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Executive Summary

BRAZIL'S RARE EARTHS

State of the Art, Scenarios, and a Strategic Roadmap for 2026–2040

Center for Strategic Studies and Management
Science, Technology and innovation

MINISTRY OF
SCIENCE, TECHNOLOGY,
AND INNOVATION

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Brazil's Rare Earths

State of the Art, Scenarios, and a Strategic Roadmap for 2026–2040

Executive Summary

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Opening Message

Rare-earth elements are not just a mineral resource; they are one of the material foundations of the 21st-century economy.

Brazil has one of the world's largest geological reserves of rare-earth elements and is among the few countries with the potential to make a significant contribution to the diversification of global supply chains for critical minerals.

However, the availability of mineral resources does not automatically translate into industrial development, technological capacity-building, or strategic integration into global value chains. Despite possessing the second-largest known geological reserves of rare-earth elements, including strategic deposits of heavy rare-earth elements associated with ion-adsorption clays, Brazil accounts for only a small share of global production and has virtually no presence in the higher-value-added segments of the chain, such as chemical separation, refining, metallurgy, specialty alloys, and permanent magnets.

The international context is marked by growing competition for critical minerals essential to the energy transition, defense, digital technologies, artificial intelligence, and economic security. In this scenario, strengthening national capabilities across the rare-earth production chain has become not only an economic opportunity but also a strategic issue for national development.

The key issue for Brazil is not the availability of resources but rather identifying the links in the chain where the country intends to build competitive advantages, as well as the technological, industrial, and institutional capabilities needed to capture economic and strategic value.

This Executive Summary provides an overview of the key findings of the study *Brazil's Rare Earths: State of the Art, Scenarios, and a Strategic Roadmap for 2026–2040*, highlighting the essential elements for the formulation of public policies, business strategies, and technological development initiatives aimed at consolidating national rare earths supply chain.

The study brought together experts from various sectors of academia, government, and industry, combining expertise in geology, mining, mineral transformation, chemical separation, refining, metallurgy, metal alloys, permanent magnets, advanced materials, sustainability, the circular economy, innovation, industrial policy, and the geopolitics of critical minerals. This multidisciplinary

approach made it possible to integrate technological, economic, regulatory, environmental, and institutional aspects into a systemic view of the production chain.

More than just an update to previous studies conducted by the Center for Strategic Studies and Management (CGEE), this initiative aims to provide input for the development of a long-term national strategy for rare earths in Brazil. The document brings together technical contributions from recognized experts in the sector and incorporates forward-looking analyses aimed at identifying opportunities, risks, and priorities for the period 2026–2040.

The study was structured into 14 chapters organized into three complementary thematic sections.

Section I – Fundamentals presents the key elements necessary for understanding the sector, including the geopolitics of rare earths, the main global players, international scenarios, and the fundamentals of the proposed strategic roadmap (Chapters 1 through 3).

Section II – Strategic Guidelines brings together analyses and recommendations for the five production chains prioritized by the study—permanent magnets, catalysts, metal alloys, phosphors, and materials for advanced optical applications—preceded by a cross-cutting chapter dedicated to the circular economy and sustainability (Chapters 4 through 9).

Section III – Strategy consolidates the study's integrated vision, beginning with an examination of the two structural links in the production chain—mining and refining—which determine the industrial viability of downstream segments. It then presents the instruments, actions, and strategic priorities necessary for developing national capabilities throughout the value chain (Chapters 10 through 14).

Each chapter is designed to be read independently, serving both as a specialized technical reference and as a decision-making tool. The summary tables, strategic action tables, and consolidated roadmap provide quick-reference tools for public policymakers, government officials, business leaders, investors, and science, technology, and innovation institutions.

This Executive Summary presents the study's key findings and summarizes the elements considered critical for guiding decisions regarding the development of the rare earths supply chain in Brazil for the 2026–2040 period. We begin this Executive Summary with an overview of the proposed strategy, the envisioned timeframes, and what must be achieved to transform Brazil into a supplier of rare earths—not only in the form of raw ore but also as high-value-added inputs.

For a more in-depth understanding of the fundamental concepts and findings that emerged from this study, we recommend consulting the full document, which can be navigated according to your interests, using the Reading Guide for the Strategic Document at the end of this Executive Summary.

Enjoy reading.

Anderson Gomes

Chief Executive Officer, CGEE

June 2026.

Note: *After this document was finalized in June 2026, CEBRI (Brazilian Center for International Relations) presented the Final Report on the document supporting the preparation of Brazil's National Rare Earths Strategy, commissioned by the Ministry of Mines and Energy.*

The Strategic Roadmap for 2026–2040

Building competitive Brazilian rare earths supply chain requires a long-term vision and a coherent sequence of capacity-building efforts. The proposed strategic roadmap organizes this trajectory into three complementary and cumulative phases, in which each stage creates the necessary conditions for the next.

Horizon 1 (2026–2030) – Building the Foundations

This is the most critical period of the entire strategy. The decisions made during this phase will determine the country's ability to move on to the subsequent stages of industrialization.

Priorities

- Establishment of permanent mechanisms for national governance and coordination;
- Regulatory improvements and strengthening of the business environment;
- Creation of financial instruments suited to long-term projects involving high technological risk;
- Expansion of investments in research, development, and innovation;
- Implementation of the first national separation and refining capabilities.

Expected Outcome

Establishment of the institutional, technological, and industrial foundations necessary for the development of the production chain, with initial domestic processing capacity and the ability to attract strategic investments.

Horizon 2 (2031–2035) – Industrial Rollout

Now that the structuring phase is complete, the focus shifts to the industrial consolidation of the supply chain.

Priorities

- Operation of commercial-scale industrial separation and refining plants;
- Development of domestic production of rare-earth metals and alloys;
- Integration with industrial consumer sectors;

- Expansion of participation in global supply chains.

Expected Outcome

Consolidation of an integrated production chain capable of adding value to domestic mineral resources and reducing external dependencies at strategic stages.

Horizon 3 (2036–2040) – Regional Leadership and Global Integration

The third horizon corresponds to the consolidation of the long-term strategic vision.

Priorities

- Domestic production of permanent magnets and advanced magnetic materials;
- Development of high-performance materials for technological applications;
- Expansion of exports of higher-value-added products;
- Integration of the circular economy and recycling into the production chain.

Expected Outcome

Brazil as a strategic global supplier of rare-earth materials.

How can Brazil ensure that it succeeds in converting its geological advantage into lasting industrial, technological, and geopolitical capabilities?

Governance: The Key Factor for the Strategy's Success

The development of the rare-earth chain does not depend solely on mineral resources or technology. The decisive factor is the ability to coordinate among the government, the private sector, scientific institutions, and financial institutions.

Key Recommendation

Create a permanent, three-tiered governance structure:

LEVEL	ROLE
National Council on Rare Earths and Critical Minerals	Strategic Direction
Interministerial Executive Committee	Policy Coordination
Permanent Thematic Groups	Implementation and Monitoring

Without permanent governance, the strategy runs the risk of institutional fragmentation and discontinuity between administrations.

National Agenda 2026–2030: Actions for the Next Five Years

The next five years will be decisive. It is during this period that Brazil must lay the institutional, technological, and industrial foundations to make the rare earths supply chain viable.

Key Actions

Governance

- Establish the National Rare Earths Committee.
- Implement the National Rare Earths Observatory.

Refining

- Implement the first domestic industrial separation plant.
- Develop domestic capacity for refining high-purity oxides.

Metallurgy

- Produce rare-earth metals.
- Implement pilot-scale capacity for magnetic alloys.

Magnets

- Create the Brazilian Permanent Magnet Program.
- Implement a pilot plant for NdFeB magnets.

Innovation

- Create a National Rare Earths Research Network.
- Fund R&D in separation, metals, and magnets.

Funding

- Create dedicated funding lines at BNDES and Finep.
- Establish a Rare Earths Supply Chain Development Fund.

International Cooperation

- Sign agreements with the U.S., Japan, the EU, and Australia.
- Attract investments for processing and manufacturing.

The Strategic Roadmap is not just a long-term vision. It defines institutional responsibilities, strategic partners, and deadlines for each action.

The Seven Critical Determinants of Success

Even with a well-formulated strategy, there are external factors that can prevent its implementation.

The study identifies seven critical determinants.

Conditioning factors	Why is it important?
Institutional continuity	Avoid discontinuity between administrations
International prices	Protect projects from price wars
Technology partner	Ensure genuine knowledge transfer
Technological substitution	Monitor competing technologies
Environmental permitting	Avoid excessive delays
Human resources	Train a sufficient number of specialists
Diversification of partnerships	Preserve strategic autonomy

The study identifies **institutional continuity** as the most significant risk. Without institutional stability and permanent governance mechanisms, the other objectives become difficult to achieve.

Strategy Risk Matrix

Strategic Risk	Probability	Impact	Potential Consequences	Mitigation Measures
Discontinuity in public policies	**High**	**Very High**	Disruption of programs, loss of investments, and uncertainty for investors	Establish permanent governance and a national policy for critical minerals
Delays or failures in establishing national separation and refining capacity	**Medium**	**Very High**	Continued reliance on foreign sources and an inability to make progress in metals, alloys, and magnets	Government support, dedicated funding, and technology partnerships
Dependence on foreign technology	**High**	**Very High**	Limited industrial and technological autonomy	Require technology transfer and strengthen domestic R&D
Insufficient long-term funding	**Medium**	**Very High**	Stagnation of industrial and technological projects	Create specific lines of credit at BNDES, Finep, and strategic funds
Volatility in international prices	**High**	**High**	Decline in the economic attractiveness of new projects	Product diversification and long-term contracts
Shortage of specialized human resources	**Medium**	**High**	Operational bottlenecks and delays in industrial expansion	Training and technical capacity-building programs

Regulatory delays and environmental permitting	**Medium**	**High**	Delays in the development of mines and industrial plants	Regulatory improvements and forward planning
Lack of development in the metals, alloys, and magnets industry	**Medium**	**Very High**	The country's continued reliance on low-value-added sectors	Incentives for industrialization and strategic procurement
Overconcentration among international partners	**Medium**	**High**	Geopolitical vulnerability and dependence on foreign countries	Diversification of international agreements and partnerships
Disruptive technological changes	**Low**	**Medium**	Declining demand for certain materials or applications	Ongoing technology monitoring and support for innovation
Geopolitical conflicts and trade restrictions	**Medium**	**High**	Difficulties in accessing markets and technologies	Active diplomatic strategy and market diversification
Failures in institutional coordination	**Medium**	**Very High**	Fragmented strategy and loss of investment efficiency	Interministerial Executive Committee and National Observatory

Critical Risks (Highest Priority)

The risks considered most relevant to the strategy's success are:

1. **Discontinuity in public policies**
2. **Lack of domestic capacity for separation and refining**
3. **Dependence on foreign technology**

4. **Insufficient funding**
5. **Lack of development in the metals, alloys, and magnets supply chain**

These five risks have the potential to undermine the entire national strategy, even if mineral resources are available and international demand remains strong.

Strategic Interpretation of the Matrix

The risk analysis shows that Brazil's greatest challenges are not geological. The country already possesses significant mineral resources and holds a privileged position in the new geopolitics of critical minerals. The most significant risks are concentrated in the **institutional, technological, financial, and industrial** dimensions, reinforcing the study's conclusion that the strategy's success will depend on the government's ability to coordinate efforts, the development of industrial capabilities, and the rapid implementation of the support measures outlined in the Strategic Roadmap for Rare Earths in Brazil 2026–2040.

The Strategic Choice Brazil Must Make

The study states that Brazil faces a strategic choice:

Path 1

Continue exporting concentrates and raw materials.

Result:

- Low value capture.
- Technological dependence.
- Limited industrial integration.

Path 2

Build an integrated supply chain.

Result:

- Domestic refining.
- Production of metals and alloys.

- Manufacture of magnets.
- Export of higher-value-added products.
- Greater international prominence.

The current opportunity is temporary. As the U.S., the European Union, Japan, Australia, and other countries consolidate their alternative supply chains, Brazil's bargaining power will diminish.

Brazil's challenge is not to discover rare earth elements or to prove their strategic importance. The challenge is to build institutions, financial instruments, industrial capabilities, and coordination mechanisms capable of transforming mineral resources into industrial development, technological innovation, and a leading geopolitical role. Ultimately, the strategy's success will depend on the speed and consistency of the decisions made between 2026 and 2030.

Expected Outcome

Positioning Brazil as a strategic international supplier of critical materials and a key player in global supply chains related to the energy transition, digital transformation, and advanced technologies.

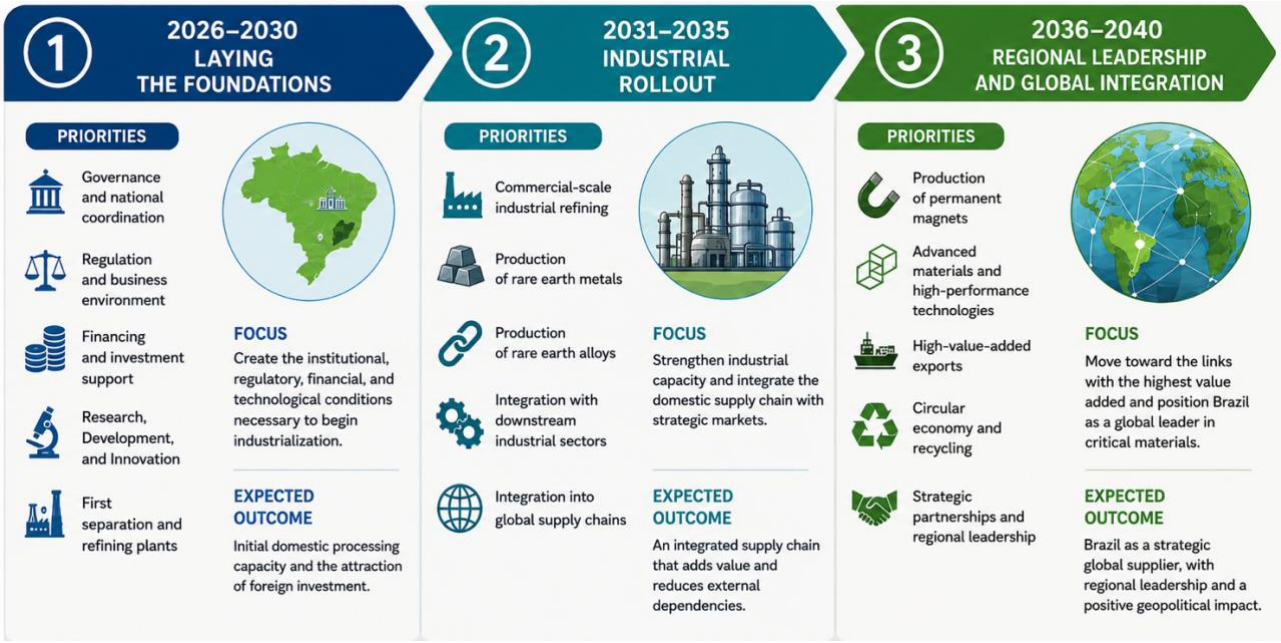


Figure 1. The 2026–2040 Strategic Roadmap

The development of the rare earths supply chain goes beyond the mineral sector. It is a strategic agenda for national development, directly linked to industrial competitiveness, technological sovereignty, and Brazil's strategic integration into the 21st-century economy. Advancements in this supply chain simultaneously contribute to:

- Industrial development and diversification of production;
- Economic and technological security;
- Energy transition and decarbonization;
- Strengthening the national scientific and technological base;
- Creation of skilled jobs;
- Enhanced international standing for Brazil.

More than just a mineral resource, rare earths represent an opportunity to build industrial, technological, and strategic capabilities for the coming decades.

The benefits associated with the development of Brazil's rare earths supply chain extend beyond the mineral sector and take on strategic dimensions that are fundamental to the country's future. Implementing the proposed strategic roadmap has the potential to generate positive impacts on multiple fronts, contributing to the strengthening of Brazil's national competitiveness, industrial capacity, and international integration. From an economic standpoint, the strategy enables greater value addition to mineral resources and expands exports of products with higher technological content. On the industrial front, it creates conditions for the emergence and consolidation of new production chains associated with advanced materials and critical technologies.

From a technological standpoint, it fosters the development of national expertise, strategic knowledge, and innovation. Social benefits include the creation of skilled jobs, the training of specialized human resources, and regional development in areas related to mining and industry. From an environmental perspective, it promotes the adoption of sustainable practices, the strengthening of the circular economy, and the establishment of supply chains aligned with global sustainability requirements. Finally, from a geopolitical perspective, it strengthens Brazil's position as a strategic supplier of critical minerals and a key partner in new global supply chains, expanding its international relevance in sectors that are fundamental to the energy transition, technological security, and industrial development in the 21st century.

Expected Benefits

DIMENSION	BENEFIT
Economic	Greater value addition and expansion of exports
Industrial	Development of new production chains

Technological	Development of critical skills and innovation
Social	Creation of skilled jobs and regional development
Environmental	Circular economy and sustainable production
Geopolitical	Greater international strategic relevance

Priority Decisions for the Next 24 Months

The currently open window of opportunity is limited. The strategy's success will depend on the ability to quickly turn potential into action.

The analysis presented leads to an unequivocal conclusion: Brazil has the mineral resources, scientific capabilities, and a favorable geopolitical environment to become a major player in the global rare earths supply chain.

However, turning this potential into concrete results will depend on decisions made in the short term. The international reorganization of supply chains—driven by the search for alternative suppliers and by growing demand associated with the energy transition, digitalization, and technological security—has created a window of opportunity that is unlikely to remain open indefinitely.

The next 24 months will be decisive in determining whether the country will occupy a strategic position in the highest value-added segments of the supply chain or whether it will remain confined to its traditional role as a supplier of raw materials. In this context, certain decisions take on a priority and foundational nature, as they have the potential to create the institutional, industrial, technological, and financial conditions necessary to support the implementation of the national strategic roadmap for rare earths through 2040. The most important decisions for the short term are:

1. Establish a Permanent National Governance Framework

Establish coordination mechanisms capable of aligning the government, academia, the private sector, and financial institutions around common objectives.

2. Enable the First National Separation and Refining Capacity

Structure and support the implementation of the industrial link that connects mining to segments with higher value added.

3. Create Dedicated Financing Instruments

Develop appropriate mechanisms for capital-intensive, technology-intensive projects with long maturation periods.

4. Establish International Technology Partnerships

Attract investments and agreements that promote effective knowledge transfer, industrial capacity building, and local productive development.

5. Integrate Rare Earths into National Industrial Policies

Place the rare earths supply chain at the center of strategies for neo-industrialization, innovation, defense, energy transition, and critical minerals.

The strategic question is no longer whether the country has potential. The question is how quickly it will be able to transform that potential into lasting industrial, technological, and economic capabilities. The opportunity exists now. The challenge is to turn it into development.

A Strategic Choice for Brazil

Throughout this study, one conclusion emerges clearly: Brazil has the real potential to become one of the key players in the new global landscape of critical minerals.

Few countries possess the combination of attributes observed in Brazil's case. The country possesses one of the largest geological reserves of rare-earth elements on the planet, including strategic deposits of heavy rare-earth elements. It has established scientific expertise at universities, research institutes, and technology centers. It boasts a diversified industrial base, a predominantly renewable energy mix, the ability to attract investment, and a geopolitical position that allows it to engage with different hubs of the global economy.

Brazil's challenge, therefore, is not to discover resources. Nor is it to demonstrate potential. The challenge is to transform potential into capacity.

Economic history offers countless examples of countries that possessed abundant resources but failed to convert them into technological, industrial, or strategic development. It also offers examples of countries that used their natural resources as a platform to build productive capabilities, generate knowledge, create competitive companies, and expand their international influence. Brazil's future trajectory will depend on the choice between these two paths.

Rare earths offer the country a unique opportunity to break historical cycles of specialization in primary products and build an international presence based on knowledge, technology, and value addition.

The debate presented in this study is not limited to mining.

- It is a discussion about industrial policy.
- It is a discussion about innovation.
- It is a discussion about technological sovereignty.
- It is a discussion about national development.

In a world increasingly driven by electrification, digitalization, artificial intelligence, and technological competition, the ability to produce and process strategic materials will be one of the key determinants of nations' competitiveness.

Critical minerals constitute the invisible infrastructure of the 21st-century economy.

Electric vehicles, wind turbines, defense systems, satellites, robotics, data centers, digital networks, and artificial intelligence applications all depend on complex supply chains whose material foundation includes rare earth elements.

The strategic question is not whether these technologies will continue to grow. The question is which countries will participate in the value creation associated with them.

Brazil has a rare opportunity to participate in this transformation from a more advanced position than the one it has historically occupied in various cycles of global industrialization.

For the first time in decades, the world's leading economies are actively seeking new suppliers, new technology partners, and new locations for investments related to critical minerals.

This international demand coincides with the availability of Brazilian resources, the maturity of the country's scientific expertise, and the need to chart new paths for economic development.

Such a convergence does not occur often in history. And it will not remain available indefinitely.

The window of opportunity currently open is the result of specific geopolitical circumstances. As new projects move forward in other countries, new supply chains are consolidated, and new suppliers reach industrial maturity, Brazil's comparative advantage will tend to diminish.

For this reason, the decisive factor will not be merely the quality of the proposed strategy. It will be the speed of its implementation.

The study shows that the country already has many of the elements needed to embark on this path:

- It has resources.
- It has knowledge.
- It has a market.
- It has potential partners.
- It has growing global demand.

What still needs to be built is the capacity for coordination capable of transforming these scattered assets into an integrated national strategy.

This is the primary responsibility of the current generation of public policymakers, institutional leaders, business leaders, and researchers.

The development of the rare earths supply chain will not happen spontaneously.

It will require a long-term vision. It will require coordination among institutions. It will require consistent investment. It will require continuity. It will require the ability to implement decisions that will yield results not only in the coming years, but in the coming decades.

The return on this effort, however, transcends the boundaries of the production chain itself. By developing expertise in advanced mining, chemical processing, metallurgy, specialty materials, the manufacturing of strategic components, and recycling, Brazil will strengthen capabilities that will benefit various other sectors of the economy.

Rare earths can serve as a catalyst for a broader process of technology-driven reindustrialization.

- They can stimulate new investments in research and development.
- They can expand the training of highly qualified human resources.
- They can strengthen integration among universities, technology centers, and companies.
- They can help reduce strategic vulnerabilities in critical sectors.
- They can expand Brazil's participation in knowledge-intensive global markets.

From this perspective, the development of the rare earths supply chain should be understood as an investment in national capabilities.

The ultimate goal is not to produce more ore. The ultimate goal is to produce more knowledge. More technology. More industry. More innovation. More competitiveness. More sovereignty. More development.

The strategic roadmap presented in this study offers a clear direction for this path. It demonstrates that the path is technically feasible, economically justifiable, and strategically relevant.

Vision 2040
BRAZIL as a **strategic global supplier of rare earths**, with a comprehensive, sustainable, and innovative supply chain.

Building this path will require perseverance and coordination. There will be no immediate results or simple solutions. Complex industrial chains are built over the course of years—and often decades.

But the countries that lead strategic sectors rarely get there first by chance. They get there first because they started earlier.

The opportunity is there. The resources exist. The skills exist. The demand exists. The strategy is in place.

Without coordinated action:

- Brazil will remain an exporter of raw materials.
- It will miss its current geopolitical opportunity.
- Other countries will consolidate alternative supply chains.
- The country's competitive advantage will gradually diminish.

The question that remains is whether Brazil will choose to turn this opportunity into a national development project. If it does, rare-earth elements could represent much more than just a new economic activity. They could become one of the pillars for building a more sophisticated, innovative, and competitive economy.

More than just a mineral opportunity, this is a historic opportunity. And, like any historic opportunity, its value will depend on the ability to recognize it and act at the right moment.

Immediate Agenda for the Next 24 Months

For decision-makers, the strategic roadmap suggests an initial implementation agenda with six priorities:

1. Establish a national governance framework for critical minerals and rare earths.
2. Develop the country's first domestic separation and refining capacity.
3. Create financial instruments dedicated to long-term projects involving high technological risks.
4. Establish international technology partnerships that include effective knowledge transfer.
5. Train specialized personnel in mining, refining, metallurgy, advanced materials, and supply chain management.
6. Integrate the rare earths strategy into industrial, technological, energy, and defense policies.

The ultimate goal of Brazil's strategy is not merely to open mines, produce concentrates, or export oxides. Rare earths are a means to achieve broader objectives: industrial development, technological innovation, security of supply, meaningful international integration, and technological sovereignty.

The 2026–2040 strategic roadmap should be understood as a path toward building national capabilities. Its success will depend on the correct sequence of actions, institutional continuity, and

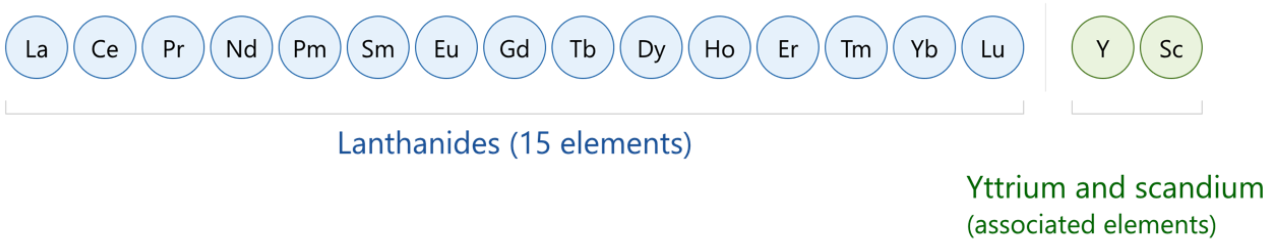
the speed with which Brazil is able to transform mineral resources into industry, technology, and international competitiveness.

SECTION I - FUNDAMENTALS

This section describes the fundamentals of rare earth production, maps global stakeholders, major producing nations, major consuming nations, companies, and multilateral initiatives, and identifies the eight national priorities. It also describes the global landscape of demand, supply, mineralogical typology, and mechanisms for reorganizing the supply chain, projecting future scenarios through 2040 and situating Brazil's position within a comparative framework. In addition, it outlines a strategic roadmap across three-time horizons, detailing the institutional and industrial decisions that underpin Brazil's integration into the global supply chain.

International Context

So-called rare earth elements are a group of 17 chemical elements that are essential due to their unique magnetic, optical, electronic, and catalytic properties (see Figure below). As a result, secure access to these materials has come to be treated by the world's major economies as a matter of economic, technological, and industrial security.



Over the past four decades, China has established the most integrated rare earths supply chain on the planet, accounting for approximately 90% of global refining capacity and about 80% of worldwide production of permanent magnets. This position stems not only from the availability of mineral resources, but primarily from the deliberate development of industrial, technological, and institutional capabilities throughout the entire value chain.

The current structure of the global supply chain remains heavily concentrated in China, especially in the industrial segments with the highest value added.

Link in the Chain	Chinese Participation
Refining	~90%
Permanent Magnets	~80%
Global Consumption	~60%

This poses a tremendous strategic risk to other countries, leading to vulnerabilities in the global supply chain, export restrictions, price volatility, and risks to economic and national security.

In response to this concentration, the United States, the European Union, Japan, Australia, South Korea, and India have been implementing policies aimed at diversifying suppliers, reducing strategic vulnerabilities, and strengthening alternative supply chains. The competition for critical minerals has become an integral part of national strategies for competitiveness and economic security.

In this context, Brazil stands out as one of the few countries capable of contributing significantly to the diversification of global supply, especially in elements critical to the production of high-performance permanent magnets. The combination of abundant resources, potential for heavy rare earths, an established scientific base, and the capacity for production expansion gives the country a unique strategic position.

However, this opportunity has a limited timeframe. The reorganization of global supply chains is already underway, and new projects are being developed in various regions of the world. As alternative suppliers consolidate their production and industrial capacities, Brazil's relative advantage will tend to diminish.

The strategic challenge for Brazil is to convert its geological advantage into industrial, technological, and commercial capabilities before the current international window of opportunity closes.

Strategic Opportunity

Rare earths [1] are strategic inputs for the energy transition, digital transformation, artificial intelligence, and defense technologies. Elements such as neodymium (Nd), praseodymium (Pr), dysprosium (Dy), and terbium (Tb) are essential components of electric vehicles, wind turbines, robotics, satellites, data centers, and advanced military systems (see Figure 2).

[1] From a chemical standpoint, rare earths constitute a group of 17 elements in the Periodic Table, consisting of the 15 lanthanides—lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), and lutetium (Lu)—in addition to scandium (Sc) and yttrium (Y), which have similar chemical properties and often occur in the same mineral deposits. Although they are commonly referred to as "rare earths," many of these elements are not geologically rare; their strategic importance stems from the difficulty of economically concentrating, chemically separating, and refining them. Each element has specific applications associated with its magnetic, optical, catalytic, or electronic properties. Neodymium (Nd) and praseodymium (Pr), for example, are essential for the production of permanent magnets used in electric vehicles and wind turbines; dysprosium (Dy) and terbium (Tb) increase the heat resistance of these magnets; cerium (Ce) is widely used in automotive catalysts and glass polishing; lanthanum (La) is used in batteries and catalysts for oil refining; europium (Eu), terbium (Tb), and yttrium (Y) are essential for phosphors used in screens, LEDs, and lighting systems; samarium (Sm) is used in high-temperature magnets for aerospace and defense applications; gadolinium (Gd) is used as a contrast agent in MRI scans; and scandium (Sc) is used in lightweight aluminum alloys for aeronautical and space applications. Together, these elements constitute critical inputs for technologies related to the energy transition, digital transformation, defense, healthcare, and advanced manufacturing.

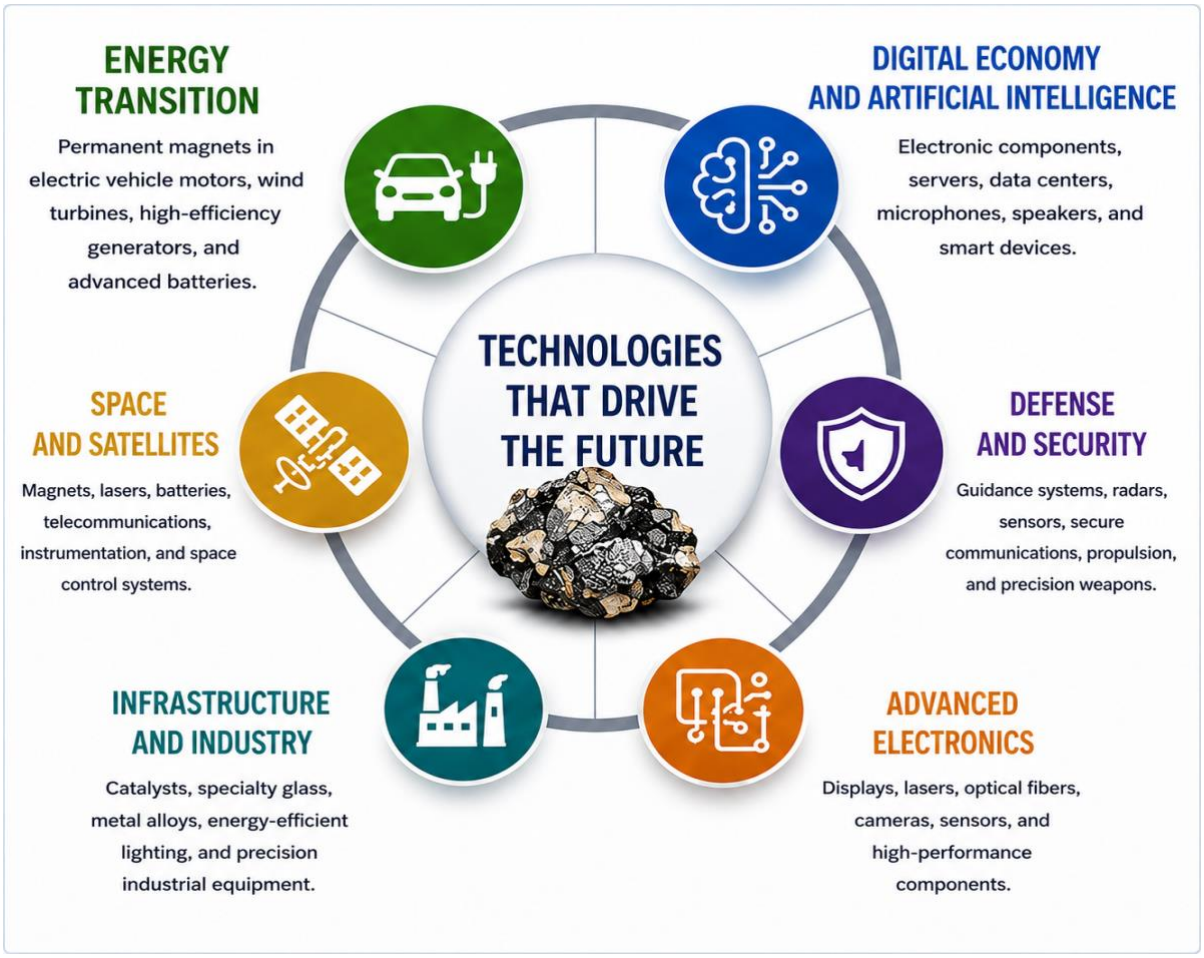


Figure 2. Where Rare Earth Elements are Used (Source: CGEE).

In this context, Brazil occupies a unique position. The country holds approximately one-quarter of the world's known geological reserves of rare earths, making it the second-largest reserve on the planet. Also noteworthy are the deposits of ion-adsorption clays containing heavy rare-earth elements, which are considered strategic for technologies with higher value added.

At the same time, the international landscape is undergoing profound restructuring. The United States, the European Union, Japan, Australia, South Korea, and other advanced economies are seeking to reduce their dependence on supply chains currently concentrated in China. This movement is linked to the concept of "de-risking," or reducing the risks arising from excessive dependence on a single supplier for materials considered strategic.

Following episodes of trade restrictions, export controls, and growing geopolitical tensions, the security of supply for critical minerals has become an integral part of national strategies for competitiveness, economic security, and industrial development. As a result, various initiatives are being implemented to diversify suppliers and build alternative supply chains, including the European

Union's Critical Raw Materials Act, the U.S. Inflation Reduction Act, national refining programs, funds dedicated to critical minerals, and international agreements on technological and industrial cooperation.

In this context, Brazil ranks among the few countries capable of making a significant contribution to expanding the global supply of critical elements, positioning itself as a potential strategic partner in the new supply chains. The combination of resource availability, potential for heavy rare earths, established scientific capacity, and relative institutional stability provides the country with a unique opportunity to attract investment, establish technological partnerships, and develop domestic industrial capabilities.

For the first time in decades, there is an explicit demand for new, reliable suppliers of rare earths and other critical minerals. However, this opportunity has limited duration. The reorganization of global supply chains is already underway, and new projects are being developed in different regions of the world. As alternative suppliers consolidate their production and industrial capacities, Brazil's comparative advantage will tend to diminish.

The Brazilian Challenge

Despite possessing the world's second-largest geological reserves of rare-earth elements, Brazil plays only a marginal role in the global supply chain for these materials. Domestic production accounts for a small share of global supply, and the country has virtually no presence in the industrial segments with the highest value added, such as chemical separation, refining, metal production, specialty alloys, and permanent magnets.

This contrast highlights Brazil's main strategic challenge: transforming a geological advantage into industrial, technological, and commercial capabilities capable of generating economic value, competitiveness, and international relevance.

International experience shows that the wealth associated with rare earths is not concentrated in mining, but in the industrial links that connect the ore to the products. The greatest economic and technological gains are realized in the stages of separating individual oxides, producing metals and specialty alloys, and manufacturing advanced components, particularly permanent magnets.

In this context, Brazil's main structural bottleneck lies in the separation and refining stage. This stage transforms mineral concentrates into high-purity individual oxides, which are essential inputs for virtually all high-value-added industrial applications. Without domestic refining capacity, the

country remains dependent on foreign production capacity and is limited to exporting raw materials or low-value-added intermediate products.

Figure 3 highlights this challenge by comparing reserves and production among the leading rare earth-producing countries. Although Brazil ranks among the countries with the greatest availability of resources, its share of global supply remains disproportionately small.

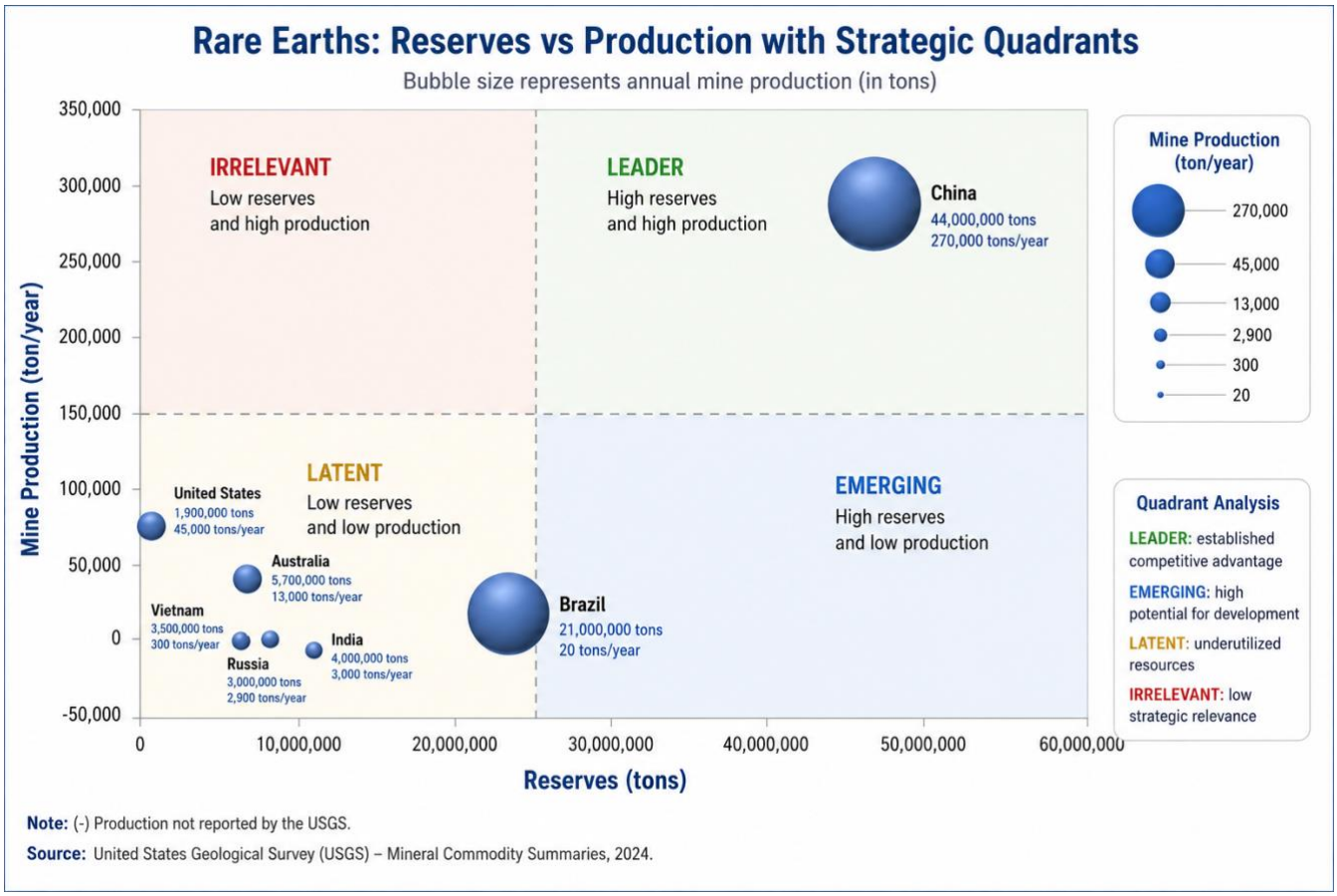


Figure 3. Reserves vs. Rare Earth Production: Strategic Quadrants (Prepared by CGEE, using USGS data)

Brazil's challenge is not to discover new reserves. The challenge lies in building the industrial, technological, and institutional capabilities needed to transform mineral resources into products, technologies, and effective participation in the strategic markets of the 21st century.

The central question, therefore, is not whether Brazil should participate in the global rare earths supply chain, but in which segments it intends to compete and what national capabilities it will need to develop to capture economic, technological, and geopolitical value.

Brazil has:	**But it still lacks:**
✓ Mineral resources	× Industrial separation capacity
✓ Scientific knowledge	× Significant production of metals and alloys
✓ Market potential	× Permanent magnet supply chain
✓ International interest	× Competitive presence in high-value-added segments

International experience shows that the wealth generated by rare earths is not concentrated in mining, but in the industrial and technological sectors located downstream in the production chain. Brazil already possesses significant strategic assets.

Figure 4 illustrates the progression of value added along the production chain, showing that the greatest economic returns are associated with the stages of chemical processing, metallurgy, alloy manufacturing, and the production of permanent magnets.

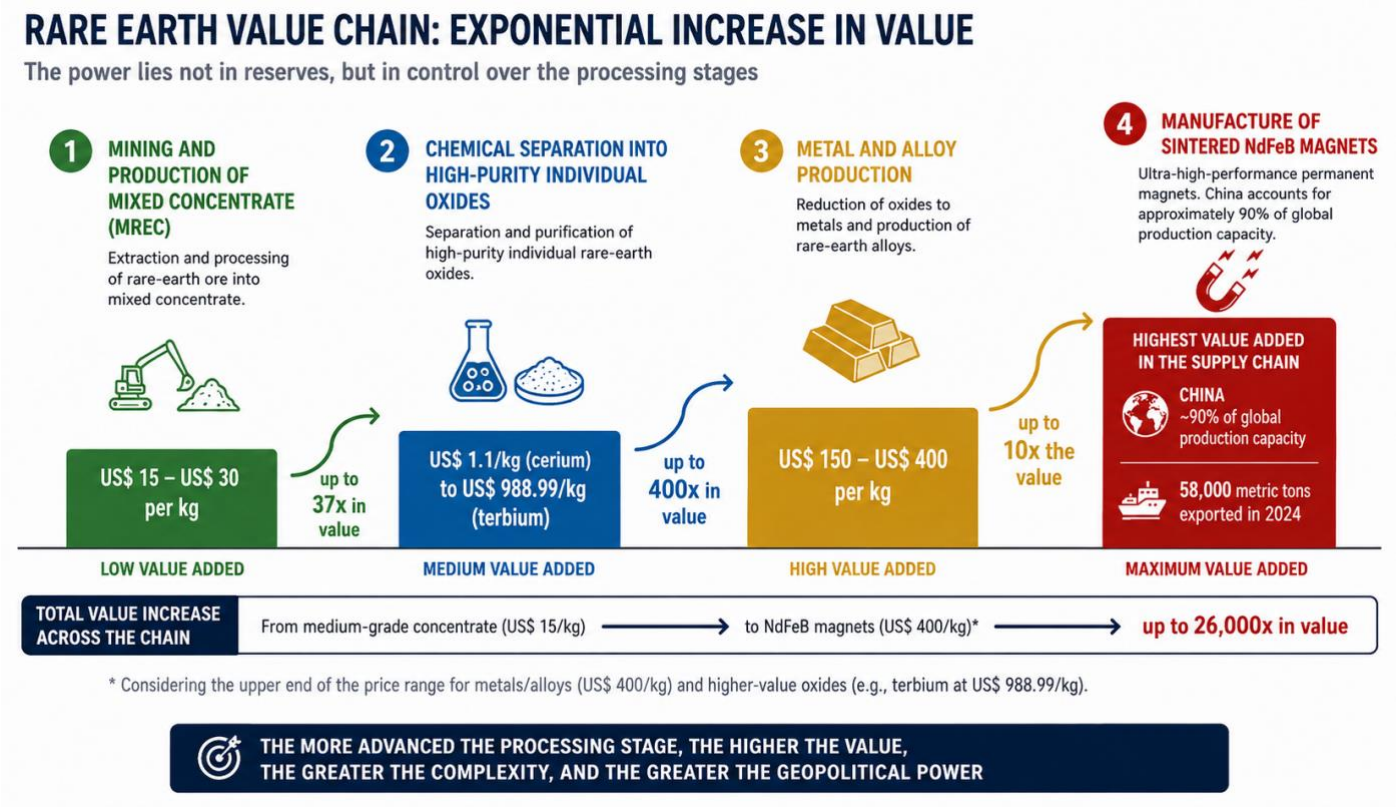


Figure 4. Rare Earth Value Chain II: Value Leap (Prepared by CGEE).

Rare earth elements are critical inputs for strategic sectors of the global economy, including electric mobility, renewable energy generation, defense systems, artificial intelligence, robotics, satellites, advanced electronics, and digital infrastructure. Without secure access to these materials, it becomes impossible to sustain the expansion of the energy transition and the digital economy on a global scale.

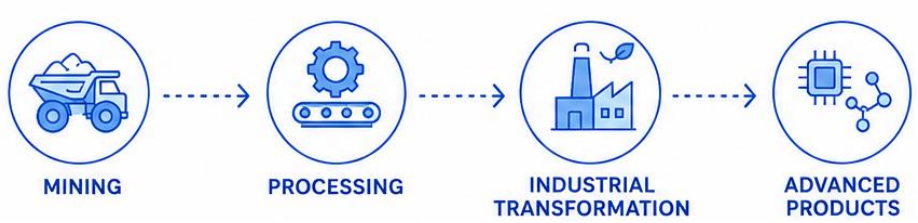
An assessment limited to resource availability may lead to the perception that Brazil's main advantage lies in its rare earth reserves. The study demonstrates that the country's competitive edge is broader.

In addition to having one of the world's largest geological reserves, Brazil possesses deposits of both light and heavy rare earths, a well-established scientific base, a significant domestic market, industrial sectors with potential for consumption, and the ability to attract domestic and international investment.

The combination of these factors sets Brazil apart from many countries that possess mineral resources but lack the necessary conditions to develop complete production chains.

International experience shows that competitiveness in the sector does not stem solely from mineral production. Remaining limited to exporting concentrates would repeat a historical pattern of specialization in commodities, with limited capture of economic and technological value.

The development of the supply chain requires a progressive path of value addition:



The strategic objective should not be merely to expand mineral production, but to increase domestic participation in the most technologically intensive industrial sectors. Figure 5 illustrates how strategic applications unfold along the value chain.

Figure 5. Rare-Earth Value Chain: Strategic Applications (Prepared by CGEE)

An analysis of the production chain shows that the main bottleneck for the sector's development in Brazil lies in the separation and refining stage. This process transforms mineral concentrates into high-purity individual oxides, which are essential inputs for the production of metals, specialty alloys, permanent magnets, and advanced materials.

Refining

Refining is the link that connects geology to industry. Without this capacity, value creation remains limited, and dependence on external production capacity tends to persist. With it, new stages of industrialization, innovation, and competitive entry into international markets become viable.

Among all segments of the production chain, the separation and refining of rare-earth elements represent the main bottleneck for Brazil's competitive entry into these markets. This stage, carried out primarily through solvent extraction (SX) processes, transforms mineral concentrates into high-purity individual oxides, which serve as raw materials for virtually all high-value-added industrial applications.

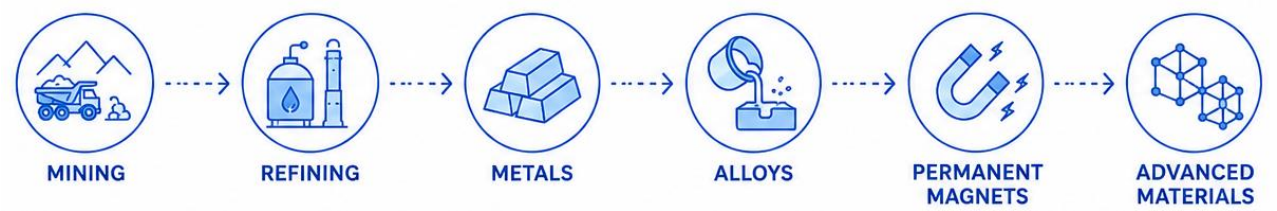
Although the country possesses scientific knowledge accumulated at institutions such as CETEM, IPEN, CDTN, USP, and other research organizations, there is still no rare-earth separation plant operating commercially within the country. The contrast between scientific expertise and the lack of production capacity reveals that Brazil's problem is not merely technological; it is primarily a challenge involving institutional coordination, financing, industrial scale, and integration with consumer markets.

The study considers the decision to establish domestic separation and refining capacity to be the turning point that determines all other strategic decisions along the supply chain. Without this link, the country will remain dependent on foreign capacity to transform its mineral resources into industrial products with higher value added.

For this reason, the study identifies the development of national refining capacity as the foundational decision upon which all other opportunities related to rare earths rest.

At the same time, international experience shows that the development of a competitive supply chain does not occur through the simultaneous construction of all its links. Successful strategies follow a gradual path of accumulating productive, technological, and industrial capabilities.

In this context, the proposed path for Brazil is based on the progressive addition of value throughout the supply chain:



Each stage creates the technical, economic, and industrial conditions necessary to make the subsequent stages feasible. The strategic objective is not to immediately enter the most sophisticated segments of the chain, but to begin building, starting now, the capabilities that will enable the country to reach them in a sustainable manner.

National Strategy

The proposed national strategy is structured around four complementary and simultaneous transformations:

Mineral Transformation

Expand domestic production in a competitive, sustainable, and environmentally responsible manner, converting geological resources into a stable supply of strategic raw materials.

Industrial Transformation

Build domestic capabilities for separation, refining, and processing, laying the necessary foundations for the development of high-value-added sectors.

Technological Transformation

Convert existing scientific expertise into innovation, technological scaling, intellectual property, and productive capacity.

Institutional Transformation

Establish permanent mechanisms for coordination, governance, and financing capable of ensuring continuity, predictability, and strategic alignment among the government, academia, and the private sector.

These four transformations are interdependent and must occur in a coordinated manner. Progress in just one of them, in isolation, will not be enough to change Brazil's position in the global rare earths supply chain.

The strategy does not call for the creation of a fully domestic supply chain or one isolated from international dynamics. The goal is to expand Brazil's participation in global value chains by attracting investment, forming technology partnerships, integrating into international markets, and strengthening critical domestic capabilities.

By 2040, Brazil is expected to establish itself as a major producer of rare earths, a supplier of high-purity separated oxides, a producer of special metals and alloys, a participant in segments related to permanent magnets, and a strategic partner in global supply chains focused on the energy transition, digital transformation, and advanced technologies.

From this perspective, the rare earth strategy should not be viewed as an isolated mineral policy. Its scope is directly linked to national objectives in industrial development, technological innovation, energy transition, economic security, and defense. Rare earths should be understood not merely as mineral resources, but as a platform for the country's industrial, technological, and strategic development.

SECTION II – STRATEGIC GUIDELINES

While Section I defined the strategic vision for the development of Brazil's rare earths supply chain, this section identifies the capabilities needed to turn that vision into reality. The main conclusion is that no single action can create a competitive national supply chain. The sector's development will not be achieved solely by opening new mines, establishing a refining plant, increasing investment in research, or creating a specific public policy. Building a rare earths industry requires the simultaneous advancement of multiple economic, technological, industrial, and institutional factors.

For this reason, the study organizes the national strategy into eight structural pillars that, together, form the capacity framework necessary to sustain the development of the supply chain over the 2026–2040 horizon.

A Capability-Based Strategy

International experience shows that complex production chains function as ecosystems. Progress in a single segment is not enough to ensure competitiveness when the other links are missing or weak.

Mining without refining results in the export of low-value-added concentrates. Refining without a consumer market compromises the economic viability of investments. Research without industry reduces the ability to transform knowledge into innovation and production.

The Eight Structural Pillars

In this context, the eight pillars should be understood as interdependent components of a single strategy.

1. Mineral Exploration and Sustainable Mining

> This aims to ensure the availability of raw materials necessary for the development of the supply chain by expanding geological knowledge, converting resources into economically viable reserves, and promoting the sustainable expansion of mineral production.

2. Separation and Refining

This constitutes the most critical pillar of the national strategy. The capacity for separation and refining links mining to industrial segments with higher value added and represents the main turning point for the development of the Brazilian production chain.

3. Metals and Alloys

It seeks to develop metallurgical capabilities capable of transforming refined oxides into strategic industrial materials, laying the groundwork for applications of greater technological complexity.

4. Permanent Magnets and Advanced Materials

This represents the main long-term industrial objective. These segments generate substantial value added and are fundamental to sectors such as electric mobility, wind energy, industrial automation, robotics, defense, and the aerospace industry.

5. Science, Technology, and Innovation

The goal is to transform the country's existing scientific base into productive capacity, industrial innovation, intellectual property, and the development of specialized human resources.

6. Sustainability and the Circular Economy

This initiative seeks to incorporate environmental and circularity criteria from the very beginning of the supply chain, strengthening the international competitiveness of Brazilian products and reducing vulnerabilities associated with the supply of raw materials.

7. International Integration

It aims to capitalize on the current reorganization of global supply chains by attracting investment, forming technology partnerships, and competitively integrating into international markets.

8. Governance and Financing

This is the integrating element of the strategy. Its objective is to ensure institutional coordination, alignment of public policies, financing mechanisms, and the continuity of actions over time.

More than just a set of projects, the eight pillars represent a capabilities framework aimed at building strategic competencies for the country.

Building Brazilian rare earths supply chain requires not only investments in physical assets, but also the simultaneous development of the productive, technological, institutional, and commercial capabilities that underpin the sector's international competitiveness.

Mineral Exploration and Sustainable Mining

A national strategy for rare-earth elements will only be viable if there is a stable and competitive supply of raw materials capable of sustaining industrial development over the coming decades.

The main conclusion of this chapter is that Brazil possesses sufficient mineral resources to support a long-term national strategy. However, geological availability alone does not guarantee production, industrialization, or competitiveness. The challenge lies in transforming mineral potential into economically viable projects, sustainable operations, and a reliable supply for industry.

Brazil possesses one of the world's largest geological reserves of rare-earth elements and exhibits a diversity of deposits that is unusual on an international scale. This diversity includes deposits associated with carbonatite complexes, monazite, and, in particular, ion-adsorption clays.

The strategic importance of this combination lies in its potential to supply both light and heavy elements, thereby expanding the country's opportunities to participate in different segments of the global supply chain.

Brazil's competitive edge lies not only in the volume of available resources, but also in its geological diversity, which enables it to serve distinct markets and high-value-added applications.

Ion-Adsorption Clays: a Unique Strategic Opportunity

Among the various types of deposits identified in the country, ion-adsorption clays are of particular importance because they concentrate heavy elements such as dysprosium (Dy) and terbium (Tb),

which are essential to produce high-performance permanent magnets used in electric vehicles, wind power generation, defense, robotics, and aerospace applications.

Historically, the supply of these materials has remained heavily concentrated in China. In this context, Brazilian deposits represent one of the few significant opportunities to diversify the global supply of heavy rare earths.

For Brazil, these resources may represent a strategic opportunity comparable to that which the pre-salt layer represented for the national oil industry: a concrete possibility for international repositioning in a sector considered critical to the 21st-century economy.

The study concludes that the main obstacles to the development of the supply chain are not related to the availability of mineral resources.

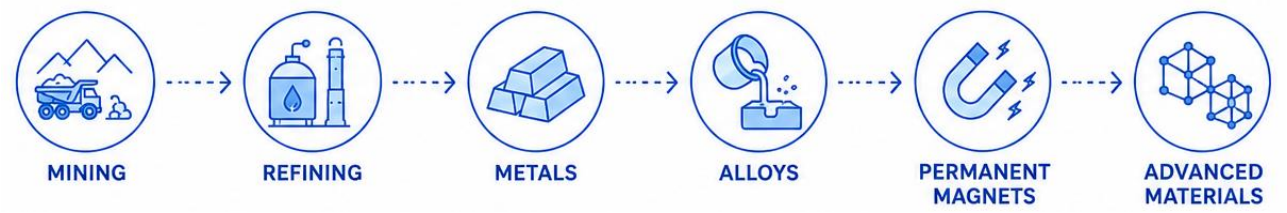
The country already has sufficient geological knowledge to demonstrate the potential of most of the relevant mineral provinces. The most significant challenges currently lie in transforming these resources into economically viable projects and effective production capacity.

The bottlenecks are concentrated in areas such as financing, licensing, infrastructure, industrial processing, the development of consumer markets, and institutional coordination.

In other words, Brazil has already made significant progress in identifying resources. The challenge now is economic, technological, and institutional. Mining is a necessary but not sufficient condition for the development of the supply chain.

The strategic objective should not be measured solely by the expansion of mineral production, but by the ability to use that production as a basis for developing industrial activities with higher value added.

The proposed path remains guided by the progressive addition of value throughout the supply chain:



From this perspective, mining is no longer viewed merely as an extractive activity but is now understood as the material foundation of an industrial strategy aimed at building national technological, productive, and economic capacities.

The future competitiveness of rare earth mining will increasingly depend on the ability to meet the environmental, social, and governance standards required by international markets.

Traceability, certification, transparency, and the reduction of environmental impacts are likely to become prerequisites for accessing more sophisticated markets and attracting investment.

In this context, sustainability should not be viewed merely as a regulatory obligation, but as a central element of the Brazilian supply chain's international competitiveness.

Brazil already possesses the mineral resources necessary to support a national rare earth strategy. The central challenge is not geological. It lies in transforming this mineral advantage into productive, industrial, and technological capacity capable of positioning the country in the highest value-added segments of the global supply chain.

Sustainability and the Circular Economy

The development of a Brazilian rare earths supply chain is expected to take place in an international environment with increasingly stringent environmental, social, and governance criteria. The markets that will demand these materials the most in the coming decades—the European Union, the United States, Japan, and South Korea—will also be the most rigorous regarding traceability, carbon emissions, waste management, water use, and social and environmental responsibility.

The main conclusion of this chapter is that sustainability should not be treated as a constraint on the supply chain's development, but rather as a prerequisite for competitiveness. In a global market marked by growing demands, products with a smaller environmental footprint, greater transparency, and certification tend to have better access to buyers, investors, and financing mechanisms.

Rare earth production presents specific environmental challenges throughout the entire supply chain. In mining, key issues include soil disturbance, water consumption, and land reclamation. In processing, challenges arise related to tailings generation, energy consumption, and the use of reagents. In refining, complexity increases due to the intensive use of chemicals, effluent generation, and the need for strict control of industrial processes.

In this context, Brazil has a strategic opportunity: to structure its supply chain from the outset with high standards of sustainability, thereby avoiding the environmental liabilities seen in older producing regions. The use of renewable energy, water recycling, waste minimization, the adoption of clean technologies, and digital traceability can set Brazilian production apart in international markets.

The circular economy must be incorporated as part of this strategy. Its goal is not limited to recycling but involves keeping critical materials in circulation for as long as possible through reuse, reprocessing, component recovery, and the reintroduction of materials into the production chain.

In this regard, urban mining is likely to gain importance in the long term, with the recovery of rare earths found in electric motors, hard drives, electronic equipment, wind turbines, batteries, and electric vehicles. However, recycling will not replace primary mining in the coming decades, as global demand is growing faster than the availability of recyclable materials. Supply security will depend on a combination of primary mineral production and the circular economy.

Traceability will be a central element of this new competitiveness. International buyers will demand verifiable information on the origin of materials, production conditions, environmental impacts, emissions, and the social standards adopted. For Brazil, demonstrating compliance with these requirements will be essential for accessing markets with higher value added.

Thus, ESG practices should be viewed as tools for international integration, attracting investment, and enhancing the value of Brazilian products. Sustainability can expand access to financing, strengthen strategic partnerships, and position the country as a reliable supplier of critical minerals.

Brazil's strategy should, therefore, seek a competitive advantage based not only on mineral resources but also on sustainability, traceability, and social and environmental responsibility. In the future, the competitiveness of the supply chain will be defined by a combination of price, quality, security of supply, and environmental performance.

Permanent Magnets and Advanced Materials

The true strategic value of rare earths lies not in mining or even refining, but in the technological products that use these materials. Among these applications, rare-earth permanent magnets—especially neodymium-iron-boron (NdFeB) magnets—represent the segment of greatest economic, technological, and geopolitical significance in the global supply chain.

These materials constitute the primary consumer market for rare earths, account for a significant portion of the chain's value added and are present in technologies considered essential for energy transition, digital transformation, and national security.

This chapter demonstrates that the development of the magnet supply chain should be viewed as a long-term strategic objective for Brazil, capable of guiding investments and capacity-building in the upstream segments of the chain.

The value of rare earth elements stems not only from their chemical properties but also from their incorporation into high-tech products. Permanent magnets represent the most significant example of this transformation.

At this stage, chemical elements become integral components of products essential to the modern economy, capturing the largest share of the economic value generated throughout the supply chain.

Permanent magnets are indispensable components for electric motors, generators, automation systems, and energy-efficient equipment.

Demand for them is growing, driven by sectors such as electric mobility, wind energy, industrial automation, robotics, defense, and the aerospace industry.

In this sense, the expansion of the rare earths supply chain is directly linked to the advancing electrification of the global economy and the increasing demand for low-carbon technologies.

International experience shows that China's leadership in the sector stems not only from mining or refining. Its key differentiator is the capacity to produce permanent magnets on a large scale, supported by vertically integrated production chains and strong industrial capability.

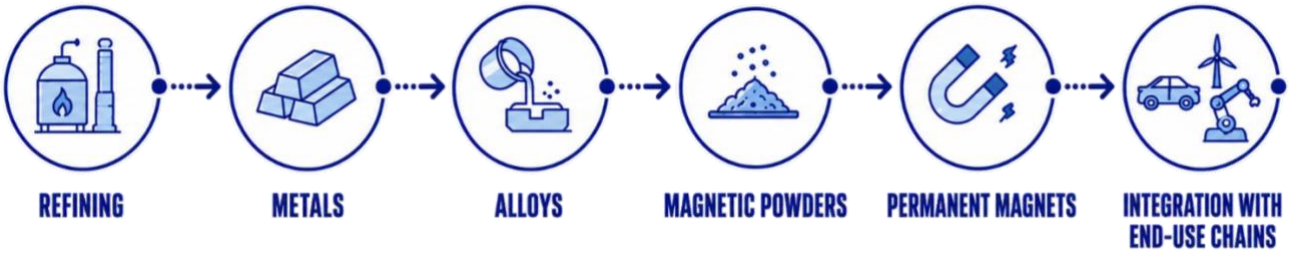
For this reason, international efforts to diversify suppliers are not limited to opening new mines. Countries such as the United States, Japan, South Korea, and members of the European Union have also been investing in building industrial capacity related to the manufacture of magnets and advanced components. Magnets, therefore, represent the true center of gravity of the global rare earths supply chain.

Although it does not yet have a well-established permanent magnet industry, Brazil possesses significant assets to embark on this path.

Among these are the availability of strategic elements such as neodymium, praseodymium, dysprosium, and terbium; the existence of scientific and technological expertise at universities and

research centers; the presence of potential consumer markets; and the growing international search for alternative suppliers.

The country is not starting from scratch. However, it still needs to build productive, industrial, and technological capacities on a scale commensurate with the sector's challenges. The proposed path includes:



Each stage builds the capabilities, infrastructure, and knowledge needed for the next stage, reducing technological risks and increasing the likelihood of investment success.

The development of the supply chain does not depend exclusively on foreign markets. Brazil already has sectors capable of generating significant demand for permanent magnets, including wind energy, electric mobility, defense, industrial automation, and energy-efficient equipment.

This potential demand can play an important role in creating production scale and attracting investment for the early stages of industrialization.

This chapter proposes a strategic interpretation of the production chain. As a country progresses from mining to refining, to metallurgy, and subsequently to magnet production, its capacity to capture value, generate knowledge, and participate in the most technologically sophisticated segments of the economy increases.

From this perspective, the production of permanent magnets can be understood as an indicator of the level of industrial maturity achieved by the national rare earth strategy.

The consolidation of a national permanent magnet supply chain will depend on the prior development of the mining, processing, separation, refining, and metallurgy segments. For this reason, its implementation is treated as a strategic objective associated with the 2035–2040 timeframe.

Magnets are not the starting point of the Brazilian strategy. They represent its primary industrial destination.

The production of permanent magnets accounts for most of the economic and technological value of the rare earths supply chain. The development of this capacity should guide the construction of the preceding links in the chain, and it constitutes the main long-term industrial objective of the national strategic roadmap.

Consumer Markets and Strategic Applications

Brazil's strategy for rare earths should not be guided solely by the availability of mineral resources, but primarily by developments in consumer markets. The growth in global demand for these materials is linked to structural transformations in the world economy, including the energy transition, the electrification of transportation, digitalization, industrial automation, artificial intelligence, and the modernization of defense systems.

In this context, the future of the rare earths supply chain will be determined less by the availability of geological resources and more by the expansion of technologies that depend on these materials.

There is no single rare-earth market. Each element has specific applications and is associated with different industrial sectors, each with its own growth dynamics.

This diversity reduces dependence on a single economic segment and expands market opportunities for producers capable of meeting different industrial demands.

The rare earths supply chain should therefore be understood as a technological platform that serves multiple strategic markets simultaneously.

Most of the future growth in global demand is linked to the decarbonization of the economy.

Electric vehicles, wind power generation, energy storage systems, and industrial electrification depend directly on materials containing rare earths, especially high-performance permanent magnets.

The growing replacement of fossil fuel-based technologies with electric systems creates a structural demand for elements such as neodymium, praseodymium, dysprosium, and terbium.

From this perspective, rare earths should be understood as part of the material infrastructure of the global energy transition.

Among the various consumer markets, electric mobility and wind power generation stand out. High-efficiency electric motors use permanent magnets containing neodymium, praseodymium,

dysprosium, and terbium. Similarly, modern wind turbines — especially those equipped with direct-drive systems — require significant quantities of these materials.

The simultaneous growth of these two sectors is expected to drive a significant portion of the global expansion in demand for rare earths over the coming decades.

For Brazil, this scenario presents an additional advantage: both segments are already playing an increasingly important role in the national economy, creating opportunities for the development of domestic consumer markets.

Although decarbonization is the main driver of growth, rare earths also play a significant role in other strategic sectors.

Artificial intelligence, data centers, robotics, industrial automation, aerospace systems, and defense technologies all rely on components that use rare earths in various applications.

This diversification makes demand more resilient and reduces the sector's exposure to fluctuations in specific markets. One of the most significant conclusions from this section is the convergence between the fastest-growing global markets and Brazil's strategic priorities.

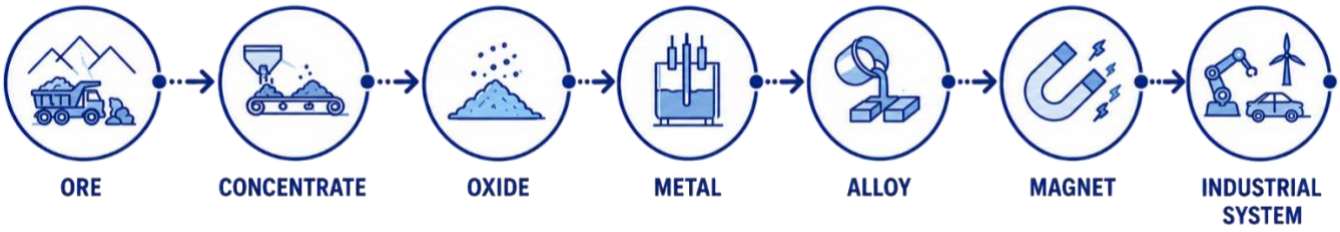
Renewable energy, electric mobility, defense, digital transformation, and advanced manufacturing are simultaneously among the leading future consumers of rare earth elements and among the country's industrial and technological development goals.

This convergence expands the potential for integration between the rare-earth strategy and other public policies aimed at national development.

Brazil is in a unique position compared to many other countries that produce critical minerals.

In addition to being able to meet international demand from the United States, the European Union, Japan, and South Korea, the country has domestic markets capable of absorbing part of its future production, particularly in the wind energy, electric mobility, defense, and industrial automation sectors.

This combination reduces market risks and may help make the first industrial investments viable. Economic value increases as the supply chain moves closer to end-use applications.



Each stage incorporates greater technological intensity, specialized knowledge, intellectual property, and added value. Brazil's strategy should therefore aim for progressively closer integration with end-consumer markets and the most technologically sophisticated industrial segments.

The projections analyzed in the study indicate that the expansion in demand for rare earths is not linked to a business cycle but rather to structural transformations in the global economy.

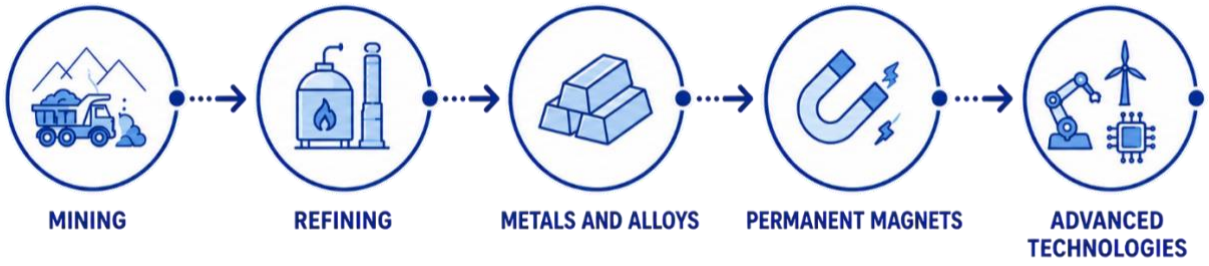
Electrification, digitalization, automation, artificial intelligence, energy security, and defense are long-term trends that are expected to sustain the growth in consumption of these materials over the coming decades.

Brazil's main challenge is not to generate demand for rare-earth-derived products. The demand already exists and is expected to grow steadily over the coming decades. The challenge lies in developing the productive, industrial, and technological capacity needed to serve these markets and capture a growing share of the value generated by the ongoing transformations in the global economy.

Rare-Earth Metals and Alloys

The production of rare-earth metals and alloys serves as the intermediate link connecting refining to the manufacture of more technologically advanced products. Without this step, even a supply chain capable of producing separate oxides would remain dependent on external suppliers to transform these materials into advanced industrial components.

The value-added process can be represented as follows:



In this context, metallurgy plays a strategic role by transforming chemical materials into industrial materials, thereby creating the conditions necessary for the development of the most sophisticated segments of the supply chain.

One of the chapter's key contributions is to demonstrate that refining does not represent the final stage of the production chain. Separated rare-earth oxides serve as raw materials for the production of metals and alloys, which in turn supply industrial applications with higher value added.

Elements such as neodymium, praseodymium, and dysprosium must be converted into high-purity metals and subsequently incorporated into specific alloys to meet the requirements of different technological applications.

The economic value of the chain continues to increase after refining, in tandem with the incorporation of knowledge, industrial processing, and technological specialization.

The production of metals and alloys represents the transition between chemical separation processes and the industrial processes associated with the manufacture of technological components and systems.

Without metallurgy, there is no integrated industrial chain based on rare earths.

In addition to supplying raw materials for the production of permanent magnets, metals and alloys have their own markets in metallurgical, automotive, aerospace, chemical, and energy applications.

This diversity expands opportunities for industrial integration and reduces dependence on a single consumer segment.

The country possesses accumulated expertise in areas such as extractive metallurgy, materials engineering, specialty alloys, and the characterization of advanced materials.

Research institutions, technology centers, and universities are already conducting activities related to the metallurgical challenges associated with rare earths, creating a knowledge base that can be mobilized for the sector's industrial development.

This distinction sets rare earth metallurgy apart from other segments that are further removed from the country's current installed capacity.

The conversion of oxides into metals involves complex processes, including metallothermic reduction, electrolysis, controlled melting, and handling controlled atmospheres.

These operations require high levels of purity, contamination control, energy efficiency, and operational safety.

For this reason, metallurgy represents both a significant technological barrier and an opportunity to build more sophisticated industrial capabilities.

Among the various industrial applications of rare earths, the production of alloys holds a strategic position because it serves as the bridge to advanced magnetic materials.

The manufacture of permanent magnets depends on a production sequence that necessarily involves the production of specialized alloys:

The ability to produce high-performance alloys is, therefore, a necessary condition for any future strategy aimed at the domestic manufacture of permanent magnets.

Even before the consolidation of a large-scale magnet industry, Brazil can significantly increase its value capture through the production of metals and alloys.

This stage represents an intermediate opportunity for industrialization, capable of generating economic value, developing production capabilities, and strengthening integration among the mining, refining, and manufacturing sectors.

In addition, various sectors of the Brazilian economy—including steel, specialty metals, energy, defense, automotive, and industrial equipment—can serve as potential consumers of these materials.

The main conclusion is that the challenges associated with the production of metals and alloys do not center on the generation of scientific knowledge, but rather on the ability to transform existing expertise into competitive industrial operations. The main obstacles relate to production scale, economic viability, supply chain integration, attracting investment, and market access. In this regard, building national metallurgical capacity represents a decisive step toward reducing foreign dependence and increasing value capture throughout the supply chain.

The study suggests that the production of metals and alloys may represent one of the most realistic paths for Brazilian industrial expansion in the short and medium term.

While the manufacture of permanent magnets requires highly integrated production chains and more intensive investments, metallurgy can serve as a bridge between the refining sector and the more ambitious industrial goals projected for the 2040 horizon.

Metals and alloys constitute the link connecting refining to industrial segments with higher value added. Developing this capacity will enable Brazil to advance in capturing economic and technological value, reducing external dependencies, and laying the groundwork for future entry into the markets for permanent magnets and advanced materials.

SECTION III - STRATEGY

After presenting the strategic foundations, the international context, and the structural conditions for the development of the rare earths supply chain in Brazil, this section focuses on the industrial links responsible for generating economic, technological, and geopolitical value.

Rather than merely describing specific production sectors, this section demonstrates how transforming mineral wealth into higher-value-added products constitutes both the true challenge and, at the same time, the primary opportunity for the country. It is at this stage that rare earths cease to be merely natural resources and become integral parts of technology chains associated with the energy transition, electric mobility, defense, advanced manufacturing, and the digital economy. Thus, the following chapters show where the economic value of the chain lies, what capabilities need to be developed, and how Brazil can strategically position itself to capture a growing share of the benefits generated by the new global economy of critical minerals.

The Geopolitics of Rare Earths and Critical Minerals

Rare earths are no longer merely a mineral or industrial issue; they have become a matter of economic, technological, and national security. The growing dependence on critical minerals for the energy transition, digital transformation, artificial intelligence, and defense systems has placed these materials at the center of the national strategies of the world's leading economies.

This chapter demonstrates that the reorganization of global supply chains for critical minerals is creating a strategic opportunity for countries capable of offering resources, institutional stability, and industrial development potential. In this context, Brazil is no longer viewed merely as a holder of mineral resources but is now perceived as a potential strategic partner in building more diversified and resilient global supply chains.

One of the chapter's most important conclusions is that the international problem associated with rare earths does not stem from geological scarcity. Mineral reserves and resources exist in numerous countries.

The vulnerability of global supply chains is concentrated primarily in the industrial segments with the highest value added, particularly in separation and refining, the production of metals and alloys, and the manufacture of permanent magnets.

The central issue for industrialized economies is not finding new resources, but reducing the concentration of production capacities considered critical.

China's position stems not only from the availability of mineral resources. Over several decades, the country has developed industrial, technological, and institutional capabilities across all strategic links in the chain.

Refining, metallurgy, alloy production, magnet manufacturing, human resource development, and vertical integration have been developed in a coordinated manner, enabling China to consolidate a dominant position in various segments.

This chapter reinforces one of the central messages of the entire study: the strategic power associated with rare earths stems primarily from mastery of industrial and technological processes, and not merely from the possession of mineral resources.

For much of the past few decades, global supply chains have been organized according to criteria of economic efficiency and cost reduction.

However, recent events — including geopolitical tensions, logistical disruptions, the pandemic, and trade restrictions—have led governments and companies to reassess their supply strategies.

Priorities now include criteria such as security of supply, supplier diversification, and the reduction of strategic vulnerabilities.

This shift creates opportunities for new entrants and favors countries capable of offering stability, predictability, and potential for production expansion, as critical minerals have become an explicit part of the industrial and national security strategies of major economies.

The United States, the European Union, Japan, Australia, South Korea, and other countries have been implementing programs aimed at diversifying supply, strengthening domestic industrial capabilities, and building strategic international partnerships.

These initiatives reflect a structural transformation: critical minerals are no longer merely a market issue but have become an integral part of industrial, technological, energy, and defense policies.

Brazil is Seen as Part of the Solution

Several international studies identify Brazil as one of the countries with the greatest potential to contribute to the diversification of global critical mineral supply chains.

This perception stems from a combination of factors that few countries are able to bring together simultaneously: significant mineral resources, potential for heavy rare earths, established scientific capacity, a diversified industrial base, and relative institutional stability.

This combination gives the country a unique position in the current process of reorganizing global supply chains. International interest in new suppliers, new projects, and new technology partners creates a unique opportunity for Brazil.

However, this opportunity is not permanent. Countries such as Australia, Canada, and the United States have been expanding their investments and consolidating new production capacities. Other projects under development are also vying for a place in future global supply chains.

Brazil's advantage stems not only from the availability of resources but also from the timing at which these resources can be put to work in building new supply chains. However, Brazil's integration into the global economy should not be limited to the supply of raw materials.

Mineral resources can be used as a tool to attract productive investments, promote technology transfer, train specialized human resources, and stimulate the development of national industrial capabilities.

The proposed strategy seeks to transform geological advantages into technological and industrial advantages, using current international demand as a catalyst for this process.

One of the most relevant conclusions is that geopolitics should not be interpreted solely as a source of risk or instability.

The current trend toward diversification of global supply chains can serve as a mechanism to accelerate Brazilian industrial development, creating opportunities for investment, technology partnerships, joint ventures, and expanded access to strategic markets.

In this sense, the reorganization of global supply chains for critical minerals represents not only an international challenge but also a concrete opportunity for national development.

The global competition for critical minerals is not centered on resource ownership but on control of the industrial and technological capabilities that transform these resources into strategic products. Brazil has a rare opportunity to leverage its geological advantage to attract international investment, technology, and partnerships capable of accelerating the development of a national rare earths supply chain. This opportunity, however, has a limited timeframe and will depend on how quickly the country can transform its potential into productive capacity.

International Integration and Strategic Partnerships

Brazil should not seek merely to sell rare earths to the international market. The strategic objective should be to leverage its geological position to attract investment, technology, industrial capabilities, and integration into the higher-value-added segments of global supply chains.

The international competition for rare earths is not merely about access to mineral resources, but also about control over the industrial and technological capabilities associated with refining, metallurgy, alloys, permanent magnets, and advanced materials. In this context, Brazil's strategy must combine mineral resources, industrialization, sustainability, technological cooperation, and geopolitical integration.

Simply exporting concentrates or oxides may increase revenues in the short term, but it yields limited benefits in terms of industrial capacity-building, technological autonomy, skilled jobs, and international bargaining power. The country must avoid a passive role and seek partnerships that result in technology transfer, local production, human resource development, and the building of national capabilities.

Brazil possesses strategic assets that set it apart from many competitors: significant mineral resources, potential for light and heavy rare earth elements, an established scientific base, relatively clean energy, a substantial domestic market, and institutional stability. The central challenge is not to create advantages from scratch, but to transform these potential advantages into effective competitive advantages.

Sustainability can strengthen this position. In an increasingly demanding global market, sustainable production, traceability, ESG criteria, renewable energy, and the circular economy can set Brazil apart as a reliable supplier of critical minerals. Future competitiveness will depend not only on price and quality, but also on predictability, environmental compliance, and international reputation.

International integration should occur gradually. In the short term, the country could expand its participation in the production and export of concentrates and oxides. In the medium term, it should move toward processed materials, metals, and alloys. In the long term, the goal should be to participate in supply chains for permanent magnets, advanced components, and industrial applications with higher value added.

This trajectory requires structured international partnerships. The United States, the European Union, Japan, South Korea, and other players are seeking reliable suppliers to diversify their supply chains. Brazil can position itself as a long-term strategic partner, provided it negotiates based on a clear strategy for industrial and technological development.

International cooperation should be evaluated based on its potential to build national capabilities. Every agreement, investment, or partnership must contribute to expanding technological expertise, production capacity, human resource development, market access, and competitive integration into global supply chains.

There is also room for Brazil to play a role in South-South cooperation, involving Latin America, Africa, and other emerging countries on issues such as mineral research, processing, capacity building, sustainability, and governance of critical minerals. This role can strengthen Brazil's position not only as a supplier but also as a regional coordinator for strategic minerals.

The main message of this chapter is that international integration should be treated as an instrument of national development. This is not merely a matter of trade policy, but of industrial, technological, innovation, and development policy.

The scenario to be avoided is a repeat of the primary-export model, in which Brazil exports ore and imports technology. The desired scenario is one in which the country uses its mineral resources to build capacity in refining, metallurgy, alloys, magnets, and advanced materials, progressively exporting higher value-added products.

Brazil must seek international integration based on value addition, technology transfer, sustainability, and the building of national capabilities. The goal is not merely to export rare earths, but to transform mineral resources into industry, technology, and meaningful participation in global supply chains for critical minerals.

Governance, Coordination, and Implementation Tools

While the previous chapters demonstrate that Brazil possesses mineral resources, market opportunities, scientific expertise, and a favorable geopolitical environment, this chapter addresses the main challenge to turning this potential into reality: the capacity for institutional coordination.

The study's main conclusion is that the greatest risk to the development of Brazil's rare earths supply chain is not geological, technological, or market-related. The greatest risk is institutional.

The country already possesses mineral resources, scientific knowledge, business interest, and potential demand. The challenge now is to build governance mechanisms capable of aligning public policies, coordinating stakeholders, mobilizing investments, and ensuring strategic continuity over decades.

In short, the success of the strategy will depend less on what Brazil possesses and more on its ability to coordinate the assets it already has.

The rare earths supply chain does not fall under the purview of a single ministry, agency, or company. Its development simultaneously involves mineral policy, industrial policy, science and technology, defense, foreign trade, financing, and human resources development.

Ministries, regulatory agencies, financial institutions, universities, research centers, and private companies play complementary and interdependent roles.

The central challenge is not a lack of actors or expertise. The challenge is to create permanent mechanisms for coordination among them. It is proposed that governance be understood as a national capacity just as important as mining, refining, or metallurgy.

Just as mining produces mineral resources and refining produces industrial materials, governance produces coordination, predictability, and the capacity for execution.

Without institutional coordination, efforts tend to become fragmented and isolated initiatives multiply. With proper governance, it becomes possible to transform scattered projects into a coherent, long-term national strategy. Rare-earth projects have time horizons that are incompatible with short-term political cycles.

Mining projects can take more than a decade to become operational. Industrial facilities require significant investment and long consolidation periods. The development of specialized human resources demands ongoing planning.

For this reason, the chapter recommends the creation of permanent coordination and monitoring mechanisms capable of ensuring strategic continuity through 2040 and beyond. The institutionalization of governance is presented as a necessary condition for avoiding discontinuity and loss of focus over time.

The rare earths supply chain exhibits characteristics typical of strategic sectors: high initial investments, significant technological risks, long maturation periods, and uncertainties associated with international markets.

In this context, conventional financing mechanisms are often insufficient to support technology demonstration projects, pilot plants, industrial rollout, and innovation infrastructure.

The study concludes that the availability of appropriate financial instruments can be just as important as the availability of technology. The proposed strategy does not presuppose a fully state-owned supply chain, nor a model based exclusively on market forces.

The role of the government is to act as a coordinator and catalyst, reducing risks, correcting market failures, and creating conditions for mobilizing private investment.

Instruments such as innovation procurement contracts, targeted credit, government procurement, innovation support, and risk sharing are presented as mechanisms capable of accelerating the development of the supply chain.

Brazil already has a variety of tools that could potentially be applied to the development of the rare earths supply chain.

Science and technology funds, innovation programs, financing programs, industrial support tools, mineral research programs, and trade promotion initiatives can contribute to different stages of the strategy.

The main challenge is not to create new instruments, but to coordinate existing ones around common objectives and shared goals.

Building the supply chain will require professionals specialized in geology, mining, hydrometallurgy, chemistry, metallurgy, materials engineering, and advanced manufacturing. The training of this workforce should not be treated as a natural consequence of the supply chain's development, but as an integral part of the strategy itself.

The availability of qualified professionals will be critical to the operation of the future industrial plants and technology centers planned for the coming decades. Markets evolve, technologies change, new opportunities arise, and unforeseen risks can alter priorities over time.

For this reason, permanent mechanisms for monitoring, evaluation, and strategic updating are considered essential to ensure the relevance and effectiveness of the national strategy.

Rare earths should not be treated as a standalone project.

The development of the supply chain must be part of a broader national policy focused on critical and strategic minerals, capable of ensuring institutional coordination, regulatory predictability, alignment of investments, and continuity of government actions.

This approach makes it possible to integrate rare earths into broader objectives related to industrial policy, technological innovation, the energy transition, defense, and economic security.

Priorities for Public Policymakers

Five key priorities have been identified for the implementation of the national strategy:

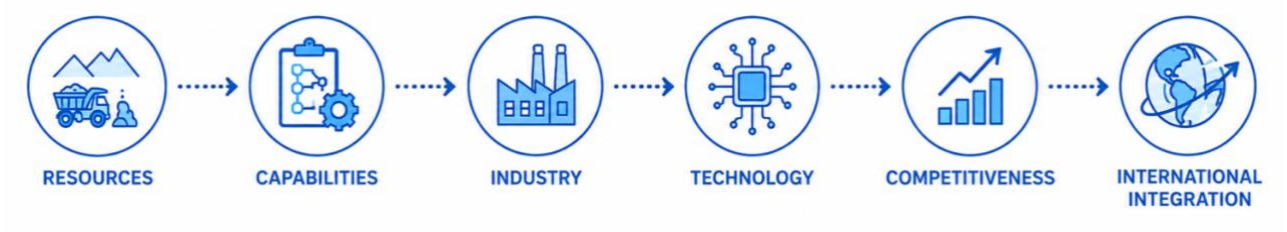
- **Permanent Governance** – define who coordinates and monitors the strategy's implementation.
- **Financial Instruments** – facilitate long-term investments in industrial and technological projects.
- **Interministerial Coordination** – align policies and instruments across different government sectors.
- **Human Resources Development** – ensure the availability of critical skills for the supply chain.
- **Strategic Monitoring** – track the implementation of the strategic roadmap and adjust priorities over time.

The main barrier to the development of Brazil's rare earths supply chain is not a lack of mineral resources, technology, or markets. It is the ability to coordinate these assets around a common strategy. Governance must be understood as a strategic national asset, capable of transforming potential into long-term productive, industrial, and technological capacity.

Strategic Roadmap 2026–2040

The roadmap integrates the strategic assessment, the national strategy, the eight structural pillars, the links in the production chain, and the governance and financing mechanisms necessary for implementation.

The main conclusion is that the development of Brazil's rare earths supply chain will not occur through a single project or isolated investment. It is a gradual process of building national capacity, spread across three-time horizons. The roadmap should not be understood as a simple project timeline, but rather as a coordinated sequence of transformation:



Each step creates the necessary conditions for the next step. The goal is not merely to carry out actions, but to build lasting skills.

Horizon 1 – 2026–2030: Laying the Foundations

The first horizon is critical to the strategy's success. The decisions made between 2026 and 2030 will determine the viability of subsequent industrial advances. The central objective of this period is to create the institutional, financial, technological, and productive conditions necessary for the future industrialization of the supply chain.

Priorities include establishing a national governance structure, creating dedicated financial instruments, expanding geological knowledge, converting resources into reserves, developing pilot plants and demonstration projects for separation and refining, and training specialized personnel.

Without consistent progress during this first horizon, the objectives set for subsequent periods will be difficult to achieve.

Horizon 2 – 2031–2035: Industrial Rollout

The second horizon marks the transition from emerging capabilities to industrial production.

The main objective is to transform the advances achieved in the previous period into productive operations, with an emphasis on establishing industrial refining capacity, developing domestic production of metals and alloys, integrating with consumer sectors, and consolidating international industrial and technological partnerships.

This stage is expected to yield the strategy's first visible economic results, expanding Brazil's participation in the intermediate segments of the supply chain and reducing external dependence at critical stages.

Horizon 3 – 2036–2040: Global Integration and Higher-Value-Added Products

The third horizon corresponds to the consolidation of the long-term strategic vision. The goal is to position Brazil as a strategic international supplier, with a presence in segments characterized by higher technological intensity and greater value capture.

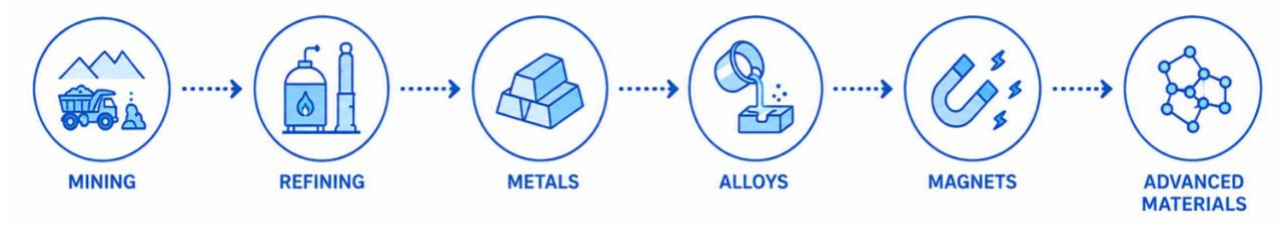
Priorities include domestic production of permanent magnets, the development of advanced materials, the incorporation of circular economy practices, and the expansion of exports of higher-value-added products.

At this stage, the strategy should move beyond merely producing industrial and economic effects to also generating geopolitical impacts by expanding Brazil's relevance in global critical mineral supply chains.

The stages outlined in the strategic roadmap should not be interpreted as mutually exclusive phases. They are cumulative. Even in the most advanced stages, the country should continue to invest in mineral research, sustainability, human resource development, technological innovation, and governance.

Similarly, the strategic roadmap should not be treated as a rigid plan. Markets change, technologies evolve, risks emerge, and geopolitical scenarios shift. For this reason, its implementation must be accompanied by ongoing mechanisms for monitoring, evaluation, and strategic review.

In summarizing the findings of the entire study, this chapter reaffirms that separation and refining constitute the main turning point in the national strategy. This link connects mining to the industrial segments with the highest value added:



Building national capacity for separation and refining is, therefore, the most important industrial decision in the strategic roadmap. Without this link, the supply chain will remain limited to mineral production or the export of intermediate products. With it, the subsequent stages of metallurgy, alloys, magnets, and advanced materials become viable.

The implementation of the strategic roadmap will depend on simultaneous coordination among the government, companies, Science and Technology Institutions (STIs), development agencies, and international partners. No single actor will be able to execute the strategy on its own. The permanent governance framework discussed in the previous chapter is a necessary condition for aligning instruments, reducing fragmentation, monitoring targets, and ensuring continuity across the three-time horizons.

Reading Guide for the Strategic Document

This report was designed to support the formulation of public policies, industrial strategies, and investment decisions related to Brazil's rare earths supply chain.

Although the document presents detailed technical analyses of geology, mining, processing, markets, and industrial applications, its main contribution is strategic: to demonstrate how Brazil can transform its geological advantage into industrial, technological, and geopolitical capabilities over the coming decades.

To facilitate its use by public officials and decision-makers, this section presents the study's main themes, the associated strategic issues, and the chapters where each topic is addressed in greater depth.

Where to find the main themes of the study

If you want to understand…	Main Message	Where to Look
Why rare earth elements have become strategic for the 21st century	Rare earths are critical inputs for the energy transition, defense, artificial intelligence, and advanced manufacturing	Chapters 1 and 2
Why Brazil has a unique opportunity right now	The reorganization of global supply chains creates a window of opportunity for new strategic suppliers	Chapters 2 and 11
What Brazil's strategic challenge is	The country has abundant mineral resources, but still captures little value from the supply chain	Chapter 1
What position Brazil should occupy in the global supply chain	The focus should be on refining, metals, alloys, and magnets—not just mining	Chapter 3

If you want to understand…	Main Message	Where to Look
What vision guides the national strategy	Transforming geological advantages into industrial, technological, and geopolitical capabilities	Chapter 4
Which areas need to be developed simultaneously	Eight pillars underpin the development of the national supply chain	Chapter 5
Brazil's geological potential and the main deposits	Brazil has the resources to sustain a long-term supply chain	Chapter 6
The role of ion-adsorption clays	These resources could position Brazil among the few major suppliers of heavy rare earths	Chapter 6
How to build a sustainable and competitive supply chain	Sustainability, traceability, and the circular economy will be key factors in competitiveness	Chapter 7
Why permanent magnets are so important	Magnets account for a large portion of the value added in the supply chain and support strategic sectors	Chapter 8
Where the future demand for rare earths lies	Electric vehicles, wind energy, defense, AI, robotics, and digital infrastructure will drive the market	Chapter 9
How to add value before reaching the magnets	The production of metals and alloys represents a strategic stage of industrialization	Chapter 10
How China built its leadership	Dominance lies in the industrial links of the supply chain, not just in mining	Chapters 2 and 11

The Five Most Important Messages in the Document

1. Brazil does not have a geological problem.

The country has sufficient resources to play a significant role in the global rare-earth market. The challenge lies in building industrial capacity.

2. The value does not lie in the mine.

Most of the economic value is captured in the refining, metallurgy, alloys, and permanent magnet stages.

3. A window of opportunity is open.

The reorganization of global supply chains for critical minerals creates an unprecedented opportunity for Brazil to attract investments and technological partnerships.

4. Refining is the critical link.

Without domestic separation and refining capacity, the country will remain dependent on production capacity located abroad.

5. The next decade will be decisive.

Decisions made between 2026 and 2030 will determine whether Brazil will be merely a supplier of raw materials or a key player in the new global economy of critical minerals.

BRAZIL'S RARE EARTHS

State of the Art, Scenarios, and a

Strategic Roadmap

for 2026–2040

Check it out!

(book in Portuguese)

Final Considerations

Rare earths have become strategic inputs for the energy transition, digital transformation, defense, and the advanced technologies that will shape the economy in the coming decades. In this context, Brazil occupies a privileged position, as it possesses one of the world's largest geological reserves, established scientific capacity, a significant domestic market, and favorable conditions for attracting international investment and partnerships.

However, the main national challenge lies not in the availability of mineral resources, but in the ability to transform this geological advantage into industrial, technological, and institutional capabilities. The development of expertise in separation and refining, metallurgy, special alloys, permanent magnets, and advanced materials will be crucial for increasing value addition, strengthening national competitiveness, and positioning the country as a key player in global supply chains for critical minerals.

This Executive Summary presents the main results, conclusions, and recommendations of the study. However, the in-depth analyses, reference data, prospective scenarios, and detailed strategic actions are presented in the full report, organized into 14 chapters that cover everything from geological and geopolitical fundamentals to the governance, financing, and implementation tools for the strategic roadmap for 2026–2040.

For policymakers, managers, investors, researchers, and business leaders, reading the full study offers a comprehensive view of the challenges, opportunities, and decisions necessary to transform Brazil's potential into industrial development, technological innovation, and a leading international role.

Access the full document via the QR code on the right and explore, in greater depth, the proposed paths for consolidating a competitive, sustainable, and integrated Brazilian rare earths supply chain.

Brazil has the resources, the knowledge, and the opportunity. The central question is no longer whether the country has the potential to take a leading role in this strategic sector, but whether it will be able to act with speed, coordination, and a long-term vision to turn this opportunity into a lasting reality.

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