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Security Nexus Perspective

# THE POTATO LOGIC OF POWER

## HOW EFFICIENCY FORGES STRATEGIC VULNERABILITY

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*Critical minerals processing remains concentrated in few hands across the Indo-Pacific, mirroring historical patterns from Europe's potato dependency to twentieth-century oil geopolitics. The question is whether dependencies formed through efficiency are recognized before disruption forces awareness.*

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Strategic vulnerabilities form not through scarcity but through uniformity. Europe learned this in the 1840s when potato blight turned fields black across Ireland and Belgium, exposing how a single crop had become indispensable. The Indo-Pacific faces a similar pattern today: critical minerals - lithium, cobalt, rare earth elements - enable electrification, energy storage, and precision manufacturing, yet their processing remains concentrated in few hands. As China controls the majority of rare earth refining and gallium processing, dependencies are already structural.

In July 2023, China's Ministry of Commerce published a brief notice requiring export licenses for gallium and germanium. The announcement was technical, procedural, nine sentences long. Within hours, metals markets began adjusting. Prices spiked. Supply chains tightened. Governments that had assumed abundance discovered concentration.

The materials in question are not household names. Gallium enables the semiconductors in advanced radar systems and solar cells. Germanium appears in fiber optics and infrared technology. Both are critical to defense electronics, energy infrastructure, and satellite communications. China controls roughly eighty percent of global gallium production and over ninety-five percent of processing capacity.

When export controls arrived, markets did not collapse. They adapted. Substitutes were explored; none proved immediate. What became visible was not shortage, but leverage: quiet, structural, and difficult to undo quickly. This is the geopolitics of materials most people never see.

## THE LOGIC OF THE OVERLOOKED

History is often misread because it looks for power where power prefers to be seen. It studies weapons rather than rations, doctrines rather than diets, ships rather than the coal that moved them. Yet again and again, the forces that most decisively shape societies are neither spectacular nor self-advertising. They work below the level of notice, embedded in habit and routine, taken for granted until their absence forces recognition.

In 1949, historian Redcliffe Salaman published a study that sounds, at first, like an odd choice for strategic thinking: *The History and Social Influence of the Potato*. He treated an ordinary crop as one of European history's quiet engines. The potato did not announce a new age; it sustained one. It fed bodies, stabilized labor, enabled density, and, most importantly, made expansion affordable.

What made the potato consequential was compatibility with scale. Dense in calories, tolerant of poor soil and cold climates, easily stored and transported, it answered questions states rarely articulated: How do you feed growing populations cheaply? How do you support industrial labor without raising wages? How do you endure scarcity without social rupture?

The potato functioned less as food than as infrastructure. It embedded itself so completely into European life that its presence faded from view. Power accumulated around it not through design, but through reliance.

When blight finally exposed that reliance in the 1840s, the shock was not merely agricultural. It was political, demographic, and moral. Entire systems discovered that what had seemed merely convenient had become indispensable. Alternatives had withered. When disruption arrived, societies had nowhere else to turn.

The potato's lesson was simple but durable: dependence becomes dangerous not when resources are scarce, but when they are uniform. The learning was expensive, the lesson clear, and the tendency to repeat it apparently irresistible. We have simply moved from tubers to minerals, from Irish cottages to Chilean plateaus, from famine to supply chain disruption. The pattern persists; we merely update the commodities.

## FROM CALORIES TO KILOGRAMS

If calories once formed the hidden arithmetic of power, kilograms now perform similar work. Walk through any electric vehicle battery plant today, and you will see the new arithmetic at work. Lithium, nickel, cobalt, graphite: materials most consumers never think about, arranged in layers, refined to precise chemical grades, assembled at industrial scale. Remove any single element from the supply chain, and production stops. Not slowly. Immediately.

Modern states measure endurance in material throughput: how much can be extracted, processed, and transformed without interruption. Industrial strength today lies less in invention than in repetition: the capacity to produce the same components, at scale, under strain.

This capacity does not reside in blueprints or strategy documents. It resides in matter. The pattern is not new. Nineteenth-century industrial power rested on coal and iron. Twentieth-century geopolitics

pivoted on oil. Each era had its material substrate, the physical resources that made expansion possible and whose interruption made it unsustainable.

But today's critical minerals differ in one crucial aspect: they enable not combustion, but transformation. Coal and oil released energy through burning. Lithium and rare earth elements store, convert, and regulate it. The shift is from fuels that are consumed to materials that circulate, embedded in devices that outlast their immediate use.

This changes the grammar of dependence. Scarcity is no longer measured in barrels per day. It is measured in processing capacity: the ability to refine ores into battery-grade chemicals, to produce rare earth magnets, to separate elements that naturally occur together. The knowledge required to do this at scale is concentrated. The facilities that can do it reliably are few.

**THE GEOGRAPHY OF CONTROL**

What distinguishes critical minerals from earlier strategic resources is asymmetry. Deposits are geographically dispersed. Processing and integration are not. China refines roughly sixty percent of the world's lithium, processes about seventy percent of cobalt, and controls the overwhelming majority of rare earth element refining. This dominance did not arise from geology alone. China holds significant rare earth deposits, but not disproportionate shares of lithium or cobalt reserves.

What Beijing developed instead was industrial capacity: refining infrastructure, accumulated expertise in separation chemistry, and tolerance for environmental costs that other states preferred to avoid.

Strategic positioning began decades before critical minerals entered mainstream discourse, back when Western governments could still afford to be uninterested in such matters. By the time energy transition made them fashionable, the architecture of dependency was already fixed. Beijing had built what the rest of the world was only beginning to notice. This is not unusual; foresight tends to favor those who act over those who deliberate.

Recent analysis frames China's mineral dominance primarily as coercive statecraft, citing export controls on gallium and rare earths as evidence of weaponized supply chains. This captures an important dimension but arrives late to the pattern. By the time minerals function as instruments of pressure, the architecture of dependency has already been fixed through decades of choices made in the name of efficiency, cost reduction, and environmental offshoring. China's processing dominance emerged not through coercion but through patient industrial strategy meeting Western decisions to avoid domestic costs and assume market continuity. When the United States closed its only rare earth mine at Mountain Pass, California, in the early 2000s due to environmental concerns, Chinese processing capacity expanded to fill the gap. The vulnerability preceded the weapon. Focusing on export controls as the primary threat obscures the structural choices - prioritizing efficiency over redundancy, offshoring environmental costs, assuming continuity of supply - that created the dependency in the first place.

Something similar is unfolding. Supply chains function smoothly. Markets clear. Products ship. Yet beneath that efficiency lies a narrowing ecology optimized for speed and cost rather than resilience. As with the potato, success itself becomes the argument against diversification.

## GALLIUM'S QUIET WEIGHT

Return to that July 2023 announcement. Gallium occupies a narrow but critical intersection: defense technology, energy systems, consumer electronics. It appears in compound semiconductors that enable high-frequency radar, satellite communications, and advanced solar cells.

When export controls were introduced, they were not presented as coercion. They were framed as governance: environmental standards, national security reviews, licensing requirements. The language was administrative, technical, procedural. Markets understood perfectly. They did not panic; they adjusted. Prices rose, then stabilized at higher levels. The genteel terminology did not obscure the substance: leverage had been made visible, and nomenclature would not unmake it.

The material itself costs cents per gram. Its strategic weight cannot be measured in price. It resides instead in the systems that depend on it and the scarcity of alternatives that can replace it quickly.

Salaman's potato revealed a similar truth: systems appear stable until the conditions sustaining them narrow unnoticed. Efficiency hardens into brittleness. Convenience calcifies into constraint.

## EXTRACTION WITHOUT LEVERAGE

Fly over Chile's Atacama Desert, and you will see lithium brine evaporating in vast, geometric ponds that stretch across highland plateaus. The scale is industrial. The economics are global. The environmental consequences are local.

Chile holds some of the world's largest lithium reserves. Yet extraction contracts negotiated decades earlier, before lithium became central to the strategic imagination, tied revenues to royalty structures designed for copper, not battery materials. As electric vehicle demand surged, those agreements proved difficult to revise. Renegotiation is complex. Investment agreements carry sovereign guarantees. International arbitration looms over revision.

Meanwhile, brine extraction depletes aquifers that Atacameño communities depend on. Environmental costs were never priced into the original agreements. The minerals move rapidly into global supply chains. Water tables fall. Revenues remain modest relative to downstream battery production.

The arrangements are entirely legal. They were negotiated properly, executed professionally, and administered with appropriate paperwork. That one party holds the resource while another holds the leverage is simply how such arrangements tend to settle.

In the Democratic Republic of Congo, cobalt extraction follows a similar geometry. The DRC holds roughly two-thirds of the world's cobalt reserves, essential to nearly every lithium-ion battery produced globally. Yet most mining operations, whether industrial or artisanal, feed into processing networks controlled elsewhere. The mineral leaves rapidly—by truck, by ship, through supply chains optimized for speed. What remains are the costs: environmental degradation, community displacement, revenues modest relative to the value added downstream during refining and battery production. The cobalt moves to processing facilities in China and Finland; the leverage accumulates there as well.

It would be convenient to assign blame cleanly: to cast Chile as victim, foreign capital as predator, contracts as instruments of exploitation. But systems of dependence rarely arrange themselves so neatly. The contracts were signed by sovereign governments advised by competent lawyers. The terms seemed reasonable when lithium was marginal. No party could foresee that battery chemistry would transform a specialty metal into a strategic resource.

Foresight is distributed unevenly, and arrangements negotiated in one era can harden into constraints in another. This is not malice. It is simply how materials move through time: predictably for those who study such patterns, surprisingly for those who assumed continuity.

Chile possesses the resource but not the processing capacity. It holds extraction rights but not pricing power. It bears environmental liability but lacks strategic influence.

This dynamic repeats across the Indo-Pacific and the wider Global South. Mineral deposits are increasingly framed as strategic assets, proof of relevance within emerging supply chains. History suggests otherwise.

Extraction alone rarely confers agency. More often, it inaugurates an asymmetry in which resources are abundant but decisions are not.

Indonesia banned nickel ore exports to force domestic processing, discovering in the process that sovereignty over extraction does not automatically confer sovereignty over value chains. The policy attracted investment; investment that brought its own conditions, its own expertise, and its own distribution of returns. Jakarta sought autonomy; it achieved partnership. The distinction, while subtle, proves consequential.

Australia, despite leading lithium production, has only recently begun developing refining capacity, decades after ceding that role to China.

Vietnam, whose rare earth deposits rank among the largest outside China, has explored partnerships with Japan, South Korea, and the United States to develop mining and processing infrastructure.

These efforts reflect a growing recognition: extraction is not leverage. Processing is. Integration determines who absorbs shock and who transmits it.

**THE INDO-PACIFIC'S MINERAL MONOCULTURES**

The Irish famine's deeper truth was that efficiency had narrowed choice long before blight arrived. A single potato variety, optimized for yield and convenience, displaced alternatives that were less productive but more resilient. When failure came, it did not introduce vulnerability. It revealed one that had already been normalized.

While deposits of lithium, nickel, cobalt, rare earth elements, and graphite are widely distributed across the region, the systems that refine, process, and integrate these materials are far more concentrated.

Rare earth processing remains concentrated in China at proportions that would alarm any strategist applying the lessons of energy security.

Speed intensifies this vulnerability. Energy transition, electrification, and defense modernization unfold simultaneously, compressing timelines and encouraging shortcuts. Diversification is promised. Concentration persists. Stockpiles are announced. Redundancy remains thin.

One observes this pattern with a certain weary familiarity. Governments announce initiatives, industries pledge cooperation, think tanks produce reports. Five years later, a different set of officials will announce similar initiatives, pledge renewed commitment, and commission updated reports. The cycle has a comforting predictability. It substitutes motion for progress, and most participants seem content with the exchange.

When disruption arrives, the decisive question will not be who possessed the most advanced technologies. It will be who retained the capacity to improvise, substitute, and endure.

**WHAT DEPENDENCE LOOKS LIKE**

Inside semiconductor fabrication facilities, battery production lines, and precision manufacturing plants, the materials are invisible. They disappear into performance. Lithium becomes range. Cobalt becomes stability. Rare earths become precision.

Function masks origin. What remains visible is capability. Advanced technologies create an impression of autonomy, as though power emerges fully formed from innovation and capital. Yet beneath every platform lies a chain of dependencies longer, narrower, and more fragile than the systems they support. Sophistication does not eliminate material constraint. It concentrates it.

The more complex a system becomes, the less tolerant it is of disruption at the base. No amount of strategic planning can compensate for an absent supply chain. There is no doctrinal substitute for missing matter.

**THE QUIET ARBITERS**

History rarely offers guidance in the form of instruction. What it offers instead is recognition; a way of seeing familiar arrangements as contingent rather than inevitable.

Critical minerals are treated as inputs rather than foundations, as logistical challenges rather than strategic conditions. Their circulation appears seamless. Their availability is taken as given. Their vulnerabilities are absorbed into technical debates that rarely trouble political imagination.

This is misrecognition - the belief that what enables transformation can remain permanently subordinate to it.

The Indo-Pacific's mineral future will be shaped less by dramatic confrontation than by accumulated choices made in the name of efficiency, speed, and necessity. These choices may never produce crisis. But they will determine how shock is absorbed when it arrives and by whom.

Critical minerals are already following a similar path: not as agents of collapse, but as quiet arbiters of which systems can absorb disruption and which cannot. Which states retain the capacity to improvise when supply chains fail. Which discover that sophistication without material autonomy is fragility disguised as progress.

The question is not whether dependence exists. All interdependent systems create mutual vulnerability. The question is whether that dependence is acknowledged, diversified, and governed with the understanding that what enables transformation today may constrain it tomorrow.

By the time markets signal shortage, the architecture of dependency is already fixed. By the time substitutes are explored, decades of accumulated expertise have already concentrated elsewhere. By the time strategic planners notice the gap, the choices that created it have already hardened into structure.

**THE NEGOTIATOR'S RECOGNITION**

In government offices across the Indo-Pacific, officials tasked with energy security know this arithmetic well. The spreadsheets show the dependencies. The briefings map the chokepoints. Understanding changes nothing when alternatives take decades to build.

Somewhere in the Indo-Pacific, a government official sits across from foreign investors discussing processing capacity, technology transfer, and partnership terms. The presentation is professional. The financing is real. The contracts will be properly drafted and duly executed. Yet even as the documents are prepared, there is recognition: clear, unsentimental, and unavoidable, that "partnership" distributes returns asymmetrically, that "technology transfer" comes with conditions that extend beyond the contract's term, that what appears as mutual benefit at signing will harden into constraint over time. This is known. It is understood. The contracts are signed anyway, because the alternatives are fewer and worse. Years later, when the terms prove difficult to renegotiate, no one will be able to say they were deceived. That is what makes the arrangement endurable and unbearable in equal measure.

In this sense, critical minerals resemble the potato less as metaphor than as warning. They work quietly. They enable scale. They concentrate risk. And when disruption arrives, the societies that prepared for it will bend. Those that assumed continuity will break.

The lesson is not new. The materials are. But the pattern - efficiency hardening into dependency, convenience calcifying into constraint - repeats with the reliability of tides. The ocean rewards preparation and punishes assumptions. It has always done so.

In these waters, what appears peripheral can become structural. What seems abundant can prove scarce. And what enables power today becomes the trap of tomorrow. We mistake the map for the territory, forgetting that maps are drawn by those with the most to gain from our acceptance of their lines.

The map is already being redrawn. The question is whether we are reading it or merely accepting the lines others have drawn.


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