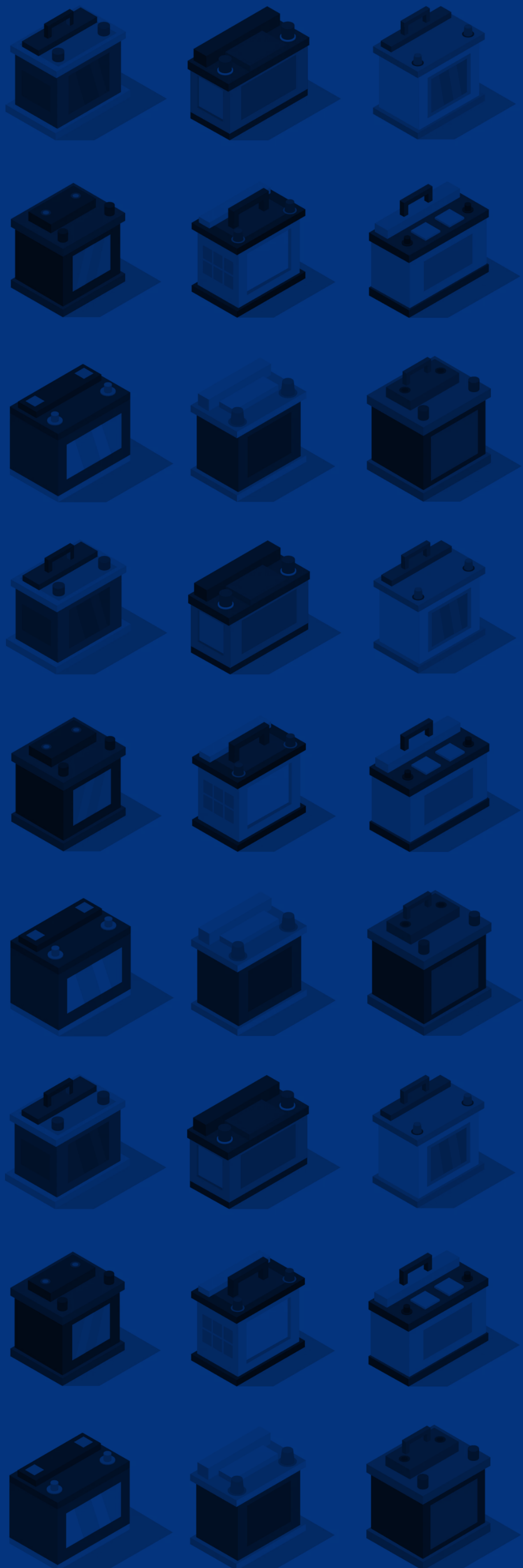

CPA ECONOMICS REPORT

WARTIME FOOTING

How the United States Can Reverse China's Dominance of Battery Minerals Processing

MARCH 2026

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EXECUTIVE SUMMARY

This report applies a stages-of-control framework spanning mining, refining, processing, manufacturing, and recycling to identify where power and vulnerability reside in battery and critical mineral supply chains. The analysis finds that loss of control over refining and processing—the midstream stages that transform raw materials into battery-grade inputs—has become a national security threat, enabling China to convert industrial advantages into strategic leverage through gray-zone economic coercion.

The report grounds this framework in a detailed case study of lead-acid batteries. Despite U.S. leadership in manufacturing and a 99% recycling rate for lead-acid starter batteries, dependence on Chinese-controlled antimony refining has proven sufficient to create systemic vulnerability. The same structural pattern extends to lithium-ion batteries, where lithium chemical conversion, nickel and cobalt refining, graphite processing, and manganese sulfate production remain highly concentrated.

To address this vulnerability, the report outlines eight actionable policy recommendations, consolidated into four pillars that restore investment viability, defend against market distortion, and rebuild domestic and allied refining capacity. Because these midstream stages underpin defense manufacturing, energy resilience, and surge capacity in a conflict scenario, rebuilding processing control must be treated on a wartime footing.

KEY FINDINGS

U.S. national security risk in critical minerals is structural and concentrated in midstream processing.

While mining of lithium, nickel, cobalt, graphite, manganese, and antimony occurs across multiple regions, refining and chemical conversion are highly concentrated in China. China refines approximately 59% of global lithium, 68% of nickel, and 73% of cobalt, processes over 90% of graphite, and controls roughly three-quarters of global antimony refining capacity, centralizing decisive power at the midstream stage. This concentration creates direct exposure to supply denial, price volatility, and strategic leverage.

The United States is processing-constrained, not resource-poor.

The United States and its allies retain strength in mining, manufacturing, and recycling, but have ceded control of midstream refining and processing to China, allowing the country to determine price, availability, and industrial viability. This was most evidenced during 2023–2025, when China's export restrictions on gallium, graphite, germanium, and antimony triggered price volatility in global markets.

China's control of critical mineral refining and processing functions as a gray zone instrument of economic coercion.

As documented by the U.S.–China Economic and Security Review Commission, China uses non-market policies, overcapacity, price suppression, and export controls to create and weaponize supply-chain dependencies in strategic sectors, including critical minerals. Control over midstream processing allows Beijing to retaliate against foreign policy actions, deter competing investment, and exert leverage below the threshold of armed conflict.

Defense supply chains face acute chokepoints at specific processing nodes.

Core U.S. defense systems—including munitions, missile guidance, aircraft, naval platforms, energy storage, and communications—depend on minerals for which refining and processing are overwhelmingly foreign-controlled. These chokepoints translate directly into risks to surge capacity, sustainment, and wartime readiness.

Lead-acid batteries demonstrate how a single midstream chokepoint can override strength elsewhere in the supply chain.

Lead-acid batteries remain a pillar of U.S. energy and defense resilience, combining mature technology, large-scale deployment, and a highly domestic manufacturing and recycling base, including a 99% recycling rate for lead. Yet dependence on Chinese-controlled antimony refining creates a single point of failure, as recent export bans and price spikes show how loss of control at one midstream stage can negate advantages across mining, manufacturing, and recycling.

Mining statistics alone mislead policymakers.

Shares of global mining production are a poor proxy for supply-chain security. Value capture, pricing influence, and investment leverage reside in refining and processing stages, not extraction. Countries that mine but lack conversion capacity become exporters of low-value inputs and importers of high-value processed materials.

Restoring U.S. leadership requires action across four pillars.

Restoring U.S. leadership requires rebuilding domestic and allied refining dominance at the midstream chokepoint through four strategic pillars:

1. ***ANCHOR LONG-TERM DEMAND & INVESTMENT STABILITY***
2. ***ENFORCE OWNERSHIP-BASED ELIGIBILITY STANDARDS***
3. ***INTEGRATE RECYCLING & ALLIED PROCESSING AS STRATEGIC FEEDSTOCK***
4. ***INVEST IN APPLIED RESEARCH FOR NEXT-GENERATION BATTERIES***

INTRODUCTION

The United States faces a national security vulnerability in the battery supply chains that underpin defense systems, military logistics, grid resilience, and critical civilian infrastructure. Modern batteries—both lead-acid and lithium-ion—depend on a set of critical minerals whose security is determined not by access to raw materials alone, but by control over refining and chemical processing. Critical minerals refer to 60 non-fuel minerals designated by the U.S. Geological Service (USGS) as essential to U.S. economic or national security with supply chains vulnerable to disruption. Critical minerals implicated in both lead-acid and lithium-ion batteries include antimony, lead, cobalt, and lithium. While policy debates often emphasize domestic mining or next-generation technologies, this report finds that supply-chain risk stems from foreign dominance of the midstream stages of production.

Using a stages-of-control framework, this analysis evaluates security across five stages: mining, refining, processing/alloying, manufacturing, and recycling. A consistent pattern emerges. The United States and its allies possess substantial mineral resources and remain competitive in manufacturing and recycling. However, refining and chemical conversion—the stages that transform minerals into battery-grade inputs—are heavily concentrated in China.

This concentration is most evident in battery-critical materials. China dominates global lithium chemical conversion, nickel and cobalt refining, graphite anode processing, manganese sulfate production, and antimony refining. Rare earth elements—while essential to EV motors and certain defense systems—are not core battery inputs but illustrate the same broader loss of midstream control. Across these materials, Chinese processing dominance creates predictable outcomes: exposure to supply denial, price volatility, and sustained deterrence of private investment in competing capacity. These dynamics reflect a broader form of strategic competition often described as gray-zone economic coercion—using economic and regulatory tools to shape markets and constrain rivals without triggering open conflict.

To ground this framework, the report examines lead-acid batteries in depth. This mature technology remains indispensable to U.S. defense and infrastructure because it combines large-scale deployment, intrinsic safety, and a highly domestic manufacturing and recycling base. Lead-acid batteries are indispensable to U.S. national defense applications. Military vehicles, base power systems, communications infrastructure, and emergency backup installations all rely on lead-acid batteries and associated lead-based inputs to ensure continuity of operations under stress. They are also integral for nearly all internal-combustion vehicles and commercial fleets, material-handling equipment across logistics networks, and uninterruptible power supply systems for data centers and telecommunications. They provide approximately 88% of backup power for 24/7 telecommunications systems and meet roughly 90% of U.S. UPS demand, underscoring their central role in systems that do not tolerate disruption (Battery Council International). The United States leads globally in lead-acid battery production and operates a recycling system that recovers approximately 99% of lead.

Yet despite these strengths, the industry remains exposed at a single midstream chokepoint: antimony refining. Antimony is a non-substitutable alloying input that hardens lead grids and ensures durability in high-reliability applications. Because China controls the overwhelming majority of global antimony processing, recent export restrictions and price spikes demonstrate how loss of control at one refining stage can override advantages in mining, manufacturing, and recycling.

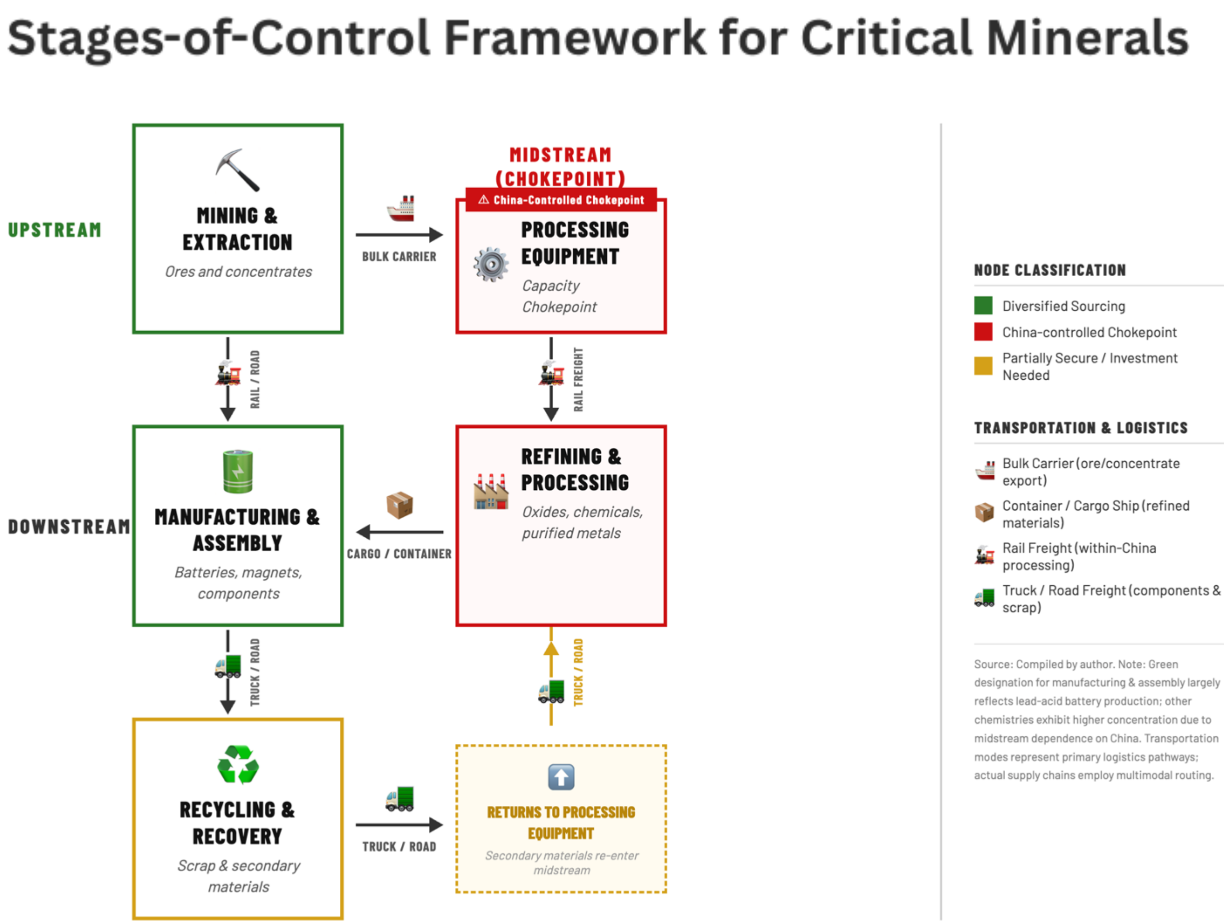
The conclusion is straightforward: the United States is not resource-poor; it is processing-constrained. Reversing this vulnerability requires a coordinated industrial response centered on rebuilding domestic and allied refining dominance, anchoring long-term demand for battery-critical materials, and restoring control over the midstream stages that determine security.

I. THE STAGES-OF-CONTROL FRAMEWORK AND REPORT SCOPE

The global supply chain for battery-related minerals is best assessed using a stages-of-control framework that indicate where control is exercised, where vulnerabilities arise, and which stages ultimately determine industrial resilience. Specifically, there are five distinct stages that together determine supply-chain security. They range in value-added from upstream activities, to downstream (Figure 1):

- Upstream: mining and extraction of raw materials.
- Midstream: refining and chemical processing into purified metals and battery-grade chemicals. China maintains a decisive chokehold at this level of production. China dominates in this area.
- Downstream: intermediate processing and alloying into performance-critical inputs such as precursors and alloys; manufacturing and assembly of finished products including batteries, magnets, and components; and recovery, recycling, and reuse of materials at end of life, which often feed back into upstream refining.

FIGURE 1: STAGES OF CONTROL IN BATTERY SUPPLY CHAINS



Why Processing Determines Security

Advanced manufacturing depends not on raw ore, but on processed inputs: battery-grade chemicals, refined metals, engineered alloys, and intermediate components produced through capital-intensive and technologically complex processes. These stages determine cost structures, market access, and industrial survivability. Where processing capacity is absent, mining alone offers little protection, even when material is plentiful.

How China Shifted the Battleground

China's critical-minerals strategy illustrates the shift away from extraction toward control of value-added stages. Rather than prioritizing mining alone, Chinese industrial policy concentrated on refining, chemical processing, and intermediate manufacturing, supported by large-scale state financing, permissive environmental and labor regulation, and a demonstrated tolerance for sustained losses.

China's success in consolidating control over midstream processing reflects a deliberate gray zone strategy: the coordinated use of economic, financial, regulatory, informational, and, when necessary, military-adjacent tools to coerce outcomes without triggering open conflict. Recent research by the RAND Corporation finds that China deliberately layers multiple instruments of national power—particularly economic and regulatory measures—to alter market structures, suppress competing investment, and entrench dependency while remaining below the threshold of a conventional military response.

In contrast to the United States, where authority over these instruments is dispersed across institutions and constrained by statute, China's centralized system enables the synchronized use of industrial policy, export controls, pricing power, and regulatory action in pursuit of strategic objectives. As a result, vulnerabilities in critical mineral refining and processing are predictable outcomes of a coordinated state strategy—making policy and law essential tools for restoring supply-chain security. China has also used international forums such as the World Trade Organization and the United Nations to their competitive advantage by delaying any actions to impede their goals. These entities have proven insufficient to address state-backed market distortions, exposing the limitations of free trade frameworks.

Over time, this strategy concentrated global midstream capacity within China, even as mining and some downstream manufacturing dispersed geographically. Chinese state-linked firms secured access to mineral extraction across Africa, Southeast Asia, and Central Asia through a network of joint ventures, shell companies, and right-of-first-refusal agreements, while ensuring that ores and concentrates flowed back to China for processing. At the same time, price suppression and overcapacity at the refining stage forced competing processors and downstream manufacturers either to shut down or to relocate operations closer to Chinese-controlled inputs.

The result is a geographically fragmented supply chain in which extraction occurs globally, some assembly takes place near end markets, but control over conversion into usable industrial inputs remains centralized. Today, China refines approximately 73% of global cobalt, 68% of nickel, 59% of lithium, and processes roughly 85–90% of rare earth elements, giving it decisive influence over pricing, availability, and investment outcomes across battery and critical mineral markets.

The Resulting Structural Imbalance

The result is a structural imbalance. Many economies, including the United States, retain the ability to mine minerals or assemble finished products but remain dependent on foreign-controlled processing steps that cannot be readily substituted or bypassed. As of 2024, the United States was 100% net-import reliant for 12 critical minerals and at least 50% net-import reliant for another 29, even where domestic extraction exists.

When demand is defined conservatively as minimum defense continuity requirements, the gap is even more evident. The Defense Logistics Agency's Annual Materials Plan identifies ceiling acquisition quantities for materials such as antimony, electrolytic manganese metal, rare earth oxides, permanent magnets, graphite, and tungsten that cannot be met through domestic production or processing, leaving core defense supply chains dependent on foreign-controlled inputs (Table 1).

TABLE 1: DEFENSE LOGISTICS AGENCY CRITICAL MATERIALS ACQUISITION GAPS

Defense Supply Chain Chokepoints: U.S. Reliance on Foreign Processing for Essential Materials

Minimum Defense Material Requirements Compared with U.S. Reliance on Foreign Processing and Imports

Material	DLA FY2025 Ceiling Quantity	U.S. Mine Production (2024)	Domestic Supply Notes (USGS)	Net Import Reliance (%)	Structural Gap
Antimony	700 MT	0 MT	Recycling supplies only ~15% of apparent consumption; no domestic mining	85	Defense demand entirely import-dependent
Electrolytic Manganese Metal	5,000 MT	0 MT	No domestic ore production since 1970; negligible recycling	100	Entire demand import-dependent
Iso-Molded Graphite	1,700 MT	0 MT	No domestic natural graphite production; no battery-grade processing	100	No domestic supply
Nd-Pr Oxide	300 MT	Limited concentrate only	No domestic separation or oxide processing	100	Midstream chokepoint
NdFeB Magnet Blocks	450 MT	0 MT	No domestic magnet manufacturing	100	Fully import-dependent
Tungsten	2,040 MT	0 MT	Some recycling; no mine production; processing dominated abroad	50	Import-dependent even at defense floor

Source: DLA Strategic Minerals, USGS • Quantities reported in pounds in the DLA Annual Materials Plan are converted to metric ton equivalents for comparability.
U.S. net import reliance figures reported by USGS reflect dependence on the commercially relevant forms of each material—including refined metals, oxides, and chemical intermediates—and in several cases understate reliance on foreign-controlled processing where domestic finishing steps depend on imported feedstock.

This dependence exposes domestic industries to export restrictions, price volatility, and chronic overcapacity, suppressing private investment in alternative capacity and reinforcing existing chokepoints. For example, in late 2024 China imposed an export ban on antimony, gallium, and germanium to the United States—materials for which the U.S. is 100% import-reliant in the case of antimony—demonstrating how foreign control over processing can translate directly into immediate supply disruption for defense- and infrastructure-critical applications.

Framing the Analysis That Follows

This report therefore reframes supply-chain security around control rather than resource abundance. The analysis that follows evaluates where control is exercised across each stage of the battery materials supply chain, and how loss of control at key midstream stages can negate strengths elsewhere. The next section applies this framework in depth to lead-acid batteries, where U.S. leadership in manufacturing and recycling coexists with a single, decisive midstream dependency.

II. CASE STUDY: LEAD-ACID BATTERIES

U.S. Leads in Lead-Acid Batteries

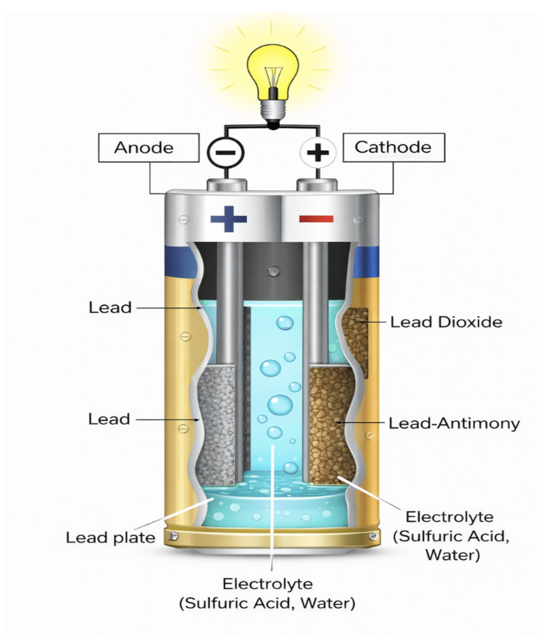
Lead-acid batteries provide a clear test case to apply the stages-of-control framework. The U.S. lead-acid battery industry represents one of the most operationally embedded and domestically integrated battery sectors supporting military mobility, backup power, and mission-critical infrastructure. Lead-acid batteries are widely used in military vehicles, tactical communications systems, base power systems, logistics platforms, and emergency backup installations. Their durability, temperature tolerance, and reliability make them indispensable in defense-adjacent and infrastructure-critical applications.

Unlike many advanced battery chemistries, the U.S. lead-acid supply chain retains significant domestic strengths. The primary material input—lead—is accessible through both domestic mining and, more importantly, a highly effective recycling system. The United States operates a lead battery recycling network with a 99% recovery rate, allowing lead to be reused indefinitely without performance degradation. This closed-loop system sharply reduces reliance on primary mining markets and reinforces domestic material availability.

Domestic production is competitive, technologically mature, and geographically diversified. Lead battery manufacturing and recycling operations span 38 U.S. states, supporting high-wage employment and stable regional industrial ecosystems. In 2023, the industry generated approximately $3.01 billion in federal, state, and local tax revenues, including $2.08 billion at the federal level. Average wages in lead battery recycling ($119,700) and lead mining ($113,000) substantially exceed the national private-sector average, underscoring the workforce and industrial base implications of supply continuity.

From a materials perspective, lead-acid batteries rely on a relatively narrow set of inputs (Figure 2). The core electrochemical components—lead and lead dioxide—are supported by grid alloys that incorporate small quantities of additives to enhance strength and durability.

FIGURE 2: LEAD-ACID BATTERY MATERIAL INPUTS



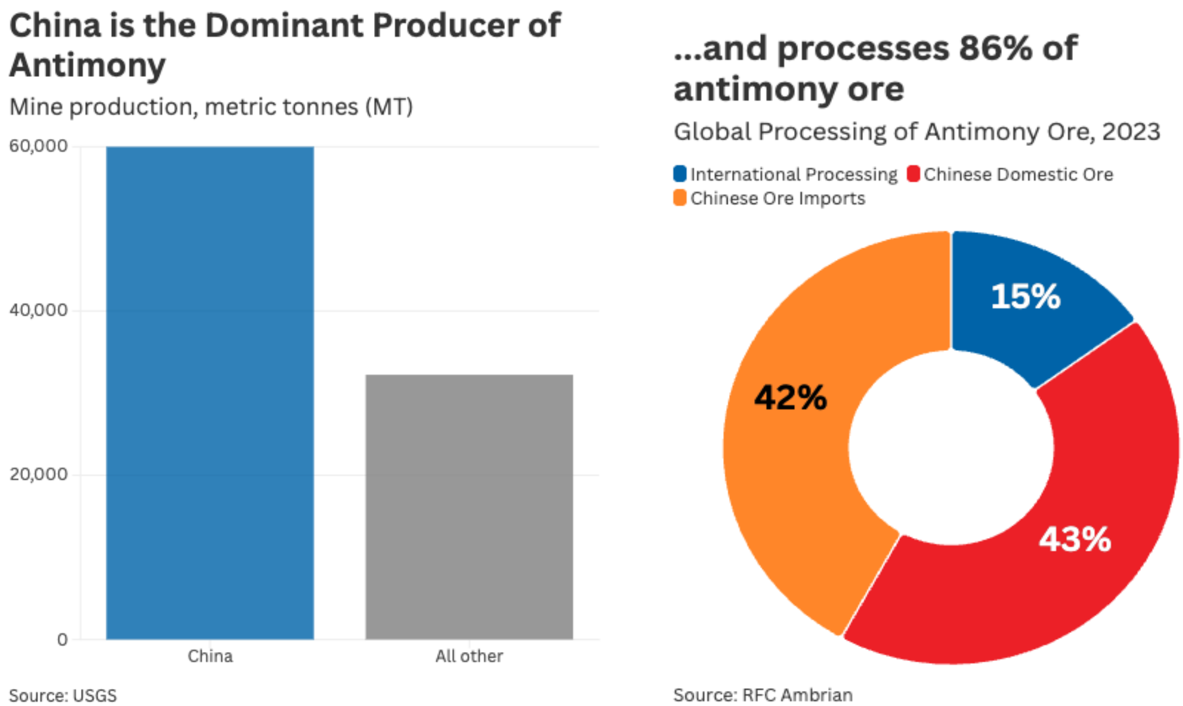
Globally, metallic antimony used in lead-acid battery production accounts for roughly 23% of total antimony consumption, making batteries one of the three dominant end uses worldwide. In the United States, antimony demand is closely tied to national security and infrastructure uses: in 2023, approximately 43% of U.S. antimony consumption was attributable to metal products, including antimonial lead and ammunition, with an additional 35% used in flame retardants.

These characteristics—domestic material access, high recycling rates, competitive manufacturing, and integration into defense and infrastructure systems—would appear to position the U.S. lead-acid battery industry as strategically resilient.

The Critical Vulnerability: Antimony Refining

Yet despite these advantages, the industry remains exposed at a single decisive chokepoint: antimony refining. While lead supply is domestically accessible and highly recyclable, the United States relies overwhelmingly on foreign-controlled antimony processing, with China dominating global refining capacity (Figure 3).

FIGURE 3: GLOBAL ANTIMONY REFINING CAPACITY AND U.S. DEPENDENCE

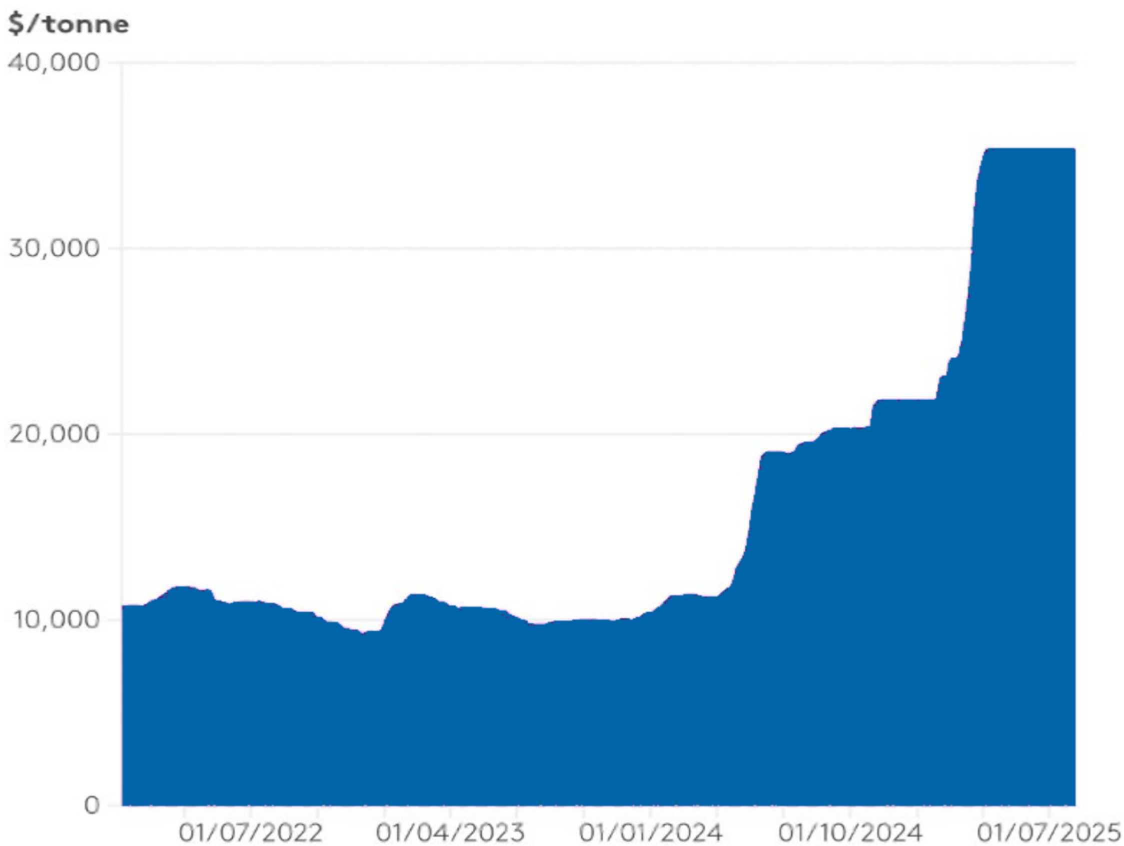


That vulnerability materialized in 2024–2025, when China imposed export licensing requirements and an outright ban on antimony shipments to the United States. Global exports fell to roughly one-third of prior levels, and antimony prices surged to more than four times their historical average—the steepest rally recorded in the antimony market (Figure 4).

FIGURE 4: ANTIMONY PRICE SURGE FOLLOWING CHINESE EXPORT CONTROLS

Antimony Prices Spiked After China's Export Restrictions, 2022-2025

$/ton



Source: Fastmarkets, Antimony trioxide 99.5% Sb2O3 min, fob China, $/tonne, MB-SB-0006

For U.S. lead-acid battery producers, the impact was immediate. Because antimony is a non-substitutable alloying input used in a majority of U.S. lead-acid batteries, disruption at the refining stage functioned as a single point of failure. Even short-term supply constraints propagated rapidly through transportation fleets, logistics equipment, data-center backup systems, and defense-adjacent applications, all of which depend on uninterrupted battery performance.

III. THE PATTERN EXTENDS ACROSS BATTERY CHEMISTRIES

Lithium-Ion Batteries: China's Control of Refining

The structural pattern observed in lead-acid batteries extends across lithium-ion chemistries. While lithium, nickel, cobalt, graphite, and manganese are mined across multiple regions—including Australia, Chile, the Democratic Republic of the Congo, Indonesia, and the United States—refining and chemical conversion remain highly concentrated in China (Figure 5).

FIGURE 5: CHINESE SHARE OF CRITICAL MINERAL REFINING FOR LITHIUM-ION BATTERIES

Mining Is Global: Battery Materials Are Extracted Across Multiple Regions

Unweighted average share of global mining across lithium, nickel, cobalt, manganese, graphite, and phosphate, 2024

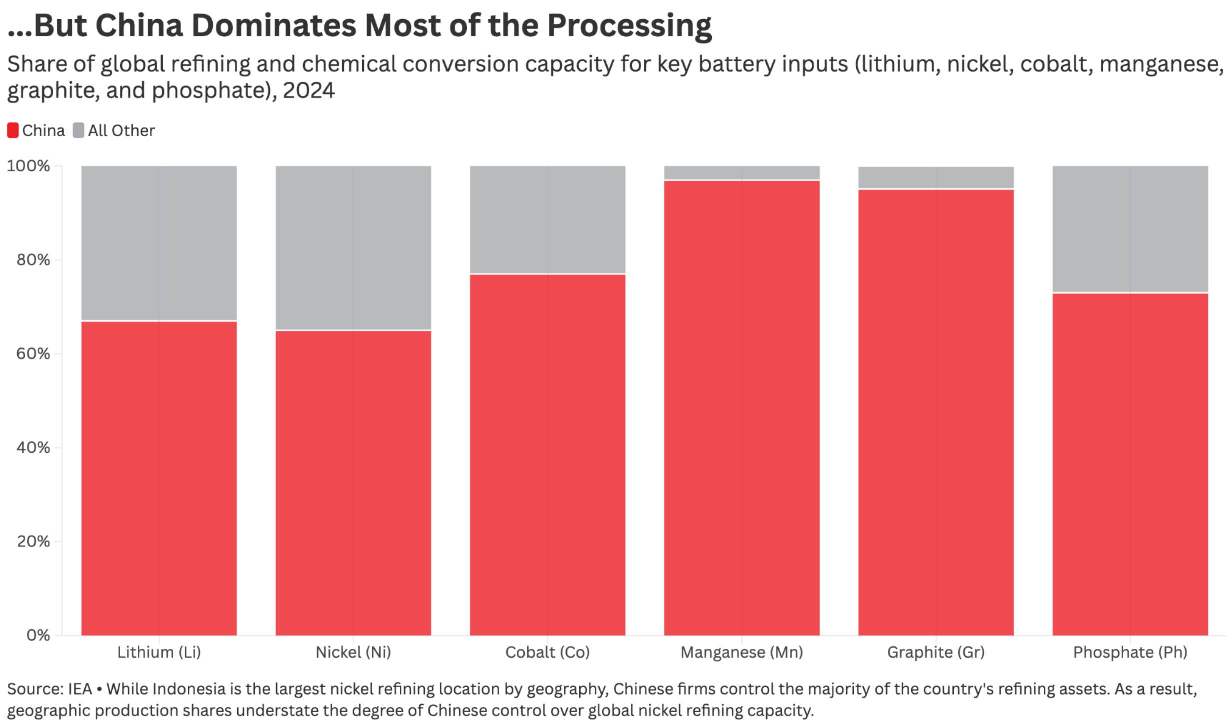
Source: IEA World Bank Official Boundaries

With the growth of deep-sea mining technology, several of these materials—cobalt, nickel, and manganese in particular—are increasingly recoverable from polymetallic nodule fields outside of China's direct control.

However, advanced battery manufacturing depends not on raw ore, but on processed inputs: lithium hydroxide and carbonate, nickel sulfate, cobalt chemicals, graphite anode material, and manganese sulfate. These stages are capital-intensive, technologically complex, and characterized by high barriers to entry. Where domestic control of chemical conversion is absent, mining alone offers little protection.

China has concentrated global midstream capacity through sustained state-backed industrial policy. Today, China refines the vast majority of the refining of critical minerals associated with battery production, while at the same time dominating graphite processing and anode production capacity (Figure 6). Even where extraction occurs abroad, ores and concentrates frequently flow to China for conversion before being re-exported as battery-grade materials.

FIGURE 6: CHINA'S DOMINANCE IN GRAPHITE PROCESSING AND ANODE PRODUCTION



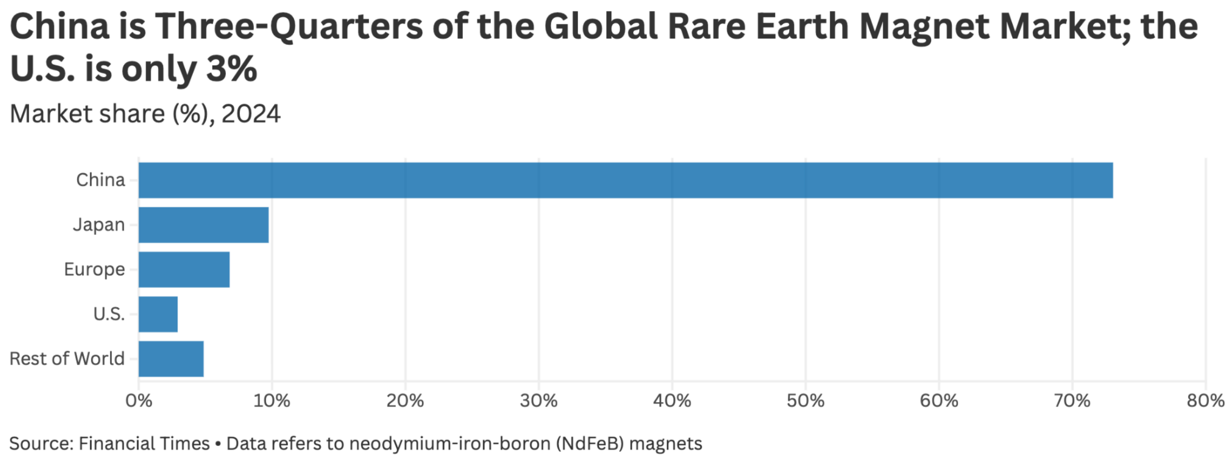
For example, in 2023, China accounted for 46% of global raw battery mineral imports, but exported 58% of processed battery minerals and 74% of battery packs and components. Since refined battery materials command multiples of the price of raw ores, control of refining and conversion stages centralizes value capture and affords China heavy influence over global pricing and investment decisions.

Rare Earth Elements: How the U.S. Surrendered Leadership to China

Rare earth elements (REEs)—a group of 17 chemically similar metals essential to high-strength permanent magnets, advanced electronics, and certain defense systems—are not core battery inputs, but they provide a cautionary example of how midstream control can be lost and consolidated. Over the past three decades, the United States surrendered leadership in rare earth permanent magnet manufacturing to China. In the mid-1990s, amid broader trade liberalization, the Committee on Foreign Investment in the United States (CFIUS) approved the sale of Magnequench—an Indiana-based manufacturer of rare earth magnets used in computer hard drives, consumer electronics, and jet guidance systems—to state-backed Chinese entities. Although assurances were given that production would remain domestic, manufacturing lines were relocated to China beginning in 2001.

By 2010, U.S. rare earth permanent magnet production had ceased. Chinese export quotas, dual pricing, and preferential domestic access to processed rare earth inputs eliminated U.S.-based magnet production. Today, China accounts for roughly three-quarters of the global rare earth magnet market, while the United States accounts for approximately three percent (Figure 7).

FIGURE 7: GLOBAL RARE EARTH MAGNET MARKET SHARE



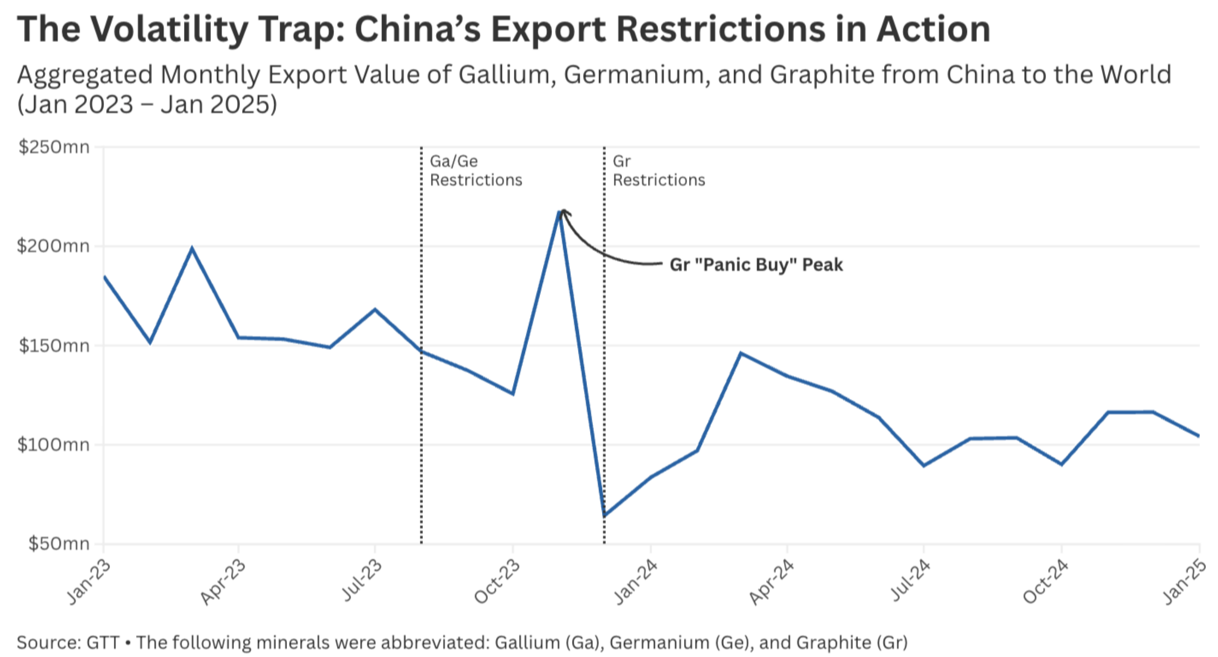
How China's Processing Dominance Creates Price Volatility

Control over refining and processing capacity gives China pricing power to shape market conditions in ways that systematically deter competing investment. In China's case, the imposition of "dual-use" export licensing regimes for gallium, germanium, and graphite has enabled authorities to throttle supply unilaterally, introducing severe unpredictability into global markets.

This weaponization of supply chains creates a "volatility trap" for Western investors: abrupt export restrictions can drive sudden price spikes, while unchecked domestic overcapacity can crash prices just as competing projects attempt to come online. For example, witnesses at the U.S.-China Economic and Security Review Commission's June 2025 hearing noted that while China utilizes export controls on minerals like gallium and germanium to create supply shocks, its simultaneous buildup of overcapacity in sectors like foundational semiconductors threatens to flood global markets and depress prices, thereby undermining the commercial viability of new U.S. manufacturing investments. Consequently, private capital has remained hesitant to fund alternative refining infrastructure, as investors cannot model stable returns against a competitor capable of manipulating margins at will.

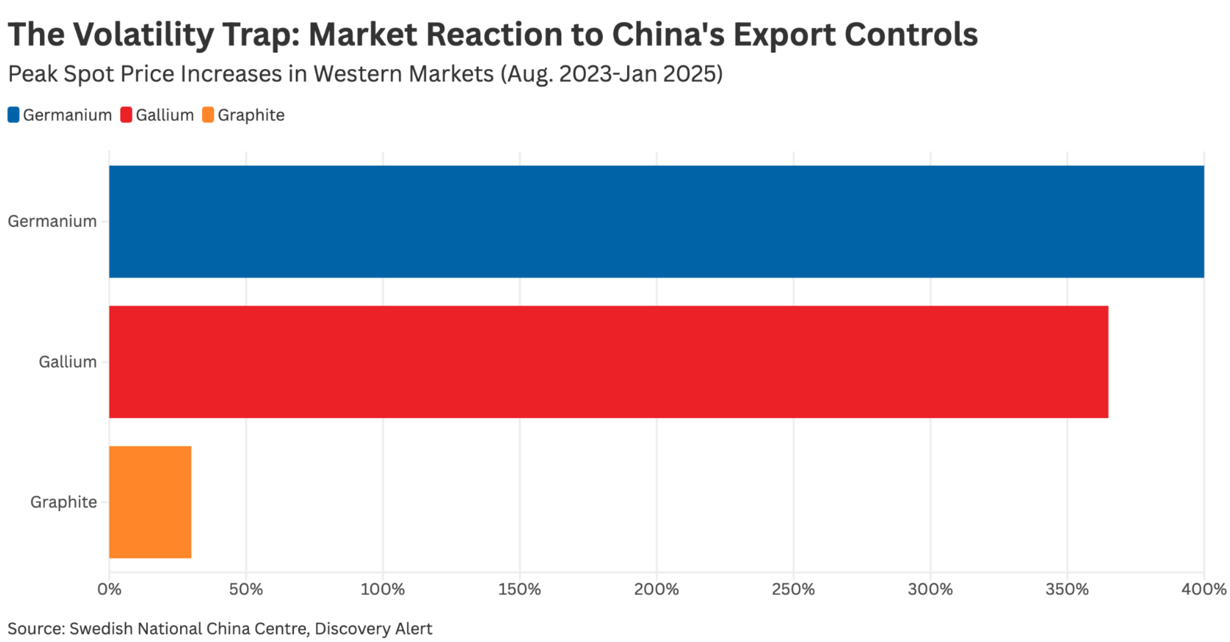
This control operates through two complementary channels best illustrated during 2024–2025. China's export restrictions on gallium and germanium during this period produced abrupt declines in export volumes, coinciding with severe shortages in Western markets (Figure 8).

FIGURE 8: CHINESE EXPORT VOLUMES AND WESTERN MARKET SHORTAGES (2024–2025)



For instance, following the escalation of controls in late 2024, Chinese shipments of unwrought gallium and germanium to the U.S. and Europe effectively ceased, driving up prices for these minerals, while graphite spot prices rose more modestly due to licensing delays (Figure 9).

FIGURE 9: GALLIUM, GERMANIUM, AND GRAPHITE SPOT PRICE RESPONSES



However, because this supply was trapped within China rather than cut from production, domestic Chinese prices for these metals remained depressed, diverging sharply from international benchmarks. This created a "two-tier" market that undermined the commercial viability of non-Chinese projects: Western refiners faced high input costs or total unavailability, while Chinese downstream manufacturers enjoyed a cost advantage fueled by the domestic glut.

At the same time, Chinese authorities shape inventory behavior among foreign buyers through opaque licensing. Unlike clear quotas, the "dual-use" licensing system allows regulators to delay or deny applications arbitrarily, preventing foreign firms from building safety stockpiles. Regulators reportedly use the end-user certification process to gather intelligence on Western supply chains, approving just enough volume to keep foreign industries running but not enough to reduce reliance on Chinese supply.

In addition, China has demonstrated the ability to weaponize "predatory pricing" to crush emerging competitors. For example, as potential graphite and gallium projects were proposed in the United States and Australia, market observers noted that Chinese producers retained the capacity to flood the global market at prices far below Western break-even rates.

This threat of "flooding" acts as a powerful deterrent: investors fear that if they finance a capital-intensive refinery outside China, Beijing will simply relax export controls, crash the global price back to its low domestic level, and bankrupt the new competitor. As a result, China remains the lowest-cost option not just due to efficiency, but because it can manipulate the "spread" between domestic and international prices to render Western entry commercially unviable without massive state support.

This strategy allows China to undercut competitors and discourage alternative capacity from forming, while retaining the ability to tighten supply when strategic conditions change. Concentration of refining and processing capacity makes this possible: where midstream control is centralized, prices reflect administrative and strategic choices rather than pure market fundamentals.

IV. POLICY RECOMMENDATIONS: RESTORING CONTROL AT THE MIDSTREAM

Below are eight actionable items organized into four strategic pillars that will ensure American dominance in battery production and innovative technologies. The analysis in this report demonstrates that U.S. vulnerability in battery and critical mineral supply chains is constrained by a loss of control at the refining and processing stages of production. Just as environmental and safety standards favor inherently safer designs, industrial policy should prioritize inherently more secure supply chains—directing public investment toward technologies and processes where the United States and its allies can maintain durable control, rather than reinforcing dependence on Chinese-linked inputs.

This limitation is further compounded by China's state-backed market distortion strategy that deters private investment. Addressing this vulnerability will require a coordinated policy response focused on restoring investment viability and control at the decisive chokepoints of the supply chain. The following recommendations translate that diagnosis into actionable policy priorities.

Accordingly, the eight recommendations that follow are structured under four strategic pillars:

1. Anchor long-term demand and investment stability;
2. Enforce ownership-based eligibility standards;
3. Integrate recycling and allied processing as strategic feedstock; and
4. Invest in applied research for next-generation batteries.

Together, these pillars translate the report's diagnosis into a coherent industrial strategy for restoring domestic and allied refining dominance.

Pillar 1: Anchor Long-Term Demand and Investment Stability

Midstream Production Incentives

Restoring domestic refining and processing capacity requires long-term revenue certainty. Section 45X of the Inflation Reduction Act represents an important step in this direction, but its effectiveness depends on duration, stability, and design.

Production credits for refining and processing should be extended on a long-term horizon to provide investors and manufacturers with the certainty required to finance capital-intensive facilities. As the program is reauthorized, Congress should consider extending eligibility beyond 2030 and aligning the credit horizon with industrial investment cycles that extend into the 2030s and beyond.

In addition, higher credit rates should be available to facilities that strengthen the domestic industrial base through workforce development and regional investment, including apprenticeship-linked hiring, veterans transition pipelines, partnerships with community colleges, and siting in rural or industrial recovery regions. These enhancements should not be mandatory for qualification, but should reinforce production incentives where they advance broader economic resilience.

Federal Procurement and Defense Industrial Policy

Supply continuity is essential for defense systems, grid infrastructure, emergency power, and federal fleets. Procurement policy should reflect this reality by requiring U.S.-sourced or allied-sourced refining and processing content for national security–sensitive systems, with waivers permitted only under declared emergency conditions. Clear certification requirements should apply not only to prime contractors but throughout the supply chain.

At the same time, defense industrial financing tools should be expanded to support refining and processing capacity, including:

- Defense Production Act Title III investments,
- Department of Energy Loan Programs Office instruments,
- equipment modernization and pilot-scale processing facilities,
- and targeted R&D for refining, processing, and recycling competitiveness.

The objective is not permanent subsidy, but preservation and rebuilding domestic and allied refining dominance critical to national security.

Pillar 2: Enforce Ownership-Based Eligibility Standards

Close Loopholes That Subsidize Foreign-Controlled Processing

U.S. industrial policy cannot succeed if federal incentives indirectly reward Chinese-controlled processing. Today, minerals may appear to be sourced from friendly jurisdictions while being refined, separated, or processed by Chinese-owned firms operating abroad through layered ownership structures designed to obscure control.

Federal tax credits, procurement programs, and clean energy incentives should therefore treat minerals as adversary-origin when Chinese entities exercise ownership or control over the refining or processing stage, regardless of:

- where extraction occurs,
- where processing physically takes place, or
- whether transactions flow through Free Trade Agreement partners.

Ownership and control at the refining and processing stage—not geography alone—must be the determinative criterion. Establishing clear definitions based on ownership thresholds and governance control would provide the certainty required for both U.S. and allied investors.

To support enforcement, Congress or the Administration should consider traceability standards and certified supplier registries for tax credit eligibility, defense procurement, and federal purchasing. These measures would close the most significant loophole in current industrial policy and ensure U.S. tax dollars do not reinforce the very supply chains the policy is intended to replace.

Defend Strategic Industries Against State-Backed Price Suppression

Foreign state-backed producers have repeatedly driven down global prices for strategic minerals to collapse Western competitors, then restricted supply once dependency was established. This is economic statecraft, not market competition.

To prevent permanent loss of domestic refining and processing capacity during price suppression cycles, the United States should establish strategic market defenses, including:

- multi-year government offtake agreements for specific volumes of critical refined materials,
- strategic price floors that prevent sustained undercutting below viable operating costs,
- and expanded use of the National Defense Stockpile to stabilize demand over time.

Recent federal action demonstrates the feasibility of these tools. In February 2026, the Export-Import Bank approved up to $10 billion in long-term financing for Project Vault, a public-private initiative establishing a U.S. Strategic Critical Minerals Reserve designed to buffer domestic manufacturers from supply shocks and destabilizing price swings. Project Vault combines long-term offtake commitments, physical stockpiling, and private capital participation to provide a market backstop for critical materials—directly addressing the investment and volatility risks identified in this report.

Pillar 3: Integrate Recycling and Allied Processing as Strategic Feedstock

Build Trusted Allied Processing Networks

The United States cannot meet all processing needs domestically in the near term, but it can build reliable, transparent, non-adversarial supply networks with aligned partners seeking independence from Beijing's leverage.

This requires identifying a limited group of trusted partner countries and co-financing refining and separation facilities in those jurisdictions, with agreements structured to benefit both local workers and U.S. industry. Harmonized standards for ownership transparency, governance, and environmental performance should underpin these arrangements, coordinated through existing mechanisms such as the Minerals Security Partnership.

Recent U.S. policy reflects growing recognition of this challenge. The Administration has pursued "friend-shoring" arrangements with Ukraine, Quad partners, and G7 allies, and has expanded coordination through initiatives such as the Minerals Security Partnership to diversify access to critical minerals. Deep-sea mining represents an additional frontier for allied diversification. Partner nations with demonstrated commitments to sustainable environmental management—such as the Cook Islands, a major source of polymetallic nodules—have active or advanced programs to evaluate seabed critical mineral extraction in their Exclusive Economic Zones under rigorous ecological best-practices frameworks.

However, official assessments note that the United States still lacks sufficient refining and processing infrastructure at scale, even where extraction exists, and remains exposed to export controls and geopolitical retaliation.

Absent enforceable ownership standards, co-financing of processing capacity, and long-term, volume-stable offtake commitments, allied diversification risks reproducing shared chokepoints rather than eliminating dependence. Long-term offtake agreements between allied processors and U.S. defense and industrial buyers are therefore essential to anchor investment and sustain diversified capacity.

Modernize Regulation and Integrate Recycling as a Strategic Asset

Permitting delays and regulatory uncertainty are binding constraints on restoring U.S. mining, refining, and recycling capacity. Secondary inputs such as recycled batteries, used electronics, and industrial scrap should be treated as strategic assets rather than waste streams, with policies designed to retain their capture, recovery, and processing within U.S. and allied control. Absent predictable, coordinated permitting timelines, capital-intensive processing facilities—whether primary or secondary—cannot be financed when approvals stretch unpredictably across multiple agencies and years.

To address this, the federal government should establish a maximum two-year permitting timeline for large-scale mining, refining, and recycling projects involving critical minerals, with One Federal Decision authority to eliminate duplicative reviews and sequential delays. Defense-critical processing facilities should qualify for a fast-track permitting category, recognizing their role in national security and supply continuity.

Existing mechanisms such as FAST-41 have improved coordination but remain insufficient given the scale of current dependence. Congress or the Administration should go further by designating critical mineral processing and recycling as priority industrial infrastructure under the National Environmental Policy Act (NEPA), with clear deadlines for Environmental Impact Statements and limited scope for serial litigation once those deadlines are met.

In parallel, the federal government should advance a regulatory framework for responsible deep-sea mining within U.S. Exclusive Economic Zones and under international agreements with like-minded partners. The U.S. Geological Survey has documented substantial concentrations of battery-critical minerals in polymetallic nodule fields off the coast of the U.S., its Western Hemisphere territories and in the Pacific.

At the same time, recycling must be treated as a strategic industrial capability, not an environmental afterthought. The United States already leads globally in battery and metals recycling, and policy should reinforce this advantage by integrating recycled material directly into domestic and allied refining and processing capacity. This requires standardized battery and materials labeling, mandatory sorting enforcement at ports and materials recovery facilities, and the development of regional recycling and processing hubs aligned with downstream manufacturing.

Federal procurement and defense purchasing should explicitly prioritize inputs that incorporate domestically recycled content where technically feasible. Recycling is not a substitute for primary refining capacity, but when paired with domestic processing it reduces import dependence, dampens price volatility, and strengthens supply resilience across both civilian and defense-critical applications.

Consider Industry Impact of Environmental Regulations

Restoring American refining dominance requires regulatory stability alongside environmental stewardship. New environmental rules that materially affect refining, precursor manufacturing, or battery component production should be implemented with clear coordination between federal agencies and affected industries.

Regulatory actions that inadvertently constrain key inputs or industrial processes risk accelerating offshoring rather than strengthening domestic supply chains. For example, restrictions on trichloroethylene (TCE)—used in certain separator and component manufacturing processes—illustrate how well-intentioned environmental policy can unintentionally impair domestic battery production if viable technical substitutes are not commercially ready at scale.

Before implementing new Environmental Protection Agency (EPA) rules affecting critical mineral refining, chemical conversion, or battery manufacturing inputs, federal agencies should:

- Conduct supply-chain impact assessments,
- Engage industry through formal consultation processes,
- Phase in compliance timelines aligned with substitution feasibility, and
- Coordinate with defense and energy agencies where national security implications are present.

Pillar 4: Invest in Applied Research for Next-Generation Batteries

Sustaining long-term refining dominance requires forward-looking technological leadership in both chemistry and processing. Federal and private investment in basic and applied research should be expanded not only to improve battery performance, but to reduce exposure to highly concentrated refining chokepoints.

Research priorities should include:

- Advanced lithium-ion chemistries with reduced cobalt and high-purity nickel dependence, including LFP and manganese-rich cathodes;
- Solid-state systems and alternative electrolytes that reduce reliance on graphite or foreign-controlled precursor materials;
- Sodium-ion and iron-based chemistries that leverage more geographically diversified inputs;
- Breakthroughs in cathode and anode precursor processing, including domestic production of battery-grade lithium hydroxide, nickel sulfate, and synthetic graphite;
- Improvements in recycling efficiency, closed-loop recovery, and material substitution pathways that reduce demand for highly concentrated inputs.

Investment should be structured through coordinated programs at the Department of Energy (including ARPA-E and the Office of Energy Efficiency and Renewable Energy), the Department of War, national laboratories, and university–industry consortia. Programs should include clear pathways from laboratory research to pilot-scale processing facilities, demonstration plants, and domestic precursor manufacturing capability.

In addition to chemistry innovation, federal support should target process innovation—reducing the capital intensity, environmental footprint, and energy consumption of refining and chemical conversion. Scaling alternative processing methods within the United States and allied jurisdictions is essential to preventing future concentration at the midstream stage.

While current vulnerabilities require near-term industrial policy responses, long-term security depends on maintaining leadership in the next generation of battery architectures and processing technologies. Strategic R&D reduces future dependency risks while reinforcing domestic refining and materials innovation ecosystems.

CONCLUSION: REBUILDING CONTROL ON A WARTIME FOOTING

The United States' vulnerability in battery and critical mineral supply chains owes to China's dominance of the refining and processing stages that convert resources into usable industrial inputs. Through its deliberate industrial strategy—state-backed overcapacity, price suppression, export controls, and tolerance for sustained losses—China has systematically displaced competing capacity and deterred private investment elsewhere. Once dependence is established, these same tools can be reversed to impose supply shocks, price volatility, and strategic leverage, as demonstrated repeatedly across rare earths, battery materials, and antimony.

The lead-acid battery case study underscores the stakes. Even in a sector where the United States retains global leadership in manufacturing and recycling, reliance on a single, Chinese-controlled refining chokepoint has proven sufficient to create systemic vulnerability. This pattern is not unique to lead-acid batteries; it is structural and repeats across battery chemistries and critical mineral markets.

Reversing this scenario across the battery and critical mineral processing stage of production will require fresh policies: long-term production incentives, enforceable ownership standards, strategic offtake and price stabilization mechanisms, allied co-financing, and procurement-backed demand are not distortions. The United States is not resource-poor, technologically behind, or industrially incapable. It is processing-constrained. Reversing that constraint is not optional. It is an industrial and national security necessity.

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