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Iran-US Conflict, Weaponization of REE Scarcity, and the International Economic Law Governance Gap

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Abstract. Rare Earth Elements have grown into an indispensable aspect to both clean energy infrastructure and advanced military systems, yet their global supply chain is dominated by China, commanding 60% of global mining and 91% of refining capacity. This concentration, further exposed by the United States-Iran conflict's depletion of American munitions reserves, has enabled China to weaponize resource scarcity as geopolitical leverage through export control policies. Using a normative legal approach, this research examines the adequacy of existing international economic law instruments, including GATT 1994 Articles XI, XX, and XXI, drawing on the China-Raw Materials and China-Rare Earths Dispute to reveal their structural limitations. Finding current multilateral trade law reactive and ill-equipped, this research proposes a purpose-built multilateral REE governance framework incorporating binding supply chain commitments, security obligations, environmental standards, and adaptive institutional mechanisms.

Keywords: Export Controls; International Economic Law; Rare Earth Elements; Supply Chain; Weaponization of Scarcity.

1. Introduction

Rare Earth Elements 'REEs' consists of a group of 17 metallic elements from 15 lanthanides – cerium, neodymium, lanthanum, praseodymium, promethium, europium, samarium, terbium, gadolinium, thulium, lutetium, holmium, ytterbium, dysprosium, and erbium – together with scandium and yttrium. The term 'rare' reflects how extraordinarily difficult they are to extract and refine. What firmly establishes REEs as materials of profound strategic, economic, and technological importance in the twenty-first century is the impressive functional influence they possess, encompassing electronics, petroleum refining, medical imaging technologies, fiber optic communications, hybrid vehicle batteries, defense systems, and renewable energy infrastructure (1). Neodymium and dysprosium, in particular, are vital to a high-performance permanent magnets in direct-drive wind turbines and electric vehicles production as clean energy technologies drive continuously growing demand. These magnets can deliver exceptional magnetic performance at reduced size and weight, enabling more compact and efficient designs without any compromise in output. As demand from these two sectors alone is projected to

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outpace conventional mining supply by 2050, mining activity will be required to accelerate significantly just to keep pace (2).

REEs sit at an uncomfortable crossroads between clean energy and national defense, enabling both while also deepening the tension between them. A single F-35 multirole stealth combat aircraft requires approximately 417 kilograms of REEs for its electrical systems and permanent magnets (3); US consumes roughly 5% of global REE production for defense purposes alone. Their applications cover a wide range of military systems, for example: missile guidance systems fin actuators; jamming devices and electromagnetic railguns; laser and targeting systems; and the radar, sonar, and detection infrastructure of submarines and surface ships (4). The same elements driving the clean energy transition are simultaneously critical to advanced military systems, illustrating the strategic tension that defines the global REE challenge.

REEs mining and production sector pose considerable environmental costs. These procedures generate significant quantities of partially radioactive tailings which can contaminate the environment through pathways, such as air dispersion, wastewater discharge, and rainwater leaching. The tailings pond at Baotou, China, situated about 35 metres above the Yellow River, produces radioactive contents contaminated with 5% thorium. This poses serious toxicity hazards to nearby water, soil, and air due to leakage, dust dispersion, and rain-induced erosion. A significant share of global REE supply is extracted from ion-adsorption clays, a particularly damaging method that generates wastewater containing ammonium levels above 150 mg/l and sulfate concentrations exceeding 5000 mg/l, alongside heavy metals that threaten groundwater quality. Many of these environmental impacts are inherent to the mineral composition itself, meaning they cannot be fully mitigated regardless of the processing method employed (5).

The indispensable role of REEs to both clean energy and the modern defense sector, the strategic tension their shared demand creates, and the significant environmental toll their extraction imposes reveal a resource whose importance to the global economy and security is matched only by the complexity of its challenges. Growing demand that conventional mining cannot meet, combined with unavoidable environmental consequences of extraction leaves regardless of the method employed, leaves the global REE supply in a precarious position. Understanding who controls that supply and how that control is exercised are not merely economic concerns but carry direct implications for energy security and international stability, demanding scrutiny through the lens of international economic law. Central to that scrutiny is China, which has long dominated the majority of REE production and processing capacity globally. China possesses abundant REE deposits and a well-integrated industrial supply chain, where it has dominated the REE supply market globally since the 1990s (6). However, due to the increase of global demand and long-term over-mining, issues of excess production capacity and environmental degradation of mining, smelting, and separation processes exist.

Global concerns on potential disruptions of supplies have driven numerous REE exploration projects as well as processing plants that manifests supply chain diversification (7) along with technological advancement, prompting many nations to develop their own REE supply chains. However, with China's long-standing dominance, China is able to shape global manufacturing and trade negotiations, affecting dependent industries. In 2025, China has implemented export restrictions on heavy REE and magnet licensing, causing global producers for manufacturing industries, including energy, automotive, and defence industry, to face declining supplies. Additionally, REE producers outside of China are still in relatively early phases of development (8), unlikely achieving sufficient production capacity in the near future.

Presently, no regulation specifically governs critical mineral export controls within international economic law, nor any binding legal mechanisms on the exportation and trade of REE that are aligned with states' environmental and climate obligations. Furthermore, there

exists no World Trade Organization 'WTO' level instrument that addresses REE supply chain security in the midst of global energy dynamics between states in pursuit of economic, social, politic, and military stability. This research will analyze existing international economic law instruments adequacy in governing REE supply chains and to propose a multilateral governance framework that is capable of addressing the compounded legal, security, and sustainability challenges with regards to the weaponization of REE scarcity.

2. Method

To examine issues at hand, this research will use a normative approach. Using a normative approach, the research was conducted as a method to identify legal rules, principles, and doctrines of law in order to address the issue at hand (9). Data analysis involves the process of systematically searching for and compiling data obtained by organising it into categories, synthesising it, and drawing conclusions (10). Normative approach research data are secondary data, such as literature and legal documents or legal materials (11). Furthermore, research data are obtained from literature review and document review. Literature review encompasses books, journals, or other written legal materials and document review covers legal documents, and other regulations.

3. Result and Discussion

3.1 United States' Reliance on China: Lessons Exposed by the Iran Conflict

The unique physical and chemical characteristics that REE possesses enabled them to advance defense systems, including advancing precision guidance systems, radar and sonar systems, robust communications systems, and other stealth technologies serving as the backbone of modern military superiority with its clean energy technologies potential (12). REEs serve as indispensable materials in modern defense and aerospace applications. Neodymium iron boron 'NdFeB' and samarium cobalt 'SmCo' magnets are widely used in precision-guided weaponry and stealth technology, including Tomahawk cruise missiles, yttrium- and scandium-based alloys are employed in advanced jet engines and hypersonic structural components, and strategic platforms such as the F-35 combat aircraft incorporate over 400 kg of REEs to enable avionics, electronic warfare, stealth coating, and flight control systems (13).

The United States recognized the strategic importance of REE due to its essential role for the country's economic and national security interests. However, this has also shown the high vulnerability of supply disruption considering the heavy concentration of the REE global supply chain dominated by China. Furthermore, China is still relied upon by the US in the final refining of intermediates (13). For example, the US relies entirely on foreign suppliers for its REE supply needs, mainly China, where the US consumes approximately 10% of the global rare earth metal production (14). The US military is highly dependent on foreign REE to continue fulfilling its weapons systems needs (15). The estimated measured and indicated REE resources in North America itself reached 3.6 million tonnes, however it remained largely unexploited and has not yet been explored (16).

Operation Epic Fury, US' large military campaign against Iran, has significantly depleted US' strategic military weapon supply as a direct consequence of the operation's rapid pace and high-intensity offensive operation demands. The US' dependence on China extends across a wide range of strategically critical materials, as China serves as the dominant supplier of REEs fundamental to high-performance magnets in drones, radar systems, and satellite communications, while simultaneously functioning as the primary source of tungsten, antimony, and other indispensable inputs that underpin the production and operability of advanced military technologies (17). The total incurred by the US from its military campaign against Iran

was estimated at nearly one billion dollars per day, a figure that underscores the extraordinary consumption rate of advanced munitions throughout the operation, involving the deployment of approximately 1,100 JASSM-ER long-range stealth cruise missiles against Iranian missile silos and airfields, 1,000 Tomahawk cruise missiles targeting missile sites and radar infrastructure, more than 1,200 Patriot anti-missile interceptors utilized for active neutralization of Iranian missile strikes targeting American military bases and other Persian Gulf strategic infrastructures, and over 1,000 precision-guided and ground-strike missiles directed against a diverse array of strategic targets (18).

A 2025 report by the International Energy Agency states that China accounted for approximately 60% of global mining output with even more pronounced dominance at the separation and refining stage, where it commands approximately 91% of global production capacity. Additionally, China's market share has risen significantly which has climbed 94% of the share (19). Such a dominant position may lead to vulnerable global supply chain disruptions due to its inherent exposure to a confluence of risks as a result of geopolitically motivated export controls, domestic regulatory shifts, environmental policy adjustment, and other logistical bottlenecks, which could precipitate shortages across energy, defence, and advanced manufacturing sectors that depend upon rare earth inputs. In light of China's dominance over global REE supply chains that reaches further than extraction which covers processing, separation, and downstream manufacturing activities (20), US has pursued an ambitious agenda to diversify procurement sources, such as from Mongolia and Greenland (21), and stimulate domestic REE production, driven by growing recognition that dependence on a strategic rival for critical materials poses a fundamental threat to national security and long-term technological competitiveness. However, without adequately developing domestic demand within the US, the current supply-side strategy could lead to an oversupply.

Since 2025, China has expanded REE export controls, adding five strategic elements, and issued State Council Decree 834, authorizing action against foreign entities imposing discriminative measures affecting Chinese supply chains (22). Furthermore, additional regulatory instruments authorize the adoption of countermeasures against foreign entities considered to be exercising illegal extraterritorial jurisdiction against China in its State Council Decree Number 835 (22). China's export restrictions go beyond trade and diplomacy, serving to consolidate supply chain dominance, fuel industrial growth, and limit essential materials to Western military and technological sectors amid growing geostrategic tensions (23). The dominance over REE supply chains has become deeply intertwined with defense strategy, technological sovereignty, and geopolitical alliances, whereby China's recent imposition of export restrictions and withholding of midstream technologies has generated strategic ambiguity that serves as a form of implicit signaling, further intensifying the transformation of resource competition into broader strategic rivalry (24). REE supply chain dependence carries consequences that extend beyond economic inefficiency into questions of strategic and military capacity. China's ability to leverage its dominant position through regulatory and export control measures further underscores that this dependence is subject to deliberate strategic global status quo management rather than neutral market forces. Accordingly, REE supply chain governance demands engagement at international economic law level.

3.2 The REE Shock and the Governance Gap

The convergence of military consumption, Chinese export controls, and supply chain concentration does not produce three separate, manageable pressures. It produces a single compounded shock. China accounted for 68% of global REE production in 2019, though this likely understates the reality since illegal mining and smuggling go untracked (25). More significantly, China's 86.4% share of separated and purified REE production means that states sourcing raw ore elsewhere remain structurally dependent on Chinese processing. This is a

vulnerability that diversifying mining locations alone cannot fix (26). China has actively maintained this dominance through limit pricing, periodically flooding the market with underpriced REEs whenever credible competition emerges and foreclosing any challengers before they can gain a foothold (25). The military dimension compounds this further, as simulation modelling suggests that a sustained Chinese export cutoff would produce a significant technological disconnect in the US military-industrial system within three to five years, and a systemic capability lag within eight to twelve, at an estimated annual economic cost of $35-40 billion. More than 95% of key US Department of Defense systems depend on supply chains traceable to China (27). What the convergence ultimately reveals is a governance gap. No international legal instrument exists to anticipate, absorb, or regulate a shock of this kind. That gap is what this analysis addresses under international economic law.

The WTO framework theoretically provides disciplines against the kind of export restrictions China has employed over REEs. Under the WTO framework, Article 'Art.' XI of the General Agreement on Tariffs and Trade 'GATT' 1994 generally prohibits states from restricting how much of a good they export, while Art. I requires that any trade advantage a member extends to one trading partner must be extended equally and unconditionally to all others (28). Both the *China-Raw Materials* and *China-Rare Earths* disputes saw China impose export duties, quotas, and licensing requirements on REEs, which China acknowledged conflicted with Paragraph 11.3 of its Accession Protocol. China invoked Arts. XX(b) and XX(g), but the Panel rejected both, ruling Paragraph 11.3 fell outside Art. XX exceptions (29). While both panels found China's export measures to be in breach of its WTO obligations, they produced no prospective framework governing REE export restrictions more broadly. Therefore, the WTO framework is reactive and measure-specific, capable of adjudicating individual violations but structurally unequipped to govern REE supply chains in a comprehensive or forward-looking manner.

WTO law's limitations on REE supply chains reflect the boundaries of what the system was designed to govern. Art. XXI of the GATT 1994 is the clearest illustration. For nearly seven decades, Contracting Parties treated it as a provision best left uninvoked due to its abuse potential. The 2019 *Russia-Traffic in Transit* panel held that Art. XXI(b) is not purely self-judging, yet still left invoking Members considerable discretion over what qualifies as an essential security interest (30). This residual self-judgment, alongside the ability of states to withhold information under Art. XXI(a), limits meaningful legal review and leaves room for protectionism dressed in security language. Art. XXI(b)(ii), the provision most relevant to peacetime export controls, is outdated, lacks interpretive practice, and was not drafted with the technological and geopolitical realities of REE supply chains in mind (31). China's control over the entire REE supply chain, from mining through to the production of key intermediate materials such as magnets, represents precisely the kind of structural condition this provision was not designed to address. That dominance was built on cost competitiveness enabled by lower environmental and labor standards and has since consolidated into near-monopoly control over processing and distribution capacity (32). These are structural features of a supply chain shaped by sustained industrial policy rather than discrete trade measures amenable to WTO disciplines. Consequently, most strategic dimensions of REE shock, including military dependency, processing monopoly, and logistics vulnerability, fall outside the reach of existing WTO frameworks.

No *lex specialis* governing REE supply chains currently exists. China's export quota regime illustrates the scope of this gap (33). By restricting REE exports while leaving finished product exports unrestricted, China created a long-term supply chain constraint rather than an abrupt disruption, shaping both domestic and international prices in ways existing multilateral instruments were not designed to address. Attempts to develop alternative supply sources have been insufficient, limiting the supply diversity available to importing states (32). Existing

regional initiatives such as the European Commission's system for classifying critical raw materials remain confined to listing exercises and do not constitute binding governance mechanisms. United Nations Sustainable Development Goals 'SDGs', climate obligations, and intergenerational equity principles point toward a lifecycle-sensitive, multilaterally governed approach to REE extraction and consumption within international economic law (34). No binding instrument currently integrates these dimensions into a coherent governance structure for REE supply chains. This represents an inconsistency between the normative commitments international law formally endorses and the instruments available to implement them. The fragmented and non-binding character of existing responses has not adequately addressed this gap, and their structural limitations suggest they cannot.

3.3. Multilateral REE Governance Framework

International economic law has expanded in both scope and depth, extending its reach into domains once considered peripheral to trade and economic relations, including human rights, environment protection, and cultural values (35). At its core, international economic law works to build stable and mutually beneficial relationships between states through deeper economic integration, a principle originated in the Bretton Woods framework and the conviction that economic interdependence generates mutual understanding and shared stability interest. The effectiveness of global economic governance rests on states' willingness to accept constraints on sovereignty. Multilateral agreements give states a rules-based alternative to raw power dynamics, within which REE governance finds both its justification and institutional foundation.

WTO's existing negotiating architecture could serve as the basis for developing dedicated trade arrangements to secure REE supply chains, particularly given the growing intersection between critical mineral access and climate commitments (36). Yet the institutional architecture of WTO alone can not address the full complexity of REE supply chain governance. Vietnam, Malaysia, and Indonesia hold significant REE potential, but governance gaps, environmental risks, and community resistance limit development (37). Any multilateral framework must extend beyond trade barriers elimination, considering the conditions and standards of REE production, means and method of REE trade practices, particularly in resource potential regions which are constrained by these factors.

In addition, the concentration of REEs production in China was a product of structural advantages, such as low labor costs, lax environmental standards, and an 'easy access' licensing policy that allows mining companies to proliferate without significant regulatory requirements (38). Therefore, China's domestic background and rationale that has consistently advanced to justify its restrictive trade regime must be assessed. China contends that its export controls were justified under environmental grounds, citing excessive extraction rate, severe environmental damages, from under-regulated mining, and artificially suppressed prices that failed to reflect REEs' exhaustible and strategic nature. The proposed framework must incorporate resource conservation, fair pricing, and environmental remediation as core governance objectives pursued through multilateral disciplines rather than unilateral export controls used as strategic leverage, given REE supply chain concentration, the obligation that follows, and implications for national industrial policy.

Any multilateral REE governance framework must be designed with institutional credibility in mind (39). Compliance obligations should be structured through tiered commitments accounting for varying regulatory capacities of producing states. China's domestic experience is instructive, as its policy spans command-control mechanisms, economic incentives, and social autonomy instruments, with market-based mechanisms expanding in parallel (40). A multilateral framework could draw on this architecture, establishing minimum binding standards for extraction, processing, and environmental remediation while allowing flexibility in the policy tools states use to meet them, including environmental taxation (41).

Monitoring and enforcement present a distinct challenge. Effective oversight requires transparent, science-based regulatory decision-making that can adapt to technological change, as demonstrated by France's *Installations Classées pour la Protection de l'Environnement* 'ICPE' licensing framework for REE processing sites (42). The WTO Dispute Settlement Body offers a reference point on the dispute settlement side, though any REE-specific mechanism must be designed to account for the political dimensions inherent in treaty interpretation rather than relying on purely textual readings (43). Public engagement and multi-stakeholder participation, as demonstrated by South Korea's approach to nuclear governance (42), should also be embedded in the framework's design. Taken together, these elements suggest a framework that is binding in its core obligations, adaptive in its implementation, and credible in its oversight, conditions that the existing governance landscape has so far been unable to meet.

4. Conclusion

This research examined whether existing international economic law instruments are adequate to govern REE supply chains and found clearly that they are not. The WTO framework, while theoretically capable of disciplining discrete export restrictions, proved reactive and measure-specific in practice. The *China-Raw Materials* and *China-Rare Earths* disputes confirmed that specific measures could be found WTO-inconsistent but produced no prospective governance framework. Art. XXI compounds this limitation further, leaving military consumption, processing monopoly, and logistics concentration without multilateral oversight. The Iran-US conflict made this exposure concrete, demonstrating that REE supply chain dependence carries consequences extending well beyond economic inefficiency into questions of strategic and military capacity. No *lex specialis* exists to fill this gap, and existing responses remain fragmented, non-binding, and incapable of governing a shock of this character. The choice is not between a multilateral framework and the *status quo*, but between a multilateral framework and a governance vacuum.

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