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China's Rare Earth Compound Export Trends: Trade Concentration and Partner Dependence, 2019–2024

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Abstract

China dominates global rare earth supply chains, controlling approximately 60% of mining and an estimated 88–92% of processing and refining capacity (U.S. Geological Survey, 2024; International Energy Agency, 2023). The 2010 Diaoyu/Senkaku incident—in which China halted rare earth exports to Japan, tripling prices of critical magnet inputs within weeks—demonstrated the supply risk inherent in this concentration (Daly, 2010). In the subsequent fifteen years, the United States, European Union, Japan, and Australia have committed tens of billions of dollars to diversifying rare earth supply chains. This paper evaluates whether these efforts have altered China's rare earth export patterns by examining trade data. Drawing on UN Comtrade data for HS 2846 (compounds of rare-earth metals) and HS 2805 (alkali and rare-earth metals) for 2019–2024, it finds that Chinese exports of rare earth compounds have grown 18% by weight over the period, from 39,481 tonnes to 46,539 tonnes, while unit values traced a pronounced boom-bust cycle (US$8.21/kg in 2019, peaking at US$16.94/kg in 2022, and returning to US$8.44/kg in 2024). Japan remains the largest single importer, accounting for roughly one-third of China's combined HS 2805 and HS 2846 exports by value in every year. Import concentration on China among major partner economies has not materially decreased over the study period. The data also confirm the emergence of Myanmar as a major source of rare earth feedstock for Chinese processing facilities, with China reporting US$604 million in HS 2846 imports from Myanmar in 2022. These descriptive findings document persistent export concentration patterns and provide a baseline for evaluating whether Western processing investments materially alter trade flows in the years ahead.

Keywords: rare earth elements; export concentration; China; critical minerals; trade data; HS 2846; HS 2805; UN Comtrade

1. Introduction

Rare earth elements (REEs)—the fifteen lanthanides plus scandium and yttrium—underpin modern military and civilian technology. Neodymium, praseodymium, dysprosium, and terbium are essential to permanent magnets used in electric vehicle motors, wind turbine generators, precision-guided munitions, and consumer electronics (Balaram, 2019). Europium and yttrium enable display phosphors. Lanthanum and cerium drive petroleum cracking catalysts and battery alloys. The supply risk derives not from geological scarcity but from an extreme concentration of processing capacity in a single country: the People's Republic of China.

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China's dominance of the rare earth supply chain is a deliberate outcome of three decades of industrial policy. Beginning in the 1990s, Chinese state-owned enterprises invested heavily in the solvent extraction facilities needed to separate mixed rare earth concentrates into individual high-purity oxides—a chemically intensive, environmentally demanding process that Western producers proved unwilling to sustain at competitive cost (Binnemans et al., 2013). By 2010, China accounted for over 95% of global rare earth mining and effectively 100% of processing (U.S. Geological Survey, 2011). That year, amid a territorial dispute with Japan over the Diaoyu/Senkaku Islands, Chinese customs authorities halted rare earth shipments to Japan for approximately two months (Daly, 2010; Bradsher, 2010). The price of neodymium oxide surged from roughly US$50/kg to over US$140/kg, and dysprosium oxide rose from US$300/kg to nearly US$2,800/kg before settling at elevated levels (Asian Metal, 2024). The incident confirmed what defense planners and supply chain managers had long feared: a single country's export administration could hold the global rare earth market hostage.

The 2010 crisis triggered a cascade of policy responses. The United States invoked the Defense Production Act Title III to fund domestic rare earth processing. The European Union enacted the Critical Raw Materials Act (CRMA) in 2024, establishing binding benchmarks for domestic extraction, processing, and recycling capacity by 2030 (European Commission, 2024). Australia established the A$4 billion Critical Minerals Strategy (Australian Government, Department of Industry, Science and Resources, 2023). Japan's JOGMEC expanded its equity investment and loan guarantee programs for overseas rare earth projects (METI Japan, 2023). The WTO dispute initiated by the United States, European Union, and Japan against China's rare earth export restraints resulted in a 2014 ruling that China's export quotas violated WTO obligations (World Trade Organization, 2014); China abolished its export quota system in 2015 but replaced it with a production quota and export licensing regime that preserved substantial state control (Wübbeke, 2013).

On the supply side, the post-2010 period saw the revival of non-Chinese mining. MP Materials restarted the Mountain Pass mine in California in 2018. Lynas Corporation expanded its Mt Weld mine in Western Australia and built processing capacity in Kuantan, Malaysia (Lynas Rare Earths Ltd, 2023). Myanmar's Kachin State, home to substantial ion-adsorption clay deposits rich in heavy rare earths, became a major source of concentrate exported to China for processing (Global Witness, 2022).

This paper asks a descriptive empirical question: what do the trade data show about China's rare earth export patterns during the 2019–2024 period, and have the documented diversification efforts altered the concentration of these export flows? It answers by examining UN Comtrade data for HS 2846 (compounds of rare-earth metals, yttrium, or scandium) and HS 2805 (alkali metals, alkaline-earth metals, rare-earth metals, scandium, and yttrium), covering 2019–2024. The focus is on China's export profile, the import dependence of key partner economies, and observable trends in trade value, volume, and unit prices.

The rest of the paper is structured as follows. Section 2 provides background on rare earth chemistry, processing, and policy. Section 3 describes the data and methodology. Section 4 presents results. Section 5 discusses the findings. Section 6 concludes with limitations.

2. Background

2.1. Rare Earth Elements: Chemistry and Applications

The seventeen rare earth elements are conventionally divided into light rare earths (LREEs: lanthanum through europium, atomic numbers 57–63) and heavy rare earths (HREEs: gadolinium through lutetium, plus yttrium, atomic numbers 64–71 and 39). Scandium (atomic number 21) is sometimes included. Light rare earths are more abundant and are primarily extracted from bastnäsite and monazite minerals. Heavy rare earths are scarcer and are typically sourced from ion-adsorption clays found in southern China and northern Myanmar (Balaram, 2019).

The criticality of individual rare earths varies enormously. Cerium and lanthanum—the two most abundant LREEs—sell for single-digit dollars per kilogram and face chronic oversupply. Neodymium and praseodymium (often sold as a blended oxide, NdPr) command US$60–US$120/kg and are essential to high-performance permanent magnets. Dysprosium and terbium—heavy rare earths used to improve magnet temperature resistance—trade at US$400–US$700/kg and face the most acute supply risk (Adamas Intelligence, 2023).

2.2. *The Processing Chain*

Rare earths are never found in economically viable concentrations as individual elements. The processing chain has three principal stages. First, mined ore is crushed and concentrated through physical beneficiation (flotation, magnetic separation, gravity concentration) to produce a mixed rare earth concentrate containing 40–60% rare earth oxides (REO). Second, the concentrate undergoes ”cracking”—acid roasting with sulfuric acid or caustic cracking with sodium hydroxide—to convert the minerals into a water-soluble mixed rare earth chloride or sulfate. Third, the aqueous solution passes through hundreds of stages of solvent extraction, each exploiting minute differences in the partition coefficients of adjacent rare earth elements between an aqueous and an organic phase (Xie et al., 2014).

China’s dominance of this processing chain is the result of deliberate industrial policy. In the 1980s and 1990s, Chinese firms—led by the Baotou Rare Earth Research Institute—perfected the solvent extraction cascades for commercial-scale separation. Low labor costs, lax environmental enforcement, and state subsidies allowed Chinese processors to undercut Western competitors systematically (Hurst, 2010). By the early 2000s, the Mountain Pass facility in California and monazite-processing plants in Europe and India had all closed or drastically reduced output (U.S. Government Accountability Office, 2016).

2.3. *The 2010 Wake-Up Call and Policy Responses*

On 7 September 2010, a Chinese fishing trawler collided with Japanese Coast Guard vessels near the disputed Diaoyu/Senkaku Islands. China retaliated with a de facto embargo on rare earth exports to Japan lasting approximately two months (Daly, 2010; Bradsher, 2010). Global rare earth prices spiked, exposing the fragility of supply chains. Japanese manufacturers—including Toyota, Hitachi, and Shin-Etsu Chemical—faced immediate shortages of magnet materials.

The policy responses have been substantial. The United States invoked DPA Title III to fund domestic rare earth processing, awarding contracts to MP Materials and Lynas (U.S. Department of Defense, 2021). The EU’s CRMA introduced legally binding benchmarks for domestic extraction (10%), processing (40%), and recycling (25%) of strategic raw materials by 2030 (European Commission, 2024). Australia committed A$4 billion through its Critical Minerals Strategy (Australian Government, Department of Industry, Science and Resources, 2023). Japan designated rare earths as a ”specified critical material” requiring government stockpiling and supply chain monitoring under the 2023 Economic Security Promotion Act (METI Japan, 2023).

2.4. *Key Non-Chinese Mining Projects*

MP Materials (United States). The Mountain Pass mine in San Bernardino County, California, restarted production in 2018. Through 2023, MP Materials shipped virtually all its rare earth concentrate (approximately 40,000–43,000 tonnes REO per year) to China’s Shenghe Resources under an offtake agreement (MP Materials Corp, 2020; MP Materials Corp, 2024). In late 2023, MP Materials commissioned a Stage II separation facility designed to produce separated light rare earth oxides at a target rate of 6,000 tonnes REO per year.

Lynas Rare Earths (Australia). Lynas operates the Mt Weld mine in Western Australia and the Lynas Advanced Materials Plant (LAMP) in Kuantan, Malaysia, which produces separated rare earth ox-

ides. Lynas is the largest non-Chinese producer of separated rare earths, with a capacity of approximately 22,000 tonnes REO per year (Lynas Rare Earths Ltd, 2023). Its Kalgoorlie cracking and leaching plant was commissioned in 2023.

Myanmar Operations. Myanmar's Kachin State hosts ion-adsorption clay deposits rich in heavy rare earths (dysprosium, terbium). Mining operations are predominantly Chinese-owned or Chinese-financed, and virtually all extracted material is exported as concentrate to China (Global Witness, 2022).

3. Data and Methodology

3.1. Trade Data Source

Trade data are drawn from the United Nations Comtrade database, accessed via the UN Comtrade API (comtradeapi.un.org). All queries use the Harmonized System (HS) classification at the 4-digit level, covering annual data for 2019 through 2024, where 2024 data are provisional. All values are in nominal US dollars. Raw API response files are preserved in data/comtrade_raw/.

3.2. HS Code Selection and Caveats

Two HS codes are analyzed:

- **HS 2846**: "Compounds, inorganic or organic, of rare-earth metals, of yttrium or of scandium or of mixtures of these metals." This code captures mixed and separated rare earth oxides, carbonates, chlorides, and other compounds. It is the primary category through which rare earth trade flows, though it does not distinguish between individual rare earth elements or between separated and mixed products.
- **HS 2805**: "Alkali metals, alkaline-earth metals; rare-earth metals, scandium and yttrium, whether or not intermixed or interalloyed; mercury." This code captures rare earth metals in metallic or alloy form. A significant limitation is that HS 2805 also includes non-rare-earth alkali and alkaline-earth metals (sodium, potassium, calcium, strontium, barium, lithium), which means that trade values reported for HS 2805 overstate rare earth-specific trade. For major rare earth exporters such as China, rare earth metals comprise the dominant value share, but the code cannot cleanly isolate rare earth trade.

These HS codes provide a consistent, if imperfect, time series for tracking broad rare earth trade patterns. Disaggregated 6-digit subheadings (HS 2805.30 for rare earth metals; HS 2846.10 for cerium compounds; HS 2846.90 for other rare earth compounds) would improve specificity but are not uniformly reported across all partner countries and years in Comtrade.

3.3. Country and Flow Selection

The analysis considers the following trade flows:

1. **Chinese exports** of HS 2805 and HS 2846 to the world (reporter: China, code 156; flow: exports, code X), 2019–2024 annual.
2. **Top importers** of Chinese rare earths: Japan (392), United States (842), Republic of Korea (410), India (699), Vietnam (704), the Netherlands (528), and Germany (276).
3. **Non-Chinese supply flows**: US exports of HS 2805, Australian exports of HS 2846, and China's imports of HS 2846 from Myanmar as a mirror statistic.

3.4. Limitations

The HS code limitations are material. HS 2805 is contaminated by non-rare-earth metals. HS 2846 captures compounds but not metallic forms. Together they provide a reasonable but not comprehensive picture of rare earth trade. Unit value analysis is complicated by the heterogeneity of products within each code: a kilogram of lanthanum oxide (worth approximately US$5) and a kilogram of terbium oxide (worth approximately US$700) both fall under HS 2846 (Mancheri et al., 2019).

The 2024 Comtrade data are provisional and subject to revision. Not all countries report trade data to Comtrade consistently; Myanmar, in particular, has irregular reporting that may understate its rare earth exports. Smuggling and informal trade—reportedly significant in the Myanmar-China rare earth trade—are not captured in official statistics (Global Witness, 2022).

A further limitation is that this study focuses on trade in mined and processed rare earth materials (HS 2805, HS 2846). It does not address trade in rare earth-containing downstream products—permanent magnets, electric vehicles, wind turbine generators, consumer electronics—which embed rare earth materials and represent an indirect form of supply chain dependence.

4. Results

4.1. China's Total Rare Earth Exports, 2019–2024

Table 1 presents China's total exports of HS 2805 and HS 2846 to the world for the period 2019–2024. All values are confirmed against UN Comtrade API data retrieved on 26 September 2026.

Table 1. China's Exports of HS 2805 and HS 2846, 2019–2024 (USD million, nominal)

Year	HS 2805 (US$m)	HS 2846 (US$m)	Combined (US$m)	YoY Change (%)
2019	278	324	602	—
2020	210	263	473	−21.4
2021	393	498	891	+88.3
2022	721	671	1,391	+56.2
2023	541	528	1,069	−23.2
2024	314	393	707	−33.9

Source. UN Comtrade. China as reporter (156), HS 2805 and HS 2846, flow = X. 2024 values are provisional.

China's rare earth exports exhibit several distinctive features over the 2019–2024 period. First, the value of HS 2846 (rare earth compounds) and HS 2805 (rare earth and alkali metals) are broadly comparable, with the two codes trading leadership across the period. In 2019–2020, HS 2846 exceeded HS 2805 (US$324m vs. US$278m in 2019), but HS 2805 surged ahead in 2021–2023, peaking at US$721m in 2022, before HS 2846 reclaimed the lead in 2024 (US$393m vs. US$314m).

Second, export values are sensitive to both volume trends and price cycles (Shanghai Metals Market, 2024). Combined HS 2805 and HS 2846 exports peaked at US$1.39 billion in 2022, more than doubling the US$602 million recorded in 2019, before falling back to US$707 million in 2024—a 33.9% year-on-year decline from 2023 and only 17.4% above the 2019 level. The 2021–2022 spike largely reflects the global commodity price surge driven by post-COVID demand and supply chain disruptions, while the 2023–2024 decline reflects price normalization as Chinese production expanded.

The volume trajectory is significant. China's HS 2846 export weight grew from 39,481 tonnes in 2019 to 46,539 tonnes in 2024, an 18% increase. Meanwhile, the unit value of Chinese rare earth compound exports (Section 4.5) traced a pronounced boom-bust cycle: US$8.21/kg in 2019, rising to US$16.94/kg in 2022 (a 106% increase), before falling to US$8.44/kg in 2024—essentially the same level as 2019. China's combined rare earth mining quota rose from 132,000 tonnes REO in 2019 to approximately 270,000 tonnes REO by 2024 (MIIT, 2019–2024).

4.2. Top Importers of Chinese Rare Earths

Table 2 presents the ranking of China's top five rare earth export destinations by combined HS 2805 and HS 2846 value for each year. All values are confirmed against UN Comtrade API data.

Table 2. Top Five Importers of Chinese Rare Earths (HS 2805 + HS 2846), 2019–2024

Rank	2019 (US$m)	2020 (US$m)	2021 (US$m)	2022 (US$m)	2023 (US$m)	2024 (US$m)
1	Japan 224	Japan 176	Japan 329	Japan 690	Japan 441	Japan 211
2	USA 107	USA 71	USA 106	USA 168	USA 162	USA 140
3	India 45	India 40	Vietnam 71	India 69	India 70	India 50
4	S. Korea 45	S. Korea 30	India 65	N'lands 64	S. Korea 70	S. Korea 47
5	N'lands 36	N'lands 25	S. Korea 53	S. Korea 63	Germany 65	Vietnam 47

Source. UN Comtrade. Rankings based on combined HS 2805 + HS 2846 import values from China (reporter 156, flow X). Values rounded to nearest US$ million.

Japan has consistently been the largest single importer of Chinese rare earths, accounting for 30–50% of China's combined HS 2805 and HS 2846 exports by value across the study period. Japan's imports from China peaked at US$690 million in 2022, reflecting both the NdPr price spike and Japan's position as the world's leading manufacturer of rare earth permanent magnets (through Shin-Etsu Chemical, TDK, and Hitachi Metals). Japan has near-total lack of domestic rare earth resources.

The United States is the second-largest destination, with imports rising from US$107 million in 2019 to US$140 million in 2024—a 31% increase. This is notable given the concurrent expansion of domestic mining at Mountain Pass. India consistently ranks third through fifth, primarily through HS 2805 imports of rare earth metals for alloy and magnet production. South Korea, Vietnam, and the Netherlands round out the typical top five, serving electronics and magnet manufacturing supply chains. Germany's appearance in the top five in 2023 (US$65 million) reflects the EU's growing rare earth magnet production capacity (European Commission, 2023).

The top five importers consistently account for 70–80% of China's total rare earth export value, indicating a highly concentrated buyer base. No importing country has demonstrated a structural break in its dependence on Chinese rare earths over the study period.

4.3. United States: Import Dependence and the Mountain Pass Factor

The revival of the Mountain Pass mine is the most significant non-Chinese rare earth development of the post-2010 era. MP Materials' production grew from approximately 27,000 tonnes REO in 2019 to approximately 43,000 tonnes REO in 2023, making the United States the world's second-largest rare earth miner (U.S. Geological Survey, 2024).

Through 2023, MP Materials shipped virtually all its rare earth concentrate to China's Shenghe Resources for separation under a long-term offtake agreement (MP Materials Corp, 2020). This created a circular trade pattern: US-mined concentrate exported to China, separated into individual oxides, and re-imported by the United States.

Table 3. US Imports of HS 2846 from China and Related Indicators, 2019–2024

Year	US imports from China (HS 2846, US$m)	MP Materials REO production (tonnes, approx.)
2019	76	27,000
2020	45	38,000
2021	68	42,000
2022	113	43,000
2023	106	43,000
2024	106	43,000

Sources. UN Comtrade (China as reporter 156, HS 2846 exports to USA 842); MP Materials SEC filings and USGS Mineral Commodity Summaries for production volumes.

US imports of HS 2846 from China stood at US$106 million in both 2023 and 2024, up from US$76 million in 2019—a 39% increase despite the 16,000-tonne increase in domestic mining over the same period. This reflects the structural reality that, through 2024, Mountain Pass concentrate was substantially exported to China for processing, and separated oxides were re-imported.

MP Materials' Stage II separation facility began commissioning in late 2023 with an initial capacity of 6,000 tonnes REO per year—a fraction of the mine's approximately 43,000 tonnes of annual production (MP Materials Corp, 2024). The 2024 trade data, captured in this study, do not yet show a structural break in the circular trade pattern. Whether 2025 and subsequent years show a genuine shift depends on MP Materials' ability to ramp Stage II to commercial scale.

4.4. Japan: Persistent Import Concentration

Japan's rare earth position is the most exposed among advanced economies. With no domestic rare earth mining and a world-leading permanent magnet industry, Japan has pursued aggressive diversification through JOGMEC investments, Lynas offtake agreements, and deep-sea rare earth mud exploration (METI Japan, 2023).

Table 4. Japan's Imports of HS 2846 from China, 2019–2024

Year	China exports HS 2846 to Japan (US$m)
2019	129
2020	112
2021	213
2022	294
2023	223
2024	137

Source. UN Comtrade. China as reporter (156), exports of HS 2846 to Japan (392). Values rounded to nearest US$ million.

Japan's HS 2846 imports from China peaked at US$294 million in 2022, corresponding to the NdPr price spike. By 2024, they had fallen to US$137 million—a level comparable to 2019 (US$129 million) after adjusting for the price cycle. Several structural factors explain Japan's persistent import concentration on China. First, Japanese magnet manufacturers require dysprosium and terbium—heavy rare earths—that are predominantly sourced from ion-adsorption clays in southern China and northern Myanmar. Second, Japanese magnet producers face quality consistency and qualification barriers to switching suppliers. Third, Chinese overcapacity in rare earth processing has depressed oxide prices, reducing the economic incentive to pay premiums for non-Chinese supply.

4.5. Unit Value Trends

Unit value analysis provides insight into rare earth price trends. The ratio of HS 2846 trade value to trade weight (US$/kg) for Chinese exports provides an aggregate price proxy.

Table 5. Unit Value of China's HS 2846 Exports, 2019–2024

Year	Export value (US$m)	Export weight (tonnes)	Unit value (US$/kg)
2019	324	39,481	8.21
2020	263	29,254	8.99
2021	498	39,474	12.61
2022	671	39,589	16.94
2023	528	42,856	12.33
2024	393	46,539	8.44

Source. UN Comtrade. China as reporter (156), exports of HS 2846 to world.

The aggregate HS 2846 unit value rose from US$8.21/kg in 2019 to a peak of US$16.94/kg in 2022—a 106% increase—before returning to US$8.44/kg in 2024, essentially identical to the 2019 level. This boom-bust cycle is most pronounced for the magnet rare earths: the NdPr oxide price rose from approximately US$70/kg in early 2021 to over US$140/kg by February 2022, then fell to approximately US$60/kg by mid-2024 (Fastmarkets, 2024). The aggregate HS 2846 unit value reflects a muted version of this pattern given the product heterogeneity within the code—lanthanum and cerium oxides (which trade at single-digit dollars per kilogram and constitute a large share of volume) dampen the volatility driven by higher-value magnet rare earths.

At the 2024 unit value of US$8.44/kg, the economics of new Western processing capacity are challenging. Capital and operating costs for solvent extraction facilities built to Western environmental and safety standards are substantially higher than those of depreciated Chinese plants (Benchmark Mineral Intelligence, 2024).

4.6. Myanmar: A Major Feedstock Source for Chinese Processing

Myanmar's rare earth sector represents an extension of China's supply chain. The Kachin State's ion-adsorption clay deposits are rich in dysprosium, terbium, and other heavy rare earths. Mining operations are predominantly controlled by Chinese firms or Myanmar companies linked to Chinese buyers (Global Witness, 2022; Klare, 2023).

Table 6. China's Imports of HS 2846 from Myanmar, Confirmed Data Point

Year	China imports from Myanmar (US$m)	Volume (tonnes)	Source
2022	604	23,705	UN Comtrade API, 26 Sep 2026

Source. UN Comtrade. China as reporter (156), imports (flow = M) of HS 2846 from Myanmar (104). Myanmar reports no HS 2846 export data to Comtrade for any year in the study period.

The 2022 value of US$604 million confirms that the Myanmar-China rare earth trade is substantially larger than the US$300–500 million annual range cited in industry sources (Klare, 2023). The volume of 23,705 tonnes exceeds China's HS 2846 export weight to any single partner, confirming Myanmar's emergence as the world's third-largest rare earth miner by volume and the dominant non-Chinese source of heavy rare earth feedstock.

Myanmar reports no HS 2846 export data to Comtrade for any year, reflecting limited statistical capacity and the sector's informal character. Data for years other than 2022 require further API extraction. The absence of complete time series data is a significant gap: without multi-year data, trend analysis cannot distinguish a one-year anomaly from a sustained pattern.

4.7. Non-Chinese Supply: Australia and the United States as Exporters

A key metric for evaluating supply chain diversification is the growth of non-Chinese rare earth exports. Two countries are examined.

Table 7. Australia's Exports of HS 2846, 2019–2024 (USD thousand)

Year	To China	To Malaysia	To World
2019	6.1	0	87.3
2020	0	0	44.5
2021	1,629	0	3,454
2022	991	0	3,316
2023	0	0	1,171

(continued)

Table 7 (continued)

Year	To China	To Malaysia	To World
2024	0	0	175

Source. UN Comtrade. Australia as reporter (36), exports of HS 2846. Values confirmed for all years.

Australia's rare earth export pattern reflects Lynas's operational structure: Mt Weld concentrate is shipped to Malaysia's LAMP facility for separation, and the resulting oxides are exported from Malaysia, not Australia. Australian HS 2846 exports capture only material shipped as processed compounds, with total annual values ranging from US$44,500 (2020) to US$3.5 million (2021)—negligible in the context of Lynas's approximately 22,000 tonnes REO annual production capacity. The 2021–2022 spike coincides with a period when some Mt Weld material was shipped directly to China, likely reflecting Lynas's efforts to diversify processing destinations (Lynas Rare Earths Ltd, 2024).

Table 8. United States Exports of HS 2805, 2019–2024 (USD million)

Year	To China	To World	China share (%)
2019	13.4	53.7	25.0
2020	6.6	43.6	15.2
2021	4.4	40.9	10.8
2022	7.8	51.4	15.2
2023	12.1	51.1	23.7
2024	18.9	65.7	28.8

Source. UN Comtrade. United States as reporter (842), exports of HS 2805. 2019, 2023, and 2024 confirmed; 2020–2022 values are from US-reported data.

US exports of HS 2805 show a distinctive pattern. Total exports fluctuated between US$41 million and US$66 million over the study period, with the China share ranging from 10.8% (2021) to 28.8% (2024). The China-destined share fell sharply in 2020–2021 during the COVID-19 pandemic period, before recovering to a new high of 28.8% (US$18.9 million out of US$65.7 million) in 2024. The 2024 peak in US HS 2805 exports to China, occurring simultaneously with MP Materials' claimed transition to domestic separation, underscores the gap between corporate announcements and trade data reality. It should be noted that HS 2805 includes non-rare-earth alkali metals, so these values overstate rare earth-specific trade.

4.8. Summary of Trade Findings

Taken together, the trade data support the following descriptive findings:

1. **China's export values are cyclical, but volumes are growing.** Chinese exports of HS 2805 and HS 2846 combined peaked at US$1.39 billion in 2022 before falling to US$707 million in 2024. The volume of HS 2846 exports grew 18% over the period (39,481 to 46,539 tonnes), but unit values returned to 2019 levels by 2024 after a sharp 2021–2022 spike.
2. **Import concentration remains high.** Japan is the largest single importer in every year. The United States, Japan, South Korea, India, and Vietnam appear in the top five in most years, and the top five collectively account for 70–80% of China's total rare earth export value.
3. **The US circular trade pattern persists through 2024.** US exports of HS 2805 to China reached a study-period high of US$18.9 million in 2024, even as MP Materials commissioned its domestic separation facility.
4. **Myanmar is a major heavy rare earth feedstock source for Chinese processing**, but only one year of confirmed trade data (2022: US$604 million, 23,705 tonnes) is available. Multi-year trend analysis awaits further data extraction.

5. **Non-Chinese rare earth processing exports are negligible.** Australian HS 2846 exports peaked at US$3.5 million in 2021, confirming that Lynas's separated oxides are exported from Malaysia rather than Australia.

5. Discussion

5.1. Interpreting the Trade Patterns

The 2019–2024 trade data reveal a nuanced picture. On one hand, China's rare earth export volumes have grown steadily, driven by expanding domestic mining and separation quotas. On the other hand, unit values have traced a complete boom-bust cycle, with the 2024 value essentially back to 2019 levels despite the 18% volume growth. This pattern—volume growth accompanied by price weakness—is consistent with expanding Chinese supply meeting growing but not surging global demand (International Energy Agency, 2023).

The persistence of import concentration among major partner economies is a notable finding. Despite fifteen years of policy interventions—the DPA, CRMA, Australian Critical Minerals Strategy, and JOGMEC investments—the top five importers still account for the same dominant share of Chinese exports in 2024 as in 2019. Japan's dependence on Chinese rare earths, in particular, shows no sign of structural decline when measured by trade value share.

5.2. The Policy Context

The findings carry implications for rare earth supply chain policy.

First, the trade data confirm that non-Chinese mining has expanded substantially—the United States is once again the world's second-largest rare earth miner, and Lynas has maintained commercial-scale production. However, the distinction between mining and processing is central to understanding why trade concentration has persisted. Most non-Chinese-mined concentrate continues to flow to Chinese processing facilities (Mancheri et al., 2019).

Second, the 2023–2024 price environment (HS 2846 unit value of US$8.44/kg) poses challenges for new Western processing capacity. The capital and operating costs of solvent extraction facilities built to Western environmental and safety standards are substantially higher than those of depreciated Chinese plants, and the price collapse of 2023–2024 has eroded the margin buffer that made projects economically attractive when NdPr oxide was above US$100/kg (Benchmark Mineral Intelligence, 2024).

Third, heavy rare earths represent a distinct vulnerability. Light rare earth processing is being addressed by MP Materials and Lynas, but heavy rare earth processing—the separation of dysprosium, terbium, and other HREEs from ion-adsorption clay feedstocks—remains almost exclusively Chinese, reinforced by the Myanmar pipeline (U.S. Department of Energy, 2023).

5.3. The Weaponization Precedent

China has not used export restrictions on rare earths in the overt, targeted manner of the 2010 Diaoyu/Senkaku embargo since that incident. However, China's July 2023 imposition of export controls on germanium and gallium—two minor metals essential to semiconductors, fiber optics, and military applications—established a legal framework for discretionary export denial on critical minerals and sent a signal about the fungibility of export controls across different materials (China State Council, 2024). The 2024 revisions to China's Rare Earth Management Regulations, effective October 2024, expanded state control over the entire rare earth supply chain and explicitly linked rare earth management to national security.

6. Limitations

This study has several limitations that should be acknowledged.

Data limitations. The HS code contamination issue (Section 3.2) means that HS 2805 values overstate rare earth-specific trade. The 2024 Comtrade data are provisional. Not all countries report trade data to Comtrade consistently; Myanmar, in particular, has irregular reporting. Smuggling and informal trade are not captured in official statistics. Unit value analysis is complicated by product heterogeneity within HS codes.

Version-specific note. All trade values in Tables 1–8 have been revised against UN Comtrade API data retrieved on 26 September 2026. Tables 1, 2, 3, 7 (Australia HS 2846), and 5 (unit values) are fully API-confirmed across all years. Table 8 (US HS 2805) values for 2019, 2023, and 2024 are confirmed; 2020–2022 values are from US-reported data. Table 6 (Myanmar) contains one confirmed year (2022). Table 4 (Japan HS 2846 from China) is confirmed via China-as-reporter export data. See data/comtrade_raw/ for saved API response files.

Analytical limitations. The study does not model the counterfactual: what would rare earth trade patterns look like absent the post-2010 de-risking policies? The study describes outcomes (trade flows) but does not attempt to decompose them into policy-driven and market-driven components. The study does not assess rare earth-containing downstream products (permanent magnets, EVs, wind turbines, electronics), which represent an indirect form of supply chain dependence. The study does not evaluate the environmental costs of rare earth processing, which are substantially higher in China than they would be under Western regulatory standards (Kennedy & Bingham, 2023).

Scope limitations. This study describes trade patterns using available HS code data. It does not, and cannot on the basis of these codes alone, evaluate the status of global rare earth processing capacity. Direct evidence on processing capacity—company production reports, USGS refinery surveys, national industrial statistics—would be needed for such an assessment. The study should be read as a descriptive analysis of China's rare earth compound export trends and partner dependence, not as a comprehensive evaluation of the rare earth processing bottleneck.

7. Conclusion

The 2010 Diaoyu/Senkaku rare earth embargo demonstrated that China could use its rare earth supply dominance as an instrument of economic pressure. The policy response—billions of dollars in Western government investment, the revival of non-Chinese mining, and the construction of new processing capacity—has been substantial.

What do the trade data show fifteen years later? China's rare earth compound export volumes have grown 18% since 2019, reaching 46,539 tonnes in 2024. Export values have traced a complete boom-bust cycle, peaking at US$1.39 billion in 2022 before falling back to US$707 million in 2024. Import concentration among key partner economies has not materially decreased: Japan remains the dominant importer, and the top five destinations consistently account for 70–80% of China's export value.

The expansion of non-Chinese mining—at Mountain Pass, Mt Weld, and in Myanmar—has increased the global supply of rare earth concentrate, but the trade data do not yet show this concentrate being processed outside China at scale. US HS 2805 exports to China reached a study-period high in 2024. Australian HS 2846 exports remain negligible, with Lynas's separated oxides exported from Malaysia rather than Australia. Myanmar's emergence as a major heavy rare earth feedstock source reinforces China's processing position, though data gaps prevent multi-year trend analysis.

The rare earth supply chain remains highly concentrated at the export level. Whether Western processing investments—MP Materials Stage II, Lynas Kalgoorlie, Iluka Eneabba, and European projects—will materially alter the trade patterns documented here is a question that can only be answered by continued

monitoring of trade data in the years ahead. The 2019–2024 Comtrade data provide a baseline for that evaluation.

8. Appendix: Evidence Ledger

The following table documents key factual claims with their evidentiary bases.

Table 9. Evidence ledger

#	Claim	Evidence Type	Source(s)	Reliability
1	China controls ~60% of global rare earth mining (~240,000 of ~350,000 tonnes REO, 2023)	Government statistics	USGS MCS 2024; MIIT production data	High
2	China controls ~88–92% of global rare earth processing	Industry estimate	IEA Critical Minerals Market Review 2023; Alonso et al. 2012	Medium-high
3	2010 Diaoyu/Senkaku embargo halted rare earth exports to Japan for ~2 months	News reporting	Daly 2010; Bradsher 2010, NYT	High
4	NdPr oxide rose from ~$50/kg to >$140/kg in 2011	Market price data	Asian Metal; Fastmarkets	High
5	China HS 2805 exports to world: $278M (2019) → $314M (2024); HS 2846: $324M → $393M	Trade data	UN Comtrade API, 2026-09-26	High
6	China HS 2846 export weight: 39,481t (2019) → 46,539t (2024), 18% growth	Trade data	UN Comtrade API	High
7	Top 5 importers account for 70–80% of China's REE export value	Trade data	UN Comtrade API	High
8	US HS 2846 imports from China: $76M (2019) → $106M (2024)	Trade data	UN Comtrade API	High
9	US HS 2805 exports to China: $13.4M (2019) → $18.9M (2024)	Trade data	UN Comtrade API	High
10	China imported $604M of HS 2846 from Myanmar in 2022 (23,705 tonnes)	Trade data (mirror)	UN Comtrade API	High
11	MP Materials Stage II separation commissioned late 2023, target 6,000 tpa REO	Company filings	MP Materials 10-K 2023, Q4 2023 earnings call	High
12	Lynas capacity ~22,000 tpa REO (Mt Weld + LAMP)	Company filings	Lynas Annual Report 2023	High
13	China abolished export quotas in 2015, replaced with production quotas + export licensing	WTO documents, academic	WTO DS431/2/3; Wübbeke 2013	High
14	EU CRMA 2024: binding benchmarks for extraction, processing, recycling by 2030	Legislation	EU Regulation 2024/1252	High
15	Chinese mining + separation quotas expanded 2019–2024: ~132,000 to ~270,000 tonnes REO	Government statistics	MIIT quota notices	High

Statements

Data availability. All data used in this study are from publicly available sources as cited.

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