



Essential Minerals Coalition

Role of the mining sector in decarbonization and energy transition

Executive summary

Introduction

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Critical minerals are one of today's main pillars of the global energy transition. Elements such as lithium, nickel, copper, niobium, and rare earths underpin the production of batteries, electric vehicles, wind turbines, and digital technologies that are essential for decarbonization.

In this context, Brazil holds a strategic position. The country combines vast diversity and volume of mineral reserves, a predominantly renewable energy matrix, and well-established technical institutions. This combination grants the Brazilian mining sector the ability to produce critical inputs with lower carbon intensity, transparency, and traceability — attributes increasingly demanded by global value chains.

With this purpose, and at the invitation of Ambassador André Corrêa do Lago, President of COP30, CEBDS coordinated the **Business Coalition on Critical Minerals**, in partnership with **Vale** and **IBRAM**.

The initiative brought together **25 companies and associations** in a collaborative effort that outlines a **national strategy for a transition to low-carbon mining**, with concrete goals and instruments.

The study shows that the sector can **reduce up to one-third of its direct emissions by 2035** by expanding the use of clean energy, electrifying processes, and adopting operational efficiency technologies. It also highlights pathways to consolidate Brazil as a **reliable supplier of critical minerals**, adding value to production while ensuring alignment with international standards of sustainability and environmental governance.

More than a diagnosis, this Coalition represents a **business commitment to the future of the mining sector**. It embodies the convergence of competitiveness, legitimacy, and innovation, recognizing that Brazil's mineral leadership will depend on the coherence between productivity, climate action, and social governance.

It is about turning a **natural advantage into effective climate leadership**, contributing to a global transition based on value, transparency, and cooperation.

Sustainable mining can accelerate green industrialization and Brazil's role in the global energy transition

The Global Energy Transition will be supported by mining



The global energy transition requires new supply chains for minerals such as lithium, graphite, etc...



... in addition to increasing demand for minerals with more developed chains such as iron and bauxite



Geopolitical tensions, increased defense investments, and the concentration of production heightens the risks associated with supply...



... and lead to the consequent reconfiguration of the beneficiation and processing chains globally

Brazil is well positioned strategically



Brazil has one of the greatest geological diversities in the world and one of the largest reserves of minerals with increasing demand



Its experience in the mineral sector, renewable matrix and low cost of energy and labor make the country competitive



Sound governance and regulatory frameworks make it possible to supply minerals for a transition in a way that is safe and sustainable



Potential alignment between mining expansion and local value creation through the development of beneficiation chains

The Mining Coalition was established in the context of the COP30 "Task Force," through a collaborative effort aimed at developing a unified vision for the sector

The Presidency of COP30 has invited key sectors within Brazil to propose ways to achieve decarbonization



In the context of the COP30 "Global Task Force", the private sector is expected to propose converging methods to accelerate decarbonization



In Brazil, the Presidency of COP30 has suggested that 6 key sectors should mobilize efforts in this direction: Energy, Livestock, Agriculture, Forestry, Transportation and Mining

Collaborative approach



Workshops bringing together important stakeholders in the mining chain



Complemented by in-depth interviews



Leveraging coalition expertise and sector reporting

Coordinating group



Participating organizations



TABOCA

Deliverable

Compiled document intended for the leadership of COP30, the Ministry of Environment and Climate Change (MMA), and the Ministry of Mines and Energy (MME), with a detailed overview of the contributions of the Brazilian mining sector to decarbonization...

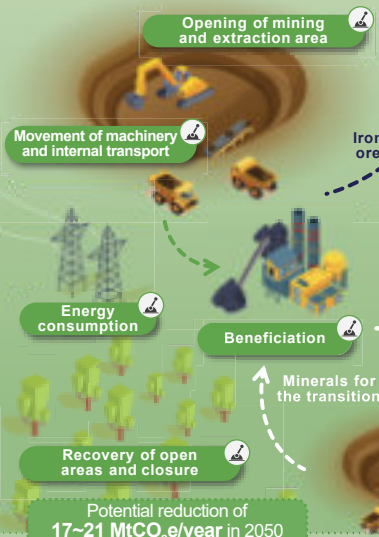
... To contribute with inputs to key discussions that enable mapped investments and opportunities

The coalition analyzed three different aspects concerning the mining sector's contribution to decarbonization and the global energy transition

Mining chains in Brazil

1 Brazilian mining sector: identification of levers and potential for decarbonization

Levers for decarbonization



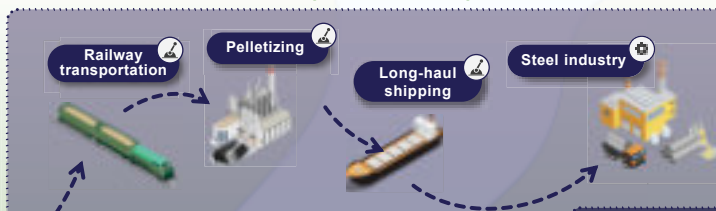
Global value chains, including those in Brazil

2 The iron ore chain: Brazil's mining sector and its contribution to decarbonization

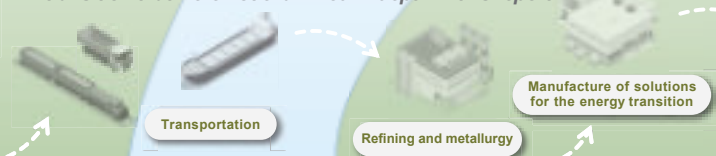
Levers for decarbonization along the global iron chain

Provision of iron ore pellets and briquettes for the global steel industry

Potential reduction of 100-110 MtCO₂e/year in 2050



Stages of the minerals value chain for the energy transition that were not examined in depth in this report

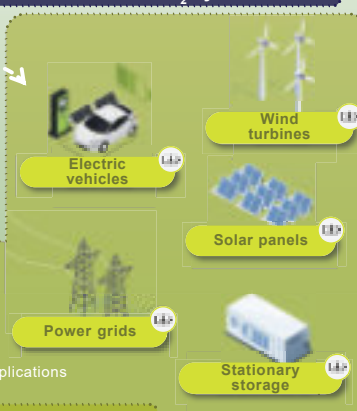


3 Minerals for the energy transition: expanding production and contributing to global decarbonization

Expansion of mineral production for the energy transition

Reduction of emissions through the use of energy transition applications

Potential reduction of 1.6-2.0 GtCO₂e/year in 2050



Summary of conclusions

The Brazilian mining offers ways to contribute to decarbonization and energy transition

Taking into account the pace of the global energy transition and the deployment of systemic enablers¹, the sector estimates it can reduce 70%-80% and neutralize roughly ~14% of its Scope 1 and 2 emissions by 2050, leading to net residual emissions of approximately ~10% relative to an inaction scenario².

- By 2035, the adoption of technologies with expected technical and economic viability¹ could enable a 25%-35% reduction in emissions and neutralize³ roughly ~14%, leading to residual emissions of about 50%-60%².

Brazilian mining can also indirectly contribute to reductions of 100-110 MtCO₂e in the global iron chain in 2050 through the provision of pellets and briquettes and reductions in emissions from shipping, pelletizing and railways.

Finally, energy transition solutions with Brazilian minerals — such as vehicle electrification, expansion of solar and wind generation, storage and distribution systems — can help prevent 1.6-2.0 GtCO₂e globally in 2050, of which 260-300 MtCO₂e can be prevented in Brazil.

Making these contributions tangible is based on the development of enabling factors that extend beyond the mineral sector

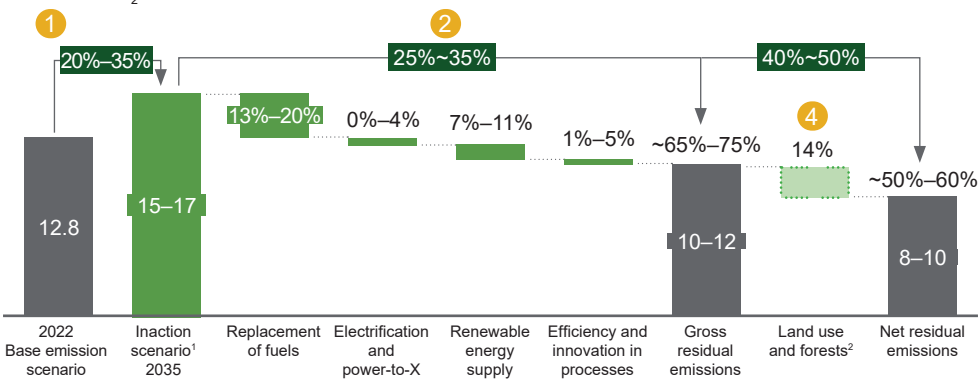
Contributions will depend on how these systemic enablers that go beyond the mineral sector will evolve and require collaboration with the entire value chain, financiers, and the public sector:

- Regulatory-economic scenario: economic incentives and carbon pricing that enable decarbonization, in addition to a regulation that facilitates the sustainable expansion of mineral production and processing chains;
- Technology and R&D: critical technologies with technical maturity and economic feasibility considering carbon pricing;
- Infrastructure: logistics, energy and storage network with distribution and capacity;
- Financing: green financial instruments and sustainable taxonomies to reduce risks and boost access to capital;
- Green Premium and value chain: an integrated ecosystem featuring predictable demand for low-carbon products and robust traceability mechanisms.

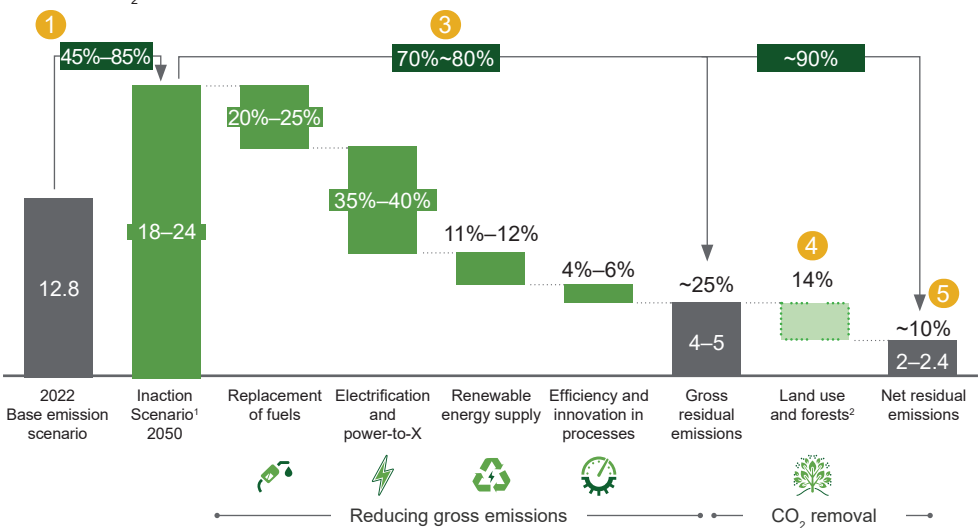
Note: reducing and neutralizing 90% of mining emissions in 2050, 17-21 MtCO₂e, would be equivalent to the annual emissions of 8-10 million gasoline-powered vehicles. A reduction of 100-110 MtCO₂e in the iron ore chain would be equivalent to another 50-55 million vehicles, which is close to the Brazilian fleet of EVs projected for 2050. A global reduction of 1.6-2.0 GtCO₂e from energy transition solutions is comparable to total Brazilian emissions, which were ~2.3 GtCO₂e in 2023. 1. It is necessary for technologies to show reductions in abatement costs and for the price of carbon to make emitting solutions unfavorable. 2. In comparison to inaction scenarios with no improvement in emission intensities, the growth in volume would result in carbon emissions of 15-17 MtCO₂ in 2035 and 18-24 MtCO₂ in 2050. 3. Carbon removals achieved within company-owned and directly affected lands are deemed sufficient to neutralize land use emissions. The current GHG Protocol methodology does not allow this approach to calculate net emissions, but accounting for sequestered carbon is an opportunity for mining companies' carbon neutrality goals.

Emission reduction potential

2035 – MtCO₂e



2050 – MtCO₂e



Conclusions

- 1 The global expansion of demand for minerals increases the Brazilian challenge of sectoral decarbonization in 2035 and 2050
- 2 With technologies that have a positive outlook for viability, levers reduce 25%–35% of emissions in 2035
- 3 Considering the development of systemic enablers, levers reduce 70%–80% of emissions in 2050
- 4 Removal of CO₂ by restoring areas can bring about additional neutralization² in 2035 and 2050
- 5 Resulting in ~10% net residual emissions to be offset in 2050

Reducing gross emissions



Replacement of fuels

Replacement of fossil fuels for heat generation by sources with lower carbon content or zero emissions



Electrification and power-to-X

Replacement of fossil fuel equipment with electrical ones and conversion of renewable energy into various vectors



Renewable energy

Electricity purchased from renewable sources used as a replacement for higher emission intensity sources



Efficiency and innovation in processes

Improved efficiency through the implementation of new technologies along the entire value chain

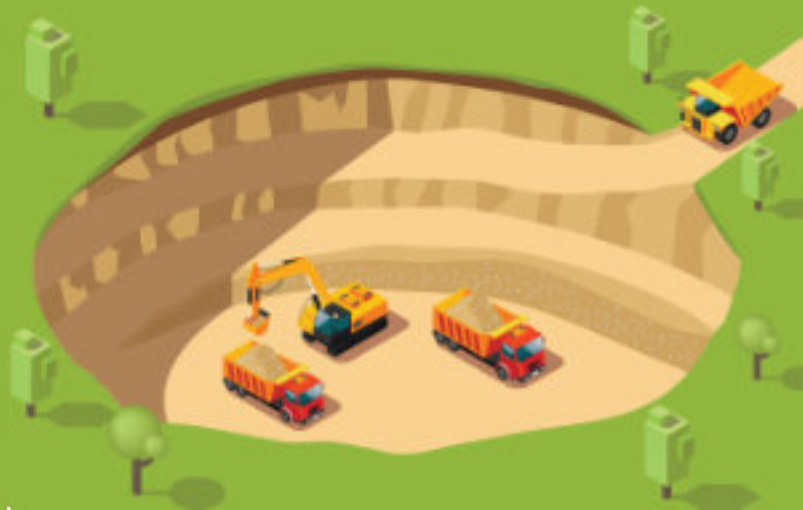


Land use and forests

Reduction and neutralization (net emissions) of emissions by restoring areas

1. Increase in emissions due to volume growth and efficiency losses, with no decarbonization actions 2. Mining companies already conduct land recovery in cleared areas to comply with legal requirements and also implement additional voluntary initiatives. The current GHG Protocol methodology does not allow this approach to calculate net emissions, but accounting for sequestered carbon in the recovery of areas will be essential for mining companies' carbon neutrality goals.

Brazilian mining can contribute to a reduction of up to 110 MtCO₂e in the global iron ore chain by 2050, conditioned to systemic enablers



100–110

MtCO₂e prevented per year in 2050

Equivalent to 7 to 8 times mining emissions in 2022 (12.8 MtCO₂e)



Supply of inputs for global routes of low-carbon steelmaking¹

~80

MtCO₂e prevented per year in 2050

The manufacture of DR-grade pellets and briquettes facilitates direct reduction routes, which emit less than conventional blast furnace processes

Decarbonization will depend on advancements in areas beyond iron-based materials:



Mature and affordable technology for use at scale



Financial viability considering the price of CO₂



Other suitable inputs (NG, H₂ and scrap)



Long-haul shipping in the export of Brazilian ore

15–25

MtCO₂e prevented per year in 2050

Adoption of sustainable fuels, technological innovation and greater efficiency



Pelletizing in Brazil

4–5

MtCO₂e prevented per year in 2050

Using biocarbon, biofuels, solar and wind PPAs, low-carbon hydrogen and innovation in technology and processes



Railway transport of iron ore in Brazil

1–2

MtCO₂e prevented per year in 2050

Increased operational efficiency, biofuels and partial electrification

1. The potential of ~80 MtCO₂e prevented considers the Brazilian production of pellets and briquettes for direct reduction (DR-grade) of ~50 Mt in 2050, which produce 40 Mt of steel on DRI routes to renewable H₂. As such, emissions would drop from ~90 to ~10 MtCO₂e (-90%).

Additionally, Transition Minerals production could contribute to global reductions of 1.6–2.0 GtCO₂e by 2050

Brazilian minerals powering global chains



Inputs for electrification of the global vehicle fleet



Inputs for expanding solar generation



Inputs for expanding wind generation

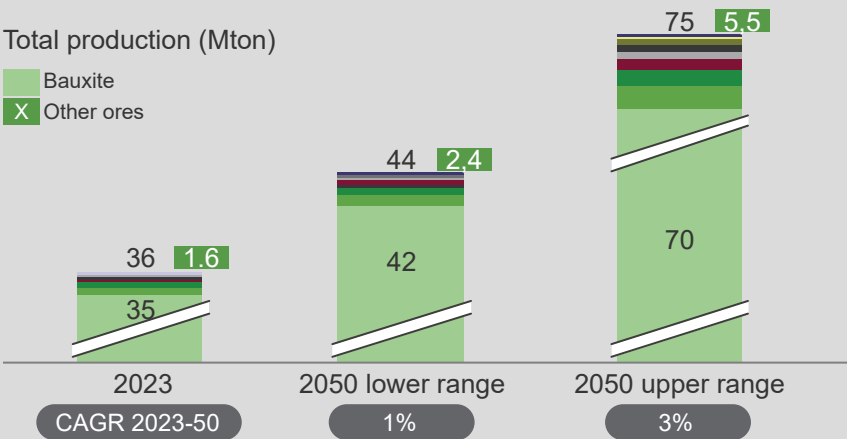


Inputs for storage systems and electrical distribution networks¹

Estimates result in a growth of 1.2 to 2.1x in the Brazilian production of selected minerals

Total production (Mton)

Bauxite
X Other ores



The supply of these inputs will have an impact on global emissions through the expansion of the EV fleet and wind and solar power generation



Global emissions prevented² via power generation and electrification



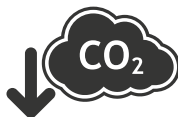
14–38 million EVs in use



600–830 GW in wind power



580–610 GW in solar power



1.6–2.0
GtCO₂e prevented
per year in 2050

Of which 260–300 MtCO₂e could be prevented in Brazil³ in 2050



National emissions prevented² via power generation and electrification



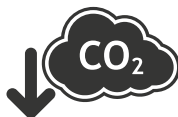
14–38 million EVs in use



~117 GW in wind power



~147 GW in solar power



260–300
MtCO₂e prevented
per year in 2050

1. Support networks with no direct impact on reductions. 2. Estimates consider the additional capacity for vehicle electrification and solar and wind generation that is enabled by the production of minerals in Brazil, with the assumption that the mineral with the highest relative contribution per technology is the one being considered. 3. Assuming that the applications made possible by Brazilian mining are to be used within Brazil, with the usage volumes being limited by the demand associated with the national transition.

To enable progress in decarbonization, levers will depend on a favorable context by 2050 — systemic enablers listed by the coalition:



Technology and R&D

Critical technologies with technical maturity and economic feasibility considering carbon pricing (e.g., electrification, alternative fuels)



Infrastructure

Logistics, energy and storage network with sufficient distribution and capacity to serve mines in operation and new projects



Financing

Green financial instruments and sustainable taxonomies, enabling the attraction of capital at scale for low-carbon initiatives



Green Premium and Value Chain

An integrated ecosystem featuring predictable demand for low-carbon products and robust traceability mechanisms to align incentives along the entire value chain



Regulatory-economic scenario

- Carbon pricing in force — ref. IEA¹: 65-125 USD/ton CO₂ (2035) and 160-200 USD/ton CO₂ (2050)
- Regulation that guides investments, enables sustainable expansion of production, and stimulates innovation in decarbonization solutions (e.g., electrification, alternative fuels)

Among the enablers analyzed, some have significant international relevance and are particularly notable in the context of COP30 in Brazil

- 1 Enable systems of emissions accounting at the product level, allowing for the recognition of low-carbon differentials (biofuels, renewable energy matrix, etc.)
- 2 Ensure compatibility of domestic systems with international mechanisms and border adjustment mechanisms (CBAM², IMO³, CORSIA⁴, etc.)
- 3 Officially recognize, within the framework of the GHG Protocol, the removal of CO₂ through the restoration of areas in corporate inventories
- 4 Harmonize green taxonomies to improve project eligibility and mobilize international capital for mining and low-carbon industrial value chains
- 5 Establish standards and certifications for low-emission hydrogen to accelerate the development of a global market

1. Price ranges defined by the IEA Announced Pledges and Net Zero Emissions scenarios for the category “Emerging markets and developing economies with net zero emissions pledges” - Global Energy and Climate Model Documentation 2024 (IEA) 2. Carbon Border Adjustment Mechanism 3. International Maritime Organization 4. Carbon Offsetting and Reduction Scheme for International Aviation

Technical Information Sheet **Essential Minerals Coalition: Role of the mining sector in decarbonization and energy transition**

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