

Response to Questions for the Record (QFR):

Submitted by Dr. Michele Bustamante, Staff Scientist, Natural Resources Defense Council

Pursuant to Oversight Hearing Testimony on the topic of

**“Powering the 21st Century with American Copper,” held April 29, 2026, before the
House Committee on Natural Resources, Subcommittee on Energy and Mineral Resources**

1. Question from Rep. Huffman: What kind of additional scientific research is needed to inform responsible mineral supply chain policy for the 21st century?

Thank you for the question, Representative Huffman. I appreciate your attention to detail on this important aspect emerging from the conversation about powering the 21st century with American copper.

The practice of looking to robust scientific research is, in itself, a critical first step toward developing more responsible policies of any kind. This is certainly true to the subject of mineral supply chain policies, where real environmental, cultural, and human health harms are at stake. We know a lot, but there is still more to find out to make the most responsible decisions possible about how much, where, and under what conditions minerals get produced to meet US needs throughout the rest of this century of rapid change.

Based on my assessment of the literature, I recommend immediate attention to the following research activities:

- Multi-model consensus-seeking projects: As the cliché goes, “all models are wrong, but some models are useful.” Best practice for using modeling research in policy is to look across as large a suite of high-quality, aligned modeling research as possible, produced by multiple modeling teams, using different peer-reviewed modeling approaches, to leverage the strengths and limit the biases of any individual model, scenario, or study. Ideally, the large ensemble of modeling results used should be produced under harmonized scenario conditions, as exemplified by the World Climate Research Programme's (WCRP) Coupled Model Intercomparison Project (CMIP)), a project utilized by the Intergovernmental Panel on Climate Change (IPCC) along with other studies to report responsible conclusions about climate change and mitigation pathways from synthesis of thousands of unique model-scenario results produced by around 100 unique models in its sixth assessment report (AR6).¹ Efforts toward a similar community-wide, ensemble modeling project for minerals needs, particularly when tied to different climate mitigation or other sustainable development scenario goals (including levels of uptake for recycling/circular economy, etc.), should be prioritized to produce the most reliable, actionable outlooks of what we need.
- Better geographic disaggregation: Most studies of copper supply and demand are globally scoped, and the same is true for many other energy transition “critical” minerals. This is a perfectly logical place to start for globally traded commodities, but it is incomplete context at best, and

¹ <https://data.ene.iiasa.ac.at/ar6/static/About.html>

functionally less appropriate for guiding national-level policy of most relevance to this body. Global results provide overly-simplified signals because they obscure national-level needs and resource sufficiency. Key factors, such as population-level consumption patterns, infrastructure conditions, and industrial activities (including manufacturing and recycling), vary significantly from country to country, and the existence of trade barriers (e.g., national import or export restrictions, tariffs decreasing economic efficiency, etc.) can further shape how much domestic primary production is needed in line with demand and available sources. Unfortunately, national-level results are significantly less available in the existing body of research. As such, I recommend support for:

- More US-specific mineral supply & demand studies: There is a clear need for more US-scoped studies of copper demand and supply scenarios. As addressed above, multi-model synthesis is the goal, not single study conclusions. Further, because conditions change so much over time, it is essential that results considered in policy reflect up-to-date conditions as best as possible. The existence of modeling on the subject from 10+ years ago is not sufficient. Funding to produce new, updated, national and material-specific modeling scenario studies, covering a broad spectrum of future technology and societal development scenarios, for use within a multi-model synthesis would be the best-case scenario for addressing major gaps.
- Better geographic disaggregation of supply-chain activities: Additionally, even for studies that do present country-level results, they often focus on estimating embodied demand (i.e., the amount of mineral contained in finished end-use products consumed, e.g., EVs deployed in the US) but ignore where the manufacturing currently takes place (i.e., where the raw materials would actually be consumed), which is often not in the same country, as is the case for the US today. Having more domestic clean tech manufacturing capacity for EVs and batteries, etc., would be beneficial in its own right; however, embodied demand estimates overstate true need for in-country consumption, especially in the short-term for import reliant countries like the US, because it implies fully isolationist supply strategies where we need to manufacture 100% of our own goods. Breaking the geographic distribution of manufacturing capacity out better within models would lead to more realistic and policy-useful insights around domestic supply needs for copper and other minerals.
- Directed development supportive data tools: A major limitation of our current system for mineral development on federal land is that it is directed only by the expression of interest from private developers scouting locations based on factors of primarily resource and profit potential, leading to conflicts with local interests. A more responsible system might look like one where locations are offered up strategically based on a multi-factorial assessment within federal agencies, involving substantive public engagement. To that end, creation of geospatial tools, which can map mineral deposits (and, where available, key indicators of likelihood for development, such as estimated operating cost based on resource type) alongside environmental and social sensitivity factors, such as indigenous and other cultural heritage sites, protected areas, biodiversity

hotspots, etc., could be incredibly helpful to developers, communities, and agencies regulating the process alike. Such tools could enable identification of more or less impactful locations for prioritizing or preventing development. If made publicly accessible, it could further enable fairer consultations, and ideally development of community benefit agreements or similar, where all parties have access to the same tools and information about risks and alternatives. NRDC has begun commissioning work to this end, in collaboration with academic partners, for our own understanding, but we believe work like this would be a powerful decision support framework for future consideration by agencies in responsible supply chain development.

Congress could consider acting to support research on responsible mineral supply chain development in a variety of ways. Federally-funded research – whether at academic institutions, independent non-profits like the National Academies, or within government agencies and national labs directly – has been, and should remain, a core driver of science for the public good. As budgetary decision makers, members of Congress hold tremendous power to shape this force directly by, for example, ensuring adequate funding for staffing and programming at relevant agencies (e.g. DOE, USGS), proposing report language calling upon those agencies to do specific kinds of research, or directing investigation by the National Academies of Science and/or Engineering.

Action today can make a big difference to the kind of future pathways that remain available for us to walk. I hope these recommendations offer helpful supplementary guidance to you and the members of the committee as you deliberate policy before you and into the future. Thank you again for the opportunity to testify on this topic and to address your questions. I would be happy to speak further upon request, as needed.