LatAm Thematic

Can Brazil become the rare earths champion of the Western Hemisphere?

Industry Overview

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Caio Ribeiro >>
Research Analyst
Merrill Lynch (Brazil)
+55 11 2188-4375
caio.ribeiro@bofa.com

David Beker >>
Bz Econ/FI & LatAm EQ Strategy
Merrill Lynch (Brazil)
+55 11 2188 4371
david.beker@bofa.com

Guilherme Rosito >>
Research Analyst
Merrill Lynch (Brazil)
+55 11 2188 4363
guilherme.rosito@bofa.com

Mariana Leite >>
Research Analyst
Merrill Lynch (Brazil)
+55 11 2188 4073
mariana.leite@bofa.com

REEs: Growing strategic importance

We are publishing this deep dive on rare earth elements (REEs) at a moment when their strategic relevance has never been greater. REEs are embedded in EV traction motors, wind-turbine generators, robotics, consumer electronics and defense systems, making them indispensable to industrial competitiveness. With global NdPr demand expected to rise more than 50% by 2030, the market is entering a phase in which securing long-term access to magnetic REEs is no longer optional.

China dominant, US scaling capacity

China retains near-total dominance in REE mid- and downstream processing, producing almost all heavy rare earths and nearly 90% of global NdFeB magnets. The US, meanwhile, has significantly accelerated its build-out, restoring NdPr separation at Mountain Pass and launching multibillion-dollar federal programs to expand refining and magnet capacity. These initiatives have pushed the US onto a clear growth trajectory as domestic projects move from early development to commissioning.

Geopolitical tension pushing the search for alternatives

Rising US-China trade tensions have brought supply-chain vulnerabilities into sharper focus, with export controls and trade restrictions affecting REEs. The US remains structurally dependent on China's downstream capacity, while China increasingly uses its dominant position on the supply side as leverage in the broader trade dispute. This friction is creating space for alternative producers to emerge, with Brazil gaining attention as a neutral, resource-rich candidate.

Brazil: Large resource base, limited processing

Brazil holds the second largest rare-earth reserve base (~21Mt, which account for ~24% of global reserves), including ionic-clay systems rich in NdPr, Dy and Tb. However, the country still accounts for less than 1% of global supply due to lack of investments and commercial-scale separation. Despite promising geological potential and a growing pipeline of projects, Brazil remains upstream-heavy and has yet to build the midstream necessary to become globally relevant.

Building the midstream is key to avoiding a value trap

Foreign investment and international partnerships could unlock the midstream capability Brazil lacks, accelerating project development and enabling the country to supply global EV, wind and tech supply chains. But they also raise a structural risk: that Brazil becomes locked into a low-value role focused on extraction and basic processing, while high-value magnet and component manufacturing remains offshore. Recognizing this, the government has added rare earths to its strategic mineral's agenda.

Refer to important disclosures on page 25 to 26.

Rare earths 101

Why rare earths matter?

Rare earth elements (REEs) are critical inputs for the global energy transition. Their combination of magnetic, optical, and catalytic properties makes them indispensable across electric vehicles (EVs), wind turbines, electronics, defense systems, and other advanced technologies. Despite their name, these elements are not geologically scarce; rather, what is rare is the ability to find deposits in concentrations that can be mined and processed economically. As global economies accelerate electrification and decarbonization, the strategic relevance of rare earths rises, with supply chain security and diversification becoming policy priorities for governments and corporates alike.

What are rare earths?

Rare earths comprise 17 elements: the 15 lanthanides (atomic numbers 57–71) plus yttrium (Y) and scandium (Sc), which share similar chemical behavior. Within this group, REEs are generally classified into light rare earth elements (LREEs), which include La, Ce, Pr, Nd, Sm, and heavy rare earth elements (HREEs), spanning Eu to Lu along with Y. LREEs are typically more abundant and associated with carbonatite-hosted deposits, whereas HREEs occur in far smaller quantities and are often recovered from ion-adsorption clays, particularly in southern China.

Where are rare earths found?

Although REEs are relatively abundant in the Earth's crust, the challenge lies in their dispersion. They rarely occur in high-grade, homogeneous accumulations. Key production centers have historically been associated with a few major deposits: carbonatites such as Bayan Obo (China), Mt Weld (Australia), and Mountain Pass (United States) dominate global LREE output, while ionic clay deposits remain the principal source of HREEs.

The distinction between LREE- and HREE-rich deposits has implications for supply, pricing, and strategic vulnerability, because HREEs such as dysprosium and terbium are essential for high-temperature permanent magnets and have limited alternative sources.

What are the key applications?

Rare earths enable a broad spectrum of high-performance applications due to their unique functional properties. In value terms, permanent magnets dominate the market, representing the bulk of the economic value in REE demand despite being only a portion of total volumes. See specific applications in the table below:

Exhibit 1: Magnets are the main application
Key application per rare earth element

Rare Earth Element	Current Applications
Scandium	Metals alloys used by the aerospace industry
Ytrium	Phosphors, ceramics, metal allows
Lanthanum	Batteries, catalysts for petroleum refining
Cerium	Autocatalysts, Chemical catalyst, glass polishing, alloys
Praseodymium	High power magnets, yellow ceramic pigment
Neodymium	High power magnets
Promethium	Beta radiation source
Samarium	High temperature magnets
Europium	Fluorescent lighting
Gadolinium	MRI contrast agent, nuclear reactor rods
Terbium	Phosphorus for lighting, high-power magnets
Dysprosium	High power high temperature magnets, lasers
Holmium	Highest power magnets in existence
Erbium	Lasers, glass colorant
Thulium	Ceramic magnetic materials
Ytterbium	Fibre optic technology, solar panels
Lutetium	PET scanners

Source: BofA Global Research, Lynas

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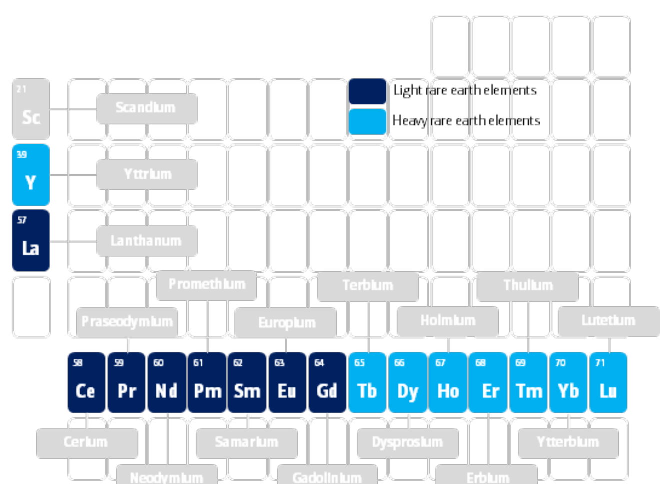
Exhibit 2: Summary of all the rare earth elements
REE in the periodic table



Source: BofA Global Research, US Government Accountability Office

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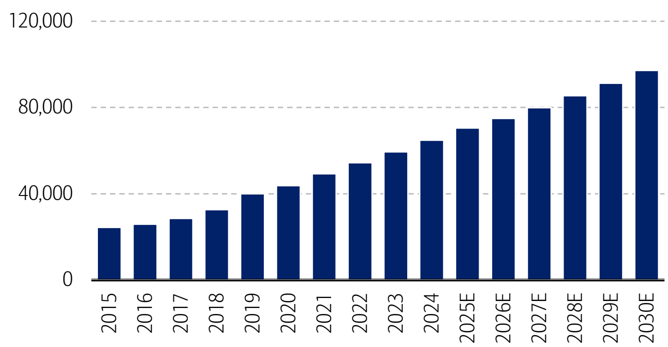
Demand outlook

Tightening demand anchored in permanent magnets

Global demand for REEs continues to intensify as electrification, renewable-energy expansion, advanced electronics, and defense systems scale globally. Within the REE basket, NdPr remains the critical bottleneck, underpinning the magnet supply chain due to its unrivaled performance in high-efficiency permanent magnets used across EV traction motors, wind-turbine generators, robotics, and strategic defense systems.

Market forecasts indicate that NdPr demand will grow ~7% annually through 2030, driven by accelerating technology adoption and geopolitical relevance. Bloomberg estimates that global supply chains will require ~97Kt of NdPr by 2030, roughly 50% above 2024 levels, with magnet manufacturing absorbing most of the volume. Decarbonization themes, particularly EV penetration and wind-generation buildout, represent ~75% of projected demand growth, while rising geopolitical tensions are increasing strategic consumption across defense and industrial systems.

Exhibit 3: Bloomberg estimates demand of ~97Kt for NdPr by 2030
Global NdPr demand forecast (tons)



Source: BofA Global Research, Bloomberg

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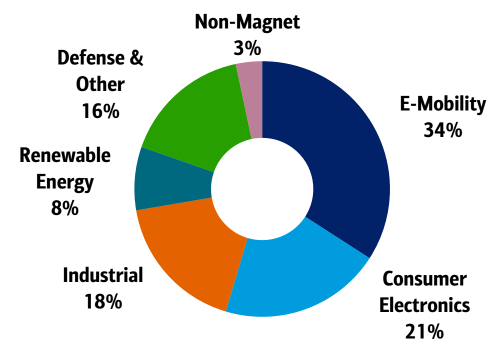
Exhibit 4: E-Mobility and consumer electronics are the main use
Global NdPr demand by end-use (%)



Source: BofA Global Research, Bloomberg

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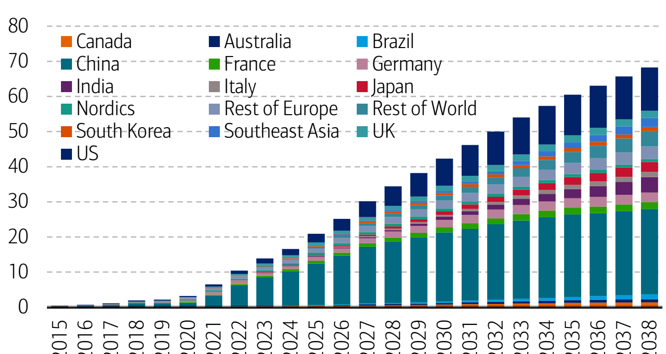
EVs are the largest and fastest-growing source of demand

EVs remain the strongest driver of REE magnet demand, automotive NdPr demand could surge 83% to 38.7Kt over the 2024-30 period, according to Bloomberg. Permanent-magnet motors continue to dominate EV powertrain architecture due to superior torque density and energy efficiency. According to Lynas, integrating ~2Kg of REEs into an EV drive motor improves efficiency by 2–5%, enabling automakers to reach target range with smaller, lighter and lower-cost battery packs, a key advantage, considering the battery accounts for ~50% of total vehicle cost.

Exhibit 5: Global EV demand set to continue increasing
Electric vehicles sales (unit)



Source: BofA Global Research, Bloomberg

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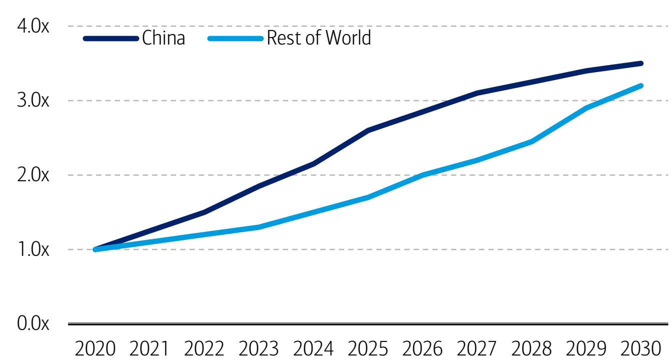
Exhibit 6: China continues to be the main driver
Vehicle Rare-Earth demand index (2020 = 100)



Source: BofA Global Research, Bloomberg

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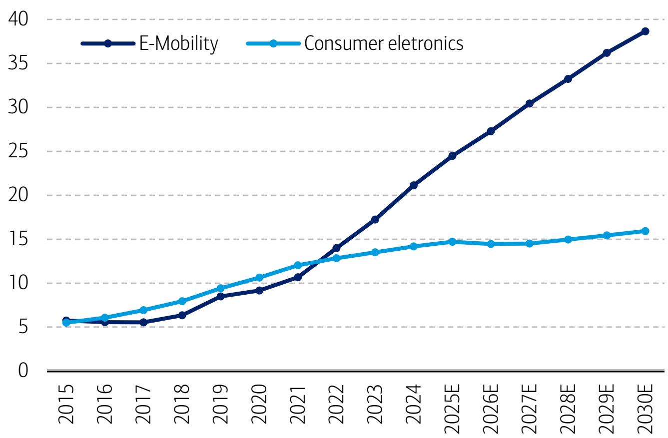
Electronics & Technology: A stable, high-volume anchor

NdPr demand from consumer electronics (smartphones, laptops, wearables, audio systems) remains a large and relatively stable portion of demand. Industrial automation and robotics add incremental growth as factories adopt high-precision NdFeB-based systems. The medical-technology sector (MRI machines, surgical robotics, magnetically actuated devices) provides an additional layer of stable consumption. These segments collectively form a structural demand floor, helping smooth out volatility from more cyclical applications. Others, such as elevators also contribute to demand increase.

Exhibit 7: E-mobility and consumer electronics demand for RE to grow
NdPr demand for e-mobility and consumer electronics (Kt)



Source: BofA Global Research, Bloomberg

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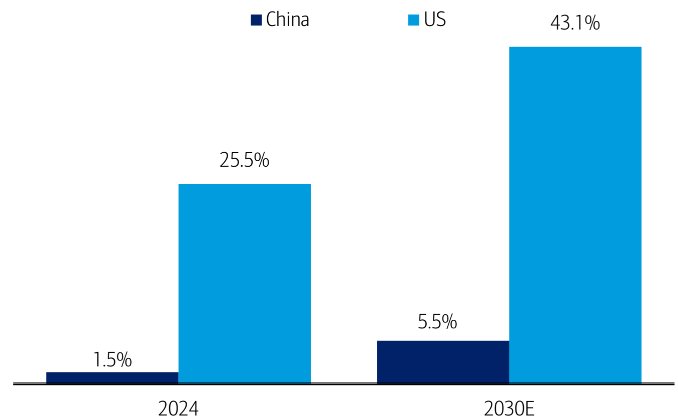
Exhibit 8: We expect robotic surgery penetration to increase
Laparoscopic robot-assisted surgery penetration (China vs. US)



Source: BofA Global Research estimates

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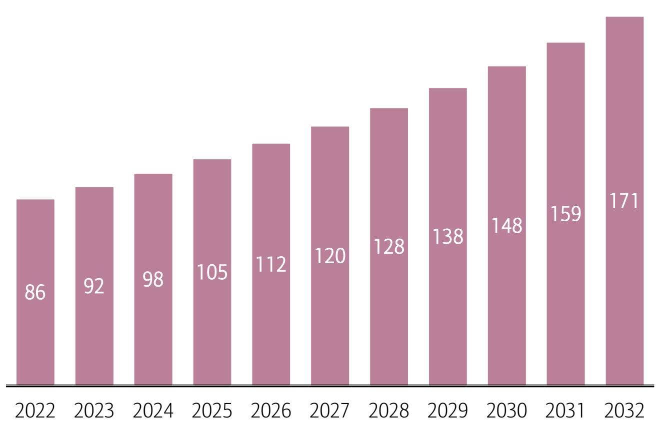
Exhibit 9: Elevator and escalator market size keeps increasing
Elevator and escalator market size ($bn)



Source: BofA Global Research, Precedence Research

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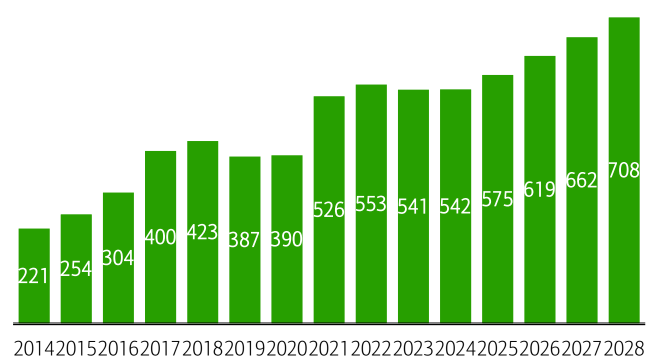
Exhibit 10: Robotics as a new form of demand
Annual installations of industrial robots ('000 units)



Source: BofA Global Research, International Federation of robotics

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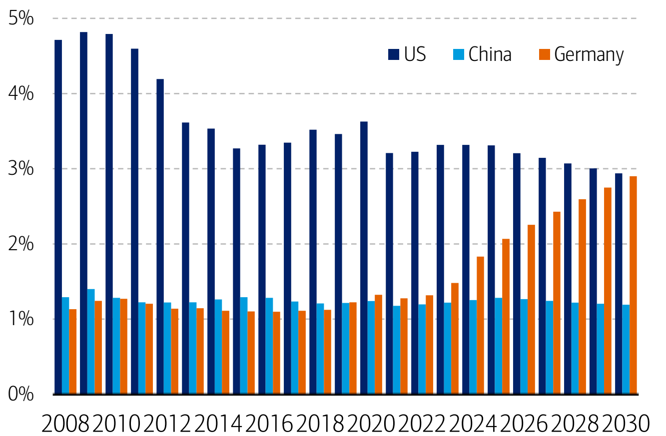
Defense: Geopolitics elevating strategic NdPr demand

Geopolitical tensions are pushing defense spending higher, lifting demand for NdPr-based magnets across advanced military systems. NATO members plan to raise defense investment to 3.5% of GDP by 2035, supporting magnet-intensive platforms like the F-35 (~0.4tons of REPMs) and Virginia-class submarines (~4.6tons). Although historically small, defense demand could temporarily outpace civilian growth, heightening concerns around supply security and refining-capacity concentration.

Climate Smart Mining = Wind Turbines = RE Demand

Wind powered energy generation is rapidly expanding but still secondary source of NdPr demand. Direct-drive turbines are especially magnet-intensive, requiring 400–600 kg of Nd-Dy magnets per 3 MW unit. Bloomberg projects 1,200 GW of new wind capacity by 2030, with offshore installations—far more magnet heavy—accounting for ~13% of additions. China is set to deliver ~60% of global turbine installations due to its supply-chain strength. While wind demand remains smaller than EVs, offshore build-out ensures the sector's long-term strategic importance for magnet consumption.

Exhibit 11: Defense spending is trending higher in Europe
Regional defense spending, % of GDP



Source: BofA Global Research, IISS, IMF

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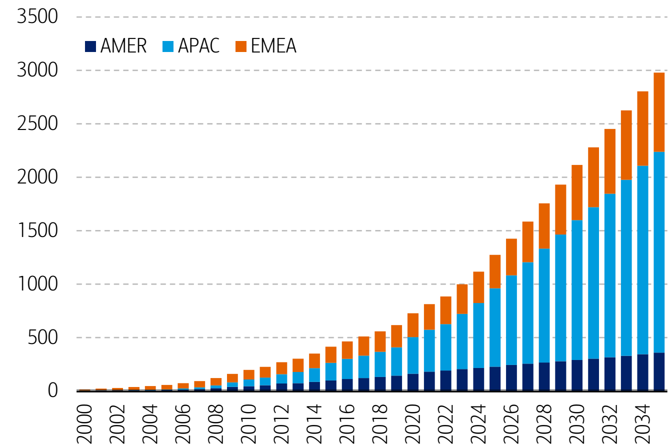
Exhibit 12: Wind demand remains rapidly expanding
Installed wind capacity (GW)



Source: BofA Global Research, Bloomberg

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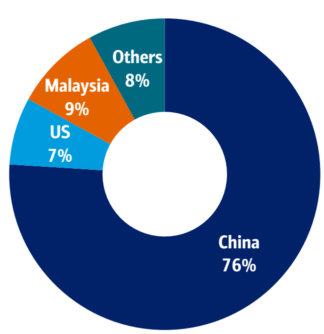
China concentrates most of demand globally today

According to the IEA Rare Earth Elements Outlook, China remains the dominant force in global rare earth demand because it controls over 80–90% of global refining capacity and a major share of downstream manufacturing that consumes REEs in magnets, electronics, and industrial components. This processing dominance ensures that even REEs mined elsewhere largely flow into Chinese supply chains, effectively centralizing global demand. The United States, Europe, and broader Asia (ex-China) are increasingly contributing to demand through EV adoption, industrial electrification, and advanced electronics, but none approach China's scale.

Exhibit 13: China to continue accounting for most refining capacity
Top tHREE refining countries by 2030 (%)



Source: BofA Global Research, IEA

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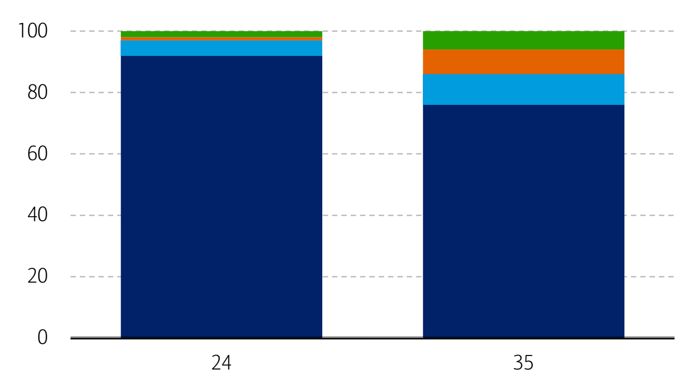
Exhibit 14: Refined material production set to remain concentrated
Geographical distribution of refined material production in IEA base case



Source: BofA Global Research, IEA

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Supply outlook

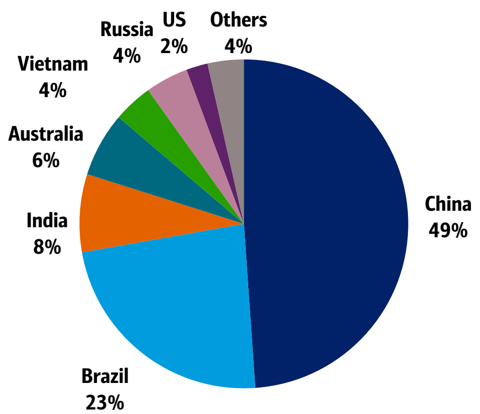
Supply chain covers everything from mine to magnet

The RE supply chain encompasses everything from mining and separation through to alloying, metal making and eventual manufacturing in catalysts, magnets etc. While mining is relatively straightforward, separation of concentrate to oxide is not, reflecting both the financial and technical hurdles, plus its environmental impacts. Most of LREE separation is done in China, while all HREE separation is done in China. This monopoly has led to China's domination of downstream, alloy and magnet making.

Global reserves are large but unevenly distributed.

According to USGS, China holds ~49% of global reserves, followed by Brazil, India, Australia, Vietnam, Russia, and the US. On the production side, China accounts for ~69% of global unseparated REO output, with the US and Australia providing ~15% combined. Myanmar also contributes to heavy rare earth supply. This mismatch between reserve and processing locations is a vulnerability of the RE ecosystem.

Exhibit 15: REO global reserves by country (2024)
China accounts for 49% of the global REO reserves. US and Australia = 8.4%



Source: BofA Global Research, US Geological Survey (USGS)

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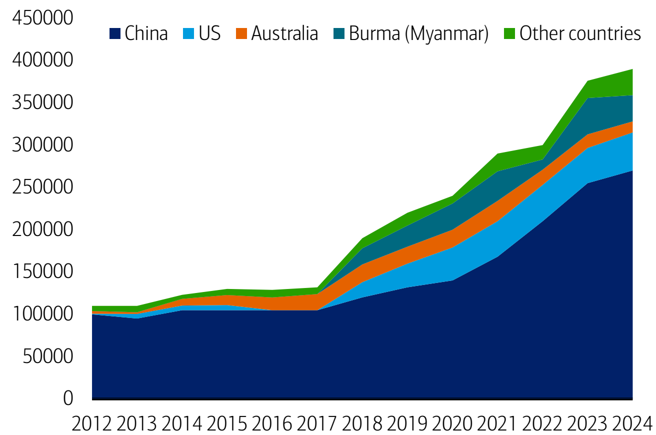
Exhibit 16: REO (unseparated) production by country (tonnes), 2024
~69% of the global REO production was produced from China in 2024



Source: BofA Global Research, US Geological Survey (USGS)

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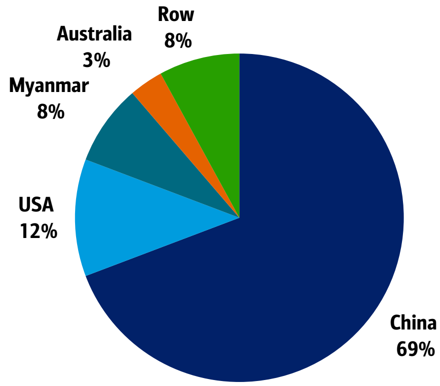
China dominates the rare-earth supply chain end-to-end

China produces more than 70% of global NdPr and nearly all heavy rare-earth oxides, while also controlling ~90% of global separation, metallization, and magnet-making capacity. This is the result of decades of state-backed investment and an integrated industry.

Production is anchored by a quota system that expanded sharply from 140Kt in 2020 to 270Kt in 2024, now concentrated in two state-owned groups that together hold 100% of mining allocations. Despite holding almost half of global reserves, China continues to import feedstock, particularly heavy rare earths from Myanmar and mixed carbonates from Malaysia, to feed its oversized refining sector.

Recent export-licensing requirements for Dy/Tb-containing materials and NdFeB magnets underscore Beijing's willingness to use its market position strategically. These restrictions have caused sharp short-term declines in exports to major buyers and reinforced China's status as the primary global bottleneck.

Exhibit 17: REO global production by producers (2024)
69% of REO is mined from China, while USA and Australia = 15%



Source: BofA Global Research, US Geological Survey (USGS)

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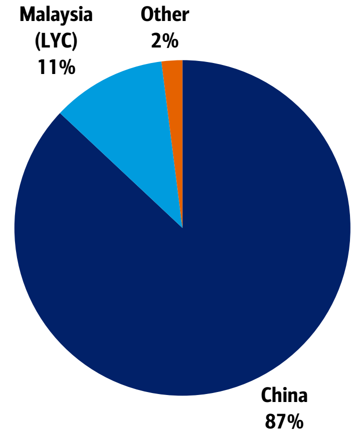
Exhibit 18: Rare earths processing capacity (mine to separated), 2023
China dominates 80-90% of rare earths processing capacity



Source: BofA Global Research estimates

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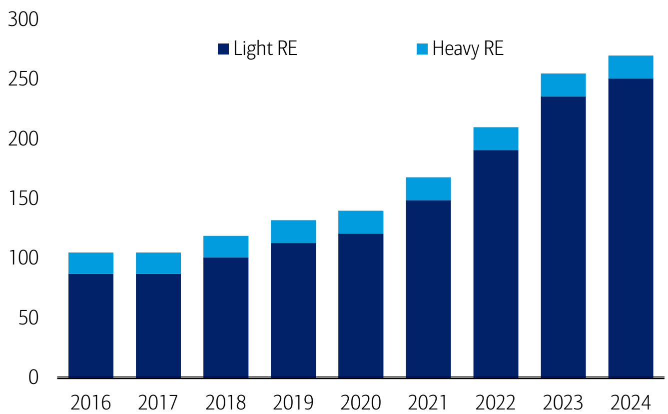
Exhibit 19: China RE mining quota (kt)
China's RE mining quota almost doubled in the last 5 years from 140kt of REO in 2020 to 270ktpa in 2024. The RE mining quota has yet to be released for 2025.



Source: BofA Global Research

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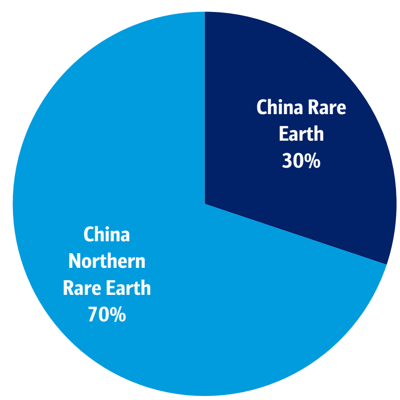
Exhibit 20: China's RE quota allocated to two RE producers in 2024
70% of quota allocated to China Northern Rare Earth, 30% to China Rare Earth



Source: BofA Global Research

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A key structural risk for the industry lies in price formation

With China maintaining near-total dominance in rare earth refining and imposing export restrictions on critical materials, international pricing often reflects conditions in the Shanghai market rather than global supply-demand fundamentals. This creates an environment of limited transparency and artificially constrained price discovery, complicating project financing and long-term planning for producers outside China.

BofA NdPr price forecast

BofA Global rare earths team view that current NdPr prices are unsustainable and unprofitable for many rare earths' producers. According to Adamas intelligence, a 90th percentile of the global cost curve (with China) is $75-80/kg NdPr. We are at the trough of the cycle, and we expect NdPr price recovery to continue. The team believes supply from China is unlikely to flood the market as China is tackling overcapacity (anti-involution). They believe price recovery will continue amid the rare earths demand recovery and disciplined supply from China.

BofA forecasts NdPr price to average at US$85/kg (including VAT) in 2H-CY25. Next 4 years NdPr price (including VAT) is averaged at US83/kg (including VAT) which is the spot. Our long term NdPr prices is set at US$110/kg (nominal). (refer to note: Lift L-T NdPr price estimate on accelerated ex-China price bifurcation development).

Exhibit 21: BofAe NdPr, Dy, Tb price forecast (US$/kg)

We forecast NdPr price to average at US$85/kg (including VAT) in 2H-CY25. Our next 4 years NdPr price (including VAT) is averaged at US83/kg (including VAT) which is the spot. Our long term NdPr prices is set at US$110/kg (nominal).

	2023A	2024A	2025E	2026E	2027E	2028E	2029E	2030E (LT Nominal)
NdPr price forecast	75	54	72	82	80	85	85	110
Dy price forecast	330	258	279	316	310	329	329	426
Tb price forecast	1,307	802	1,101	1,245	1,222	1,298	1,298	1,680

Source: BofA Global Research estimates

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China NdPr prices increased by 23% YTD

Neodymium & Praseodymium (NdPr) oxide prices (including VAT) have increased by 23% from $87/kg in early December-25 to spot $107/kg, and almost doubled versus $55/kg in January-25. Heavy rare earths terbium (Tb) oxide prices however have not increased in the same pace as NdPr. BofA's team believe the rare earths oxide prices recovery will continue amid rare earths demand recovery and disciplined supply from China.

Exhibit 22: China NdPr oxide price increasing

NdPr oxide price including VAT (US$/kg) (2016-2026)

Source: BofA Global Research, Shanghai SteelHome, Bloomberg

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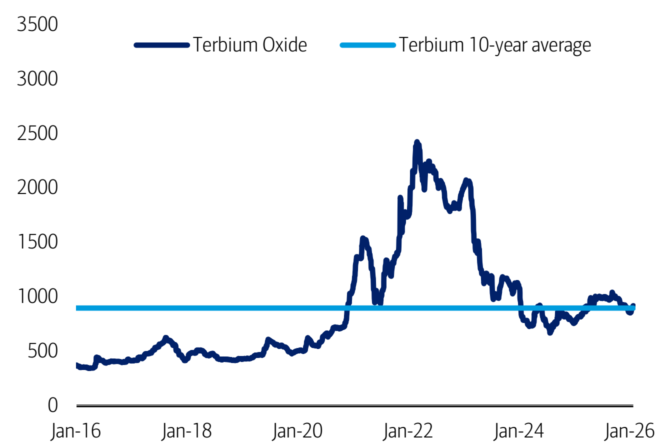
Exhibit 23: Tb oxide price close to historical average

Terbium (Tb) oxide price including VAT (US$/kg) (2016-2026)



Source: BofA Global Research, Shanghai SteelHome, Bloomberg

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See more about the Chinese REE market in:

Lynas Rare Earths: Deep dive on LYC's heavy rare earths

Global Rare Earths Enhanced rare earths exports control likely to increase OEMs' supply chain disruptions

Global Rare Earths – REMM&M wrap: Rare Earth magnet demand poised to see exponential growth

Brazil - the next large-scale producer?

Brazil holds one of the world's largest rare earth reserves yet remains largely absent from global supply chains. The country produces low volumes and captures little value from downstream processing. This disconnect between geological potential and industrial relevance is not new, but this dynamic may be starting to shift.

In recent years, Brazil has begun to frame rare earths as strategic minerals, mobilizing public capital, regulatory coordination, and early-stage industrial planning. At the same time, a growing pipeline of projects (particularly ionic clay deposits) is progressing from exploration into pilot and development stages. Brazil is not yet a significant producer, nor is a rapid scale-up guaranteed, its ability to become supply-relevant will depend less on geology and more on its capacity to alleviate processing bottlenecks, attract investment, and sequence project development pragmatically.

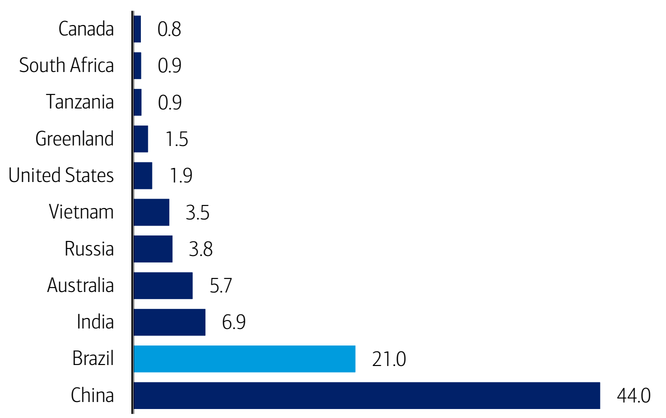
Setting the scene: Large reserves, limited industrialization

Brazil holds rare earth oxides reserves of ~21Mt (Exhibit 24), roughly 24% of global reserves, and an even larger resource base that could expand future supply. Geologically, the country stands out for its ionic adsorption clay deposits, particularly in Goiás and Minas Gerais. These clays are typically richer in high-value magnetic rare earths such as NdPr, Dy, and Tb, which are essential for permanent magnets and carry strong strategic relevance. According to some specialists, these Brazilian formations closely mirror the geological profile of the highly productive Chinese ionic clay deposits.

> Early-stage results underscore the scale and quality of Brazil's ionic clay systems. In Poços de Caldas alkaline complex, deep weathering has generated clay-rich horizons with accessible rare earths, while in Goiás, Aclara's Carina Module found large, near-surface ionic clay mineralization enriched in NdPr, Dy, and Tb. Exploration continues in regions such as Bahia, where favorable profiles have been identified.

Despite this endowment, Brazil has struggled to translate its geological potential into industrial scale. Production remains limited. Limited processing capacity, fragmented ownership, regulatory hurdles, and reliance on low-value exports continue to constrain progress, keeping Brazil under 1% of global supply even as demand accelerates.

Exhibit 24: Brazil has the second largest rare earths reserves globally ...
World rare earths mine reserves (Mt)



Source: BofA Global Research, USGS

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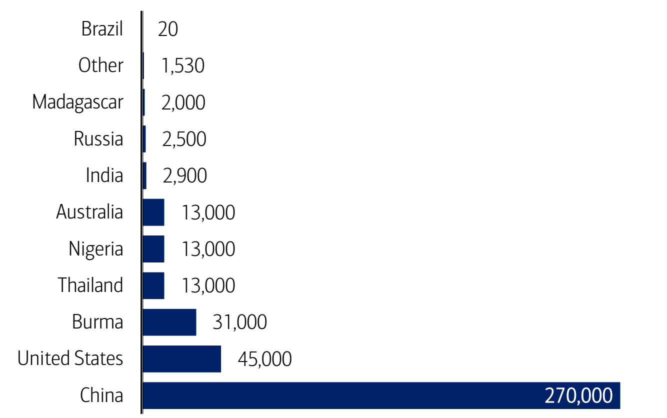
Exhibit 25: ... however it represents less than 1% of global production
World production (tons)



Source: BofA Global Research, USGS

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Ionic-clay deposits, cheaper and less harmful to the environment

Brazil's emerging rare earth pipeline is largely composed of ionic-adsorption clay deposits, a geological profile that contrasts sharply with the hard-rock carbonatite systems that dominate global LREE supply, especially in the US. This distinction has significant economic implications. Ionic clays are generally near-surface, soft, and loosely bound, which makes mining and early-stage processing simpler relative to hard-rock deposits. As a result, the initial capex required to bring projects online is materially lower, enabling production to scale with smaller, more modular investments.

In ionic-clay systems, rare earths occur adsorbed onto clay particles, rather than chemically locked in primary minerals. This allows the first processing stage to be carried out through simple leaching using a saline solution, requiring no crushing, milling, flotation, or high-temperature cracking. For Brazilian projects, this translates into: 1) lower mining costs, 2) reduced plant complexity, 3) lower energy requirements, and 4) lower investments compared to other regions.

Environmental advantages of ionic-clay systems

The simplicity of ionic-clay mining and processing also confers environmental benefits. Because clays can be leached without aggressive cracking steps, the process uses far fewer reagents and avoids the generation of radioactive or chemically complex residues typically found in hard-rock operations. Key advantages include lower generation of process tailings and more manageable waste streams, reduced need for high-temperature processes, resulting in lower greenhouse gas emissions, minimal blasting and reduced dust generation, given the soft nature of the host rock, and smaller water and energy footprints, especially during the extraction and concentration stages. This contrasts strongly with carbonatite operations, where chemical cracking creates large volumes of residues that require long-term storage and regulatory oversight.

Exhibit 26: Ionic clays mining is simpler and environmentally friendly than hard rock
Summary of differences between ionic clay and hard rock mining

	Ionic clays	Hard rock
Mining & Exploration	- Clay hosted soft material requiring no blasting - Mineralization occurs at surface - Minimal stripping - Simple exploration with homogenous Mineralization	- Requirement of blasting - Mineralization can occur at depth requiring large amounts of stripping - Mineral body can be scattered and complex
Processing	-No crushing and milling - Simple "one-step" leaching - Leaching done using cheap salts such as Ammonium - Sulfate or Magnesium Sulfate through ion-exchange mechanism - Ambient temperatures and pressures with minimal reagent consumption - No requirement for tailings dam	- Uses crushing and milling - Complex multi-step metallurgy - Leaching agent combination of expensive strong acids such as Hydrochloric Acid - Requires very high temperatures, pressure and agitation - Requirement for tailings dam, floatation, cracking, roasting, re-leaching facilities
Product	- High value Chemical Carbonate Product (90% + TREO grade) - Selective leaching with low La, Ce allowing high basket value - High payability	- Mixed Rare Earth Concentrate (20-40% TREO grade) requiring secondary processing and refining - Low payability
Environmental	- Low Uranium and Thorium - No radioactive tailings - Progressive rehabilitation of mined areas	- Presence of Uranium and Thorium waste - Large energy consumption with significant environmental and carbon footprint - Extensive mine rehabilitation required
Companies	Aclara, Ionic rare earths, Meteoric Resources, Viridis, Serra Verde	Lynas, MP Materials, Lindian Resources, Hastings, Iluka, Peak Rare Earths, Pensana
	Faster to develop, lower CAPEX and OPEX, simple and environmentally friendly process	

Source: BofA Global Research, Viridis company presentation

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Why hasn't Brazil become a rare earth powerhouse yet?

Brazil's rare earth sector faces structural barriers that slow its ability to scale. The most immediate constraint is financing: unlike other major mining jurisdictions, Brazilian firms cannot use mining rights or future production as collateral, limiting domestic credit options and pushing developers toward foreign funding. Although public institutions like BNDES and Finep have created programs for strategic minerals, access remains narrow due to strict requirements. Without flexible financing and with stronger competition from countries that already operate mature rare earth supply chains, Brazil struggles to advance beyond early-stage production or invest meaningfully in downstream capacity.

Compounding these financial constraints is the absence of a cohesive national strategy. The sector still lacks integrated policies that connect upstream extraction with midstream processing and downstream manufacturing. The value-chain distribution underscores the challenge: mining represents only 10-20% of total value, while separation and refining capture 40-50%, and permanent-magnet production accounts for another 30–40%.

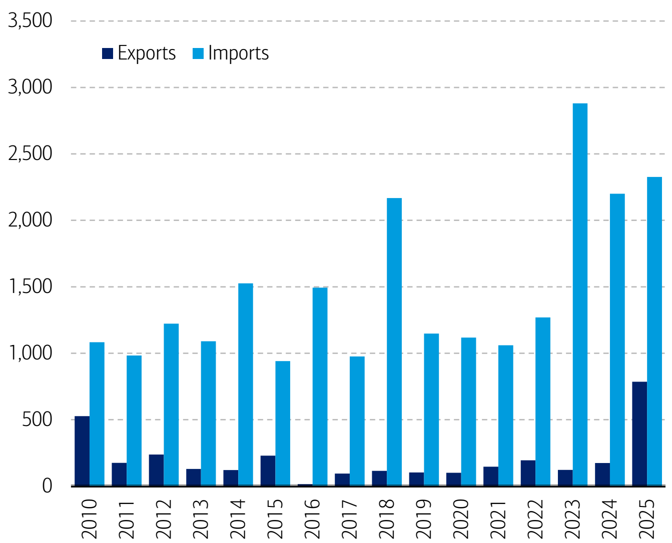
Unlike countries with clear plans to build diversified supply chains such as the US, Brazil's fragmented approach and limited incentives hinder long-term development. As a result, companies often focus on short-term financial pressures rather than investing in the broader ecosystem needed for global competitiveness.

Trade flows help us understand some bottlenecks

Trade flows make these structural gaps even clearer. Brazil's rare earth exports consist almost entirely of minimally processed materials, reflecting a domestic industry that operates almost exclusively in the upstream. The country lacks separation, refining, and metallization capacity, forcing high-value oxides and processed compounds to be imported, primarily from China.

In 2025, Brazil exported a record $13.3mn in rare earth materials, up from $3.6mn in 2024, with virtually all shipments going to China, which also supplies most of Brazil's processed REE inputs and 84% of its hybrid vehicle imports. The export surge reflects the ramp-up of Serra Verde (Brazil's only commercial-scale REE operation), but overall output remains small versus global demand. With raw materials flowing out and processed goods flowing in, Brazil captures little value from its own resource base.

Exhibit 27: Despite exports increase, Brazil is a net rare earth importer
Brazil rare earths imports and exports net weight (Kt)



Source: BofA Global Research, SECEX

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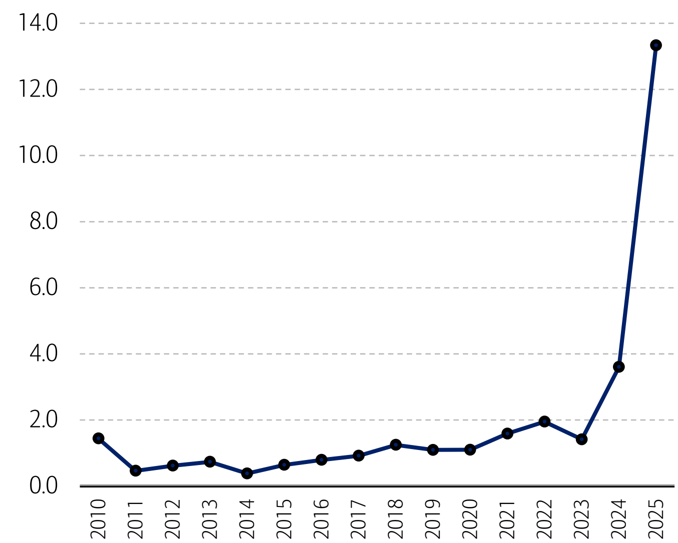
Exhibit 28: In 2025 exports surged on Serra Verde start up
Brazil rare earths exports (US$mn)



Source: BofA Global Research, SECEX

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The debottlenecking challenge: where to start?

All in all, we can conclude that, for Brazil, the transition from a large reserve-holder to a supply relevant producer is fundamentally a debottlenecking challenge. Simply put, the country's main structural limitations are mid and downstream capacity constraints, which are capital intensive, complex, and require sufficient scale to be cost-effective.

Current domestic processing facilities at a very early stage

Brazil faces a significant processing-capacity deficit across the entire value chain. While the country has made initial progress in separation technologies, major gaps persist.

Processing infrastructure remains in an early developmental stage: beyond the commercial operations at Serra Verde in Minaçu (Goiás), there are 27 research and development initiatives led by 17 companies, mostly in Goiás, Minas Gerais, and Bahia, focused on different segments of the chain, according to study by the National Mining Agency (ANM). As a result, Brazil's current processing capabilities are limited to initial steps, producing mainly carbonates and basic oxides rather than higher-value refined products or magnet-ready materials.

Government incentives and capital will be crucial

Public support, through tax incentives, financing, and targeted credit lines, can make early-stage investments more viable, lowering the costs and mitigating risk for private investors. In Oct 2025, Brazil proposed guarantees and tax breaks specially for strategic minerals like rare earths to encourage domestic processing rather than raw exports.

The sequencing challenge is that Brazil must prioritize intermediate processing facilities, such as solvent-extraction and separations plants, to capture more value domestically. Premature attempts to build full vertical value chains (all the way to finished magnets or components) could stall before the upstream base is solidified.

Aligning supply growth with global absorption

As Brazil brings rare earth projects closer to development, commercial frameworks play a critical role in ensuring that new supply enters the market without compressing project economics. Given Brazil's large reserve base and the relative simplicity of ionic-clay extraction, poorly sequenced expansion could depress prices and dilute returns. For this reason, recent policy signals have emphasized value-led integration, aligning incremental supply with downstream absorption capacity and long-term offtake visibility rather than pushing for volume-driven growth. This approach ensures that supply expansion remains economically viable while Brazil builds capabilities needed to capture value over time.

Leveraging cross-border cooperation to unlock scale …

Within this context, cross-border partnerships and offtake agreements have become essential enablers of Brazil's rare earth ambitions, as they provide long-term demand visibility, de-risk project financing, and integrate new producers into established international processing networks.

With the US accelerating efforts to diversify supply chains away from China's dominance in mining and processing, bilateral engagement has strengthened, creating a practical opening for Brazil to anchor midstream development through international cooperation. Recent meetings between US and Brazilian officials confirmed mutual interest in joint ventures and technical collaboration focused on separation and refining capacity

Concrete steps are already emerging: the US International Development Finance Corporation's commitment of up to $465 million to expand Serra Verde represents a pivotal move toward embedding Brazil into Western supply chains. Such partnerships help bridge Brazil's midstream bottleneck by providing both financing and access to industrial systems the country currently lacks, thereby reducing reliance on exporting minimally processed concentrates.

… closing the gap: Brazil's push for higher value capture

However, even as cross-border cooperation accelerates Brazil's integration into the global rare earth value chain, an important gap remains: if Brazil exports concentrates or partially processed oxides while the United States retains metalmaking, alloying and magnet manufacturing, most of the value creation continues to occur abroad. In this configuration, Brazil advances industrially but still relinquishes a significant share of the value-added segment, precisely where technological learning, margins, and strategic capabilities are concentrated.

This asymmetry helps explain why the Brazilian government has become increasingly explicit about fostering domestic separation capacity and exploring, over time, deeper integration into higher stages. The current policy push, through incentives, credit mechanisms, and coordinated planning around strategic minerals, reflects an active effort to ensure that international partnerships translate into lasting domestic industrial depth rather than another cycle of upstream dependency.

Brazil's R$5bn Strategic Minerals Initiative

Brazil launched a R$5bn BNDES-Finep program to finance strategic minerals supporting separation capacity, pilot plants, industrial-scale facilities, and RD&I. The initiative mixes credit lines, equity, and non-reimbursable funds to accelerate domestic value capture.

How BNDES strategic minerals program works in practice

The BNDES-Finep program is designed to de-risk projects that move Brazil beyond extraction and into processing. Funding can take the form of long-tenor credit, equity participation, or grants, but all proposals must include RD&I components aimed at transforming minerals into higher-value products. By April 2025, the program had already received 124 proposals totaling over $85bn, including 27 rare earth submissions, highlighting both the bottleneck and investor appetite.

In parallel, BNDES has begun structuring multi-lender financing models for rare earth developers, coordinating with foreign development banks and export credit agencies to share risk. Such blended-guarantee frameworks help rare earth projects meet bankability thresholds that usually require offtake security, minimum-price mechanisms, and international lender participation. Taken together, these steps allow Brazil to accelerate midstream build-out while ensuring that cross-border partnerships complement, rather than replace, domestic capacity creation.

A practical model: the Viridis financing structure

The Viridis project shows how rare earth financing typically requires multiple public lenders sharing risk. In this case, BNDES joined discussions, while the Development Bank of Canada (US$100m) and Export Finance Australia (US$50m) also financed it, forming a blended structure that gives credibility and reduces exposure for each institution.

This setup matters because rare earth projects need long-term offtake certainty and minimum-price protections, which private banks rarely accept alone. By combining BNDES with foreign development banks and export-credit agencies, Brazil gains a clear blueprint for how midstream rare earth investments can realistically be financed.

Beyond the policies already discussed, Brazil has also advanced a broader set of structural initiatives aimed at strengthening its critical-minerals endowment and enabling long-term industrial development. These measures span governance reforms, strategic-planning frameworks, new financing vehicles, international partnerships, and technology-focused programs. Other important developments regarding government efforts to improve Brazilian critical minerals endowment include:

- **Decree 11,964/2024 (Published March 2024)** – expands Brazil's incentivized debenture regime to include mineral-transformation projects tied to the energy transition. Follow-on guidance from the Mines and Energy Ministry later identified eligible products such as battery-grade lithium chemicals and magnet-grade rare earth oxides, chlorides, metals, and alloys.

- **R$1bn Strategic Minerals Investment Fund (Launched 2024)** – BNDES and the Mines and Energy Ministry injects roughly R$1 billion into early and growth-stage critical-minerals projects. It targets 15–20 companies involved in exploration, development, and new mine implementation for minerals vital to the energy transition, including rare earths.

- **MagBras RE Magnet Industrial Demonstrator (Funding approved 2024) –** Approved for state-level funding in late 2024, the MagBras Initiative is Brazil's first industrial demonstrator aiming to establish a full domestic permanent-magnet supply chain. Led by SENAI and supported by a consortium including Stellantis, Vale, Mosaic and Weg, it integrates oxide processing, metalmaking, and magnet manufacturing under one coordinated program.

- **Vale/BNDES R$1bn Fund (Announced Oct-2024) –** backs research, development, and implementation of projects in strategic minerals, including rare earths. Vale and BNDES each committed up to R$250 million, with private investors providing the balance, and the fund is tasked with supporting 20 junior and mid-tier companies through equity and debt instruments.

- **National Plan for Critical & Strategic Minerals (Announced April 2025) –** Brazil's Mines and Energy Ministry announced that the country would establish a national policy for strategical minerals, targeting investment attraction, licensing acceleration, and regulatory certainty for minerals such as lithium, cobalt, copper, niobium, and rare earths. The plan responds to industry demands for a coherent framework aligned with the global energy-transition agenda.

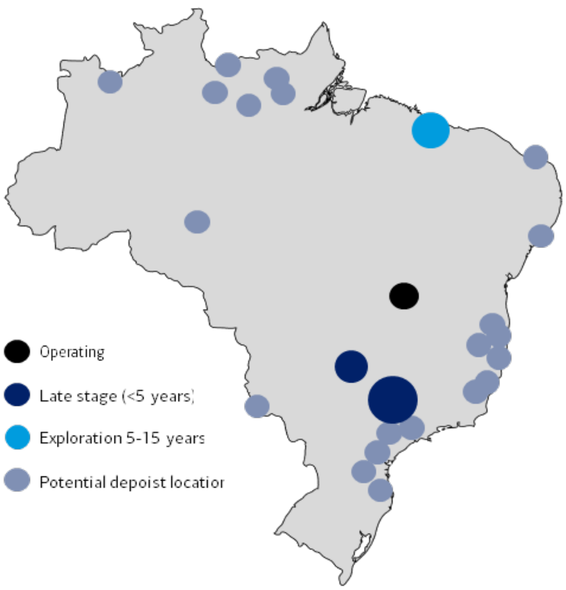
- **National Council for Mineral Policy (CNPM) (October 2025) –** consolidates mineral-policy governance across 18 ministries. The council created working groups on critical minerals, sustainability, oversight, and financial/fee reform and initiated the overhaul of the outdated National Mining Plan.

- **Brazil-Saudi Arabia Critical-Minerals MoU (Signed January 2026)** – establishes broad cooperation across geology, exploration, processing, technological exchange, training, and investment promotion. The MoU also proposes creating a bilateral Mining Investment Alliance to advance value-added projects in strategic minerals. For Brazil, this partnership brings long-term capital potential and technical collaboration that support the build-out of domestic midstream capabilities in rare earths and other critical minerals.

Summary of Brazil´s main projects

Amid a favorable geological environment, Brazil is positioning itself through early-stage development of multiple ionic-clay rare earth projects across the country. Early exploration has confirmed significant potential primarily in Minas Gerais, Goiás, and parts of Bahia. The grades observed so far in Brazilian ionic-clay systems are competitive with global benchmarks: exploration in southern Minas Gerais has returned averages of metallurgical recoveries up to 81.7% TREO and >60% magnetic REOs.

Exhibit 29: Most projects are concentrated in Minas Gerais and Goias
Map of Brazilian rare earths deposits



Source: BofA Global Research, Arthur D. Little

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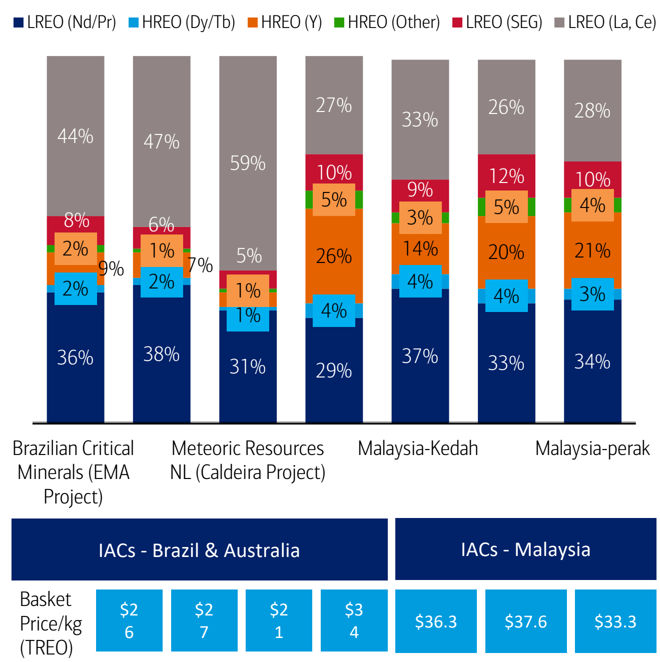
Exhibit 30: LREEO account for the biggest share inprojects
REO basket composition for IAC projects, as of May 2025



Source: BofA Global Research, Arthur D. Little

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Poços de Caldas Alkaline Complex – A key growth pole

The Poços de Caldas Alkaline Complex (~800 km² on the Minas Gerais-São Paulo border) has become Brazil's central rare earth development hub, with its deeply weathered rocks hosting widespread ionic-adsorption clays like China's major deposits. The area also marks Brazil's first step into downstream processing, as in 2025, Meteoric Resources commissioned inaugural pilot plant for rare earth extraction and MREC production.

Projects are highly competitive in capex and opex terms

Capex requirements for Brazil's emerging projects vary, reflecting differences in scale, resource size, and intended development pathways. Brazilian Critical Minerals is progressing one smaller project, with an estimated capex of roughly $55mn, while larger initiatives led by Viridis and Meteoric are budgeted in the $370–400mn range.

Meantime, all-in sustaining costs remain highly competitive (~$6.7-8.9/kg of TREO). This cost profile, paired with inherently low mining and processing expenditures typical of ionic clays, supports strong project economics. As a result, many of Brazil's ionic-clay developments are forecasting pre-tax IRRs of 40–60%, indicating attractive financial performance potential even at early project stages.

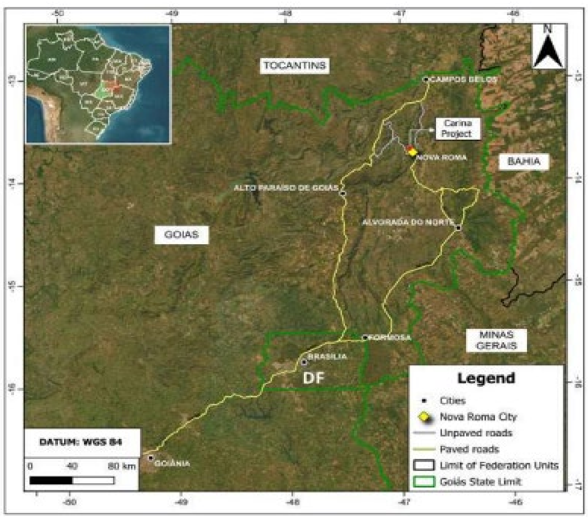
Aclara Resources (ARA CN; *not covered*)

Aclara Resources is a Toronto Stock Exchange listed company developing a mine-to-magnet supply chain focused on HREE from ionic clay deposits in South America. Its business spans three areas: mineral development (producing MREC), rare-earth separation in the US, and metals & alloys through a JV with CAP S.A., and strategic partner in Chile. The company's key shareholders are the Hochschild Group New Hartsdale Capital and CAP S.A.

Carina Project – Nova Roma, GO

Their project in Brazil is named Carina, in Nova Roma, Goiás, and covers six exploration permits totaling 9,863.6 hectares. The project hosts probable reserves of 165.4Mt grading 1,723ppm TREO, including 336ppm NdPr, 47ppm Dy and 7.5ppm Tb. Carina is designed as a conventional open-pit mine using a standard load-and-haul fleet, with no drilling or blasting required due to the orebody's friable nature. The plant will process ionic clays to produce intermediate-grade REE carbonates and hydroxides, delivering an average output of 4,265t/year of REO equivalent over an 18-year mine life.

Exhibit 31: Carina is in Nova Roma, Goiás
Map of Carina's operation



Source: Aclara

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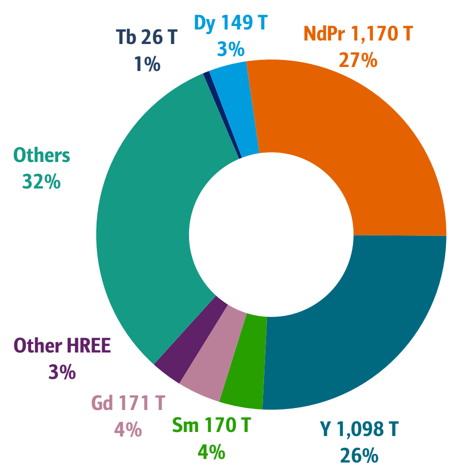
Exhibit 32: Carina produces mostly HREE
Aclara's annual production breakdown per REE



Source: Aclara

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A pre-feasibility study published in September 2025 estimated capex at $680.5mn. The company expects preliminary license approval in 1Q26, followed by completion of the feasibility study in 2Q26. Early works are planned to start by mid-2026, with full fast-track construction in 2027. Commissioning is targeted for 2H28, leading into a production ramp-up through 2029.

Exhibit 33: Probable reserves stand at 165.4Mt
Carina's reserves and resources summary

		TREO	NdPr	Dy	Tb	TREO	NdPr	Dy	Tb
Reserves	**(Mt)**	**Total Oxide Grade (ppm)**				**Desorbable Oxide Grade (ppm)**			
Proven	-	-	-	-	-	-	-	-	-
Probable	165.4	1,723	336	47	7.5	459	126	16	2.8
Resources	**(Mt)**	**Total Oxide Grade (ppm)**				**Oxide Content (t)**			
Proven	236	1,572	293	43	6.8	371,492	69,150	10,099	1,614
Probable	48	1,288	236	41	6.4	61,675	11,316	1,949	307

Source: Aclara

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Exhibit 34: Project capex is ~$680.5mn
Carina project guidance breakdown ($mn)

Description	Capital Cost ($mn)	Total Investment cost (%)
Direct	303	45
Indirect	74.5	11
Outside Project Area	37.3	5
Contingency + Allowances	149.8	22
Pre-operations costs	25.9	4
Other costs	25.5	4
Tax impacts, including tax benefits	64.5	9
Total	680.5	100

Source: Aclara

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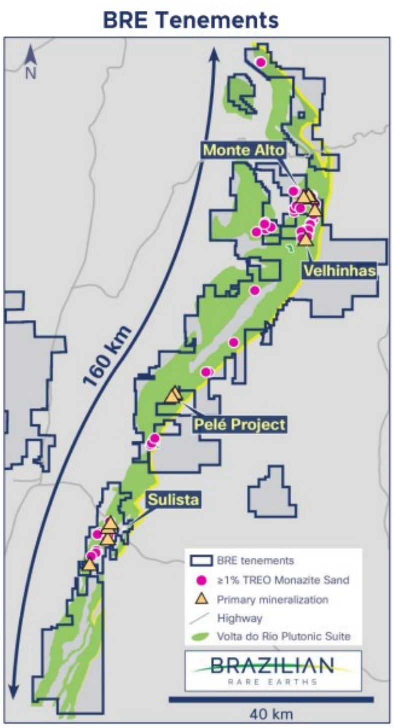
Brazilian Rare Earths (BRE AU; *not covered*)

Brazilian Rare Earths is an Australia-based exploration company with rare earth assets located in northeast Brazil. The company is conducting exploration activities across a large, district-scale mineralized area and has identified mineralization containing both heavy and light rare earth elements. Ongoing work has focused on delineating the scale and characteristics of the mineral province.

Monte Alto Project

The Monte Alto Project is located in the state of Bahia, northeast Brazil, within the broader Rocha da Rocha mineral province. The project benefits from established infrastructure, including paved highways, access to multiple ports within approximately 300 km, high-voltage power transmission lines, and availability of skilled local labour. Monte Alto is the most advanced asset within Brazilian Rare Earths' portfolio and is the primary focus of drilling, metallurgical test work, and technical studies.

Exhibit 35: Rocha Rocha province has large potential with Monte Alto the most advanced
Summary of Rocha Rocha location and deposits



Source: Brazil Rare Earths

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Monte Alto hosts rare earth mineralization associated with monazite sands at surface, with mineralization commencing at shallow depths. According to Brazilian Rare Earths' FY2024 Annual Report, the project has a JORC-compliant monazite-sand Mineral Resource of 25.2 Mt at 1.0% TREO, including a high-grade core of 4.1 Mt at 3.2% TREO. The mineralization contains both light and heavy rare earth elements and is associated with additional critical minerals, including niobium, tantalum, scandium and uranium.

Metallurgical test work conducted on Monte Alto mineralization has demonstrated high rare earth extraction rates under relatively mild leaching conditions, including the production of a mixed rare earth carbonate and recovery of uranium as a co-product. More recent work has focused on sensor-based ore sorting, showing the potential to upgrade run-of-mine material prior to downstream processing.

Monte Alto remains at an early development stage, with no declared mine plan, production rate, or development capital estimate. Current investment is directed toward resource expansion drilling, metallurgical optimization, ore sorting evaluation and scoping-level studies assessing potential development pathways from ore to separated products. No updated Mineral Resource estimate has been released since the FY2024 Annual Report, with subsequent disclosures during 2025–2026 focused on exploration and metallurgical result.

Rocha da Rocha Province

The Rocha da Rocha Province is a district-scale exploration area in Bahia, northeast Brazil, extending over an interpreted mineralized trend of approximately 160 km. In addition to Monte Alto, the province includes earlier-stage exploration areas such as Velhinhas, Pelé and Sulista, where surface sampling, geophysics and drilling have identified rare earth mineralization associated with monazite sands and hard-rock systems. These regional assets remain at an earlier stage of evaluation, with no Mineral Resources, production parameters or development studies defined to date.

Meteoric Resources (MEI AU; *not covered*)

Meteoric Resources is developing the Caldeira Rare Earths Project in Minas Gerais, Brazil. The project hosts an ionic adsorption clay rare earth deposit, with the company advancing permitting and development studies ahead of a potential investment decision.

Caldeira Project – Rare earths

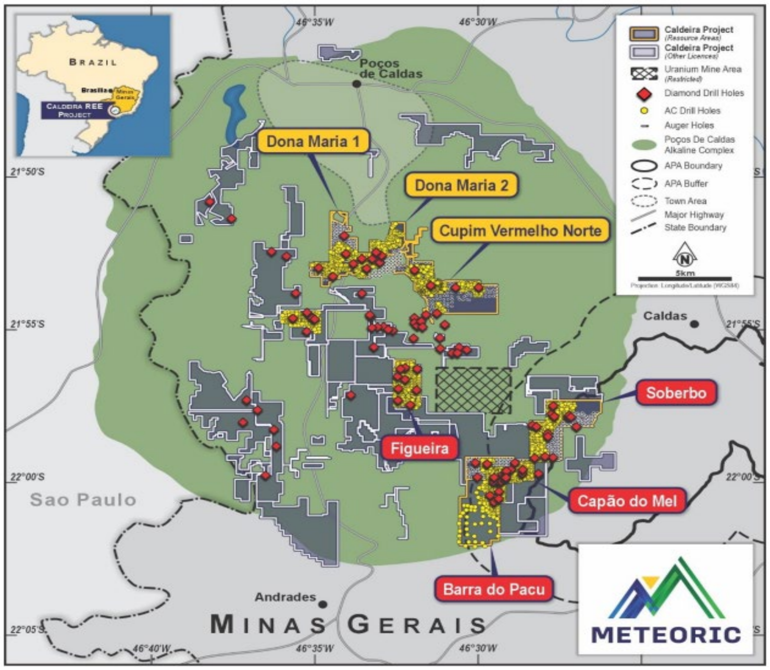
The Caldeira Rare Earths Project is located in Poços de Caldas, in the state of Minas Gerais (MG), Brazil, a long-established mining region with existing road, power, water, and port infrastructure. The project is situated approximately 250–270 km from the Port of Santos and is connected to regional transport and utilities networks. Environmental permitting is progressing under Brazil's tHREE-stage licensing regime, with the Preliminary License submitted and further approvals required ahead of construction and operations.

Caldeira hosts an ionic adsorption clay rare earths deposit with mineralization commencing at surface and extending to shallow depths. As of April 2025, the total Mineral Resource is reported at approximately 1.5Bt at an average grade of ~2,359ppm TREO, including a Measured and Indicated component of ~666Mt. A maiden Probable Ore Reserve of 103Mt at an average grade of ~4,091 ppm TREO underpins the current mine plan. The deposit is characterized by soft, free-dig material, low strip ratios, and rare earths weakly bound to clay surfaces, allowing for extraction via a low-temperature ammonium sulphate leach process.

The development concept outlined in the Pre-Feasibility Study is based on an initial 6.0Mt/yr processing facility sourcing ore from the southern licenses, with scope for future expansion into northern areas. Life-of-mine average production is estimated at approximately 13.5Kt/yr per annum of total rare earth oxides, including around 4Kt/yr of NdPr oxide, over an initial mine life of approximately 20 years. Metallurgical test work supports TREO recoveries in the mid-50% range, producing a mixed rare earth carbonate product with low impurity levels.

Total initial development capital expenditure is estimated at approximately US$443mn, inclusive of contingency, based on a Class 4 cost estimate. Funding is expected to comprise a combination of debt and equity, with reported engagement with Brazilian and international development finance institutions and strategic counterparties. Key project execution considerations include completion of permitting milestones, securing financing, construction execution, and the potential integration of downstream processing options. Subject to approvals and a final investment decision, first production is targeted for 2028

Exhibit 36: Caldeira project is located in Poços de Caldas in MG
Project location and infrastructure



Source: Meteoric Resources

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Exhibit 37: Total measured + indicated resources account for 666Mt, while inferred could add another 832Mt
Caldeira Mineral Resource Estimate, as of April 2025

Licence	JORC Category	Material Type	Tonnes (Mt)	TREO ppm	Pr ppm	Nd ppm	Tb ppm	Dy ppm	MREO ppm	MREO/TREO
Capão do Mel	Measured	Clay	11	3,888	222	586	6	28	842	21.7%
Cupim Vermelho Norte	Measured	Clay	26	2,607	156	477	5	25	663	25.4%
Total	**Measured**		**37**	**2,983**	**176**	**509**	**5**	**26**	**715**	**24.0%**
Capão do Mel	Indicated	Clay	74	2,908	163	449	5	23	640	22.0%
Barra do Pacu	Indicated	Clay	77	2,917	143	376	4	21	545	18.7%
Soberbo	Indicated	Clay	86	2,730	165	476	5	23	669	24.5%
Figueira	Indicated	Clay	138	2,844	145	403	5	28	582	20.5%
Cupim Vermelho Norte	Indicated	Clay	90	2,658	163	489	5	26	683	25.7%
Dona Maria 1	Indicated	Clay	111	2,253	128	376	4	23	531	23.6%
Dona Maria 2	Indicated	Clay	53	2,303	132	390	4	22	548	23.8%
Total	**Indicated**		**629**	**2,668**	**148**	**422**	**5**	**24**	**599**	**22.4%**
Total	**Measured + Indicated**		**666**	**2,685**	**150**	**427**	**5**	**25**	**605**	**22.5%**
Capão do Mel	Inferred	Clay	32	1,791	79	207	2	13	302	16.9%
Barra do Pacu	Inferred	Clay	190	2,153	112	296	3	18	429	19.9%
Soberbo	Inferred	Clay	89	2,713	167	478	5	24	675	24.9%
Figueira	Inferred	Clay	9	3,105	139	379	5	28	551	17.7%
Cupim Vermelho Norte	Inferred	Clay	78	2,237	126	377	4	23	530	23.8%
Dona Maria 1	Inferred	Clay	49	2,225	121	383	5	25	534	24.0%
Dona Maria 2	Inferred	Clay	29	2,324	130	397	4	21	552	23.8%
Capão do Mel	Inferred	Transition	25	1,752	86	239	3	14	341	19.5%
Barra do Pacu	Inferred	Transition	122	1,837	95	253	3	15	355	19.9%
Soberbo	Inferred	Transition	54	2,207	138	395	4	20	558	25.3%
Figueira	Inferred	Transition	24	2,174	115	328	4	21	468	21.5%
Cupim Vermelho Norte	Inferred	Transition	67	1,665	92	281	3	17	393	23.6%
Dona Maria 1	Inferred	Transition	42	1,703	95	275	3	17	390	22.9%
Dona Maria 2	Inferred	Transition	21	1,615	86	251	3	15	355	22.0%
Total	**Inferred**		**832**	**2,097**	**115**	**325**	**4**	**19**	**462**	**22.0%**
Total	**Measured + Indicated + Inferred**		**1497**	**2,359**	**130**	**370**	**4**	**21**	**526**	**22.3%**

Source: Meteoric Resources

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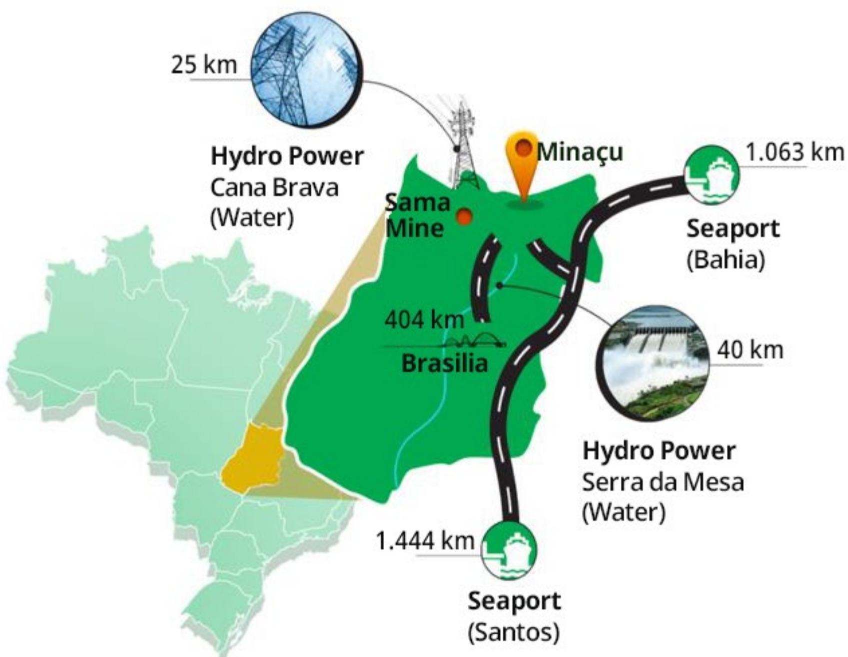
Serra Verde (*Privately owned*)

Serra Verde is a privately owned company and the only operational REE producer in Brazil, developing an integrated mining and processing operation at Pela Ema deposit. It is the first large-scale producer outside Asia of all four critical magnetic REEs. The company entered commercial production in 24, with Phase I designed to deliver 5kt/year of REO and additional upside through plant optimization and a potential Phase II.

Pela Ema – Minaçu, GO

Pela Ema is one of the world's largest known ionic-clay rare-earth deposits, located in Minaçu, Goias, a well-established mining district with strong infrastructure and access to renewable hydropower. The orebody occurs in thick weathered saprolites developed over the Serra Dourada granite and hosts both LREE and HREE, including significant Nd, Pr, Dy and Tb. Serra Verde's mining and processing flowsheet relies on low-impact open-pit extraction. Phase I, already operational, is designed for at least 5kt/yar of REO over a 25-year mine life, with optimization potential to 6.5kt/year by 2027 and a contemplated Phase II expansion that could double output to ~10kt/year by the end of the decade. The company has secured substantial offtake agreements, and the resource is supported by extensive exploration.

Exhibit 38: Pela Ema is located in Minaçu, Goias, a well-established mining district
Map of Serra Verde's infrastructure



Source: Serra Verde

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DFC Investment and Strategic Implications

In August 2025, Serra Verde secured $465mn in financing from the US International Development Finance Corporation (DFC) to support improvements at Pela Ema, operational expenditures, and refinancing existing shareholder debt. The investment underscores the project's strategic importance as a non-Asian supplier of critical magnetic REEs and has allowed the company to renegotiate its Chinese offtake agreements, which will now conclude at the end of 2026. The strengthened balance sheet provides Serra Verde with the flexibility to diversify its customer base and advance potential capacity expansions aligned with US and allied critical-minerals supply-chain strategies.

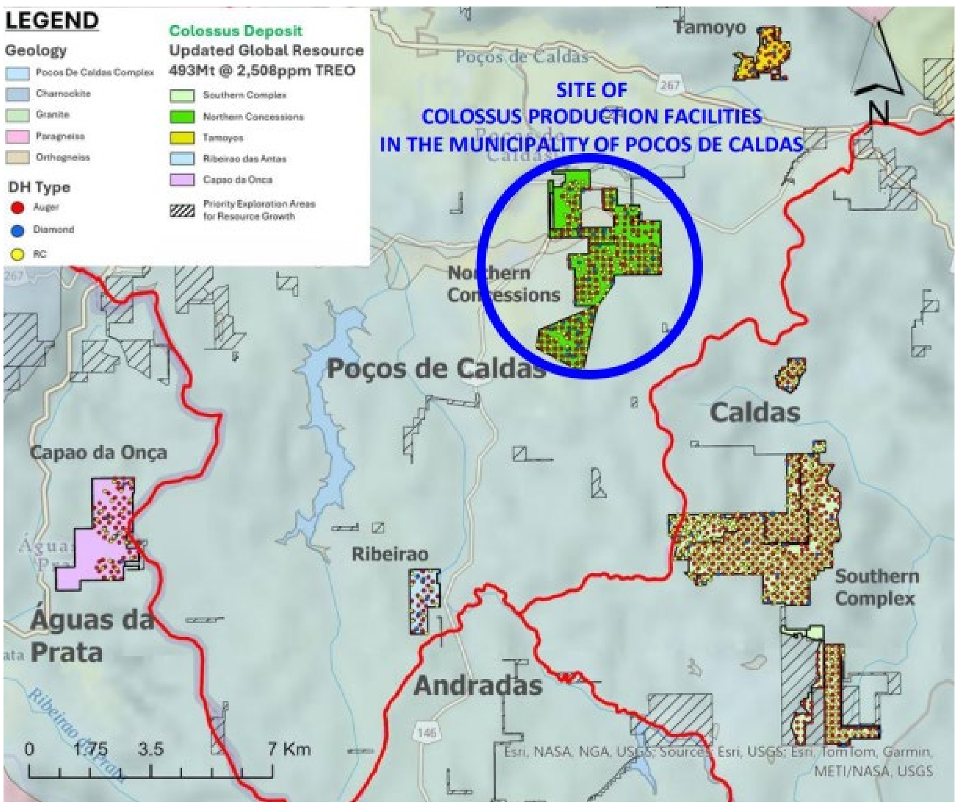
Viridis Mining & Minerals (VMM AU; *not covered*)

Viridis Mining & Minerals is an ASX-listed mineral exploration company focused on developing the Colossus Ionic Adsorption Clay (IAC) rare-earth project, positioning itself as a potential high-grade, globally significant producer. The company acquired 100% of the project's REE rights in 2023 and has since advanced an exploration program.

Colossus Project

The Colossus Ionic Clay Project is located within the Poços de Caldas Alkaline Complex in the state of Minas Gerais, Brazil. The region hosts established mining activity and benefits from existing infrastructure, including paved roads, grid power, water supply, and an experienced local mining workforce. Viridis Mining and Minerals holds a large land position in the complex, with the current Mineral Resource defined over approximately 28 km², representing around 11% of the total project area. Environmental permitting is progressing under Brazil's three-stage approval process, with the Environmental Impact Assessment submitted in support of the Preliminary License application.

Exhibit 39: Colossus project is located in Poços de Caldas
Summary of location and deposit



Source: Viridis

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Colossus hosts an ionic adsorption clay rare earths deposit with mineralization starting at surface. As of January 2025, the Global Mineral Resource is reported at 493Mt at ~2,508 ppm TREO, including a Measured and Indicated component of 329Mt at ~2,680 ppm TREO, with an average ~659 ppm MREO content. The resource includes elevated concentrations of magnetic and heavy rare earths, including Nd, Pr, Dy and Tb. Metallurgical test work indicates MREO recoveries of approximately 76–78% to a mixed rare earth carbonate product using a low-temperature ammonium sulphate leach process.

Exhibit 40: Colossus LOM is 20 years
Pre-feasibility study, as of July 2025 parameters

Life of mine (years)	20
Production facility nameplate (Dry Mtpa)	5
Total quantity mined (Dry Mt)	98.5
TREO Feed Grade (ppm)	3,380
MREO Feed grade (ppm)	936
Strip ratio	0.4
Total production (REO in t)	188,954
Annual Avg production (REO in t)	9,448

Source: Viridis

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Exhibit 41: Excluding contingency, capex is at $286mn
Detailed capex for Colossus project ($mn)

Equipment supply & installation	106
Bulk commodities	79
Total indirect costs	52
Owner's cost	9
Taxes	40
Contingency	72
Forward Escalation	Excluded
Total pre-production capex	**358**

Source: Viridis

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The Pre-Feasibility Study outlines an initial development based on a 5.0Mt/yr processing facility, with mining focused on the northern concessions in the early years. Life-of-mine average production is estimated at approximately 9.4Kt/yr REO, over an initial mine life of around 20 years, with average TREO recovery of ~57% and MREO recovery of ~76%. The flowsheet does not require drill-and-blast mining or tailings dam storage, with spent material planned to be backfilled into mined areas.

Initial capital expenditure for the project is ~$358mn, including contingency, based on a Class 4 cost estimate. Viridis is pursuing a funding strategy combining equity, strategic partnerships, and potential government and development bank support, including engagement with Brazilian institutions. Key project considerations include completion of environmental approvals, finalisation of financing, construction execution, and potential downstream integration through a joint venture focused on rare earth separation and refining. Subject to permitting and a final investment decision, the project is progressing toward construction and initial production in the second half of the decade.

Other projects

Exhibit 42: We map some other projects expected to be developed in Brazil
List of REE projects to be developed in Brazil

Company	Ticker	Project	Stage	Location
Aclara Resources	ARA CN	Carina	Exploration	Nova Roma, GO
Serra Verde	Privately owned	Pela Ema	Operational	Minaçu, GO
Meteoric	MEI AU	Caldeira	Exploration	Poços de Caldas, MG
Viridis	VMM AU	Colossus	Exploration	Poços de Caldas, MG
Brazilian Rare Earths	BRE AU	Rocha da Rocha	Exploration	Ubaira, BA
Brazilian Critical Minerals	BCM AU	Apui	Exploration	Apui, AM
Brazilian Critical Minerals	BCM AU	Ema	Exploration	Apui, AM
Atlas Critical Minerals	ATCX US	Alto Parnaíba	Exploration	Carmo do Parnaíba, MG
Atlas Critical Minerals	ATCX US	Iporá	Exploration	Iporá, GO
Resouro	RSM CN	Tiros	Exploration	Tiros, MG
Bemisa	Privately owned	Bambui	Exploration	Bambui, MG
Appia Rare Earths	API CN	PCH	Exploration	Iporá, GO
Saint George Mining	SGQ AU	Araxa	Exploration	Araxa, MG
Equinox Resources	EQXXF US	Campo Grande	Exploration	Jequie, BA
Gold Mountain	GMN AU	Down Under	Exploration	Ubaira, BA
Alvo Minerals	ALV AU	Mata Azul	Exploration	Palmeiropolis, TO
Alvo Minerals	ALV AU	Iporá	Exploration	Iporá, GO
OzAurum	OZM AU	Salitre	Exploration	Patrocinio, MG
OzAurum	OZM AU	Catalao	Exploration	Catalao, GO
Enova Mining	ANV AU	Coda	Exploration	Patos de Minas, MG
Enova Mining	ANV AU	East Salinas	Exploration	MG
Enova Mining	ANV AU	Poços	Exploration	Poços de Caldas, MG
Enova Mining	ANV AU	Juquiá	Exploration	SP
Enova Mining	ANV AU	Santo Antonio do Jacinto	Exploration	Araçuai Orogen, MG
Terra Brasil	Privately owned	--	Exploration	--
Australian Mines	AUZ AU	Jequie	Exploration	Jequie, BA
Mineraçao Terras Raras	Privately owned	Morro de Ferro	Exploration	Poços de Caldas, MG

Source: Company fillings

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Appendix I

Mining of RE deposits very much depends on individual deposit characteristics but in general, most LREE deposits (e.g. Bastnäsite) are mined using conventional open pit techniques. Key challenges include managing grade variability and differences in metallurgical characteristics as well as minimising gangue materials such as iron oxide (Goethite). In contrast, the main source of HREE is ionic clay, such as currently mined in Myanmar and southern China. These deposits are very low grade and as a result rely on in-situ leaching. This has significant environmental implications, which is why China has sought to limit both its own production and imports from Myanmar.

Processing: Once mined ore is concentrated, typically to 34% (Mt Weld) to 60% (Mountain pass) REO, before being sent to a separation facility. At this point, facilities vary considerably based on concentrate specifications and recovery priorities; however, in general, concentrate undergoes cracking or roasting, leaching, separation, precipitation and solvent extraction. As a result, process plants require a high degree of technical expertise and upfront capital (Molycorp's idled facility cost an eye-watering US$1.7bn) and as such, they pose a significant barrier to entry. In many ways, the challenges are also similar to those undertaking high pressure acid leaching of lateritic nickel deposits. Needless to say, high temperatures (>300oC) and highly concentrated sulphuric acid play havoc with pumps, valves etc. After LREE separation, products are generally in oxide form with the exception of some carbonates and a HREE compound (SEG) which requires additional separation.

Tailings: Managing waste is among the key challenges of processing rare earths given natural, low-level radioactivity of most deposits. This has historically caused significant challenges for both Lynas and Molycorp. For Lynas, the challenge is managing its Water Leached Purification Residue, an iron phosphate that is a low level naturally occurring radioactive material. Produced during cracking & leaching, LYC is being compelled to relocate this stage of separation back to Australia.

Magnet Production: Definitive data on the size of the rare earth permanent magnet market is somewhat variable given differing product specifications and reporting standards – however, according to various industry sources, it is approximately 200ktpa (US$14bn). Leveraging its market dominance in downstream mine production and separation, China is by far the largest producer, accounting for over 60% of the market, with Japan second. Key China manufacturers include Beijing Zhong Ke San Huan, Tianhe Magnets, Ningbo Yushen and JL Mag Rare-Earth. In Japan, key names include Hitachi, Shin Etsu and TDK. The U.S. has some permanent magnet production (e.g. Arnold Magnetic Technologies), but it is reliant on imports of rare earths given no existing separated rare earth production domestically. China accounts for around 90% of rare earth permanent magnet exports, with key destinations Germany, the USA, Republic of Korea, Thailand, Vietnam and Japan.

Appendix II

Strong and growing demand for certain rare earths, e.g. NdPr, has created a challenge for the rare earth industry given the typical composition of most deposits. The most common deposit type, LREE, is dominated by cerium and lanthanum, resulting in excess supply of those elements. To put it in context, the concentrate produced by Lynas Corp, a primarily LREE producer, contains around 45% Ce, 25% La, 25% NdPr and 5% SEG. However, by value NdPr typically accounts for 90% of overall product revenues.

The one mitigating factor is that the substantial price differential between products encourages producers to prioritize higher valued elements during the separation process. For example, MP Materials, the owner of the Mountain Pass mine, plans a return to the roasting process that was avoided by previous owner Molycorp. This is expected to result in the rejection of a lot of cerium up front, lower costs and more reliable operations that focus on the recovery of NdPr. Similarly, Lynas prioritizes the recovery of NdPr over cerium and lanthanum. However, even with such efforts, the oversupply of certain elements is likely to continue in the absence of new demand applications.

The net result is that if demand continues to increase for the likes of neodymium, praseodymium and dysprosium, the price of these commodities will need to increase to offset losses incurred recovering over-produced elements.

LREEs are cheaper, more abundant and more extensively used than HREEs. Cerium and lanthanum are the most abundant, hence lowest priced, and by value, the most important commodities in most LREE deposits are neodymium and praseodymium (NdPr).

Glossary

REE – Rare Earth Element

REO – Rare Earth Oxide

RE – Rare Earth

LREE – Light Rare Earth Element

HREE – Heavy Rare Earth Element

MREO – Middle Rare Earth Oxide

TREO – Total Rare Earth Oxide

Nd – Neodymium

Pr – Praseodymium

NdPr – Neodymium & Praseodymium

Dy – Dysprosium

Tb – Terbium

Ce – Cerium

La – Lanthanum

NdFeB – Neodymium magnet

MREC – Mixed Rare Earth Carbonate

IAC – Ionic Adsorption Clay

ppm – Parts per million

JORC – Joint Ore Reserves Committee

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