What will cooperation on critical minerals look like among advanced economies?

Cullen S. Hendrix
Peterson Institute for International Economics & Payne Institute

What will cooperation among advanced economies (AEs) that are net importers of critical minerals look like? These minerals range from those with widespread industrial applications spanning various sectors to those with specialized roles in national security and medical contexts. These imports arrive as raw materials, intermediate goods (wafers, ingots), and embodied imports in final goods (EVs, cell phones, weapons systems, etc.). Supply chains for many minerals are thin, concentrated in a small number of producing and refining countries, and dominated by China. Given both geopolitical considerations and the surging demand driven by the shift toward renewable energy systems, countries including the United States, European Union, United Kingdom, Korea, and Japan are actively pursuing strategies to "de-risk" supply chains and enhance resilience via a mixture of unilateral and multilateral policy initiatives.

At the same time, critical mineral-rich developing and middle-income economies are adopting more resource nationalist policy orientations, with interventions ranging from export bans on unrefined products (Indonesia, Zimbabwe) and partial/full nationalizations (Bolivia, Chile) to export taxes intended to provide domestic firms with relatively cheaper raw materials with which to build industrial capacity and move up global value chains.

Given their close trading, investment, and security relationships as well as shared supply chain vulnerabilities, these advanced economies could benefit greatly from some degree of coordination on critical mineral policy. We can envision a spectrum of cooperation possibilities, ranging from a tightly structured coalition of purchasers wielding substantial market and strategic influence, while also aligning with member states' national security interests – a rough comparison could be made to NATO – to a scenario of pure competition. This end of the continuum would approximate a "scramble" for resources in which all options – including market ones, but also unilateral military interventions and forced regime changes – would be on the table. In between we would find regimes built around information sharing, like the pilot US-Japan-Korea supply chain monitoring system[i], standards-setting initiatives like the Minerals Security Partnership (MSP)[ii], and a purchasers club composed of import-dependent advanced economies.[iii]

To anticipate where the cooperation regime might land on this continuum, we need to account for at least two overarching factors: 1) the geopolitical scenario(s) for which cooperative arrangements are being developed and 2) the political economies of specific minerals. Rather than a single overarching framework, what is more likely to emerge is a critical minerals *regime*

complex[iv]: a set of partially overlapping institutions and frameworks governing specific minerals and geographies with different memberships and degrees of coordination between members based on the political and economic incentives different countries face with respect to particular groupings of minerals.

Assessing the landscape

To anticipate what AE cooperation might look like, we first need to establish what future geopolitical scenarios the countries are anticipating. All AEs are making significant investments in decarbonizing their energy and transport systems, so they share an expectation of significant growth in future demand. Beyond this structural shift in demand, however, the question becomes: resilient to what? What types and levels of disruption are AEs planning for?

There is a huge difference between building critical mineral supply chain resilience to A) temporary supply shocks due to natural disasters and/or short-term yet disruptive events like strikes and riots in producing countries, B) slow decoupling of the United States, EU, Japan, and Korea from China in specific sectors like semiconductors amid incremental nationalization and/or rising domestic consumption of mineral deposits by producing countries, or C) major conflict between the United States and China, potentially involving third parties. In scenario A, incremental development of more resilient supply chains is warranted, with comparatively larger/smaller roles for the private sector/government policy interventions. In scenario C, large-scale state interventions would be absolutely necessary to maintain US national security. While these interventions might be coordinated with trade and security partners, they might not be.

At present, the answer seems to be scenario B: US-China decoupling in strategic sectors amid moves to nationalize mineral wealth and/or capture value further down the supply chain in mineral-rich countries. This scenario may be the most likely, if for no other reason than it is a more-or-less linear extrapolation of the current situation. Under this set of circumstances, AEs would likely engage in a variety of cooperative activities designed to mitigate uncertainty about supplies and supply chains for critical minerals but that would stop short of NATO-for-critical-minerals arrangement because of incentives to compete economically between AEs over global market shares in critical mineral-intensive industries.

But scenario C cannot be ruled out. A survey of almost 1,000 US-based international relations scholars put the likelihood of a Chinese attack on Taiwan at 23.75% in the next year.[v] Previous administrations have enacted far more sweeping foreign policies, like many aspects of the War on Terror, based on concern for much lower probability events – the Bush administration's "one percent doctrine" among them. Were the United States to render assistance even on the limited, indirect scale at which it has been supporting Ukraine in its war with Russia, Chinese retaliation would likely be both stiff and swift. This scenario would be more likely to produce either

"scramble" dynamics or – depending on the level of military mobilization and length of the crisis, critical mineral security could be folded more fully into existing military alliance structures, implying tighter coordination of minerals policies.[vi] That is, a more existential threat to existing supply chains would provoke more extreme responses – either cooperative or non-cooperative – among AEs.

Diverse minerals, diverse incentives

The minerals deemed critical according to various AE government methodologies are a diverse group in terms of their metallurgical properties, their uses in both intermediate and final goods, and the political economies that exist around their markets. To understand AE coordination around critical minerals, we must decompose critical minerals into those where AE preferences and incentives are more-or-less aligned across AEs and those where incentives to cooperate are complicated by competitive pressures and/or the structure and size of existing markets. I propose a 2x2x2 typology to work through the implications of different types of critical minerals for AE cooperation.

First, we should distinguish between those minerals with primarily broad, consumer-oriented applications and those that have more boutique and/or national security applications. Bauxite and copper would fit in the former category, lutetium in the latter. To the extent final demand is driven by governments' national security applications, it provides a clear rationale for government intervention and shared benefits to de-risking in the form of helping to secure major trading and alliance partners. De-risked supply chains would approximate a club good with few positive externalities, as trade could be highly circumscribed on national security grounds. Minerals with broad, consumer-oriented applications, create mixed incentives: investments in making supply chains more resilient will confer benefits on both cooperators but free-riders as well in the form of wider and more transparent markets, and presumably (on margin) lower global prices.

Table 1: A Political Economy Typology of Critical Minerals: Market Structures and Applications

		Substitutes	Segmented
Boutique/Nat. Security Applications	Single Supplier	Lutetium	?
	Diverse Suppliers	?	Uranium
Consumer Applications	Single Supplier	Gallium	?
	Diverse Suppliers	Copper	Silica

Second, we should distinguish between those that have comparatively large, diversified supply chains and those whose supply chains are both small and quite narrow, often with single country/producer chokepoints. Global production of bauxite, the chief ore in aluminum, was 380 million metric tons (MT) in 2022[vii], spread across Africa, the Americas, Asia, Europe, and

Oceania. According to the USGS, potential global resources are "essentially inexhaustible." But the lists also include gallium, global production of which was only 550 metric tons in 2022, with China accounted for 98.1 percent of that production.[viii] Marginal investments in comparatively smaller, thinner critical mineral markets can reshape these supply chains more quickly than investments in much larger, widely traded commodities. Small final demand and large economies of scale imply potentially significant cost savings associated with coordination and deduplication of efforts. AEs do not need seven independently de-risked supply chains for gallium—they need one or two. The purely economic benefits of building capacity for boutique applications are likely small enough as to not engender distributive conflicts between AEs over their control. Indeed, given the high energy intensity of mineral refining and separation in the case of minor metals and potentially large environmental impacts, the bigger challenge may be finding countries willing to host these activities.

Finally, we should distinguish between those where the downstream industrial outputs are substitute goods, directly competing in relevant markets, and where these outputs are used in mostly segmented markets for geographic or trade policy or national security-related reasons. EV battery minerals (lithium, cobalt, graphite, etc.) would clearly be in the former; uranium would be in the latter. With the former, efforts to coordinate will be tempered by market pressures and demand for policy interventions to enhance competitiveness of import-competing domestic industries (subsidies, domestic content requirements, etc.). These types of frictions have already been evident with respect to US and EU CHIPS Acts[ix], which have been viewed as major salvos in a subsidies war, as well as domestic content provisions in aspects of the Inflation Reduction Act.[x] In contrast, the segmented, highly regulated nature of demand for fissile material, as well as its destructive potential and AEs shared interests in nonproliferation – mean AE preferences are much more aligned and or obviated by the products not directly competing in markets.

This exercise points to several key takeaways. First, the term "critical minerals" is applied to a vast array of materials with different market structures, mixtures of consumer vs. national security applications, and implications for economic competition among AEs.[xi] Second, we should expect cooperation to de-risk supply chains for these minerals to vary substantially among AEs across minerals. For some, like those with boutique national security applications and a single source of supply, national security concerns and the benefits of de-risking for military allies should make cooperation relatively more straightforward. For others, where markets are highly segmented and competitiveness concerns muted, cooperation on critical minerals faces lower barriers but also has less obvious rationales – the case of fissile material and its relation to nonproliferation efforts being a special one. And for those with wide consumer applications and where AE products directly compete with one another in the market, coordination may be weakest – though ironically, these are the products (like most of what are being called "battery minerals") that receive the most media attention.

Finally, it is very unlikely that a single forum will emerge or be selected from existing institutional frameworks to provide broad-spectrum coordination of critical mineral policy across AEs. Because of obvious links between critical minerals and energy security, the International Energy Agency might be viewed as a logical coordinating mechanism. But while the IEA has served an important information-gathering and -sharing role so far, it is not clear how well its architecture and primary role – coordinating the maintenance and stocking/release of strategic petroleum reserves – map onto the much more diverse critical mineral problem set.[xii]

Regime complexes

Instead of one coordinating institution to rule them all, we might instead see the emergence of a critical minerals regime complex among AEs. Regime complexes are systems of transnational governance composed of loosely coupled/coordinated sets of institutions providing governance in a defined issue area.[xiii] Regime complexes tend to emerge around issues where the "structural and interest diversity" of relevant actors make agreeing to a binding set of comprehensive rules difficult or impossible.[xiv] In a maximalist sense, a global critical mineral regime complex would also include the interests and transnational efforts to coordinate policy among *exporting* countries as well, thus making the institutional frameworks governing AE interactions a subset of a larger regime complex.

We see already some elements of a regime complex forming, with particular institutional fora selected or created to address specific shared problems. For example, NATO's Energy Security Centre of Excellence has been tasked with identify shared critical mineral vulnerabilities stemming from desires to hybridize if not fully electrify vehicle and warship powertrains.[xv] The MSP may take on additional roles, but so far it seems to be operating as some form of standards-setting organization intended to help AE member-states avoid a race to the bottom in environmental, social and governance (ESG) standards when seeking to invest in building mining and processing capacity in mineral-rich but potentially governance-challenged countries.[xvi] Other elements of coordination between AEs have been/are likely to be bilateral arrangements driven by the idiosyncrasies of national/common market policies, like the proposed US-EU Critical Minerals Agreement, which would seek to guarantee for the US and EU reciprocal domestic treatment of critical minerals produced and/or processed in each market for the purposes of accessing the other market's system of subsidies and tax incentives.

This brief, and the emergent regime complex it sketches, raises several questions for discussion. The first several are analytic; the latter policy-oriented:

1. Is the proposed 2x2x2 typology sensible? Can it be simplified without doing too much violence to reality?

2. Are the categories mislabeled or mischaracterized in terms of their effects for global markets and therefore prospects for policy coordination?
3. Does the section on defining the set of appropriate geopolitical scenarios add value or muddle the discussion?
4. Is the emergent regime complex equal to the task of addressing shared critical mineral concerns?
5. Is the emergent approach likely – in and of itself – to result in more interventionist domestic/single market economic policies? Less? Or will it have no effect?

I look forward to our discussions and time together in Golden.

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[i] "Remarks by President Biden, President Yoon Suk Yeol of the Republic of Korea, and Prime Minister Kishida Fumio of Japan in Joint Press Conference," August 18, 2023. https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/08/18/remarks-by-president-biden-president-yoon-suk-yeol-of-the-republic-of-korea-and-prime-minister-kishida-fumio-of-japan-in-joint-press-conference-camp-david-md/.

[ii] "The Minerals Security Partnership," *International Energy Agency*. https://www.iea.org/policies/16066-minerals-security-partnership.

[iii] Cullen S. Hendrix, "Why the Proposed Brussels Buyers Club to Procure Critical Minerals Is a Bad Idea," *PIIE Policy Brief* 23-6, 2023. https://www.piie.com/publications/policy-briefs/why-proposed-brussels-buyers-club-procure-critical-minerals-bad-idea

[iv] Robert O. Keohane and David G. Victor, "The Regime Complex for Climate Change," *Perspectives on Politics* 9 (1): 7-23. https://www.cambridge.org/core/journals/perspectives-on-politics/article/abs/regime-complex-for-climate-change/F5C4F620A4723D5DA5E0ACDC48D860C0.

[v] Irene Entringer García Blanes, Shauna N. Gillooly, Susan Peterson, and Michael J. Tierney, "Poll: What Is the Likelihood of War Over Taiwan?" *Foreign Policy*, April 13, 2023. https://foreignpolicy.com/2023/04/13/china-attack-taiwan-war-expert-poll-biden/

[vi] The former outcome rests on the assumption, of course, that existing alliance structures would survive such an event.

[vii] *USGS Mineral Commodity Summaries 2023.* Department of the Interior. https://pubs.usgs.gov/periodicals/mcs2023/mcs2023-bauxite-alumina.pdf.

[viii] Ibid.

[ix] Ryan Browne, "Europe approves its $47 billion answer to Biden's CHIPS Act — here's everything that's in it," *CNBC*, April 19, 2023. https://www.cnbc.com/2023/04/19/europe-approves-its-47-billion-answer-to-bidens-chips-act.html.

[x] Cullen S. Hendrix, "'Made in America' Puts the Brakes on Electric Vehicles Biden Hopes to Push," *PIIE Realtime Economics*, April 10, 2023. https://www.piie.com/blogs/realtime-economics/made-america-puts-brakes-electric-vehicles-biden-hopes-push.

[xi] Hendrix, "Why the Proposed Brussels Buyers Club to Procure Critical Minerals Is a Bad Idea."

[xii] This is a topic for another memo, but it also helps explain why an "OPEC for critical minerals" is unlikely to emerge.

[xiii] Kai Raustiala and David G. Victor, "The Regime Complex for Plant Genetic Resources," *International Organization* 58 (2): 277-309.

[xiv] Keohane and Victor, " The Regime Complex for Climate Change."

[xv] K.H. Juutilainen and Ugnė Grikinytė, "Strategic Analysis on the Key Minerals Markets in the Framework of the Hybridization of Fighting Aircraft, Vehicle and Warship Powertrain," NATO Energy Security Centre of Excellence, 2021. https://www.enseccoe.org/data/public/uploads/2021/06/nato-ensec-coe-strategic-analysis-on-the-key-minerals-markets.pdf.

[xvi] Cullen S. Hendrix, "Building Downstream Capacity for Critical Minerals in Africa: Challenges and Opportunities," *PIIE Policy Brief* 22-16. https://www.piie.com/publications/policy-briefs/building-downstream-capacity-critical-minerals-africa-challenges-and.