and maximized margins, while pushing out higher competitors with higher cost-of-production.

   Furthermore, it establishes a "lowest-common-denominator" set of competitive conditions that allows Chinese production to consistently compete as the lowest-cost producer, strengthening share of upstream and midstream production amidst continued efforts elsewhere to accelerate minerals demand. Consequently, even though demand growth signals should be encouraging new market participants, market share is too often closed off to companies operating without levels of support necessary to meet these "lowest common denominator" factors.

3) **Scaling a Response to the Minerals Challenge Appropriately:** Finally, consideration must be given to scale of 'critical minerals' dependency and the amount of time necessary to solve any number of these challenges.

   As it stands, many countries have or are in the process of building their own 'critical minerals' lists. Together, the lists of the United States, Japan, the European Union, Australia, and Canada comprise over 46 minerals and materials, each with their own upstream dynamics, intensity of processing in the midstream, and volumes needed to meet componentry demand in the downstream. Of those 46 minerals, 16 are in common.

   A singular "critical minerals strategy" that fails to take into account the nuance between these different minerals ecosystems risks being too broad to truly make a difference against the pressures mentioned above. Meanwhile, standing up new segments of the supply chain is a significant time investment, particularly in the upstream where the development of a new mine can take over a decade. Building resiliency or alternative sources of supply across the supply chain can also take a considerable amount of time with underwhelming results given the urgency of this challenge.

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[5] https://perthusasia.edu.au/getattachment/Our-Work/Strategies-for-Securing-Critical-Material-Value-Ch/Final-Strategies-for-securing-critical-material-value-chains-PUSAC-WEB.pdf.aspx?lang=en-AU

[6] https://doi.org/10.1007/s13563-019-00214-2

[7] https://fas.org/sgp/crs/row/R43864.pdf

[8] https://doi.org/10.1016/j.resconrec.2018.11.017

This means that while the recognition of the minerals that we deem ‘critical’ is an important first step, establishing the criticality of these minerals in relation to each other is a necessary second step to prioritize where action can be most effective in light of significant costs, time expenditure, and investment risk.

To conclude, mineral supply chains will demand our attention for the foreseeable future, especially as efforts to deploy new technologies and clean energy resources continue at current levels. Yet even as policies are developed to ensure that supply chains remain resilient, well-governed, and sustainable, careful attention must be paid to the behavior of the markets within these supply chains, as well as the scale of establishing resiliency across a wide range of unique minerals and metals.

Thank you for the opportunity to speak today and I look forward to your questions.

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