

AeX

OUR MATERIAL FUTURE.

Part I: Securing Critical Minerals in the Decade Ahead

June 2026

At AeX, we value simplicity.

Across our businesses, we strive to distill complex problems into their clearest, most essential components so we can build prescient, actionable solutions. And when explaining who we are and what we do, we've found that plain English works better than technical jargon.

With that in mind, we've written this memo to provide—in simple terms—an overview of what we believe is one of the most severe and pressing threats to America's future: the massive import-dependency for the critical minerals that are the base inputs to our industries, economy, and defense readiness.

We explain the problem as we see it, quantify the risks to our economy, capital markets, and national security, and describe why we're uniquely positioned to address the problem over the near- and longer-terms. Our model is simple but unique, having distilled decades of experience in finance, physical commodities trading, and global logistics into a comprehensive solution. To support our thesis, we've included supporting slides and further details in the Appendix.

Whether you're a prospective investor, seeking to join our team, or a casual market observer, we invite you to review our central thesis and let us know if you see an angle we don't or have a perspective you think we need to consider. We're always looking for better ways to understand—and ultimately solve—the problem.

Thank you to the many friends and family who supported the building of AeX for your formative discussions, patience and feedback, and to AHW for your seemingly endless hospitality at North Point.

JARED.DUBEY@AEX.AI
Updated June 1, 2026
Lyford Cay, Bahamas

KAIZEN.

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Appendix.

Introduction.

Every nation, with a view to those great objects, ought to endeavor to possess within itself all the essentials of national supply.

ALEXANDER HAMILTON | Founding Father of the United States

OUR WORLD RUNS ON natural resources.

From the food we eat and the energy we harness to the satellites we deploy in space, human progress has always traced back to our ability to extract, transform, and transport the materials of the natural world. And as societies advance, our resource demand doesn't just grow—*it evolves*.

Over the last several decades, we've entered an era of unprecedented technological innovation. Ideas that once lived at the edges of our imaginations—artificial intelligence, electric cars, gene editing, renewable energy, and reusable rockets—are increasingly embedded in our way of life. The modern economy is no longer just industrial, but computational, electrified, and deeply technology-enabled.

Imagine if the technological progress of the 20th century were compressed into less than a decade.

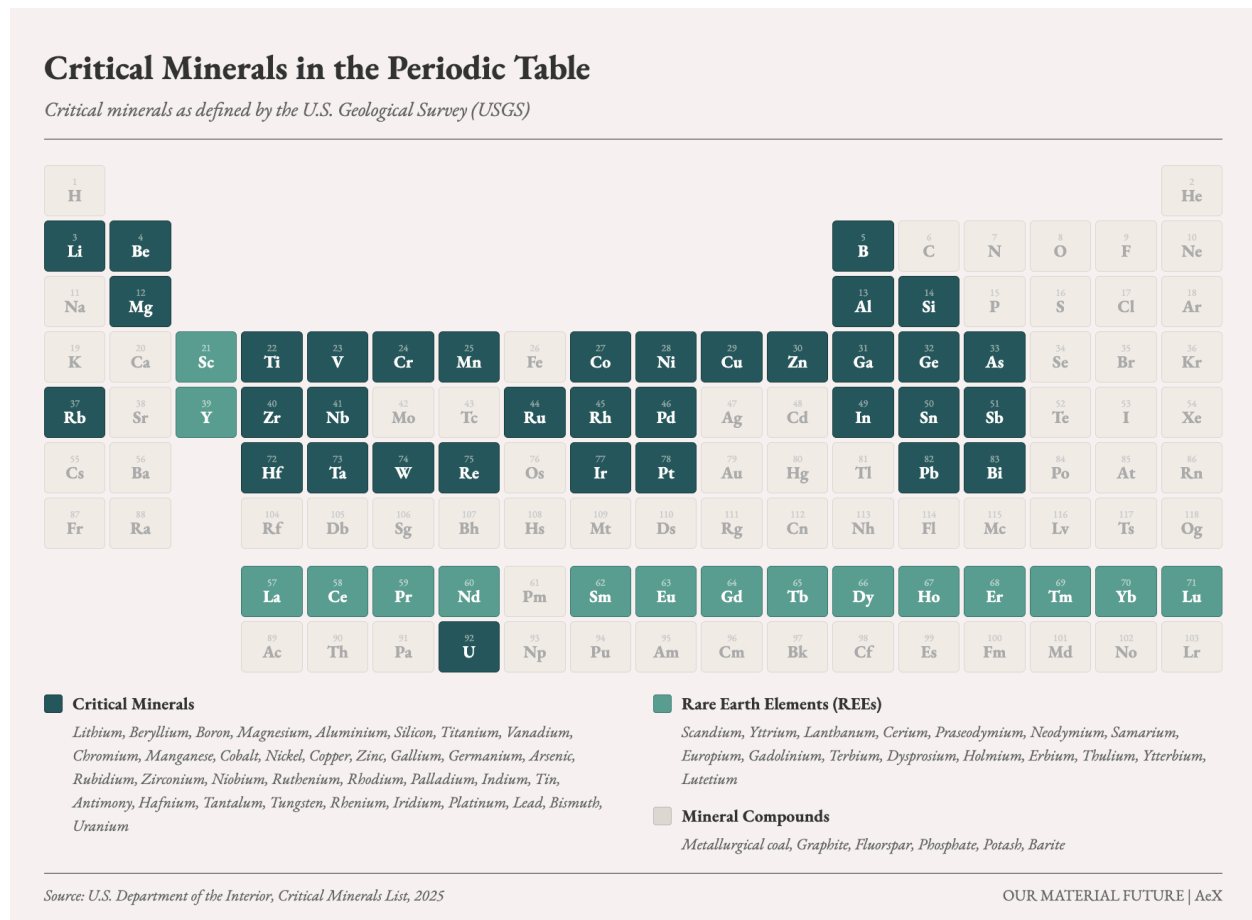
LEOPOLD ASCHENBRENNER | Founder, Situational Awareness

The sheer pace and scale of this transformation is astonishing, rapidly accelerating across functionally all domains of science and technology. Breakthroughs that once took generations now scale in years. Entire industries are being rebuilt in a single decade. Innovation has become recursive, building upon itself in ways that reshape how we understand ourselves, our technologies, and our future.

And this is just the beginning.

But, the paradox of modern progress is that as technology becomes more sophisticated, it becomes more dependent on a smaller, more constrained set of natural resources.

As a result, our resource demand has rapidly evolved beyond traditional bulk commodities (like grain, coal, and crude oil) toward a narrow group of highly-specialized materials with unique physical and chemical properties—magnetic strength, electrical conductivity, thermal stability, and energy density—that have few, if any, viable substitutes: **critical minerals**¹.



These sixty elements are indispensable inputs to (and in many cases, single-points-of-failure across) the advanced technologies and modern infrastructure that now sit at the base of multi-trillion dollar industrial and economic ecosystems. From the moment we wake up to the moment we go to sleep, nearly every interaction with the

¹ United States Geological Survey, “2025 List of Critical Minerals.” November 6, 2025.

modern world is made possible, in some way, by this largely invisible layer of materials.

They have—in essence—become **the fundamental building blocks** of our modern 21st century world. And like all resource evolutions before it, the extraction, processing and distribution of these materials is at the center of an intense global competition. The stakes of this competition are extraordinarily high, as the winner will determine the trajectory of our collective future.

We're building AeX so that America wins this race.

The State of Play.

The next era of global competition will not be determined solely by who invents the most advanced technologies, but by who controls the narrow layer of minerals that enable them.

CHRISTINA ALFONSO | Founder, Council on Global Competition and Innovation

WE BELIEVE THE UNITED STATES requires resilient, uninterrupted access to the critical minerals that underpin its industrial base, economic output, and defense readiness. **But, that's not how it works today.**

Instead, the U.S. is alarmingly dependent on foreign—often adversary-controlled—supply chains for meeting more than **80 percent** of its critical mineral needs². For 13 of 60 critical minerals (~22 percent), the U.S. is **100 percent** import dependent³, while exceeding **50 percent** import reliance for an additional 29⁴.

While this imbalance has developed over the past five decades, it is just now becoming widely examined by both U.S. policymakers and the litany of companies that depend on these materials for output of finished products and services. This has led the White House to aggressively—and publicly—support U.S. supply chain resilience

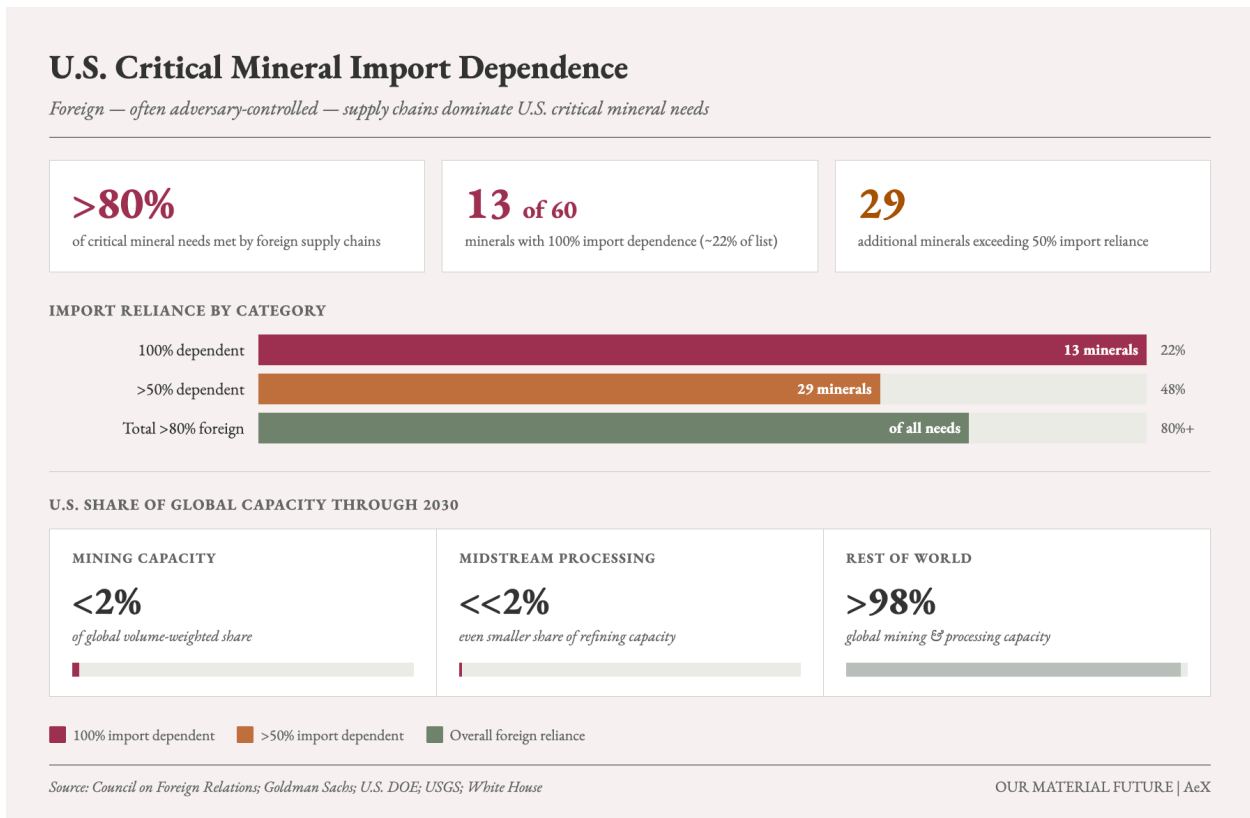
² U.S. Department of Energy, “Developing a Domestic Supply of Critical Minerals and Materials.” February 6, 2024.

³ United States Geological Survey, “2026 Mineral Commodities Summary.” February 8, 2026.

⁴ White House, “Adjusting Imports of Processed Critical Minerals and their Derivative Products into the United States.” 91 FR 2439. January 14, 2026.

through public-private partnerships, multilateral alliances, and direct investment (debt and equity) across domestic mining, processing, stockpiling, and nearshore exploration initiatives. Over the last year alone the U.S. government has committed to more than \$30 billion in letters of interest, investments, loans, and other forms of support over the past six months in partnership with the private sector⁵.

Yet despite these efforts, the U.S. is projected to account for less than **2 percent** of global volume-weighted mining capacity through 2030⁶, with an even smaller share of midstream processing —the essential stage where raw ores are refined into usable forms.



By contrast, China has pursued a coordinated, multi-decade “whole-of-government” strategy to secure control over critical nodes across the entire value chain. Through a combination of subsidies, industrial clustering, state-backed overseas investments, domestic technological development, export controls that protect key processing technologies, and other trade-distorting practices, China

⁵ U.S. Mission to the African Union, “2026 Critical Minerals Ministerial Fact Sheet,” February 4, 2026.
⁶ Council on Foreign Relations, “The U.S. Critical Minerals Dilemma: What to Know.” July 30, 2025.

has erected substantial barriers to competition, captured significant economies of scale, and entrenched its dominant market position

The scale of this effort has been extraordinary. Since 2000, China has invested an estimated **\$523 billion** in mining and related infrastructure worldwide⁷. More than \$120 billion of that total has been directed toward international mining and upstream processing projects since 2023 alone⁸. This trendline continues to accelerate.

The Middle East has its oil, China has rare earth: China's rare earth deposits account for 80 percent of identified global reserves, you can compare the status of these reserves to that of oil in the Middle East: it is of extremely important strategic significance; we must be sure to handle the rare earth issue properly and make the fullest use of our country's advantage in rare earth resources.

DENG XAIOPING | General Secretary of the Chinese Communist Party

China now commands approximately **68 percent** of world-wide critical mineral production and **85 percent** of global processing⁹. They are the top producer of **30 of 60 minerals**¹⁰ and hold nearly full control of rare earth elements (REEs) supply—15 elements essential for permanent magnet production and defense, electronics, and renewable energy applications—with a **91 percent** global processing share¹¹. This has given China *de facto* control over not just mining of key materials, but the midstream processing and export capacity portions of the value chain.

The U.S. would never design such a fragmented, competitor-controlled supply chain today. But, as demand began to grow in the 1980s, the appeal of low labor costs, loose permitting and regulatory regimes, and the ability to offshore the most environmentally-sensitive extractive and processing activities eclipsed concerns about supply-chain resilience and downstream national security vulnerabilities.

In retrospect, this was a poor trade-off.

⁷ William & Mary AidData, "AidData's Global Chinese Development Finance Dataset, Version 3.0", November 6, 2023.

⁸ CEF, *Raw Power: China locks-in global dominance of critical minerals and metals with \$120bn outbound investment surge*. March 19, 2026.

⁹ Cohen, Jared. "Resource Realism: The Geopolitics of Critical Mineral Supply Chains." Goldman Sachs, September 13, 2023.

¹⁰ Ibid.

¹¹ Kim, Tae-Yoon et al. "With new export controls on critical minerals, supply concentration risk becomes reality." IEA, October 23, 2025.

Enduring Systemic Barriers.

CRITICAL MINERALS ARE NOW so deeply woven into our 21st century world that right-sizing this imbalance is the defining industrial, economic, and national security challenge of the next decade.

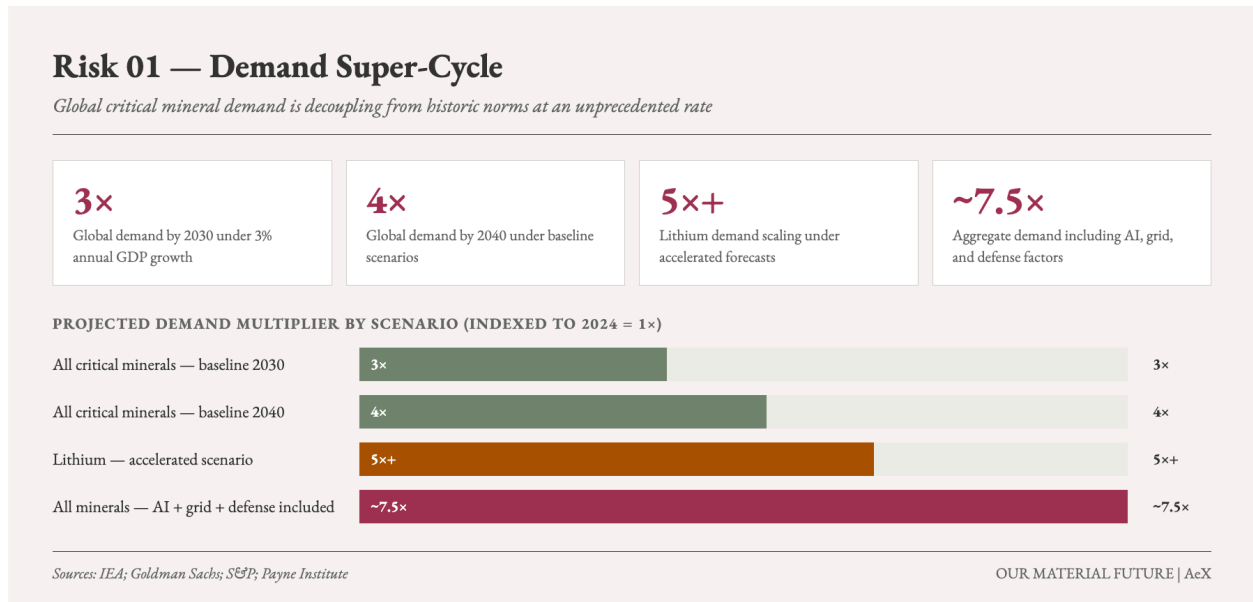
**If we're dependent on resources we don't harvest,
then our future's ultimately controlled by those who do.**

JARED DUBEY | Founder, AeX

But to be successful, the U.S. needs to overcome four enduring, systemic barriers that are accelerating this supply imbalance:

1. DEMAND SUPER-CYCLE

As economic and industrial growth accelerates, critical mineral demand is decoupling from historic norms. Under modest **3 percent annual GDP growth** scenarios, global demand is projected to triple by 2030 and quadruple by 2040¹². And for certain materials like lithium, demand expectations scale fivefold or more¹³.



¹² IEA, *Global Critical Minerals Outlook 2025*. May 2025, 8.

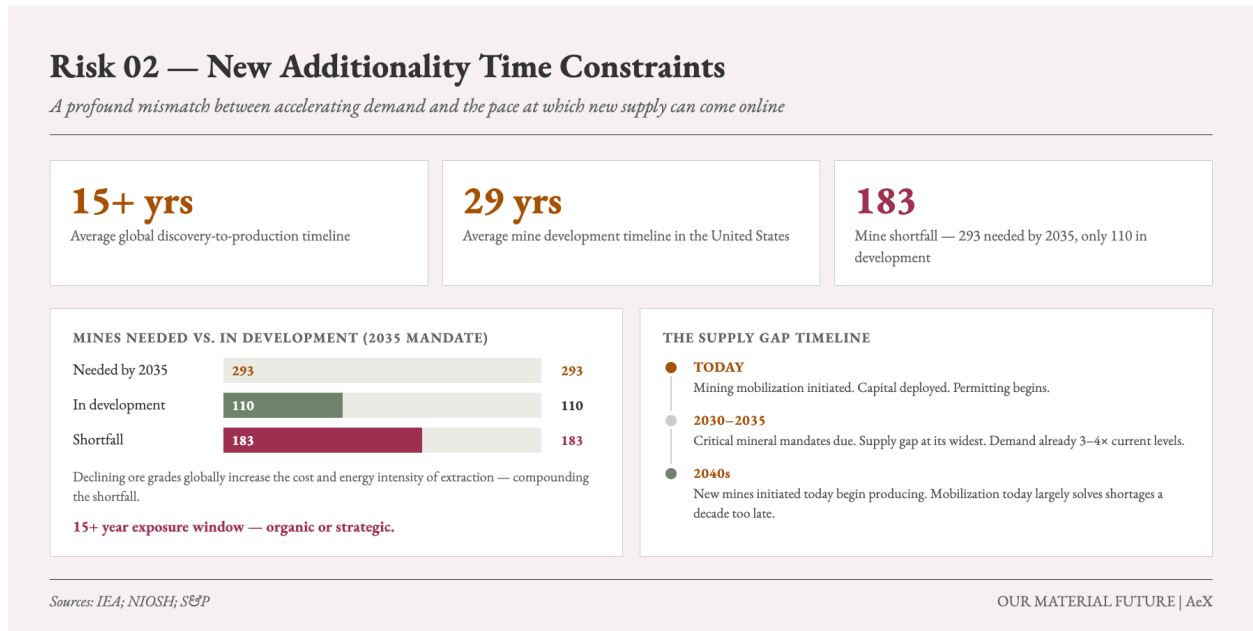
¹³ Ibid, 89.

These forecasts may prove conservative as they only partially account for the accelerating requirements associated with **AI hyperscale data centers, grid modernization, new energy supply, and next-generation defense platforms**. When including these factors, projections indicate that aggregate demand will increase another two-and-a-half fold over the same period¹⁴.

Copper—often called the “King of Minerals” and the oldest metal used by humanity—is a harbinger for the upcoming demand challenge. To sustain just 3 percent annual global GDP growth, the world will need to mine **more copper over the next 15 years** than has been extracted throughout all of recorded human history¹⁵. For those familiar with the extractives business, it’s clear that this is going to be *remarkably difficult* to pull off.

2. MINING ADDITIONALITY CONSTRAINTS

Since every critical mineral must be extracted and global stockpiles are functionally non-existent (traditionally relying instead on just-in-time delivery), meeting accelerating demand requires significant new extraction. But, this creates a profound mismatch between the economic necessity of meeting demand and the pace at which new supply can realistically come online.



¹⁴ Payne Institute for Public Policy, *The State of Critical Minerals 2025*. September 9, 2025, 4.

¹⁵ International Energy Agency, *EV Transition Targets Out of Reach Without More Copper Mines*. May 2024, 4.

Here's why: the average mineral discovery-to-production timeline now exceeds **15 years** globally and over **29 years**¹⁶ in the U.S. due to lengthy permitting processes, regulatory uncertainty, high litigation risk, and in-depth environmental reviews. To meet 2035 critical mineral mandates, for example, the global economy requires approximately **293 new major mines** (including over 60 for copper alone), yet currently, only **110** are in development¹⁷. Compounding the challenge, ore grades and deposit sizes are declining at major mines worldwide, making raw materials more expensive, energy-intensive, and time-consuming to extract.

Even under dramatically improved permitting and financing conditions, a mining mobilization initiated today would solve for shortages emerging in the **2040s** rather than the 2030s. This leaves a 15+ year exposure to growing supply constraints, whether organically or strategically derived.

3. GLOBAL PROCESSING CHOKEHOLD

Mineral deposits are geographically dispersed, but today the true locus of control in the value chain resides in the heavily-concentrated **midstream processing** layer where raw ores are transformed into application-ready forms.

Today, China holds over **70 percent of global refining capacity** and in excess of **95 percent of rare earth processing**¹⁸. This dominance is fortified by integrated industrial clusters, state-subsidized costing, and unfair trade practices (e.g., market undercutting or dumping) that create preclusive barriers to entry for Western competitors. Even when the raw ores are sourced elsewhere, China has built an integrated midstream processing ecosystem that makes them the primary agent for global distribution.

The U.S., on the other hand, has functionally **zero domestic high-purity processing capacity**, and we cannot simply build new processing to satisfy our growing demand.

¹⁶ S&P, "Average lead time almost 18 years for mines started in 2020-23." April 10, 2025.

¹⁷ National Institute for Occupational Safety and Health, "Number of Active Mines by Sector: 1983-2023." November 23, 2023, 2.

¹⁸ IEA, *Global Critical Minerals Outlook 2025*. May 2025, 8.

Risk 03 — Global Processing Chokehold

The true locus of control resides in midstream processing — and China owns it

70%+

China's share of global refining capacity across critical minerals

95%+

China's share of global rare earth element processing

~0%

U.S. domestic high-purity processing capacity

GLOBAL CRITICAL MINERAL PROCESSING SHARE (VOLUME-WEIGHTED THROUGH 2030)



U.S. BARRIERS TO NEW MIDSTREAM DEVELOPMENT

- Toxic waste management requirements
- Protracted and fragmented regulatory permitting
- Litigation exposure at every stage
- Local NIMBY-ism blocking facility siting
- Shortage of specialized engineering talent
- Chinese technology export ban on key separation processes

Sources: Council on Foreign Relations; IEA; Goldman Sachs; S&P

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The U.S. faces numerous barriers to expanding midstream infrastructure, including stringent environmental regulations, lengthy and fragmented permitting processes, litigation risks, local opposition (often referred to as NIMBYism, or “Not In My Back Yard”), and shortages of specialized engineering and technological expertise. Complicating the matter, China has taken steps to preserve its dominance in the sector by classifying critical separation, refining, and processing technologies as state secrets and prohibiting the export of related technologies¹⁹.

4. WEAPONIZATION OF TRADE

As demand surges and supply vulnerabilities deepen, governments are increasingly leveraging trade policy to secure critical mineral supply chains and, in the case of incumbents, expand strategic advantages over geopolitical competitors.

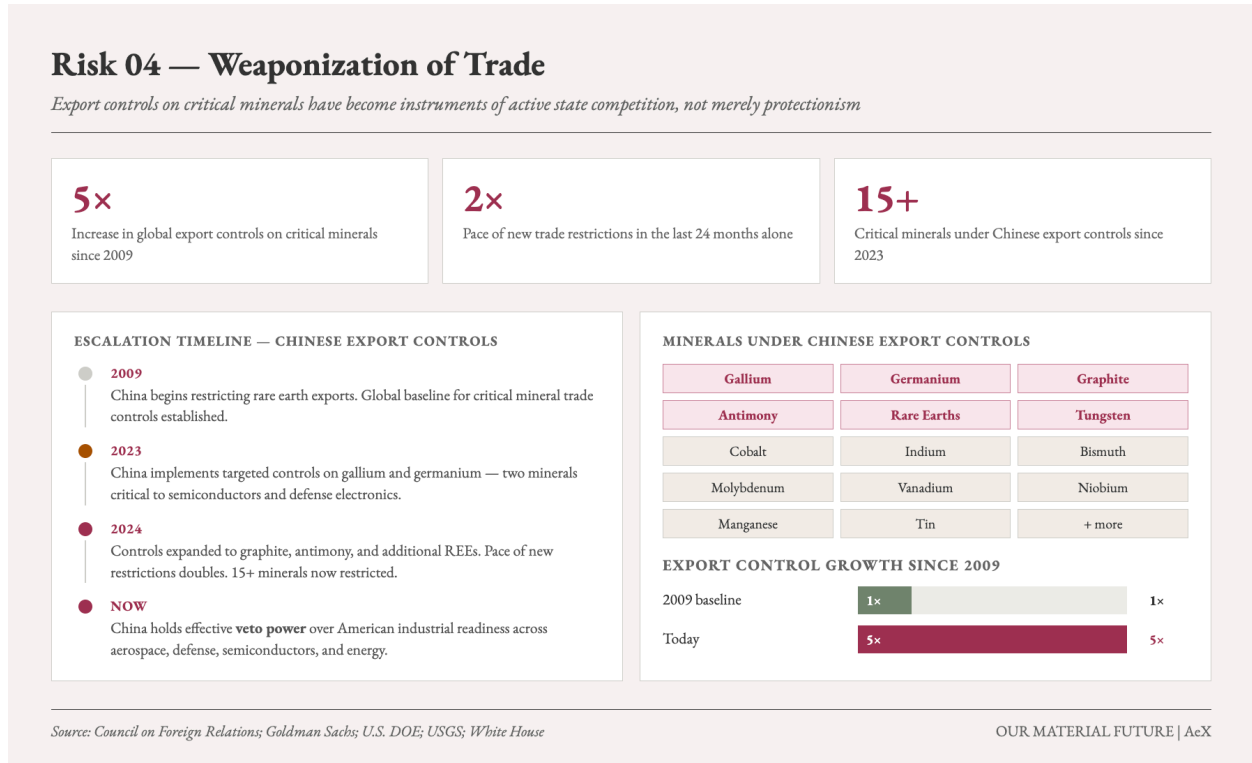
Export measures on critical minerals—including licensing requirements, export taxes and export bans—have increased **fivefold since 2009**²⁰—with nearly 100 export-related measures having been introduced on critical minerals between 2020 and mid-2026 alone²¹. The pace of new restrictions is accelerating as nations pivot towards protectionism and a willingness to exert geopolitical leverage. China

¹⁹ National Association of Manufacturers, “China Tightens Grip on Critical Minerals.” November 1, 2024.

²⁰ OECD, “Critical raw materials facing rising export restrictions, increasing risks to global supply chains.” April 28, 2026.

²¹ UNCTAD, “Critical minerals are reshaping global trade as demand surges.” June 12, 2026.

has been particularly aggressive, implementing extensive export controls on **20+ critical minerals**²²—including antimony, gallium, germanium, graphite, and yttrium—over the last several years.



These restrictions have had two nearly instantaneous effects: prices for export-controlled critical minerals have skyrocketed—in some cases over **14,000 percent**²³ in a year’s time (no, that’s not a typo)—and U.S. industrial firms and trade groups have raised the alarm that, barring swift intervention, looming production decreases are on the horizon. Extrapolated out and unmitigated, this is an effective “**veto power**” over American industrial capacity.

Negative Asymmetry, Quantified.

THE FUTURE OF AMERICAN competitiveness is now tethered to the trade and industrial policies of our most significant strategic competitors.

²² ETH Center for Strategic Studies, “China’s Strategic Use of Trade Controls.” April 23, 2026.

²³ The Oregon Group, “Rare Earth prices surge as China keeps export restrictions.” June 10, 2026.

This gives China—and other FEOCs²⁴—powerful levers that, when exercised, threaten to reshape global economic and power dynamics to the direct detriment of longer-term U.S. prosperity.

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 SUN TZU | The Art of War

Plenty of efforts have been made to model the downstream effects of supply constraints on U.S. industrial capacity and economic output, but they're understandably constrained by limited data availability, market opacity, challenges of assessing specialized applications and volumes internal to finished goods, and rapidly changing demand patterns. At best, they represent a rough estimate of what *could* happen.

Even if grossly underestimated, they should alarm everyone:

1. INDUSTRIAL DOMINO EFFECT

According to USGS risk modeling, a **30 percent** disruption across just five critical minerals is projected to cause a **12.5 percent decline in U.S. GDP**²⁶—nearly three times the peak-to-trough decline experienced in the 2007–2009 global financial crisis. Making matters worse, China controls in excess of **95 percent** of global processing for three of these five minerals, and in excess of **60 percent** for the remainder²⁷.

- **Antimony** results in a **\$544 billion** decline in total output.
- **Gallium** results in a **\$602 billion** decline.
- **Zirconium** results in a **\$700 billion** decline.
- **Graphite** results in an **\$816 billion** decline.
- **Arsenic** results in excess of a **\$1 trillion** decline²⁸.

²⁴ *Foreign Entity of Concern*: A foreign entity that is owned by, controlled by, or subject to the jurisdiction or direction of a government of a foreign country that is a covered nation (People's Republic of China, Russian Federation, Islamic Republic of Iran, Democratic People's Republic of Korea)

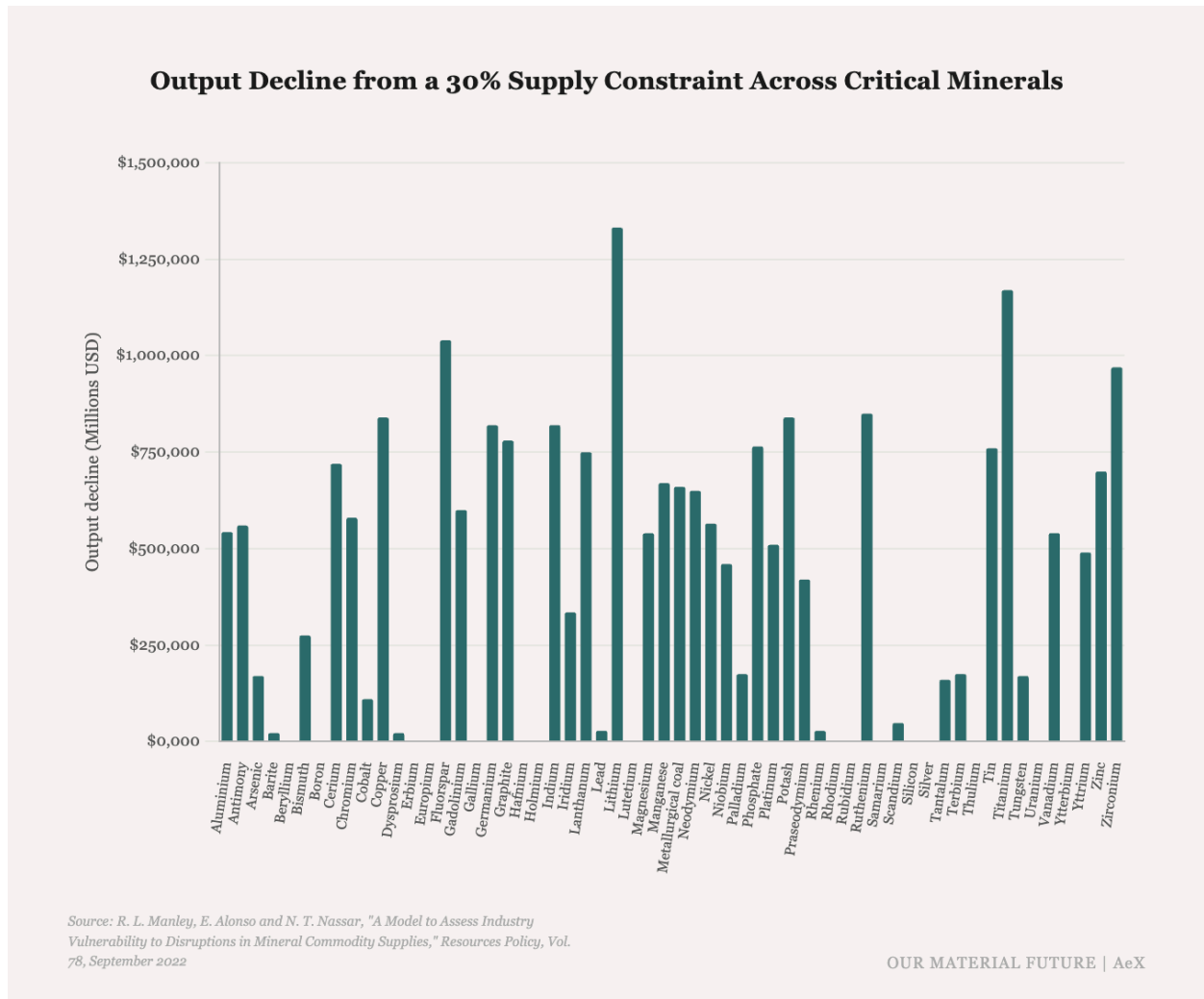
²⁵ Translation: "Winning every battle and succeeding in every attack is not supreme excellence; subduing the enemy's army without fighting is supreme excellence."

²⁶ Manley, R.L et al. "A model to assess industry vulnerability to disruptions in mineral commodity supplies." *Resources Policy*, Vol. 78, 2002.

²⁷ United States Geological Survey, "2025 List of Critical Minerals." November 6, 2025.

²⁸ Manley, R.L et al. "A model to assess industry vulnerability to disruptions in mineral commodity supplies." *Resources Policy*, Vol. 78, 2022.

Extended across all sixty critical minerals and mapped across 182 industries, projections are considerably more dire. AeX estimates an economic output decline ranging between **\$5.5 and \$6.2 trillion**—approximately 15 percent of U.S. GDP—marking what would be among **the greatest GDP declines in U.S. history**²⁹. To be clear, it would be more severe than the Great Financial Crisis *combined*.



2. CAPITAL MARKET DEVALUATION

Because critical minerals sit **upstream** (at the very beginning) of the value chain, constraints at the source creates a “Bullwhip Effect” that results in deep shortages for certain downstream finished goods.

²⁹ USGS, “A model to assess industry vulnerability to disruptions in mineral commodity supplies.” Resources Policy 78. September 2022

Under an extended supply constraint scenario, the more mineral-intensive firms—the “Magnificent Seven” (which represents approximately **\$23.5 trillion** in market capitalization), and those across defense, energy, healthcare, producer manufacturing, and utilities, for example—would be hit the hardest. However, given critical minerals’ indispensability across our economy, supply constraints would negatively affect functionally every listed company to one degree or another, from cost-of-goods increases to outright stoppages in production.

AeX meta-analysis indicates a one-year, **30 percent disruption** across listed U.S. equities would trigger a cascading **physical limit event** for U.S. equity and corporate credit markets³⁰:

- **Equity Collapse:** Total market cap losses in the U.S. Equity markets could exceed **\$20 trillion**—or roughly 25 percent of total U.S. market cap—driven by direct earnings drops and aggressive multiple contractions.
- **Structural Fragility:** Even when isolating the thirteen critical minerals for which the U.S. is 100 percent import-reliant, a 30 percent shock exposes **\$5.2 trillion** in “structural” stock value to immediate liquidation (exceeding losses from the Great Financial Crisis).
- **Credit Contagion:** Because the equity market and the corporate credit market are deeply intertwined via corporate balance sheets, equity losses would inevitably bleed into the **\$10 trillion corporate credit market**. The result—while difficult to model with any degree of accuracy—would significantly increase aggregate baseline probability of default (PD), debt-to-EBITDA covenant breaches, massive institutional downgrades, credit spread blowouts, and usher in a wave of forced restructurings or predatory high-interest financing to stave off default. The lender of last resort—the U.S. Federal Reserve—would inevitably be forced to intervene.

³⁰ AeX meta-analysis (May 2026). Sources include USGS, CSIS, KLPER, Bloomberg, S&P, IEA, White House, U.S. Treasury.

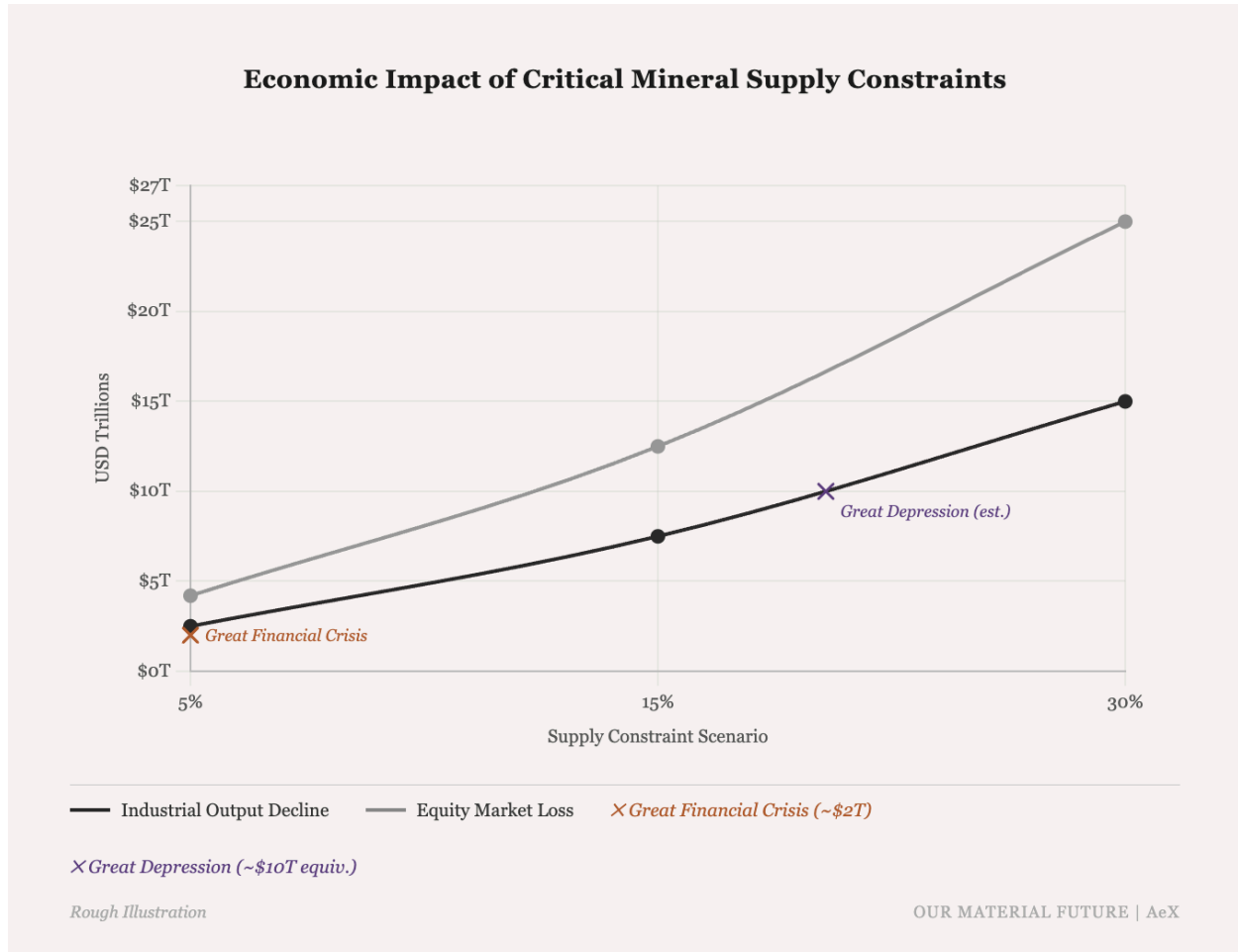


Figure 1: Supply constraints would result in severe economic output declines and US Equity valuation destruction. For example, a 5 percent constraint scenario would result in an economic decline exceeding that of the Financial Crisis in 2009. A 20 percent scenario would nearly match the economic output loss resulting from the Great Depression. A 30 percent constraint would be the most severe in contraction of economic output in U.S. history by a \$5 trillion margin.

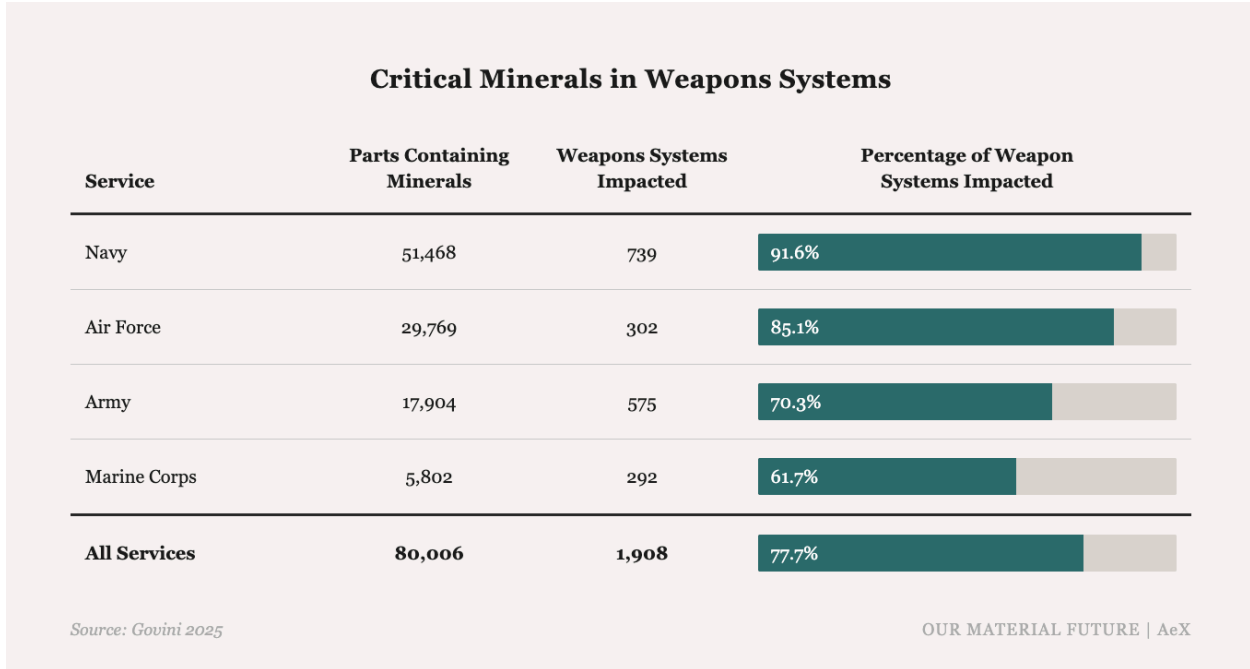
3. EROSION OF NATIONAL DEFENSE

Beyond the balance sheet, supply constraints would fundamentally compromise our national security apparatus.

A 2025 Govini study revealed that **77.7 percent of all U.S. Department of Defense weapon systems**—over 1,900 distinct platforms consisting of over 80,000 parts—rely on just five critical minerals that are disproportionately processed by China³¹. In total, over 43,000 different defense supply chains have some level of Chinese dependence extending down to six tiers of suppliers, with **88 percent** DoD supply chains containing at least one Chinese vendor³².

³¹ Govini, “From Rock to Rocket: Critical Minerals and the Trade War for National Security.” March 19, 2025.

³² Defense One, “China’s rare-earth mineral squeeze will hit the Pentagon hard.” April 23, 2025



This dependence means our primary strategic competitor can exert a **functional veto power** over American operational capacity:

- **Air Superiority:** F-22 and F-35 platforms are grounded without titanium-composites, indium, and antimony.
- **Drone Warfare:** Advanced drone platforms rely on aluminum, gallium, germanium, magnesium, scandium, and titanium to meet demands of high-performance engines and propulsion systems, thermal resilience, and precision navigation.
- **Munitions:** Ammunition and missiles require aluminium, beryllium, chromium, rare earths, tungsten and yttrium for explosive ordnance and thermal stability.
- **Naval Dominance:** Ohio and Virginia-class submarines are tethered to the availability of graphite, rare earth elements, hafnium, chromium and zirconium .
- **Global Projection:** Ford-class carriers and precision-guided munitions require a constant flow of nickel, chromium, gallium, germanium, and tungsten.
- **Command and Control:** Modern C4ISR systems—responsible for detecting, tracking, and connecting key threat information in real time—relies on gallium, rare earths, lithium, cobalt, and indium.

How all of this plays out is anyone's guess, as prognosticating about the future of geopolitics and geoeconomics is rife with unknown variables. But, what's clear is that absent deliberate intervention, these imbalances will persist and deepen, increasing economic vulnerability, constraining industrial growth, and further exposing national security supply chains to external shocks and adversarial leverage.

This is not only a risk for the U.S., but for a future that requires broad cooperation to achieve technological advancements that will benefit all of humanity.

The Costs of Dependence

THIS COMBINATION OF FACTORS presents a stark reality, and the quantitative trend is becoming increasingly difficult to ignore. Even under the best-case scenario, critical mineral prices are likely to rise sharply in the near term. We have already seen evidence of this through China's export restrictions over the past year, which drove prices for dysprosium and terbium up approximately 4–5x, while yttrium prices surged by as much as 14,000% in certain non-Chinese markets³³. Copper prices have increased ~7x since 2001, while lesser known and traded materials have all increased substantially.

The worst-case scenario, however—one that extends beyond the 30 percent modelling assumptions used by the USGS—could prove catastrophic for the United States, affecting industrial output, capital markets, and national security capabilities alike. While it is impossible to predict the extent to which China may further restrict supply in the near term, it would be historically naïve and strategically unsound to assume that China—or other competitive or adversarial nations—will refrain from using their dominant market position to weaken U.S. competitiveness during a period of heightened geopolitical competition. Failing to protect against this potentiality would have dire consequences.

The operative question becomes, *what is it worth to reduce this exposure?*

³³ Mining.com, "China's grip on rare earths remains tight amid Xi-Trump showdown." May 13, 2026.