# Shared-Use Infrastructure Along the World's Largest Iron Ore Operation:
## Lessons Learned from the Carajás Corridor



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*Cover photo: Passenger train on the Marabá Mixed Rail–Road Bridge across the Tocantins River*
*Photographer: Ricardo Teles / Agência Vale*




# Executive Summary

From a government perspective, shared-use or open-access infrastructure arrangements can provide significant prospects for sustainable development. The shared use of infrastructure built by mining companies can spur and support additional mining projects and other economic activities and services to the benefit of surrounding communities and other third-party beneficiaries. From the viewpoint of a mining company, however, such arrangements pose risks to profitability and may, in some instances, benefit competitors.

This study uses lessons learned from the shared-use arrangements along the Carajás railway corridor in Brazil to shed light on how to strike a balance between divergent private and public interests, and how countries may learn from this approach in order to increase the benefits of existing and future shared-use projects.

## Background

Upon the discovery of the Carajás iron ore reserves in 1967, the Brazilian federal government came to recognize their development as being central to its plan to develop the region around extractive, agricultural, and industrial activities, as well as attracting migrants to the region. The Greater Carajás Program (PGC) was established in 1980 and covered roughly 900,000 km$^2$, comprising the Carajás iron ore mine complex, two bauxite and aluminum projects, and a hydroelectric dam.

Within the PGC, Brazilian mining company Companhia Vale do Rio Doce (CVRD or Vale) invested the initial US$ 3.1 billion (in current prices) toward the development of a mine–railway–port complex. Vale, as a state-owned company at the time, was not only tasked to profitably extract and export the iron ore from Carajás, but also of helping achieve the government's economic and social objectives. The company built the Carajás Railroad (EFC), with an original length of 892 km, connecting Parauapebas (in the interior of Brazil's northern state of Pará [PA]), where the iron ore mines are located, to Ponta da Madeira in São Marcos Bay, in São Luis (capital of Brazil's northeastern state of Maranhão [MA]), where Vale built Ponta da Madeira Maritime Terminal, a private seaport in the Itaqui port complex. In addition to transporting iron ore from the mines to the port, the railway was also designed to provide passenger and general freight services.

Along with mining projects, throughout its history, Vale became a leading supplier of logistics services in Brazil. Vale was privatized in 1997 and rebranded as Vale S.A. in 2007. In 2010, Vale created the subsidiary VLI S.A. (VLI) in order to separate its general cargo business from core operations. In 2013 and 2014, Vale sold most of VLI's share capital, retaining a 37.6% equity. VLI currently operates third-party general cargo transportation on the EFC as well as Ponta da Madeira's general cargo pier.

## Shared-Use Infrastructure Along the Corridor Today

Vale built railway, seaport, airport, and telecommunications infrastructure along the Carajás corridor to serve its mining operations in the region. Aside from its core use as part of those operations, the infrastructure stands to benefit third-party users and local communities based on shared-use opportunities. We describe below each type of infrastructure, its shared-use potential, and how it is governed.

### Railway Infrastructure

Increased efficiency of operations and subsequent expansions of the EFC have extended it to 998 km—most of it now duplicated—with a transport capacity of 230 million metric tons per annum (Mtpa) of iron ore (up from the original 35 Mtpa of iron ore), making it one of the most efficient railroads in Brazil. Between 2006 and 2016, Vale invested about R$ 17 billion in the railroad. Vale uses the EFC primarily to transport iron ore, manganese, and copper it produces from its mines to the Itaqui port complex.

*Photo: General cargo train on the Carajás Railroad. Photographer: Ricardo Teles / Agência Vale*

The Road–Rail Bridge of Marabá (PA) on the EFC—built for Vale's needs, but with an added roadbed to serve shared-use purposes—links the city center to rural districts, facilitating the transport of passengers, food, fuel, and grains. Mixed road–rail structures like this one are good examples of shared-use practices that serve the interests of not only the mining company but also local communities and governments, by facilitating the transport of goods and people in an area where such transportation was previously less accessible and often unreliable.

Of particular relevance from a shared-use perspective, Vale offers passenger services on the EFC, making it Brazil's longest railroad with passenger services. The passenger train has five stations and ten stops, running three times per week from the interior to the coast and three times per week from the coast to the interior. In 2019, 270,000 passengers used this service. Passenger trains transport around 1,200 passengers each and have the priority of circulation over cargo trains.

Another shared-use component of the EFC is enabled by its connection to the North–South Railroad (FNS) (operated by VLI) in Açailândia (MA), allowing general cargo of third-party users to be transported between the interior of the country and the Itaqui port complex, as well as creating links with other ports. Further expansions and connections of the FNS railroad will contribute to future shared use and further inter-regional integration in the country. While Vale's mineral production is the dominant cargo transported on the EFC, third-party users also have transported increasing volumes of soybean and soybean meal, corn, pulp, and pig iron along the EFC, including through its connection to the FNS railroad. In the past, the EFC and FNS have also been used to transport beverages, cement, trucks, wood, gas, sand, bricks, and fertilizers.

Vale owns and operates all rolling stock (railcars and locomotives) needed for its mining and operational purposes and the provision of passenger services along the EFC; in turn, VLI owns and operates all rolling stock it uses to transport third-party cargo along the FNS and the EFC. Both railroads use broad track gauge; however, the fact that certain railway networks in other regions in Brazil use different gauges increases the logistics costs of railway interconnection.

The regulatory framework that governs the EFC and FNS consists of laws, regulations, and concession and sub-concession agreements. The National Agency for Land Transportation (Agência Nacional de Transportes Terrestres [ANTT]) is Brazil's independent regulatory agency for all land transportation. Several ANTT resolutions are relevant to shared use in Brazil, including the right of third-party users to invest in capacity expansions needed to accommodate transportation demands and the provision that users who are highly dependent on railway transportation are entitled to require the allocation of capacity or take-or-pay basis and subject to special freight rates. ANTT has also established a minimum level of capacity for transportation of general cargo on the EFC (8.65%), although Vale has indicated that demand has remained consistently below that established level.

The concession agreement for the EFC grants Vale a 30-year exclusive concession, dating from 1997, to develop and exploit cargo and passenger services on the railroad. Under the concession agreement, Vale is required to allow third-party access to any party that requests it. Vale negotiates access agreements with third-party users, but the federal government may make determinations regarding the avoidance of market power abuse. Vale may set freight rates for its cargo services, subject to certain limitations, and ANTT may impose caps on these. ANTT-approved price schedules set fares charged to passengers for passenger services. Federal legislation requires that Vale operationally prioritize passenger trains over cargo trains.

A mutual access agreement between Vale and a subsidiary of VLI governs transportation services with origin along the EFC and destination along the FNS or vice versa. As a rule, each concessionaire remains responsible for operating the trains in its concession area, with cargo being exchanged at the Vale-operated terminal in Açailândia (MA). Every year, Vale and VLI meet to agree on an annual plan, with indicative allocations of capacity to each other's cargo. Allocations are updated monthly, based on each party's most recent forecasts of demand for services. Each party undertakes to provide the other with access up to the capacity allocated in the annual plan. However, neither party assumes take-or-pay obligations. Although each concessionaire is responsible for agreeing its terms with the customers, the division of freight rates between the two concessionaires is made under a pre-agreed formula.

Brazil's federal government is negotiating an extension of Vale's concession for an additional 30 years. The concession's extension should result in improvements in terms of the shared use of the EFC. Furthermore, the new agreement would obligate Vale to expand the railroad's capacity whenever 90% of railroad capacity is reached—always leaving 10% of available capacity—and to double the frequency of passenger services.

## Port Infrastructure

In 2018, 198 million metric tons of iron ore were shipped out of Ponta da Madeira Maritime Terminal. The agreement granting Vale title to the Ponta da Madeira terminal designates it as a mixed-use private terminal, capable of shared use. Cargo including pig iron, soybeans, and corn are stored by facilities there. New private-use terminals sprouting up in São Luís (MA) and Alcântara (MA) will result in greater demand for the shared-use infrastructure of EFC and will require further expansion.

Vale built Pier II in 1994 for shipments of general cargo and handed it over to VLI in 2010. It is the only pier at Ponta da Madeira from which non-mineral exports can be shipped, making it sig-

nificant from the perspective of shared use. It was later incorporated into the public port of Itaqui but remains operated by VLI.

A new grain terminal entered in operation in the Itaqui port complex in 2015, and there are projects to build additional grain terminals in the region, all of them relying on connections to the EFC to receive cargo. This greater demand for the shared use of the EFC will likely mean further investments in the expansion of its capacity.

Vale pays for dredging and signaling of the navigation channel of the Itaqui port complex. Vale's sharing of the dredge for periodic maintenance dredging of berths in the public port of Itaqui has significantly reduced costs for the public entity that manages the port (EMAP).

### Airport Infrastructure and Helicopter Services

Vale built the Carajás Airport in 1981 in Marabá (PA) to serve its mining operations and, in 1985, handed it over to INFRAERO, Brazil's airport infrastructure company, which is controlled by Brazil's federal government and responsible for operating most of the country's commercial airports. The airport serves an annual average of 124,000 passengers, roughly 90% of which can be linked to Vale's businesses, even though Vale no longer operates it. The airport links the region to other states and regions, fostering economic growth within the state.

Vale and INFRAERO have entered into several contractual arrangements regarding the use of the airport. Under one such arrangement, Vale has agreed to grant a leasehold over the airport site and support INFRAERO in firefighting and emergency services without requiring in exchange any payment. Vale also shares helicopter services with Brazil's environmental agency to monitor the Carajás National Forest to prevent illegal invasions and logging.

### Information and Communications Technology Infrastructure

Three fiber-optic cables are placed along the EFC. As a result, publicly accessible telecommunications services have been expanded in a previously poorly served area, and allowing for shared-use with telecommunications companies has meant savings for the companies and lower environmental impacts by deforestation. Vale has also partnered with the telecommunications company Vivo to develop a 4G/LTE network that will serve to operate autonomous mining trucks and blasthole drills at Vale's newest iron ore mines—the S11D project. As part of the agreement, Vivo will also offer frequencies for public 4G/LTE service. This agreement may serve as a model for a larger plan to provide 4G/LTE coverage along the entire EFC.

## Impacts of Shared-Use Along the Carajás Corridor

Municipalities along the Carajás corridor have received significant socioeconomic benefits, including affordable and accessible passenger transportation, as well as the benefits that come with royalty revenues and corporate social responsibility (CSR) investments made by Vale. Municipalities in which direct mining activities are performed receive 60% mining royalties (CFEM), and those indirectly affected by mining activities receive 15% of CFEM royalties (CFEM-Affected). In certain municipalities with low budgets, CFEM-Affected royalties can make up more than 5% of their total revenues.

Poverty levels in the municipalities of the Carajás corridor are some of the highest in the country, even though extreme poverty has decreased in both Maranhão and Pará, a process that was accelerated by the development activities associated with the shared use of the corridor. GDP per capita in municipalities along the corridor are lower than Brazil's national GDP per capita in all but three municipalities—Canaã dos Carajás, Curionópolis, and Parauapebas; all of them are located in the state of Pará (PA) and host direct mining activities. In 2010, the Human Development Index (HDI) in municipalities located along the corridor was higher than other municipalities in Maranhão and Pará that lie outside the corridor. Socioeconomic indicators are highest at the endpoints of the corridor, where mining activities are hosted, in the state capital São Luís, where the port of Itaqui is located, and in urban centers that serve as logistics hubs along the corridor.

Social conflicts persist in the area of influence of the Carajás corridor, including conflicts arising from the land interests of Indigenous Peoples, residents of communities of Afro-Brazilian slave descendants (Quilombolas), small-scale farmers, and large-scale landowners in the region. These conflicts have historical roots that predate the Carajás Railroad and may be more closely related to broader changes in the socioeconomic and environmental landscape of the Amazon region, particularly since the 1980s, than to the development and shared use of the corridor. There has also been dissatisfaction regarding negative environmental and health impacts of the passage of trains, economic activities enabled by the railroad (such as pig-iron smelting), and the construction works for its double-track expansion. Blocking of the tracks by protesters still occurs, though often motivated by reasons unrelated to the Carajás Railroad.

Environmentally, Carajás is in a precarious position: it is one of the richest mineral reserves, yet it is located within the Amazon rainforest, an extremely important and vulnerable biome. Certain activities enabled by the shared use of the corridor—such as large-scale agriculture and pig-iron smelting—have had an impact on deforestation and biodiversity loss. When planning for future economic development in the region, prospective activ-

ities should be measured against the sustainable management and use of Amazonian resources.

Additional environmental impacts of the corridor, as reported by affected communities, include the suppression of wetlands; flooding resulting from insufficient rainwater drainage systems along the railroad; air, soil, and water pollution resulting from pig-iron smelters and dust and iron ore particles falling from trains; damage to buildings, roads, and wells caused by vibrations from passing trains; ecosystem fragmentation; and wildlife loss.

Throughout its operations in the Carajás region, Vale has consistently supported the forest conservation efforts of the agency responsible for managing the Carajás National Forest, the Chico Mendes Institute for Biodiversity Conservation (ICMBio). For example, Vale funds the Carajás National Forest fire protection program, monitors invasions and illegal logging in the area, and conducts and sponsors research and community-based activities to mitigate the broader environmental impacts of its activities.

Opportunities to further improve the socioeconomic benefits of the shared use of the corridor and mitigate environmental harms for affected communities are many. A central focus of further development should be to ensure that the shared-use benefits are captured by these communities, rather than mostly going to economic actors external to the corridor, such as large-scale grain producers from other regions. While they benefit from the shared use of the railroad, they leave the negative impacts of the corridor for the local communities to bear.

## Lessons Learned from the Shared-Use of the Carajás Corridor

Various positive economic, social, and environmental impacts illustrate the successes of the shared use of the Carajás corridor infrastructure from a sustainable development perspective:

- The EFC is a **safe, efficient, and reliable mode of transport**, providing **long-distance passenger services** accessible to low-income communities.
- The **third-party general cargo services** on the EFC, in particular through its connection to the FNS railroad, benefits exports of soybeans, soybean meal, corn, pulp, and pig iron.
- The 2.34-km **mixed road–rail bridge** across the Tocantins River reduces logistic costs in the region of Marabá (PA).
- Investments in **port infrastructure**, including the general cargo pier operated by VLI and Vale's signaling and dredging of the navigation channel, benefit the Itaqui port complex.
- The **Carajás Airport** in Parauapebas (PA), built by Vale and handed over to Brazil's airport authority, provides commercial passenger and cargo services for the Carajás region.
- Vale's provision of **helicopter services** and other support to Brazil's environmental agencies helps avoid deforestation and illegal logging in Carajás conservation units.
- ICT infrastructure—including fiber-optic cables along the EFC and Vale's project for a private 4G/LTE network—lowers the costs of providing Internet and cellular services.
- The **socioeconomic indicators** in the municipalities along the Carajás corridor are higher than those of Maranhão and Pará municipalities lying outside the corridor.

Reasons explaining the success of the shared use of the Carajás corridor include the following:

- The plans of Brazil's federal government to unlock the economic development potential of the Carajás region and to develop a larger national railway network connecting it to other regions of the country.
- Vale's initial role—when still a state-owned company—in helping the government achieve the socioeconomic objectives underlying those plans.
- Stringent legal provisions governing shared use, contained in federal laws and decrees, railway concession and sub-concession agreements, and rules issued and enforced by pertinent regulatory agencies, as well as private contracts.
- Vale's expertise in logistics reflected historically in the development of the company as an integrated mining and logistics company.
- The contractual arrangement with VLI, Vale's subsidiary set up to oversee third-party cargo transportation, helping to avoid conflicts of interest between Vale and other users of the EFC and limit the potential misuse of Vale's monopoly position.
- Strong coordination mechanisms established between Vale and VLI to limit the coordination cost on Vale's logistic chain.
- Social pressures on Vale resulting from its role in the region's economy, leading it to seek to generate socioeconomic benefits beyond that resulting from the mining operations.

At the same time, the shared-use undertaking in Carajás involves certain risks and negative impacts, from an economic, social, and environmental perspective:

- **Economic dimension**: Shared use of the Carajás corridor has not benefited the prevalent smallholding agriculture and farming within the region. It has also involved costs for Vale, such as infrastructure projects handed out without compensation, notably, the Carajás Airport and the road–rail bridge in Marabá (PA); the cross-subsidization of passenger services; and additional planning and coordination efforts with VLI. The Carajás experience also evidences the risk of failing to harmonize track gauges in broader networks at the outset when planning for logistic corridors.

- **Social dimension**: The Carajás corridor and its shared use have not harmonized the level of development across corridor municipalities. They have also contributed to high population growth in the region without the necessary infrastructure and services.

- **Environmental dimension**: The environmental impacts resulting from the development and shared use of the Carajás corridor include deforestation and the resulting loss of biodiversity and carbon sinks; air, noise, soil, and water pollution; and other negative impacts resulting from the passage of trains and from economic activities that developed along the railway, such as large-scale agriculture and cattle farming, and pig-iron smelting. The shared-use potential of the corridor is constrained by the risks posed and impacts caused by its location in an economically, socially, and environmentally sensitive area.

## Recommendations: How To Further Leverage Shared-Use Benefits Along the Carajás Corridor?

To further leverage shared-use benefits of the Carajás corridor—thus promoting sustainable development for the benefit of the communities of the region and helping Vale retain its social license to operate—the mining company, in collaboration with federal, state, and municipal authorities and other stakeholders, could consider adopting a series of measures and strengthening its existing efforts in various areas:

- Enhancing shared-use benefits requires **close collaboration between Vale, VLI, and the Vale Foundation**. It also requires close coordination with the federal government, the state governments of Maranhão and Pará, and the governments of the 28 corridor municipalities. This collaboration and coordination effort should include exploring the viability of unlocking the potential of the Carajás corridor for the long-distance transport of products currently carried in trucks, such as fertilizers imported into the port of Itaqui.

- The stakeholders mentioned above could prepare a **corridor-based development plan for the region to help identify synergies for private sector and government investments to improve development outcomes**. This plan should be data driven and could usefully leverage Brazil's collection of data and monitoring platforms related to the Sustainable Development Goals to identify areas of intervention, coordinate activities, assess the impact of development interventions, and adapt these accordingly if unsuccessful. The plan could include a coordination mechanism between Vale, VLI, and corporate users of the Carajás and North–South Railroads and the port infrastructure in Itaqui and its vicinity to make **joint investments along the corridor**. Corporate railway users could pool resources for and creatively explore the implementation of projects to improve the economic, social, and environmental conditions of Indigenous Peoples, Quilombolas, and local communities living along the corridor, which bear the negative impacts of heavier rail traffic.

- Vale and VLI should consider **reintroducing general cargo railcars** on the passenger train for smaller cargoes. In the past, Vale added a general cargo railcar to the passenger service, allowing passengers to transport agricultural produce from their farms to sell in São Luis (MA) and bring back goods such as seafood to sell inland. Reintroducing this service could provide a lifeline to small-scale farmers and other local entrepreneurs to transport their products by rail. Dry ports in strategic locations along the corridor could be setup that agglomerate and load the railcar before the arrival of the train. As demand increases, specific general cargo trains could be offered at least every other day in each direction.

- Vale could consider making **further safety- and environment-oriented improvements to the Carajás Railroad**, such as upgrading railway stations and stops, building additional pedestrian overpasses, and implementing measures to reduce the encroachment of third parties on the no-build zone on each side of the railway tracks ("faixa de domínio"). In line with Vale's decarbonization efforts, it should consider expediting existing plans to electrify trains on the Carajás Railroad, which currently run on diesel. These additional investments would help mitigate the negative impacts of rail traffic perceived by local populations.

- Vale could consider how to foster the further roll out of **telecommunication services in the region**, collaborating with telecommunication companies and building on Vale's experiences in sharing fiber optic and 4G/LTE infrastructure. As Internet access will continue to gain importance and can increase the efficiency of public services, these efforts could be usefully pursued. For instance, connecting public entities such as schools and hospitals could advance several Sustainable Development Goals along the corridor. Such a project would probably reach a larger number of people in the region than corporate social responsibility activities in individual municipalities. Inputs would be required from

stakeholders within Vale, the government, and the telecommunications sector. Providing free WiFi and Internet access to corridor communities—for example, at railway stations—would generate additional benefits and improve the company's social license to operate.

- While historically in the Carajás region priority was given to economic development over environmental protection, Vale has grown more environmentally sensitive to the indirect impact that the development of the corridor has had on the increased deforestation rates in corridor municipalities. With the growing climate urgency and the growing deforestation of the Amazon rainforest, it is fundamental for Vale to reinforce its efforts and allocate all necessary financial resources to achieve environmental and climate change objectives.

    - To ensure zero additional deforestation in expansion projects, and to assess forest and biodiversity conservation potential beyond the conservation units already protected, consistently adopting the forest-smart mining approach developed by the World Bank's PROFOR program could be particularly effective. This approach recommends conducting landscape assessments, strategic environmental and social impact assessments, and ecosystem services assessments. It also entails considering the direct, indirect, and cumulative impacts for forests and associated communities over time and wide areas and the systematic application of the mitigation hierarchy (avoidance, minimization, mitigation, and offsetting). Implementing this approach requires cross sectoral collaboration within the company and constant coordination between the company, local authorities, environmental agencies, and communities. Vale could encourage and enable the government to secure strong property rights and land tenure systems, for instance, by providing funding for external experts in land tenure rights.

    - Vale should consider expediting its climate change strategy to achieve carbon neutrality before 2050, monitoring progress closely and applying goals to individual sites, without internal cross-compensation. Deforestation should count as adding emissions, and offset programs should only be used as a last resort. If offset programs are used, they must follow the principles developed by the Business and Biodiversity Offsets Program (BBOP) and be rigorously developed to avoid the pitfalls of ill-designed offset programs implemented to date. Vale should also adopt a value chain approach, applying targets for carbon neutrality not only for Scope 1 and 2, but also to Scope 3. To pursue a potential Scope 3 commitment, Vale should engage in action-oriented partnerships with its suppliers and customers to identify the technology solutions to decarbonize, particularly in shipping and steel.

## Acronyms and Abbreviations

(Original Portuguese-language acronyms are used throughout the text.)

| | |
|---|---|
| ANAC | National Civil Aviation Agency (*Agência Nacional de Aviação Civil*) |
| ANATEL | National Telecommunications Agency (*Agência Nacional de Telecomunicações*) |
| ANM | National Mining Agency (*Agência Nacional de Mineração*) |
| ANP | National Agency for Petroleum, Natural Gas, and Biofuels (*Agência Nacional do Petróleo, Gás Natural e* Biocombustíveis) |
| ANTAQ | National Waterway Transport Agency (*Agência Nacional de Transportes Aquaviários*) |
| ANTT | National Land Transportation Agency (*Agência Nacional de Transportes Terrestres*) |
| CCSI | Columbia Center on Sustainable Investment |
| CFEM | Mining royalties *Compensação Financeira pela Exploração Mineral* |
| CNT | National Transportation Confederation (*Confederação Nacional do Transporte*) |
| CSR | Corporate Social Responsibility |
| CVRD | Vale do Rio Doce Company (*Companhia Vale do Rio Doce*) |
| DWT | Deadweight tonnage |
| EFC | Carajás Railroad (*Estrada de Ferro Carajás*) |
| EMAP | Maranhense Port Handling Company (*Empresa Maranhense de Administração Portuária*) |
| EMBRATEL | Empresa Brasileira de Telecomunicações S.A. |
| EPL | Empresa de Planejamento e Logística S.A. |
| FICO | Center–West Integration Railroad (*Ferrovia de Integração do Centro-Oeste*) |
| FIRJAN | Industry Federation of the State of Rio de Janeiro (*Federação das Indústrias do Estado do Rio de Janeiro*) |
| FNS | North–South Railroad (*Ferrovia Norte–Sul*) |
| GDP | Gross domestic product |
| GO | State of Goiás |
| HDI | Human Development Index |
| IBAMA | Brazilian Institute of the Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis*) |
| IBGE | Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatistica*) |
| ICMBio | Chico Mendes Institute for Biodiversity Conservation (*Instituto Chico Mendes de Conservação da Biodiversidade*) |
| ICT | Information and communications technology |
| IFDM | FIRJAN Municipal Development Index (*Índice FIRJAN de Desenvolvimento Municipal*) |
| INFRAERO | Brazilian Airport Infrastructure Company (*Empresa Brasileira de Infra-Estrutura Aeroportuária*) |
| ILOS | Logistics and Supply Chain Institute (*Instituto de Logística e Supply Chain*) |
| INPE | National Institute for Spatial Research (*Instituto Nacional de Pesquisas Espaciais*) |
| ITV | Vale Institute of Technology (*Instituto Tecnológico Vale*) |
| MA | State of Maranhão |
| MT | State of Mato Grosso |
| Mtpa | Million metric tons per annum |
| NYSE | New York Stock Exchange |
| PA | State of Pará |
| PGC | Greater Carajás Program (*Programa Grande Carajás*) |
| PGCA | Greater Carajás Agriculture Program (*Programa Grande Carajás Agrícola*) |
| PRODES | Program to Calculate Deforestation in Amazonia (*Programa de Cálculo do Desflorestamento da Amazônia*) |
| RS | State of Rio Grande do Sul |
| SC | State of Santa Catarina |
| SDG | Sustainable Development Goal |
| SP | State of São Paulo |
| SPVEA | Superintendence of the Amazonian Economic Valorization Plan (*Superintendência do Plano de Valorização Econômica da Amazônia*) |
| SUDAM | Superintendence of Amazonian Development (*Superintendência do Desenvolvimento da Amazônia*) |
| TCU | Federal Court of Accounts (*Tribunal de Contas da União*) |
| TEGRAM | Grain Terminal of Maranhão (*Terminal de Grãos do Maranhão*) |
| TELMA | Telecomunicações do Maranhão S/A |
| TO | State of Tocantins |
| VLOC | Very large ore carrier |



# 1. Introduction

This study provides insights into the logistical and institutional setup governing the shared use of the Carajás railway corridor and lessons learned for other countries seeking to implement a similar approach. It also provides insights into the benefits and costs related to shared use of infrastructure built by a mining company, as well as the potential opportunities for the region to increase the benefits resulting from shared use along the corridor.

The 998-km Carajás railway corridor connects the world's largest iron ore mine, operated by mining company Vale S.A. (Vale) in Brazil's northern state of Pará (PA), to the company's maritime terminal in São Luís, capital of Brazil's northeastern state of Maranhão (MA). Carajás is one of the few integrated railway corridors financed by a mining company that, apart from transporting the iron ore that made the infrastructure investments viable, also transports general cargo and operates passenger services. Besides the shared-use or open-access arrangement along the railroad,[1] third parties also benefit from Vale's investments in port, airport, and information and communications technology (ICT) infrastructure.

The shared-use arrangement along the Carajás corridor is unique because mining companies tend to prefer the "enclave model," whereby the infrastructure investments are exclusively reserved for the mining project. Mining companies tend to prefer the enclave model in the case of railway infrastructure, given that third-party access may lead to high additional infrastructure, logistics, and coordination costs. Shared-use arrangements may reduce the profitability of the mining project and make it harder to obtain financing from banks. Competition among mining companies may also hinder cooperation.

From a government perspective, on the other hand, shared-use arrangements have the potential to unlock additional mining projects that are unviable without access to the infrastructure, as well as develop other economic activities and provide services to the populations along a mining corridor. Furthermore, shared-use infrastructure investments can reduce the environmental footprint if the alternative is duplicative infrastructure investments by several mining companies or by the mining company and the government. Due to economies of scale, infrastructure investments with a larger capacity are also less expensive than duplicative investments. Even in cases where the private sector pays for the infrastructure, this should be considered from a public policy perspective. Capital expenditures almost always can be carried forward and deducted for tax purposes, thereby impacting tax revenues.

Because of these conflicting interests, there often is tension between the preference of the mining companies looking to develop the infrastructure and the broader goals of the host government.[2]

Section 2 outlines the background and historical context, which is key to understand how the corridor functions today. Apart from reviewing the government plans to develop the region in the 1980s, the section presents Vale's role and strategy as an integrated mining and logistics company. Section 3 explains how the corridor functions today, the roles and responsibilities of the relevant stakeholders, and the regulatory framework governing it. The section covers railway, port, airport, and telecommunication infrastructure, highlighting their shared-use components. Section 4 explores the positive and negative economic, social, and environmental impacts that the sharing of infrastructure has had on the region. Furthermore, it summarizes the costs and benefits resulting from shared-use infrastructure to Vale and puts these into perspective. Section 5 summarizes the findings and lessons learned from the Carajás corridor. In light of the prospects for the corridor, Section 5 also proposes recommendations on how Vale can leverage on the shared-use arrangements and potentials along Carajás to contribute to regional development and retain its social license to operate.



*Photo: Passengers boarding the train on the Carajás Railroad. Photographer: Ricardo Teles / Agência Vale*



# 2. Background and Historical Context

The shared-use arrangements along the Carajás corridor and the economic, social, and environmental developments in the region need to be understood in their historical context. In this section, we summarize key milestones throughout the history of the Carajás mining project and of Vale as an integrated mining and logistics company, while providing a more detailed account in Appendix 1.

Section 2.1 summarizes the Brazilian government's plans to develop the Amazon region. The plans foresaw the iron ore reserves of Carajás to be among the anchor investments to develop agriculture and industrial production in the Amazon region and help attract migrants from other parts of the country. As such, third-party access to infrastructure investments was key. When these plans were developed, environmental and social considerations of those living in the region played a secondary role, which helps explain the conflicts that can still be observed along the corridor today.

Section 2.2 summarizes Vale's history since the development of the Carajás project and the company's transformation over the years as it adapted itself to domestic and international developments. It focuses on the logistics component of the company, which sets it apart from other multinational mining companies, and on the increasingly important strategic role of the Carajás corridor.

## 2.1. Government Plans to Develop the Carajás Region[3]

Brazil's federal government created the Superintendence for the Economic Valorization of Amazonia (SPVEA) in 1953 to formulate five-year development plans for the Amazon region around extractive, agricultural, livestock, mineral, and industrial activities. Military governments starting in 1964 accelerated the program to populate and develop the region and ensure control over its territory, replacing SPVEA by the still-existing Superintendence for the Development of the Amazon (SUDAM).

Incentives included tax exemptions and subsidized credits for land acquisitions. Foreign companies flocked to the region, hoping to find mineral deposits. During an exploration flight for U.S. Steel on July 31, 1967,[4] the Carajás deposit was discovered, with 17 billion metric tons of high-grade iron ore.

Complementing the incentives, the government invested in infrastructure. For example, the controversial Trans-Amazonian Road (Rodovia Transamazônica)—a 4,000-km East–West road running across the Amazon region and some of Brazil's Northeastern states—led to large-scale deforestation, following a questionable economic rationale.

Along these infrastructure projects, other government programs redistributed land for agroindustry and farming and helped with the settling of migrants from other regions of the country. In the 1970s, the allocation of land to small-scale migrant farmers gave way to larger export-oriented investments. **Land allocation led to conflicts between the government, Indigenous communities, small-scale migrant farmers, and large-scale investors; these conflicts continue into the present day.**

Formally established on November 24, 1980,[5] the Greater Carajás Program (PGC) covered an area of roughly 900,000 km$^2$, equivalent to the size of Great Britain and France combined. It is the largest integrated development scheme ever undertaken in an area of tropical rainforest, foreseeing US$ 62 billion (in current prices) in public and private investments throughout one decade. At the PGC's core was the Carajás iron ore mine, two integrated bauxite and aluminum projects, and the hydroelectric dam in Tucuruí (PA). The PGC provided tax exemptions and reductions, and subsidized electricity prices to attract investments in large-scale mineral, infrastructure, and agroforestry projects.

**State-owned mining company Companhia Vale do Rio Doce (CVRD or Vale) financed the initial US$ 3.1 billion investment (in current prices) in a mine–railway–port complex** through bonds as well as domestic and international loans from the European Economic Commission, Japan, the Soviet Union,

*Photo: Train painted pink for breast cancer awareness month. Photographer: Ricardo Teles / Agência Vale*

the United States, and the World Bank. **The Carajás Railroad (EFC) was designed to also service downstream industries—including pig iron and ferroalloys—and transport cargo and passengers**.

**Vale and Japanese consultants advocated for using the railway infrastructure to develop export-oriented agriculture projects**, leading to the Ministry of Agriculture's US$ 1.18 billion (in current prices) Greater Carajás Agriculture Program (PGCA). The plan foresaw 238,000 hectares for soybean cultivation, 12,600 hectares for sugar-cane production, close to 500,000 hectares for beef cattle, and 3.6 million hectares for eucalyptus plantations to feed the pig-iron complexes with charcoal. However, there were challenges related to soil quality, topography, climate, lack of funding, and political wrangling. More than 90% of the soils in the region were classified as low fertility, with only 3% considered fertile enough for good crops. **As a result, few of the proposed large-scale agriculture projects in the region were implemented**.

However, with the completion of the EFC in 1985, the plan to connect it to the North–South Railroad (FNS) from Açailândia (MA) to Anápolis (state of Goiás [GO]) advanced. This completion also helped bolster the grain production potential of the northern Cerrado region, which did not face the agronomic constraints of the Carajás region.

## 2.2. Carajás and the History of Vale as a Mining and Logistics Company[6]

To implement the Carajás project, a joint venture was established in April 1970 between Vale and Companhia Meridional de Mineração, a subsidiary of U.S. Steel, which had the legal right of preference to explore the deposits it had discovered in 1967. In June 1977, U.S. Steel exited the joint venture, and CVRD became the sole shareholder.

**To transport the ore from Carajás to the coast, Vale built the EFC, an 892-km railway linking the mines, in an area currently located in Parauapebas (PA), to Ponta da Madeira in São Marcos Bay, in São Luís (MA). The EFC was also designed to provide passenger and general freight services.** At Ponta da Madeira, adjacent to the public port of Itaqui, Vale built a maritime terminal to load large ore carriers. The EFC was inaugurated in February 1985, and passenger services have operated since March 1986, when the Ponta da Madeira Maritime Terminal was also officially opened.

As a state-owned company, Vale envisioned profit-oriented as well as development objectives, playing a key role in the PGC. **Apart from developing mining projects, Vale also supported Brazil's federal government in planning agriculture and other infrastructure projects to develop the region.** This may help explain the route of the railway to São Luís (MA)—rather than the port of Belém (PA), which would have been around 250 km closer—and the origins of shared-use infrastructure arrangements.[7]

Between the 1980s and the mid-2000s, Vale's diversified mining operations included iron ore, pellets, pulp, aluminum, bauxite, manganese, gold, and copper, and its logistics services also gained importance. **For example, in 2005, Vale was the leading supplier of logistics services in Brazil, accounting for 68% of the volumes transported in Brazil's railroads and 27% of the volumes handled in the country's ports in 2005**. Important milestones in the period include the company's privatization in 1997, its listing on the New York Stock Exchange in 2000, and its rebranding as Vale S.A. in 2007.[8]

Also, in 2007, Vale won a bid for a 30-year sub-concession to operate a 720-km stretch of the FNS between Açailândia (MA) and Palmas (in the state of Tocantins [TO]). Linked to the EFC in Açailândia (MA), the FNS sub-concession allowed Vale to develop a new general freight corridor, particularly soybeans, rice, and corn.

Following the 2008 economic crisis, as Vale's operations in Brazil's Southeast ramped down, the importance of the Carajás corridor increased. To avoid rising shipping prices and restore the international competitiveness of its iron ore, Vale began acquiring its vessels, including the Valemax vessels—very large ore carriers (VLOCs) capable of transporting 400,000 deadweight tonnage (DWT),[9] and allowing a 35% reduction in carbon emissions per ton transported compared to Capesize vessels.[10]

**In 2010, Vale created VLI S.A. as a subsidiary, separating its general cargo business from its core operations and avoiding conflicts of interest with clients of logistics services**. The assets transferred to VLI included interests in the FNS railroad, rights to purchase capacity in the EFC, and the operation of Ponta da Madeira's general cargo pier (Pier II).[11] **Through railroads, inland terminals with storage capacity, and marine terminals and port operations, VLI provides integrated logistics solutions to third parties for general cargo**.[12]

To seek equity investors[13] and divest from non-core assets, including logistics, in 2013 and 2014, Vale sold 62.4% of VLI, retaining the remaining 37.6% in VLI's share capital.[14]

By the end of 2014, Vale's fleet peaked at 32 own and 16 leased vessels, and a new strategy began to emerge, focused on long-term affreightment rather than ownership of vessels.[15] Between 2014 and 2017, Vale sold all of its 19 Valemax vessels, and in 2018 it concluded long-term affreightment contracts for 47 VLOCs.[16] Second-generation Valemax vessels emit 41% less greenhouse gases per ton transported compared to Capesize vessels.[17]

In 2016, Vale started operations of its ambitious Carajás Serra Sul S11D project, consisting of developments for an iron ore mine and processing plant with an estimated capacity of 90 Mtpa. Located in Canaã dos Carajás (PA), S11D was designed to increase efficiencies and reduce environmental impacts, for example, by using conveyor belts rather than trucks to move the ore.[18]

The S11D project required an expansion of the logistics capacity of the Carajás corridor to 230 Mtpa.[19] Vale built a 101-km rail spur linking the S11D facilities to the EFC, double-tracked 570 km of the railway, increased the EFC's fleet of railcars and locomotives, and expanded Ponta da Madeira. At the time of writing, the EFC expansion project was complete, with additional investments foreseen to complete the S11D logistics project by 2023.[20] In December 2018, Vale announced an expansion of S11D production to 100 Mtpa and of the corridor's capacity to 240 Mtpa, starting up in 2022.[21]



# 3. Shared-Use Infrastructure Along the Corridor Today

The Carajás corridor comprises infrastructure built by Vale to enable its mining operations in Carajás and the transportation of iron ore from the mines to the Ponta da Madeira Maritime Terminal in São Luís (MA). In this section, we describe the current state of the infrastructure assets forming the corridor, analyze their logistical performance and potential, and present the regulatory framework that governs them. We focus on the shared-use components of the corridor and the benefits for third-party users, local communities, and indirect beneficiaries.

We cover the following assets: the EFC mine-to-port railroad and its connection with the FNS railroad (Section 3.1); the Ponta da Madeira Maritime Terminal and Vale's improvements to the public port of Itaqui (Section 3.2); the Carajás airport in Parauapebas (PA) (Section 3.3); and the fiber-optic cables and the cellular network that result from Vale's investments (Section 3.4). See the map of the corridor in Figure 1.

## 3.1. Railway Infrastructure

In this chapter, we look into the infrastructure asset that is at the center of the Carajás railway corridor—the Carajás Railroad (EFC). We begin by generally describing the physical and operational characteristics of the EFC, covering its structure of cargo depots and passenger stations or stops, the recent infrastructure investments made by Vale, indicators of efficiency of the railroad, and the logistical performance of the EFC's core operations: mine-to-port transportation of iron ore (Section 3.1.1).

We then map out the existing and projected design of the North–South Railroad (FNS) and explain, from a shared-use perspective, the relevance of the connection between the FNS and the EFC in Açailândia (MA) (Section 3.1.2). In a brief section, we discuss the integration of the EFC and FNS railroads between themselves as well as with the broader railway network in Brazil, focusing on two discrete aspects: rolling stock and track gauge (Section 3.1.3).

Against this backdrop, we turn to current and potential shared-use benefits of the Carajás railway corridor: the road–rail bridge of Marabá on the EFC (Section 3.1.4), the railway transportation of general cargo by users other than Vale on the EFC and FNS railroads (Section 3.1.5), and the provision of passenger services on the EFC (Section 3.1.6).

Finally, we analyze critical aspects of the regulatory framework governing the two railroads, with emphasis on their shared-use elements (Section 3.1.7).

### 3.1.1. The Carajás Railroad (EFC): The Backbone of the Corridor

***General Characteristics of the EFC Railroad***

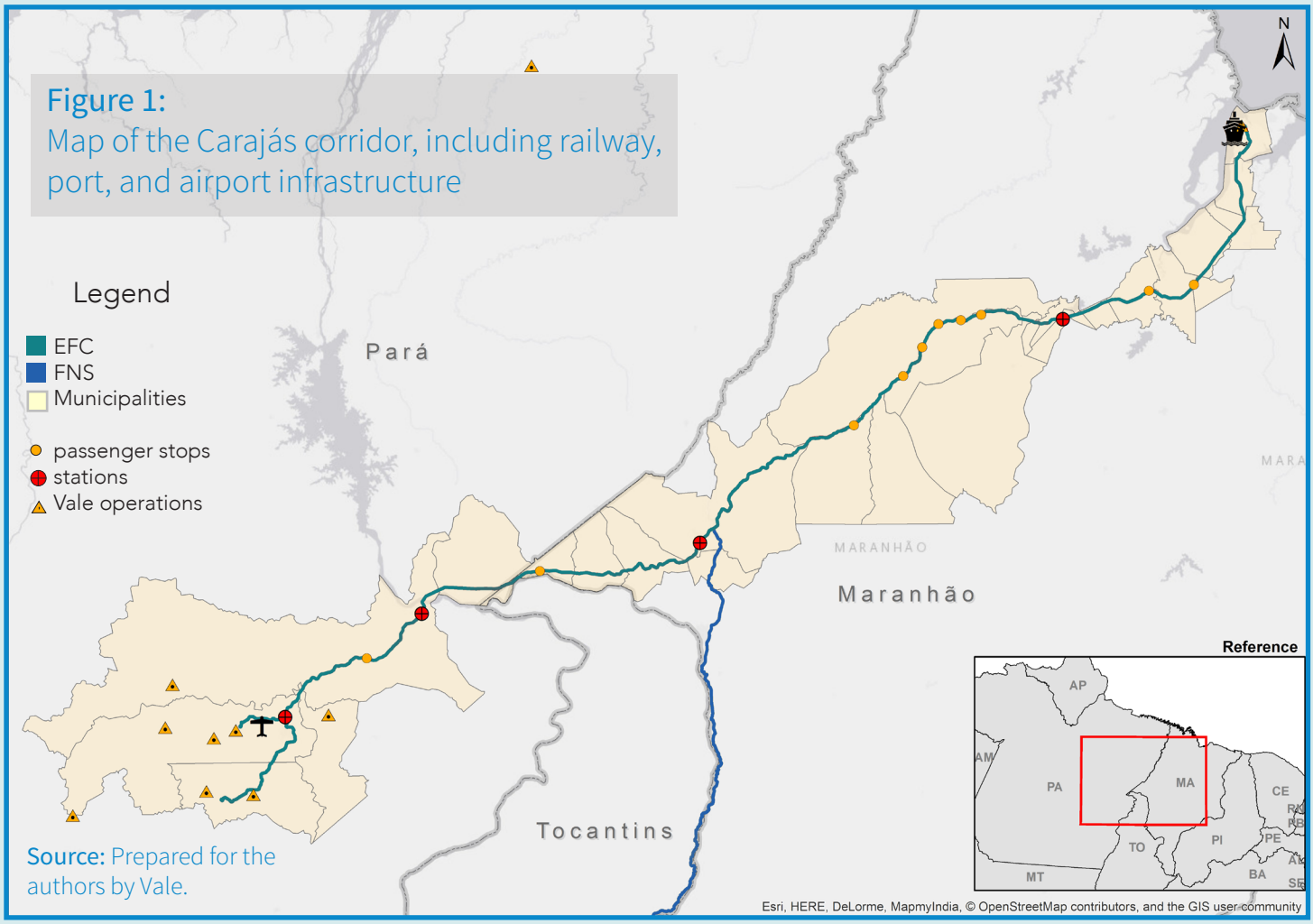
The original 892-km EFC—connecting Vale's Carajás mines in the state of Pará to the company's Ponta da Madeira Maritime Terminal, in the Itaqui port complex in São Luís (MA)—was designed to transport 35 Mtpa of iron ore, in addition to providing general cargo and passenger services.[22]

Successive expansion projects have progressively increased the EFC's logistics capacity. The S11D expansion project duplicated around 570 km of the existing railroad, added a 101-km rail spur linking it to the S11 Eliezer Batista mining complex in Canaã dos Carajás (PA)[23] and renovated other 220 km.[24] By 2017, the EFC extended over 998 km[25] and had a total transport capacity of 230 Mtpa of iron ore.

According to the latest data by the National Transportation Confederation (CNT), 19,016 railcars (data for 2017) and 314 locomotives (data for 2018) were operational on the EFC (Figure 2). Around 35 trains run simultaneously[26] on the EFC's broad-gauge railway, employing over 4,900 workers.[27] Since 2008, the Carajás corridor has operated the longest train in the world—3.5 km—transporting more than 40,000 metric tons in 330 cars.[28]

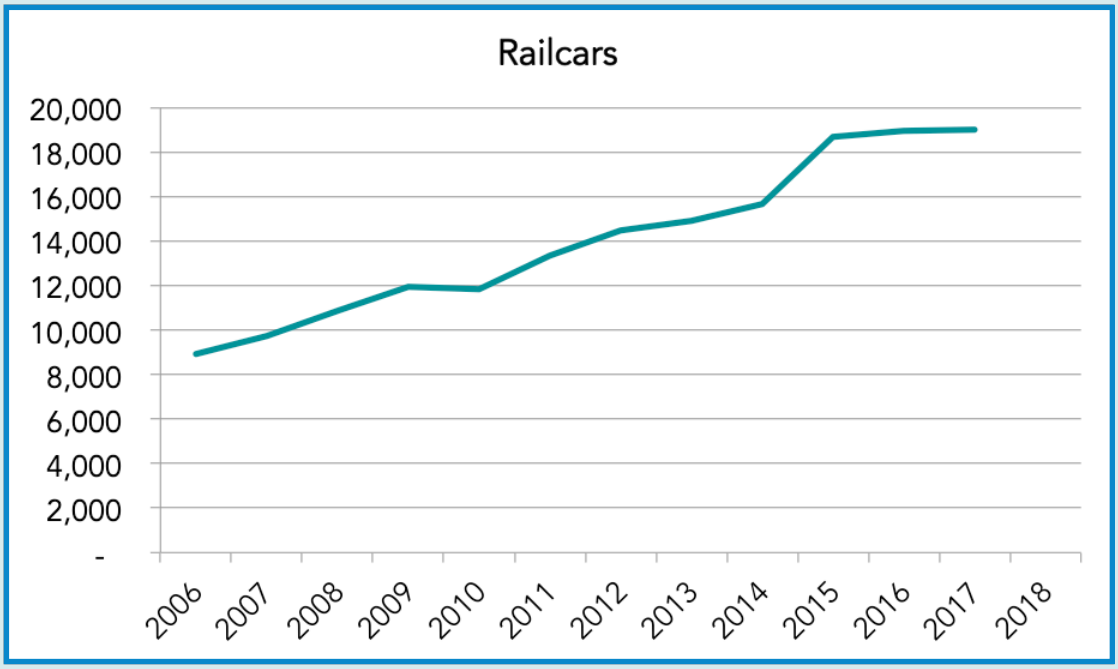
*Photo: Passenger train on the Marabá Mixed Rail–Road Bridge across the Tocantins River. Photographer: Ricardo Teles / Agência Vale*

## Figure 1:
Map of the Carajás corridor, including railway, port, and airport infrastructure




**Source:** Prepared for the authors by Vale.

## Figure 2A:
Number of locomotives and railcars, EFC (2010–2018)




**Source:** Prepared by the authors based on CNT data.[115]

On average, 55 iron ore trains and 8 general cargo trains run per day; the number of general cargo trains depends on seasonality in the production of grains. Moreover, one passenger train runs per day, six days per week (maintenance is carried out one day per week), carrying around 1,200 passengers.

***Cargo Train Depots and Passenger Train Stations or Stops Along the EFC Railroad***

At one end of the EFC are Vale's Carajás and S11D mines, where Vale's iron ore is loaded; at the other is the Itaqui port complex in São Luís (MA), where iron ore is unloaded for export, and other Vale and third-party cargo is loaded or unloaded.[29] Besides these endpoints serving Vale's core mining activities, cargo may be loaded or unloaded at four depots ("entrepostos"), from mine to port:

- Parauapebas (PA): loading of Vale's iron ore, copper concentrate, and nickel; unloading of fuels for Vale and third parties;
- Marabá (PA): loading of third-party pig iron and manganese; unloading of Vale's iron ore for third-party pig-iron plants; unloading of fuels for third parties;
- Açailândia (MA): loading of third-party pig iron; and unloading of third-party fuels; connection of the EFC railroad to the North–South Railroad (FNS).
- Santa Inês (MA): currently not operating (not enough demand).

The passenger train has five stations and ten stops, from the interior to the coast:[30]

- Parauapebas station, in Parauapebas (PA)
  - Itainopólis stop, in Marabá (PA)
- Marabá station, in Marabá (PA)
  - São Pedro stop, in São Pedro da Água Branca (MA)
- Açailândia station, in Açailândia (MA)
  - Nova Vida stop, in Bom Jesus das Selvas (MA)
  - Presa de Porco or Vila Pindaré stop, in Buriticupu (MA)
  - Altamira stop, in Alto Alegre do Pindaré (MA)
  - Auzilândia stop, in Alto Alegre do Pindaré (MA)
  - Mineirinho stop, in Alto Alegre do Pindaré (MA)
  - Alto Alegre stop, in Alto Alegre do Pindaré (MA)
- Santa Inês station, in Santa Inês (MA)
  - Vitória do Mearim stop, in Vitória do Mearim (MA)
  - Arari stop, in Arari (MA)
- Anjo da Guarda station, named after the neighborhood in which it is located, in the capital city of São Luís (MA)

***Iron Ore, Manganese, and Copper: Vale's mineral logistics on the EFC railroad***

Vale's iron ore transported on the EFC has expanded significantly over the years (Figure 3), enjoying increased efficiency of operations and expansions in the company's mining and logistics operations. As volumes increased, the Carajás region gained more importance in Vale's portfolio and national mining activi-

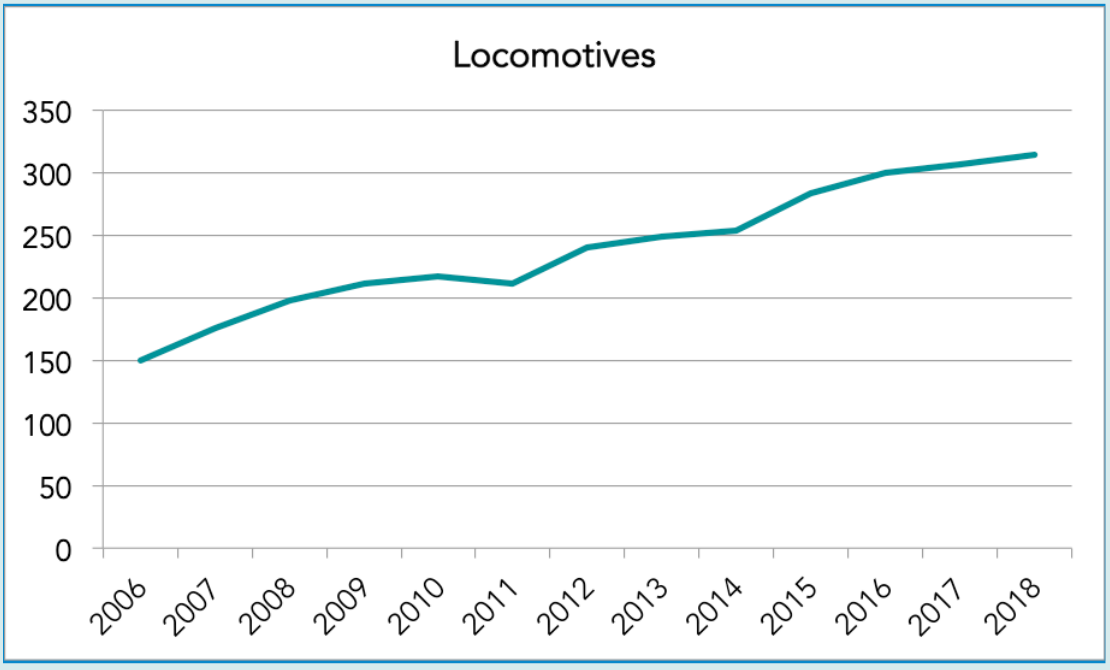



**Figure 2B:** Number of locomotives and railcars, EFC (2010–2018)

**Source:** Prepared by the authors based on CNT data.[116]

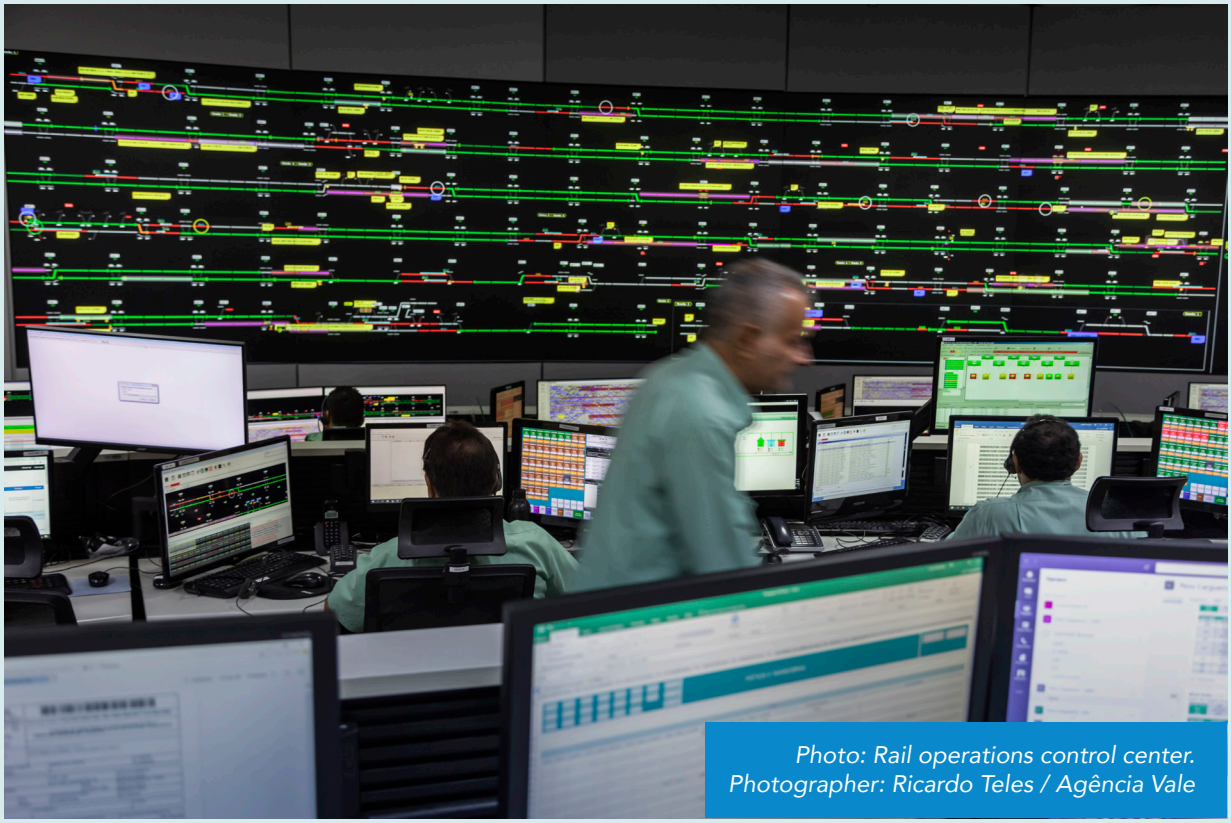


*Photo: Rail operations control center.*
*Photographer: Ricardo Teles / Agência Vale*




*Photo: Passengers waiting at a station to board the train on the Carajás Railroad.*
*Photographer: Ricardo Teles / Agência Vale*

ties. From an average of 20 Mtpa in the 1980s, Vale expanded its operations consistently, reaching an average of 43 Mtpa in the 1990s, 73 Mtpa in the 2000s, and 138 Mtpa in the 2010s, with a record of 201 Mtpa in 2018.

In addition to iron ore, Vale also transports manganese and copper. Manganese is loaded in Carajás (PA) and Marabá (PA), and copper in Parauapebas (PA). On average, Vale has transported 1.529 Mtpa of manganese and 0.406 Mtpa of copper on the EFC in the period 2006–2019 (Figure 4).

The National Logistics Plan 2025[31] recommends including in the EFC concession extension the commitment to move at least 10% of the cargo from and to the Carajás complex through the Paraense Railroad (*Ferrovia Paraense*). Still, in its conceptual phase, Paraense Railroad would connect with the ports in Vila do Conde, in Barcarena (PA), and the state capital Belém (PA). The suggestion lies in the long-term optimization of the logistic capabilities of the region to cope with the national supply and demand of goods against existing infrastructure bottlenecks. The Paraense Railroad would also connect with the FNS, diversifying logistic options for grain cargoes.

**Figure 3:** Iron ore volumes transported, EFC (1985–2019)

**Source:** Prepared by the authors based on data by Vale (1985–2005) and ANTT (2006–2019).[118]

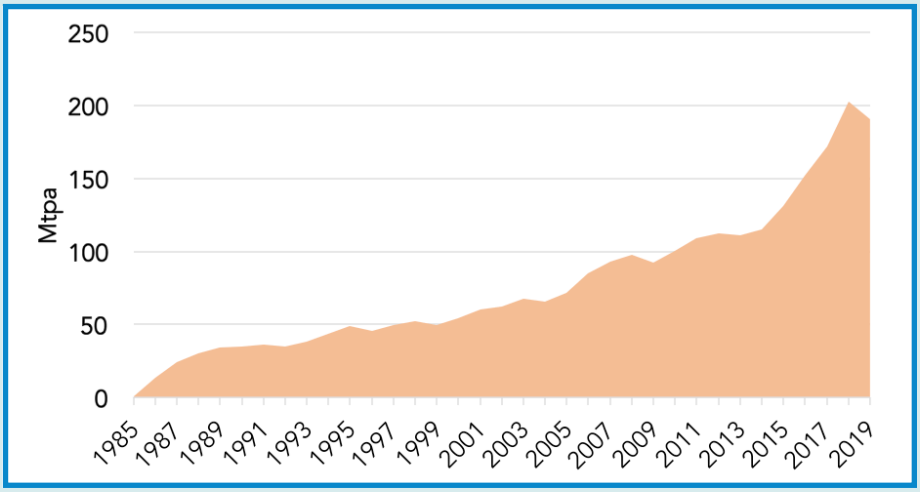



**Figure 4:** Manganese and copper volumes transported, EFC (2006–2019)

**Source:** Prepared by the authors based on ANTT data[117] and data provided by Vale for copper in 2012.

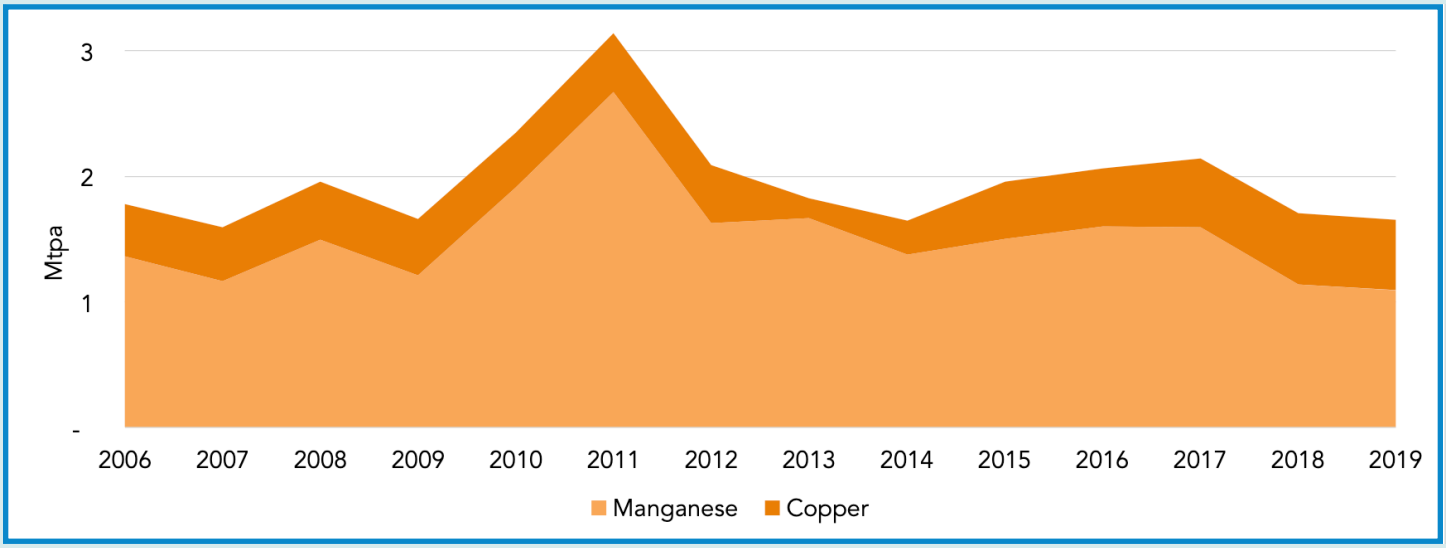




*Photo: Loading of iron ore on railcars at Vale's mine in Carajás. Photographer: Ricardo Teles / Agência Vale*

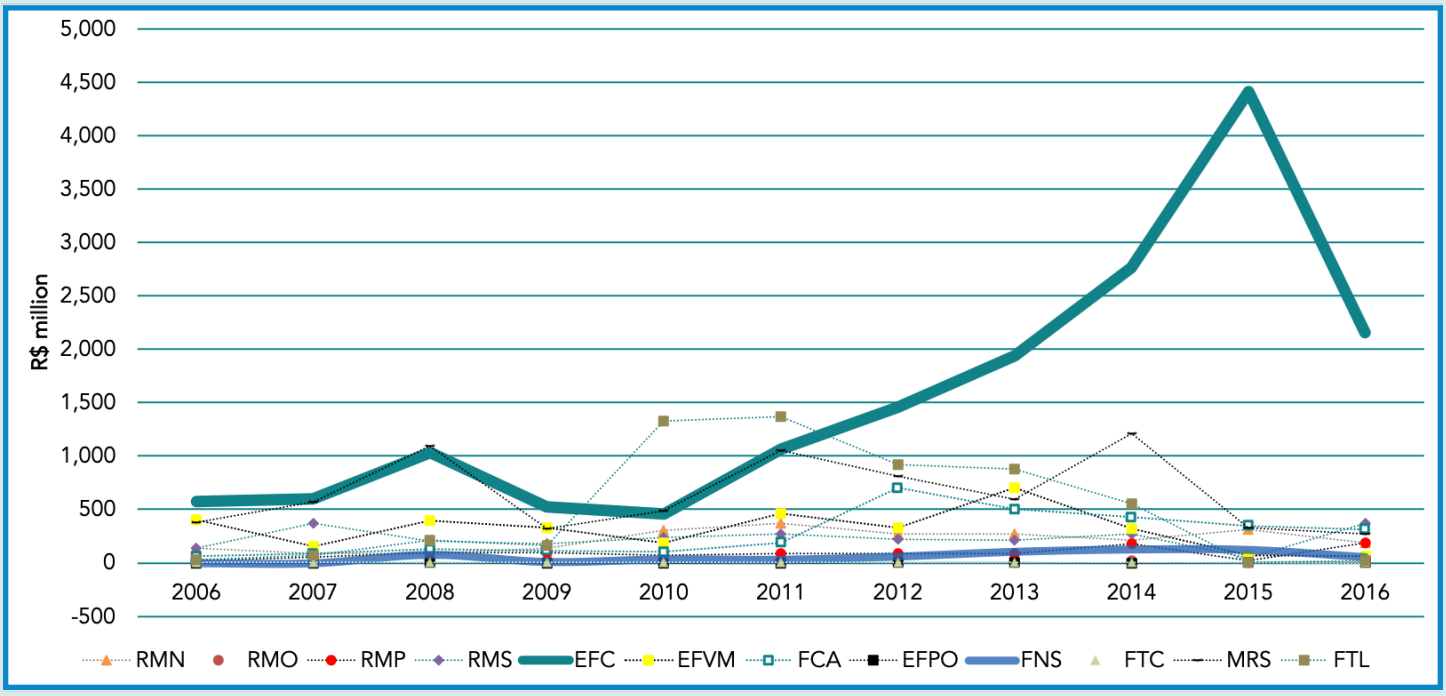
***Recent Investments in the EFC Railroad***

Vale invested about R$ 17 billion in the EFC from 2006 to 2016 (Figure 5), making it the railroad with the highest level of investment in Brazil during the period.

***Performance Indicators of the EFC Railroad***

The EFC is considered as one of the most efficient railroads in Brazil in terms of volumes, speed, and level of accidents. We discuss the factors leading to accidents and conflicts on the EFC in Section 4.1.6. The railroad was awarded a prize from the Logistics and Supply Chain Institute (ILOS) in 2012. In 2018, it ranked third among Brazilian railroads in speed (Figure 6), first in metric ton-km, and second in railcar productivity.[32]

## Figure 5: Investments by railroad, Brazil (2006–2016)




**Note:** RMN - Rumo Malha Norte ; RMO - Rumo Malha Oeste; RMP - Rumo Malha Paulista; RMS - Rumo Malha Sul; EFC - Estrada de Ferro Carajás; EFVM - Estrada de Ferro Vitória Minas; FCA - Ferrovia Centro-Atlântica; EFPO - Estrada de Ferro Parana Oeste; FNS - Ferrovia Norte-Sul - Tramo Norte; FTC - Ferrovia Tereza Cristina; MRS - MRS Logística; FTL - Ferrovia Transnordestina Logística.

**Source:** Prepared by the authors based on CNT data.[119]

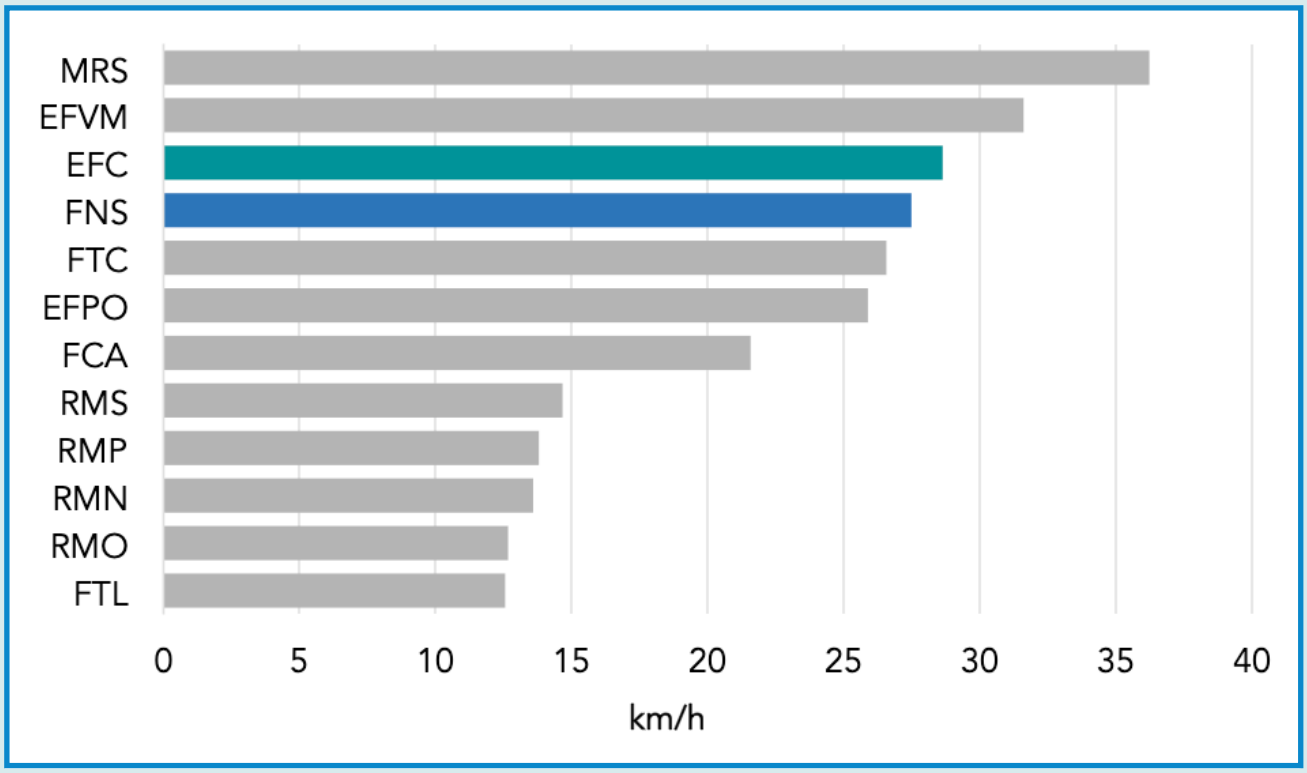
### 3.1.2. The EFC's Connection to North–South Railroad (FNS)

Though neither built nor operated by Vale, the North–South Railroad (FNS) expands the area of influence of the Carajás railway corridor and its potential for shared use, in that it allows general cargo of third-party users to be transported between various states in the interior of the country and the port complex of Itaqui (see Figure 7).

General cargo transportation on the corridor feeds from the connection of the EFC to the FNS in Açailândia (MA). Two sections of the FNS are currently operational: the 720-km-long North Section, between the connection to the EFC in Açailândia (MA) and Porto Nacional (TO), operated by VLI,[33] and the 855-km-long Central Section, from Porto Nacional (TO) to Anápolis (GO), operated by Rumo Multimodal. Construction of the 682-km-long South Section of the FNS—from Ouro Verde de Goiás (GO) (next to Anápolis [GO]) to Estrela D'Oeste (SP)—is almost complete. There, the FNS will connect with the railway network operated by the América Latina Logística concessionaire, in São Paulo (SP), reaching the public port of Santos (SP).[34]

A 2008 federal law has foreseen the expansion of the FNS to the north, from Açailândia (MA) to Belém (PA), and to the south, from Anápolis (GO) to Panorama (SP).[35] Still, currently, there are no specific projects to implement these expansions. In 2015, viability studies were undertaken to extend the railroad further south, in two additional sections: from Panorama (SP) to Chapecó

**Figure 6:** Average speed by railroad, Brazil (2018)




Source: Prepared by the authors based on CNT data.[120]

**Figure 7:**
Map of the North–South Railroad (FNS) and its connection with the Carajás Railroad (EFC)




**Source:** Prepared for the authors by Vale.

(SC), and from Chapecó (SC) to Rio Grande (RS), in the southernmost state of Brazil, where the country's fifth largest public port is located.[36]

**Therefore, the EFC–FNS connection in Açailândia (MA) already makes it possible for general cargo to be transported by rail between the Itaqui port complex in São Luís (MA) and the interior of the country, crossing several Brazilian states as well as creating railway links with other ports across the country.** Completion of projected expansions and interregional connections of the FNS railroad[37] will give the EFC a more significant role in inter-regional integration within Brazil.

### 3.1.3. Railway Network Integration in Brazil: EFC, FNS, and Beyond

***Rolling Stock***

Vale owns and operates the railcars, locomotives, and other rolling stock needed to transport the iron ore it produces as well as fuel and general cargo for its use on the EFC. Vale also operates the passenger services on the EFC and owns the necessary rolling stock. In turn, VLI operates all third-party cargo transportation, not only on the North Section of the FNS, but also on the EFC. Both Vale and VLI own rolling stock for general cargo that the companies lend to each other as needed.[38]

***Track Gauge***

When building the EFC railroad, Vale used a broad or "Irish" gauge (1.6 m), in compliance with the standard determined for modern railroads in Brazil's National Transportation Plan, in force since 1973.[39] However, most other railroads in Brazil use the metric (1 m) gauge (see Table 1). For purposes of transporting iron ore from the mines to the port on a flat region, the 1.6 m track gauge may have advantages over narrower ones. However, the existence of different track gauges presents challenges for railway network integration.[40] The existence of different gauges prevents using the same rolling stock across railroads, increasing the costs of connecting networks of different gauges.

## Table 1: Railroad network by gauge size, Brazil (2019)

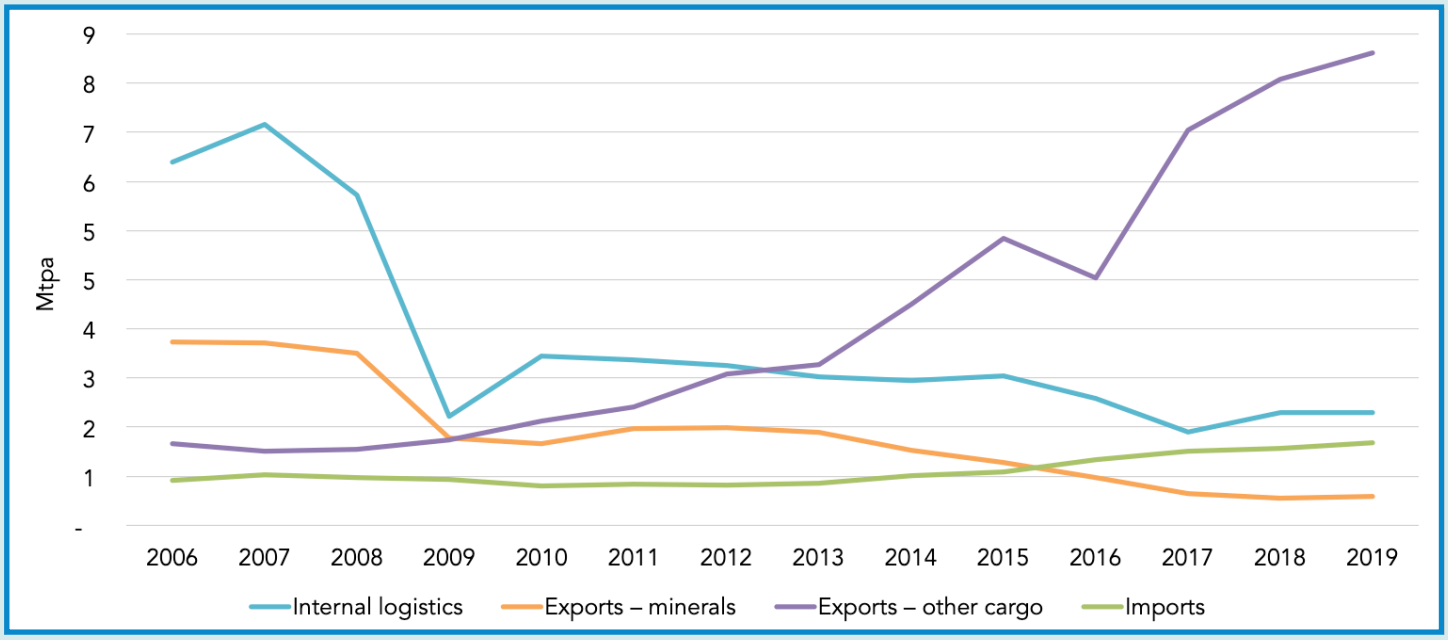
| Railroads | Railroad network length (km) | | | |
|---|---|---|---|---|
| | By gauge | | | Total (km) |
| | 1.6 m | 1 m | Mixed | |
| RMN – Rumo North Network | 735 | | | 735 |
| RMO – Rumo West Network | | 1,973 | | 0,973 |
| RMP – Rumo Paulista Network | 1,544 | 242 | 269 | 2,055 |
| RMS – Rumo South Network | | 7,223 | | 7,223 |
| **EFC – Carajás Railroad** | **978** | | | **978** |
| EFVM – Vitória–Minas Railroad | | 873 | 22 | 894 |
| FCA – Centro Atlântica Railroad | 3 | 7,089 | 131 | 7,222 |
| **FNS S/A – North–South Railroad (North Section)** | **745** | | | **745** |
| EFPO – Paraná West Railroad | | 248 | | 248 |
| FTC – Tereza Cristina Railroad | | 163 | | 163 |
| MRS – MRS Logística | 1,613 | | 73 | 1,685 |
| FTL S/A – Transnordestina Logística Railroad | | 4,275 | 20 | 4,295 |
| **FNS S/A – North–South Railroad (Central Section)** | **856** | | | **856** |
| Total | **6,473** | **22,087** | **514** | **29,074** |

**Source:** Prepared by the authors based on CNT data.[121]




*Photo: Mineral, fuel, and general cargo railcars on the Carajás Railroad, near the Ponta da Madeira terminal. Photographer: Ricardo Teles / Agência Vale*

**Figure 8:** Cargo transported, excluding Vale's mineral exports, EFC (including through FNS connection) (2006–2019)




**Source:** Prepared by the authors based on ANTT data.[122]

The EFC railroad was built in a region where existing networks adopted the metric gauge, posing challenges to network integration with, for example, the Transnordestina Logística Railroad, which also goes to the Itaqui port complex.

When the North Section of the FNS railroad was built, the broad gauge was also used, with the deliberate goal to allow it to connect with the EFC and avoid network connection issues. At the other end of its line, however, the connection of the FNS with railroads adopting the metric gauge tends to lead to higher network integration costs.[41]

### 3.1.4. Shared Use on the Road–Rail Bridge of Marabá

Of particular relevance from a shared-use perspective is the 2.34-km Mixed or Road–Rail Bridge of Marabá (PA) on the EFC, which crosses the Tocantins River. Vale's early plans only foresaw the construction of a railway bridge. At the time of its construction, however, there were no other road bridges in the area; the population depended on unreliable boats and ferries to cross the river. In this context, Brazil's transportation ministry demanded that the project also foresaw the future addition of a roadbed to allow traffic of motor vehicles. Accordingly, the conclusion of the construction works on the railway bridge allowed the EFC to enter into operation in February 1985; Vale added the road infrastructure a few months later, without disrupting rail traffic.[42] The mixed bridge—part of the federal road BR-155—is now considered the portal of Marabá (PA), linking the city center to its rural districts, and allowing greater human mobility and transportation various cargo, in particular food, fuel, and grains.[43]

Besides the initial investment in the bridge, Vale conducts periodic maintenance of the structure and railway component. In December 2017, Vale concluded nine months of broader renovation works—executed by Vale at its own expense, in collaboration with municipal and national government entities—of both the rail and the road components of the bridge, in response to community demands.[44] Vale does not consider the mixed bridge to be a significant bottleneck in the EFC railroad and therefore has not yet duplicated it but plans to do so to increase efficiency.[45] Vale is currently seeking to obtain the necessary permits to build a second mixed road–rail bridge.[46] The project is expected to be approved by Vale in 2020, and construction is expected to be concluded by 2025. Vale will bear the total cost of construction.[47]

### 3.1.5. Beyond Vale's Mineral Exports: Shared Use of the Carajás Corridor

This section presents one of the key shared-use elements of the corridor: the logistics of cargo other than Vale's mineral exports that is transported on the EFC railroad, including through its connection with the FNS railroad.

VLI is the operator of the North Section of the FNS and is responsible for the third-party cargo logistics along the EFC. As mentioned above, VLI was created by Vale as a subsidiary in 2010, and Vale still holds 37.6% in VLI's share capital. VLI has access rights to the EFC to transport general cargo from the FNS–EFC

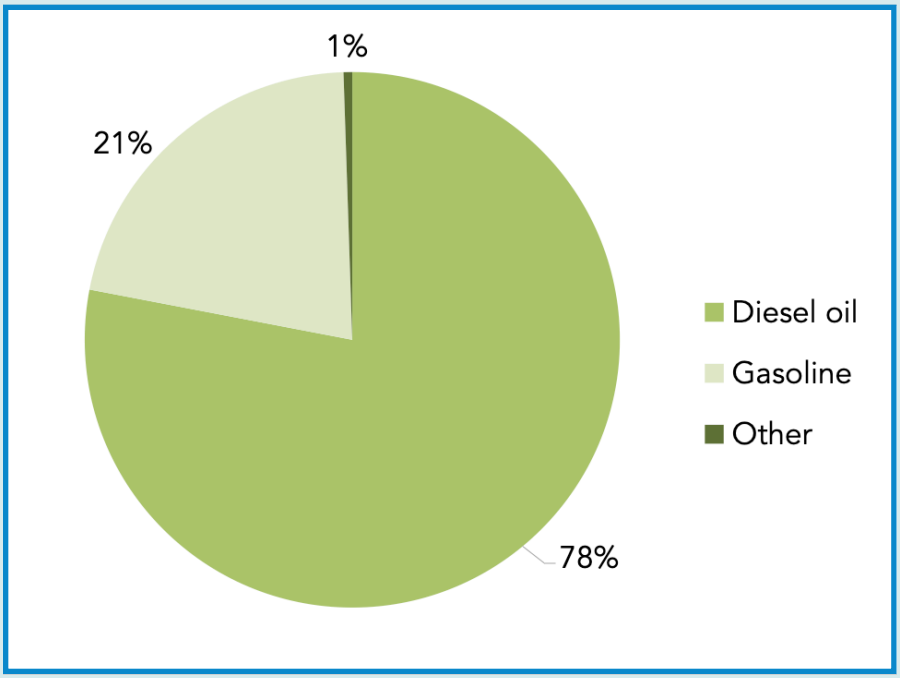


*Photo: Iron ore train on the Marabá Road–Rail Bridge across the Tocantins River. Photographer: Dario Zalis / Agência Vale*

## Figure 9:
Share of imported cargo, EFC (2019)

**Note:** Other includes ethanol, other fuels, pulp, and other products.

**Source:** Prepared by the authors based on ANTT data.[123]




connection in Açailândia (MA) to the Itaqui port complex. Accordingly, VLI and Vale discuss capacity needs yearly, with monthly updates based on demand forecasts. The volume of cargo transported by VLI is volatile due to grain production seasonality and also very weather dependent. When reserving capacity, VLI must consider these risks as it pays for the use of the EFC section regardless of whether it uses the reserved capacity or not, passing on the costs to its customers.[48]

Figure 8 presents the main volumes transported on the EFC between 2016 and 2019, including through its connection with the FNS, and excluding Vale's export-bound iron ore, manganese, and copper transported for shipping out of the Itaqui port complex.

The cargo groupings in Figure 8 are the following:

- **Internal logistics** includes all cargo that is transported on the EFC but does not originate from and is not bound to the Itaqui port complex. Most internal logistics cargo is iron ore transported from Vale's mines to be used as input by the pig-iron plants located along the EFC in Açailândia (MA), Rosário (MA), Santa Inês (MA), and Marabá (PA).

- **Imports** include all cargo loaded on EFC trains at the Itaqui port complex and transported to the interior of the country, whether unloaded along the EFC or the FNS. This category comprises mostly fuels, in particular diesel, gasoline, and ethanol, but also small volumes of fertilizers and other types of cargo.

- **Exports – minerals** present the annual volumes of minerals transported on the EFC, excluding Vale's iron ore, manganese, and copper exports. Pig iron transported from the plants mentioned above for shipping out of the Itaqui port complex accounts for most of these volumes: 99.1% throughout the period 2006–2019. These volumes also include an annual average of 25,809 metric tons of **slag** loaded in Marabá (PA) and Açailândia (MA), along the EFC railroad, in the period 2013–2019; 15,558 metric tons of **sand** loaded in 2008 in Imperatriz (MA), along the FNS railroad; 8,202 metric tons of **manganese** loaded in 2017 in Gurupi (TO),[49] also along the FNS.

- **Exports – other cargo** includes mostly soybeans, soybean meal, corn, and pulp, as well as other products loaded along either the FNS or the EFC and transported to the port.

***Internal Logistics***

The sharp reduction in volumes of internal logistics cargo transported between 2006 and 2009 was due to the closing of 18 pig-iron plants. Pig-iron imports from the United States collapsed, and charcoal, a key input in the pig-iron production process, became scarce due to deforestation in nearby areas.[50] Vale also suspended sales of iron ore to various smelters that failed to comply with environmental and labor laws.[51] **The steady increase in non-mineral exports during the period reflects the increased exports of soybeans, soybean meal, corn, and pulp**.

Today, one of the few operations that continue to process Vale's iron ore along the corridor is Sinobras—an integrated steel plant

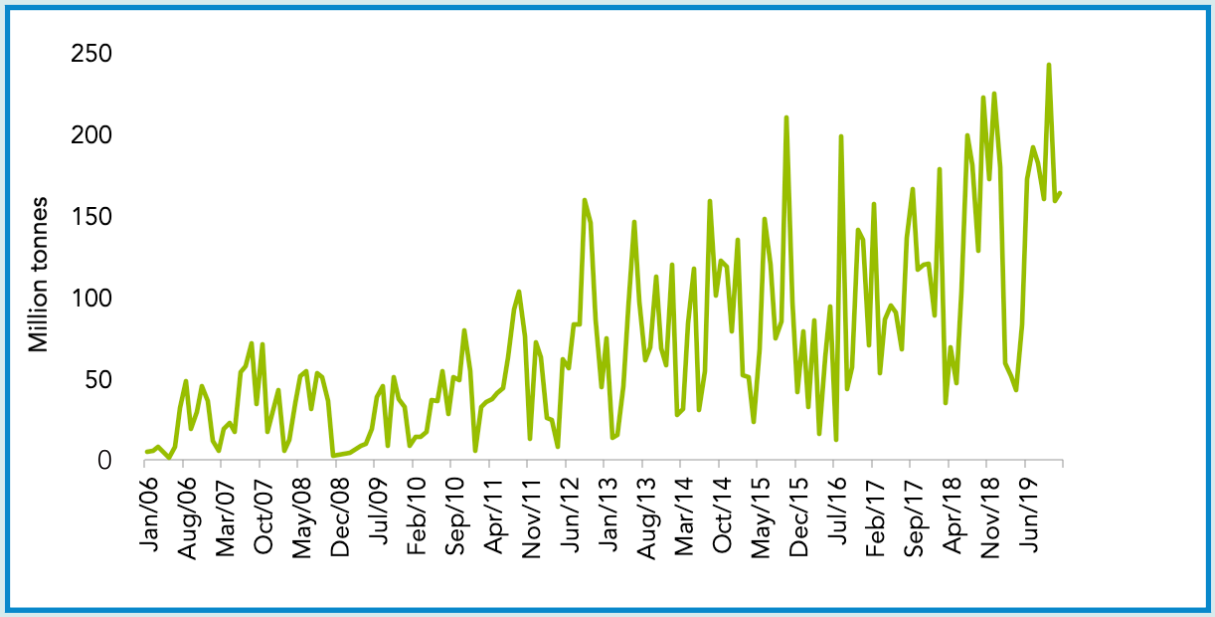


*Photo: Fuel terminal and railcars on the Carajás Railroad.*
*Photographer: Ricardo Teles / Agência Vale*




*Photo: VLI's fuel railcars at the Marabá loading depot.*
*Photographer: Ricardo Teles / Agência Vale*

## Figure 10: Fertilizer imports into the port of Itaqui in São Luís (MA) (2006–2019)




**Note:** Imports of fertilizers are coded 31 in the SH2 system.
Source: Prepared by the authors based on MDIC data.[124]

operating in Marabá (PA). Apart from the iron ore inputs from Vale to produce pig iron, it also has a contract to buy all the scrap metal from Vale's operations. Sinobras has its own eucalyptus plantation to produce charcoal and therefore has been relatively insulated from the increase in charcoal prices.[52]

***Import Logistics***

Regarding imports transported on the EFC between 2006 and 2019, most volumes were of fuels (gasoline, diesel, and others), ranging from 0.7 up to 1.9 Mtpa. In 2019, diesel represented 78% of total volumes, while gasoline 21% (Figure 9). According to Vale, about 75% of the fuels transported on the railroad belongs to third parties, and 25% is for the company's use.[53]

Before 2006, other products used to be transported on the EFC and FSN railroads, in particular from the port to the interior of the country:[54]

- **Beverages**: Coca-Cola Co. used to transport its products by rail until it set up its plant in the region. Now that it has its plant inland, the company no longer needs the rail transport option.
- **Cement**: Cement companies also transported their production by rail before setting up their plants in the Carajás region.
- **Trucks**: While trucks used to be transported to the interior by rail, this is no longer the case, particularly because of complaints about vandalism (for example, broken windows).
- **Wood**: Although transported by rail in the past, currently there is no longer demand for railroad transportation of wood.
- **Gas**: Demand for rail transportation of gas decreased in light of risks of vandalism as well as explosion.

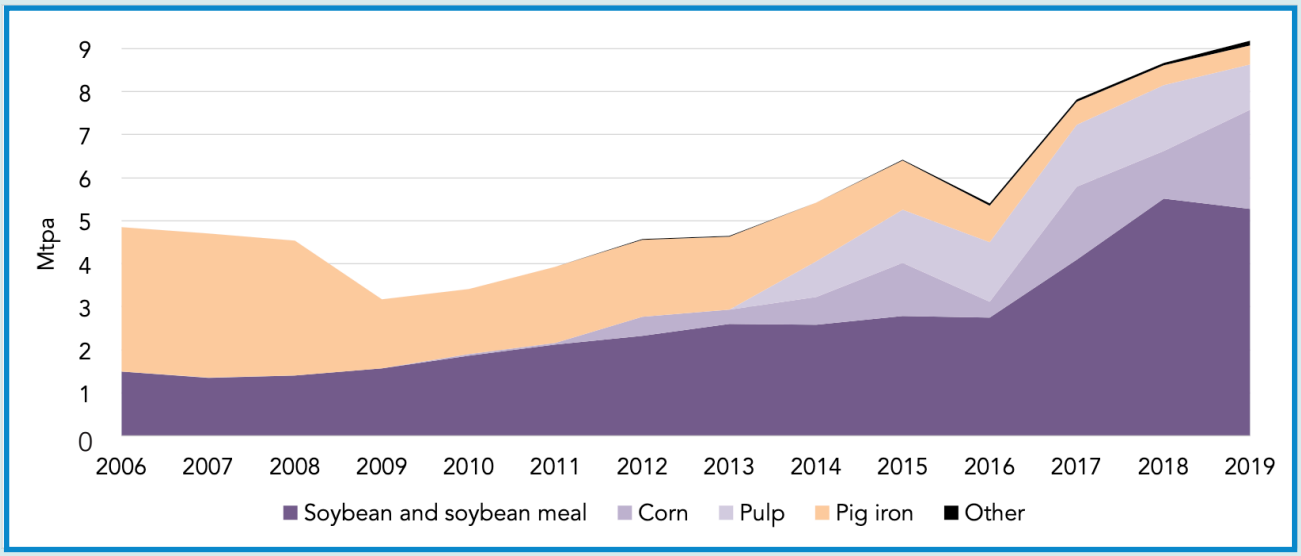


*Photo: Pig iron being loaded at the Marabá (PA) railway depot.*
*Photographer: Ricardo Teles / Agência Vale*



*Photo: Hot steel billets at the Sinobras steelworks in Marabá (PA).*
*Photographer: Ricardo Teles / Agência Vale*

**Figure 11:** Cargo transported on the EFC to the Itaqui port complex, including through FNS connection, excluding Vale's iron ore, manganese, and copper exports (2006–2019)




**Note:** Other (barely visible in the chart) includes sand, fuels (including ethanol, diesel, and others), vegetable oil, steelmaking products, manganese, and other cargo. **Source**: Prepared by the authors based on ANTT data.[125]

- **Sand and bricks**: As demand for sand and bricks increased in the region, production plans were built inland, decreasing demand for rail transportation.

- **Fertilizers**: Fertilizers also used to be transported on the EFC, depending on demand. Between 2006 and 2010, and again in 2018 (with no data recorded for 2011–2017 and 2019), a total of 56.2 metric tons of fertilizers (including potassium chloride, phosphate, urea, ammonia, and others) were loaded in the port of Itaqui and transported on the EFC and FSN.[55]

**Currently transported by trucks, fertilizers are an example of a product that could potentially be transported by railway.**[56] Fertilizers transported on the EFC and FNS accounted for only 0.48% of the 11.7 million metric tons of fertilizers imported into the public port of Itaqui in São Luís (MA) between 2006 and 2019.[57] Fertilizer imports are subject to significant seasonality and variability over time (Figure 10). It is important to consider such variation as a minimum guaranteed demand is often required for railroad transportation to make economic sense.[58]

To transport general cargo such as the product listed above, a long-term agreement (for example, ten years) is often required, as well as a guaranteed minimum number of railcars (for example, five railcars) or capacity to make it economically viable for operators to opt for railway transport.[59]

*Export Logistics*

**Turning to export logistics**—cargo transported on the Carajás railway corridor to the Itaqui port complex—**the importance of the connection of the EFC with the FNS from a shared-use perspective becomes evident.** Excluding Vale's mineral exports, 66.3% of export cargo transported on the EFC to Itaqui in the period 2006–2019 was loaded not along the EFC itself, but along the FNS. Soybean and soybean meal are the main volumes transported (Figure 11), representing 57.4% of total volumes exported in 2019, followed by corn (25.1%), pulp (11.5%), and pig iron (5.0%).

Accordingly, **the connection with the EFC railroad makes the North Section of the FNS an important corridor for the export of agricultural bulk and other cargo from Brazil's central region, promotes the Itaqui port complex as a northern outlet for Brazilian export production, and strengthens agricultural development in the interior of the country.**

The importance of the EFC for third-party cargo exports is expected to increase with the expansion of the grain export capacity of the Itaqui port complex. As discussed in greater detail in the section on port infrastructure (Section 3.4.2), an additional grain terminal has recently been built in the public port of Itaqui, and others are under construction or projected to be built in the region—all of them relying on grain transportation on the EFC and FNS railroads. The Grain Terminal of Maranhão (*Terminal de Grãos do Maranhão* [TEGRAM]), at Itaqui, has exported 10 Mtpa of grains in 2019 and projects a progressive expansion to

**Figure 12:**
Number of users of the EFC passenger train per boarding or deboarding station or stop (2019)

**Source:** Prepared by the authors based on data provided by Vale.

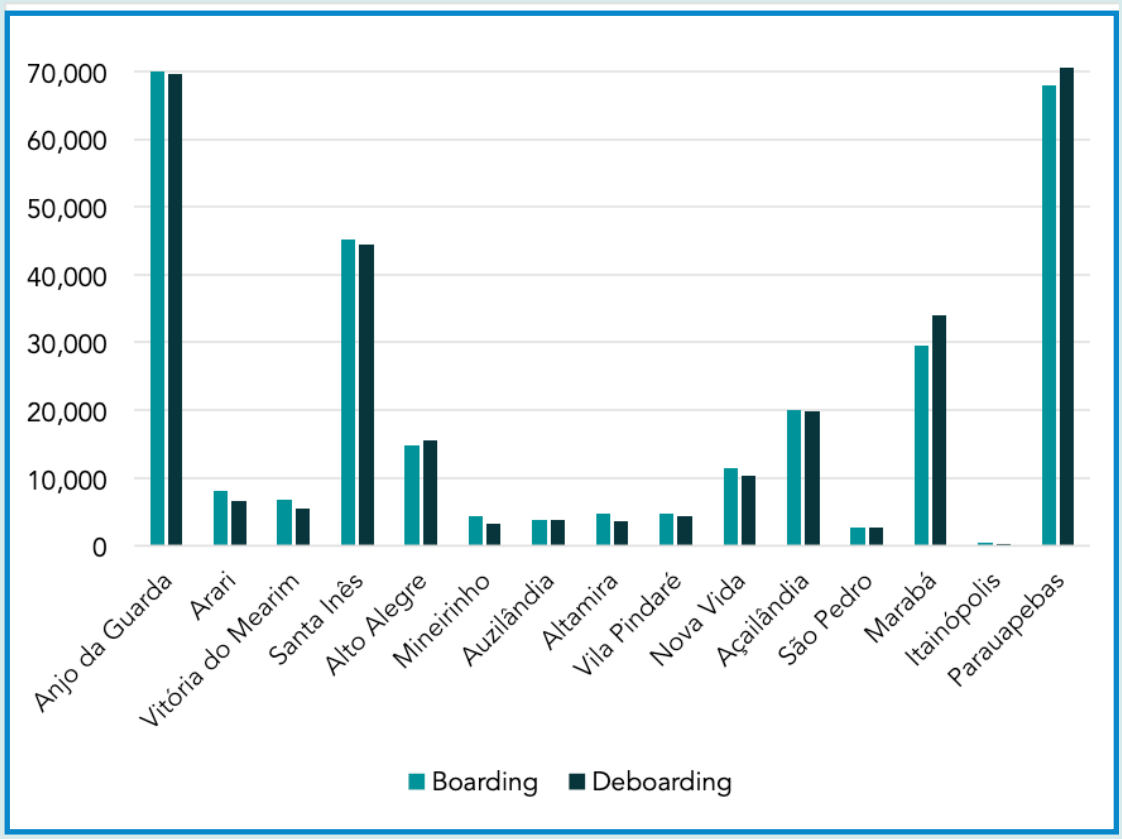
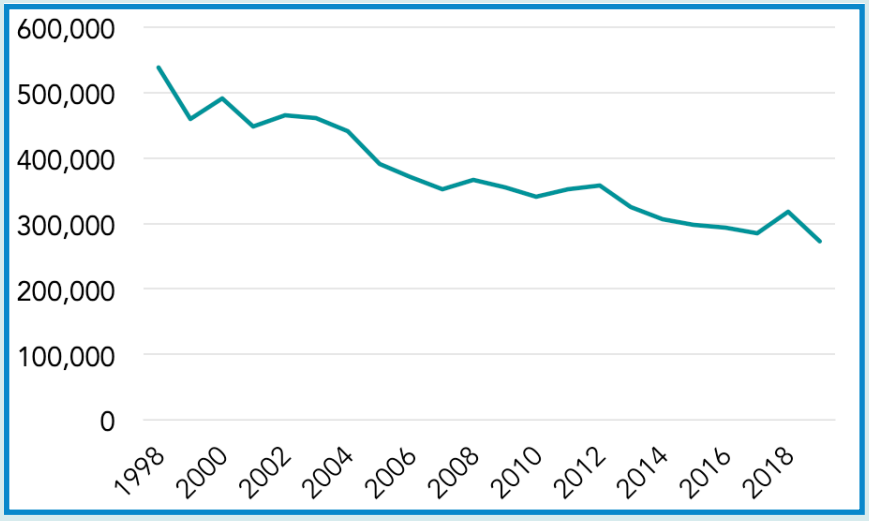



**Figure 13:**
Number of passengers, EFC (1998–2019)

**Source:** Prepared by the authors based on data provided by Vale.



14 Mtpa in the coming years. Furthermore, the São Luís Port Terminal under construction in the Itaqui port complex has a projected capacity of 15 Mtpa for various types of cargo, and the project for the Alcântara Port Terminal just outside the Itaqui port complex foresees 40 Mtpa of capacity to transport soybeans, soybean meal, and corn. **These projected new terminals and expansions tend to lead to increased demand pressure for the shared use of the EFC railroad and require investments in the progressive expansion of its capacity.**

### 3.1.6. Shared Use of the EFC: Brazil's Longest Railroad with Passenger Services

Passenger services are offered on the EFC once a day, six times a week. The passenger train has a priority of circulation along the corridor, meaning that iron ore and general cargo trains have to stop in order to not delay passenger trains. While it would be reasonable to assume that operating passenger services could negatively affect the operation of cargo trains, we did not find that to be the case on the EFC. Analyzing day-to-day data for iron ore transportation on the EFC throughout 2019, we did not find that the volume of iron ore transported by Vale decreased on average on the days when passenger trains were in operation. This result attests to Vale's success in coordinating cargo and passenger services efficiently and strengthens the argument in favor of multi-purpose shared use of railway corridors.

**Figure 14:** Number of passenger trains and passengers, EFC (2009–2018)

**Source:** Prepared by the authors based on CNT data.[126]

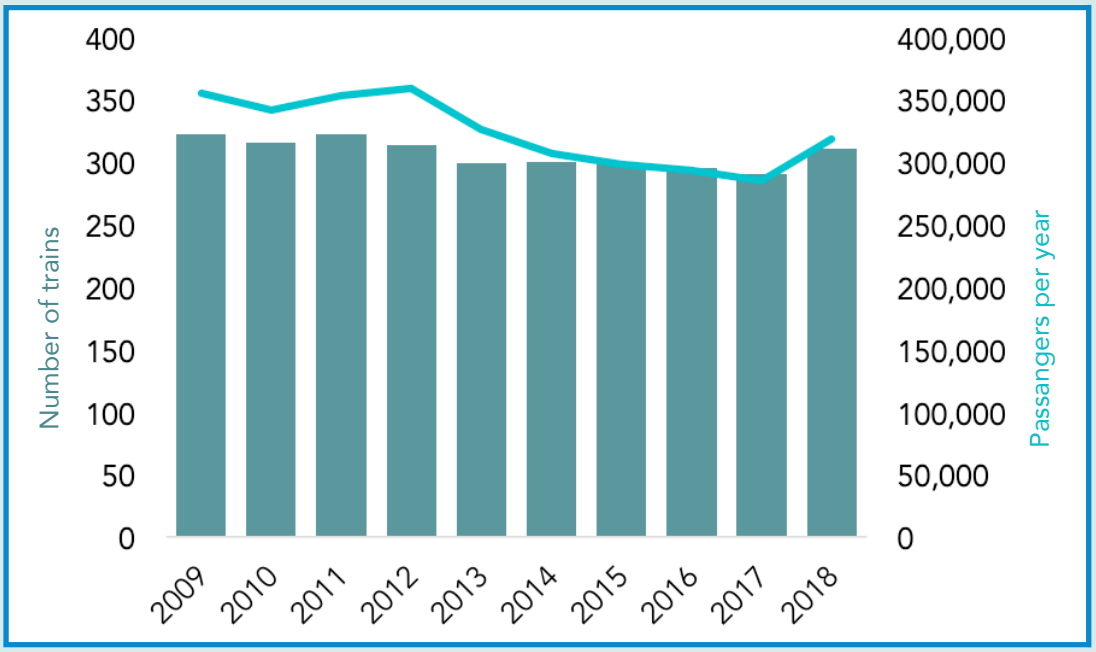



**Figure 15:** Operating costs and revenues from passenger services, EFC (2015–2019)

**Source:** Prepared by the authors based on data provided by Vale.





*Photo: Passengers boarding the train on the Carajás Railroad.*
*Photographer: Ricardo Teles / Agência Vale*



*Photo: Passengers in railcar on the Carajás Railroad.*
*Photographer: Ricardo Teles / Agência Vale*

Each passenger train trip takes around 16 hours. The train travels inner-bound three days per week and toward São Luís (MA) three days per week; maintenance is carried out one day per week. Around 1,200 passengers can be transported per trip. Demand is particularly high around national holidays. The passenger train is one of the most relevant means of transportation in some locations along the corridor, particularly during the rainy season.[60] Economy and business class tickets are offered, in addition to free or discounted fares—as provided by law—for qualifying children, seniors, students, and low-income young passengers.[61]

Passenger services began operating on the EFC in 1986. It is the longest railroad with passenger services in Brazil,[62] with five stations and ten stops.[63] Other than at the stations at each end of the line—Anjo da Guarda station in São Luís (MA) and the Parauapebas (PA) station—the stations with the highest numbers of users in 2019 were in three important urban centers along the corridor: Santa Inês (MA), Marabá (PA), and Açailândia (MA). Some train stops also recorded significant passenger traffic in 2019, such as Nova Vida, in Bom Jesus das Selvas (MA), and Alto Alegre, in Alto Alegre do Pindaré (MA) (see Figure 12). Vale operates the passenger services on the EFC and owns the rolling stock (locomotives and railcars).

The total number of passengers has been decreasing over time. In the late 1990s, over 500,000 people used the service, while in 2019, around 270,000 did (Figure 13). In 2018 and 2019, on average, 3.4% of passengers were employees and contractors traveling on Vale business on the EFC.[64] Currently, around 310 trains provide this service each year (Figure 14).

One explanation for the fall in passenger numbers is that before 2008, Vale did not limit passenger boarding; all passengers who demanded the service were allowed to board, and many passengers traveled standing. Starting from 2009, Vale established ticket quotas per station or stop to ensure the availability of seats for passengers and implemented a new ticket management system. Between 2014 and 2017, several trips were interrupted or canceled because of protests and strikes. Starting from 2018, Vale has been taking measures to optimize occupancy rates and address the downward trend.[65]

Operating costs of the passenger train are usually higher than revenues from ticket sales (Figure 15). Vale considers its passenger services to be a social expenditure and a part of the company's commitment to enhancing the benefits of shared-use transportation infrastructure in a remote region of the country that is particularly affected by the lack of adequate infrastructure.[66] The three-fold increase in operational costs of the passenger services on the EFC—from roughly R$ 15.5 million in 2016 to about R$ 45 million in 2019—results from the operation of the new, air-conditioned passenger train starting from September 2015; while capital investments were initially amortized, costs of maintenance and part replacement for the new technology used increased over time.[67]

### 3.1.7. Regulatory Framework Governing the EFC and FNS Railroads

The regulatory framework governing the EFC and the FNS railroads encompasses laws, regulations—particularly those issued by Brazil's independent regulatory agency of land transportation (*Agência Nacional de Transportes Terrestres* [ANTT])—and, more specifically, the concession and sub-concession agreements governing the two railroads. This section presents a summary of the regulatory framework applicable to the railroads (Box 1). Appendix 2 contains a detailed analysis of the various instruments governing the railroads.

**Box 1: Summary of the Regulatory Framework Governing the EFC and FNS Railroads**

- Federal legislation governs the award of railway concessions by Brazil's federal government, including the award criteria for bid processes. Shared-use terms are not a permissible differentiating factor for bids.
- The regulation of Brazil's railway sector is entrusted to ANTT, an independent regulatory agency. Federal legislation sets out its role, mission, powers, and responsibilities, which include issuing regulations applicable to the railway sector.
- Concession agreements set out key terms governing the public concessions of both EFC and FNS. The 1997 EFC concession agreement was awarded for 30 years. The FNS is subject to both a 50-year concession agreement with an SOE, concluded in 2006, and a 30-year sub-concession agreement concluded in 2007 with a fully owned indirect subsidiary of VLI.
- Under the EFC concession agreement, Vale is required to provide passenger train services. No similar requirement applies to the FNS concession. Federal legislation mandates the operational prioritization of passenger trains.
- Railway sector regulations and the concession agreements provide for third-party access rights. Subject to applicable conditions, concessionaires must allow access to trains operated by third parties.
- A mutual access agreement between Vale and VLI's wholly-owned subsidiary Ferrovia Norte–Sul S.A. governs transportation services with origin along the EFC and destination along the FNS or vice versa. As a rule, each concessionaire remains responsible for operating the trains in its concession area, with cargo being exchanged at the Vale-operated terminal in Açailândia (MA). However, VLI is exceptionally permitted to operate its own trains on the EFC when cargo

is transported from the Itaqui port complex (including the Ponta da Madeira Maritime Terminal) to a destination along the FNS.

- Multiple sources—including federal legislation, ANTT regulations, and the concession agreements—govern the setting of freight rates and fares. ANTT may impose caps on freight rates for cargo services and set actual fares for passenger services; it may also review them periodically. Special rules apply for determining freight rates that concessionaires may charge to third parties exercising access rights.
- ANTT regulations protect highly dependent users. Such users are entitled to the allocation of capacity on a take-or-pay basis, subject to special freight rates arbitrated by ANTT.
- Federal legislation establishes a user-payer principle. This principle appears to preclude the ability of ANTT to impose access terms that would result in subsidization of train services by concessionaires or anchor-clients.
- ANTT regulations provide for the possibility of third parties investing in expansions of railway capacity. In the case of users of rail services operated by concessionaires, investments may be imposed notwithstanding concessionaires' opposition. Conversely, concessionaire consent is necessary for investments by third parties exercising access rights.
- According to an ANTT deliberation, at least 8.65% of the capacity of EFC must be allocated to general cargo. Notwithstanding, Vale has indicated that, to date, general cargo used capacity has remained consistently below that minimum level.
- Railway sector regulations allow ANTT to set throughput targets for concessions. However, only in the case of FNS has ANTT exercised this prerogative.
- Federal legislation allows the federal government to authorize railway concessionaires to generate revenue from other sources unrelated to train services, such as telecommunications or power transmission infrastructure. Even so, federal legislation governing the telecommunications sector precludes railway concessionaires from charging telecommunications companies for deploying their infrastructure along railroads.
- Brazil's federal government and Vale have negotiated a new concession agreement for the early extension of the EFC concession. At the time of writing, Brazil's Federal Court of Accounts has approved, subject to certain modifications, the conclusion of the new concession agreement.
- Assuming the current draft of the new concession agreement is concluded, the extension of the EFC concession should result in improvements in terms of shared use. Vale would be required to double the current frequency of passenger services and have more stringent obligations with respect to third-party access, including the requirement not to impose requirements that are more restrictive than those established by ANTT and the allocation of capacity to the sub-concessionaire of the South Section of the FNS, between Porto Nacional (TO) and Estrela D'Oeste (SP).

## Table 2: Characteristics of the piers at Ponta da Madeira Maritime Terminal (2019)

| Piers | Berths | Maximum capacity of vessel that can be docked (DWT) | | Ship loaders | Maximum loading rate (metric tons/hour) |
|---|---|---|---|---|---|
| Pier I | | 420,000 (Valemax VLOC) | | 1 | 16,000 |
| Pier III | North | 180,000 (capesize) | If berths operated simultaneously, 180,000 each | 3 | 24,000 (8,000 per ship loader) |
| | South | 210,000 (capesize) | | | |
| Pier IV | North | 420,000 (Valemax VLOC) | | 2 working alternately | 16,000 |
| | South | 420,000 (Valemax VLOC) | | 2 working alternately | 16,000 |

Source: Prepared by the authors based on Vale NYSE report 2019; Plano Mestre do Complexo Portuário do Itaqui.



*Photo: Vale's iron ore storage yard at Ponta da Madeira.*
*Photographer: Ricardo Teles / Agência Vale*

## 3.2. Port Infrastructure

### 3.2.1. General Characteristics: Vale's Iron Ore Port and Storage Facilities

Built by Vale to export the iron ore produced in the Carajás mines and transported to Brazil's coast on the company's trains along the EFC railroad, the port is a fundamental component of the Carajás corridor. The location of the port was an important consideration in the design of the Carajás project: "São Marcos Bay, where the new [maritime] terminal would be built, was sufficiently wide and deep to accommodate bulk carriers of up to 280,000 DWT, and its natural access channel would permit simultaneous two-way traffic involving large ships. Besides having good visibility, the region was located outside all storm paths. The terminal could also operate free from wave action practically throughout the year."[68]

Ponta da Madeira Maritime Terminal—the private-use terminal built by Vale between 1984 and 1985 in the natural harbor of São Marcos Bay—officially opened in March 1986. It forms part of the Itaqui port complex, in São Luís (MA), which currently includes the adjacent public port of Itaqui (Porto Organizado do Itaqui) and the private-use terminal operated by Alumar (an aluminum smelter joint venture of Alcoa and BHP). Cargo transported by Vale on the EFC represents more than 90% of total shipments out of the Itaqui port complex.[69]

Two breakwaters built by Vale protect the terminal from currents, which are strong because of the influence of the ample tidal range in the region (up to 7 meters),[70] making the logistics more complicated. The terminal has three piers with a total of five berths, allowing five large ore carriers to be docked simultaneously (see Table 2), as well as a 15-section storage yard with a static capacity of 7 million metric tons. Only iron ore, pellets, and manganese produced by Vale and transported on the EFC are stored in the yard and shipped through Ponta da Madeira. Iron ore shipments totaled 198 million metric tons in 2018.[71]

The odd numbering scheme of the piers at Ponta da Madeira (I, III, and IV) results from the fact that Pier II, built by Vale in 1994 for shipments of general cargo, was handed over to VLI.[72] Since Pier II is the only pier at Ponta da Madeira from which grains and general cargo can be shipped, and considering that using Piers I, III, and IV to ship cargo other than minerals would not be viable due to contamination with residual iron ore, it is important to look into the potential of Pier II for shared use.

### 3.2.2. Shared-Use Benefits of Vale's Operations at the Itaqui Port Complex

***Cargo Storage and Transportation from Pier II/Berth 105***

Pier II can dock vessels of up to 155,000 DWT and has a maximum loading rate of 8,000 metric tons per hour.[73] Pier II was incorporated into the public port of Itaqui and is now known as its Berth 105; it was subsequently leased to Vale[74] and is currently operated by VLI. Vessels docked on Pier II/Berth 105 can only be loaded—through conveyor belts—with cargo transported on the EFC or stored in Ponta da Madeira storage facilities. Therefore, the operation of certain storage facilities located in Vale's Ponta da Madeira terminal was also handed over to VLI (Table 3).[75]

Cargo transported by VLI on the FNS and EFC railroads—mainly pig iron, soybeans, and corn—can be stored in the facilities operated by VLI at Ponta da Madeira or loaded from there, through conveyor belts, to vessels docked on Berth 105 at the public port of Itaqui.[76]

**Table 3:** Storage facilities operated by VLI at Vale's Ponta da Madeira Maritime Terminal (2019)

| Type of storage facility | Number of facilities | Materials stored | Total static storage capacity (metric tons) |
|---|---|---|---|
| Yards | 3 | Pig iron | 140,000 |
| Warehouses | 2 | Grains (mainly soybeans and corn) | 94,000 |
| Vertical siloes | 5 | | 131,000 |

**Source:** Prepared by the authors based on Plano Mestre do Complexo Portuário do Itaqui; http://www.vli-logistica.com.br/conheca-a-vli/portos/tp-sao-luis-ma



*Photo: Vale's Ponta da Madeira Maritime Terminal.*
*Photographer: Ricardo Teles / Agência Vale*

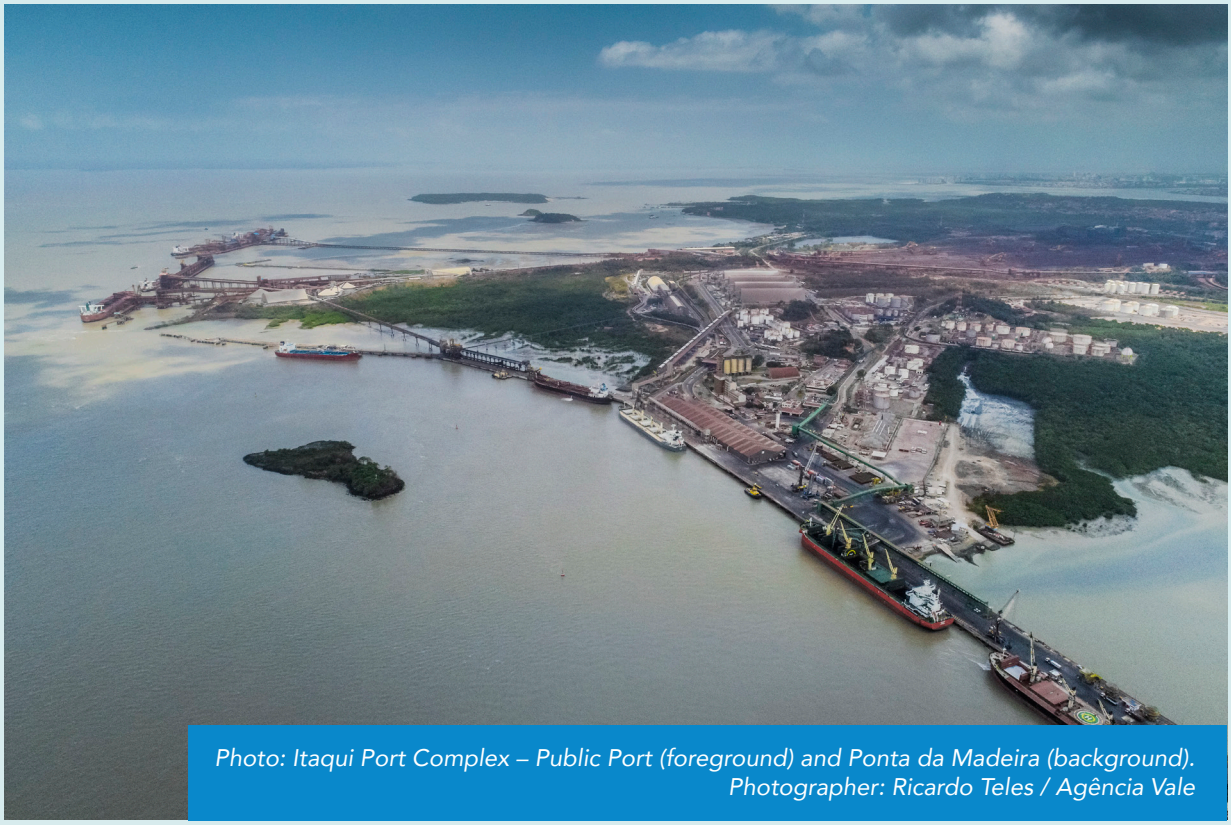
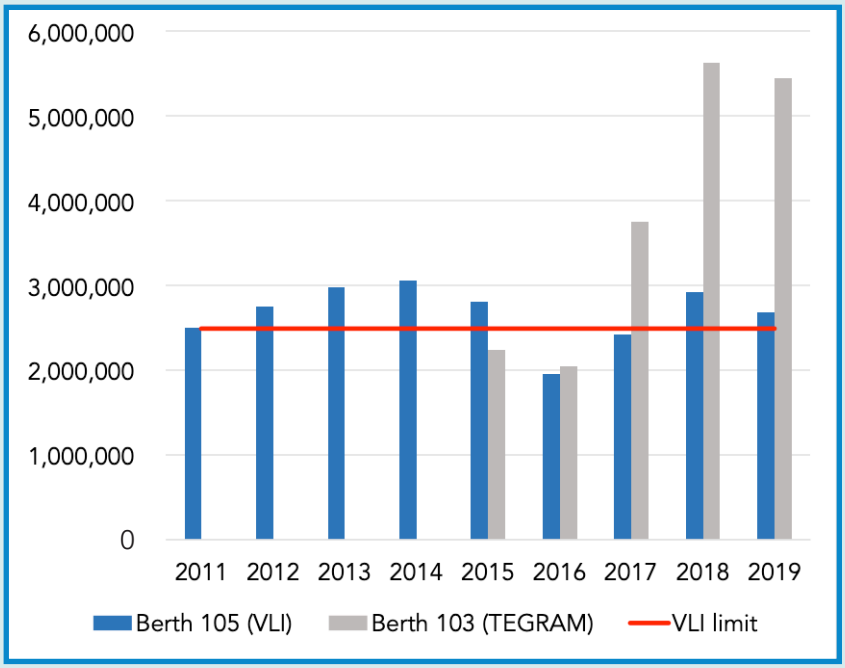


*Photo: Itaqui Port Complex – Public Port (foreground) and Ponta da Madeira (background).*
*Photographer: Ricardo Teles / Agência Vale*

## Figure 16:
Metric tons of soybeans and soybean meal transported through the Itaqui port complex (2011–2019)

**Source:** Prepared by the authors based on ANTAQ data.[127]




In December 2010, Brazil's National Waterway Transport Agency (*Agência Nacional de Transportes Aquaviários* [ANTAQ]) granted Vale permission to build warehouses for soybean and soybean meal at Ponta da Madeira. When granting such authorization, ANTAQ prohibited Vale from loading such products from its private terminal and determined that they could only be loaded from Berth 105. It also conditioned the authorization to limit the volumes moved through Berth 105 to 2,400,000 metric tons of soybeans per year and 90,000 metric tons of soybean meal per year, without limiting the shipment of corn. ANTAQ's resolution clarified that the limit could only be exceeded if it was proved that the Grain Terminal of Maranhão (Terminal de Grãos do Maranhão [TEGRAM])—still being built at the time—would not be capable of absorbing all the demand for grain transportation coming from the FNS and EFC railroads.[77]

Those limitations—imposed on Vale and currently also applicable to VLI as its successor in the general cargo operations on Berth 105—had been indicated in the public tender for the TEGRAM project to make the new terminal technically and economically viable.[78] However, even before TEGRAM became operational in August 2015,[79] the limitation already generated controversy among grain producers, arguing that it created unequal and privileged market conditions for the two neighboring terminals, as well as harmed competition in that users of public ports were deprived of their rights to choose the port of their preference.[80] Vale formally challenged the resolution, which was maintained by ANTAQ in a 2014 decision.[81] TEGRAM accounted for exports of roughly 10 million metric tons of soybean, soybean meal, and corn in 2019,[82] but the limitations imposed by ANTAQ on VLI continue to be in force (see Figure 16).

***Expansion of Port Infrastructure in the Itaqui Region***

Besides TEGRAM, **projects for building additional private maritime terminals in the region—whether within or outside the Itaqui port complex—tend to impact the demand for both Ponta da Madeira facilities and the EFC for storing and moving cargo other than Vale's iron ore.**

In March 2018, the São Luís Port Terminal project was officially launched. Storage and shipping facilities are being built in the Itaqui port complex to generate transport capacity of 15 Mtpa: 7 Mtpa in grains (including soybeans and soybean meal), 3 Mtpa in fertilizers, 2.7 Mtpa of liquid fuels, and 2.3 Mtpa of general cargo (including pulp). The project is being developed under the leadership of the China Communications Construction Company (CCCC), with 51% shareholding; other shareholders include two São Paulo–based companies—Lyon Capital (20%) and WPR Participações of the WTorre Group (24%). The first phase of the investment has a budget of R$ 800 million, while total investment may reach R$ 1.5 billion. Connecting to and spending into expanding the capacity of the EFC railroad is also projected.[83]

At the end of 2018, Brazil's federal government authorized another terminal in the same region of Maranhão state—not in the Itaqui port complex, but on the other side of São Marcos Bay, in Alcântara (MA). The R$ 12.9-billion project to build the Alcântara Port Terminal is led by the company Grão-Pará Multimodal (GPM), formed by Portuguese infrastructure investors. GPM is currently seeking the necessary environmental permits intending to start construction in 2021 and the first phase of operations in 2024. The new terminal would have the capacity for shipping up to 140 Mtpa of iron ore, bauxite, manganese, copper, and oth-

er minerals, complementing the capacity of the Ponta da Madeira Maritime Terminal, which, according to GPM's study, would be difficult to expand beyond 230 Mtpa. Furthermore, the terminal would have the capacity to transport up to 40 Mtpa of soybeans, soybean meal, and corn. Relying on transportation of cargo to the port by railway, the project's initial budget includes R$ 3.44 billion to build a 220-km rail link from the EFC railroad to the projected new terminal.[84]

Both new terminals expect to rely on their projected connection to the EFC railroad to receive export-oriented cargo from other parts of the country through the EFC's connection to the FNS railroad. In addition to increasing competition with Pier II/Berth 105 storage and shipping facilities at Ponta da Madeira, **the new private-use terminals in São Luís and Alcântara tend to result in greater demand for the shared use of the EFC and require investments in the progressive expansion of the railroad's capacity.**

***Dredging and Signaling Along the Navigation Channel***

Other shared-use benefits from Vale's operations at Ponta da Madeira result from the company's investment in general port infrastructure, particularly dredging and signaling along the 115-km navigation channel of the Itaqui port complex, which benefits Vale but also other users of the port. Currently, though, only Vale's Valemax VLOCs are large enough to require dredging.

Even if the vessels using the public port of Itaqui do not require dredging, periodic maintenance dredging of berths is necessary. In the past, the public entity that manages the port of Itaqui—Maranhense Port Handling Company (*Empresa Maranhense de Administração Portuária* [EMAP])—has shared the use of the dredge used by Vale. Sharing the dredge has significantly reduced the cost for EMAP. Contracting a separate maintenance dredge would increase dredging costs 60 times—from R$ 1 million to R$ 60 million—as the public port would have to pay for travel days and for it to be worthwhile for the dredging company. Therefore, sharing the dredging services with Vale has brought significant benefits to EMAP.

### 3.2.3. Regulatory and Contractual Framework Governing Vale's Port Operations

Vale holds title to Ponta da Madeira, a dedicated maritime terminal within the area of the Itaqui port. Such a title was granted pursuant to Law No. 8,630 of February 25, 1993, on the legal framework for the exploitation of organized ports and port terminals. Under this statute, private entities were allowed to acquire title to private use terminals by way of special governmental authorization. The authorization relating to Ponta da Madeira was granted pursuant to an agreement dated November 25, 1993, between Brazil's Ministry of Transportation and Vale, for 25 years.[85]

Law No. 8,630 contemplated both exclusive and mixed-use private terminals. The former may only be used for the cargo of the terminal holder. Conversely, mixed-use private terminals can be used for both cargoes of the terminal holder and of third parties. Therefore, mixed-used private terminals are capable of shared use. Under the agreement granting Vale title to the Ponta da Madeira terminal, it is a mixed-use private terminal.

Law No. 8,630 has since been repealed by Law No. 12,815 of June 5, 2013. Under this new statute, private terminals of exclusive use no longer exist. This entails that all private terminals are now capable of shared use.

Under Law No. 8,630, investments in federal land made by the lessee of private use terminals shall be owned by the government.[86] However, the authorization agreement expressly provides that upon its termination, movable and immovable assets of the terminal shall not be transferred to the government.[87] This issue of ownership is therefore not clearly dealt with by the authorization agreement granting title to the Ponta da Madeira terminal and the legislation in force when it was concluded.

## 3.3. Airport, Heliport, and Helicopter Infrastructure

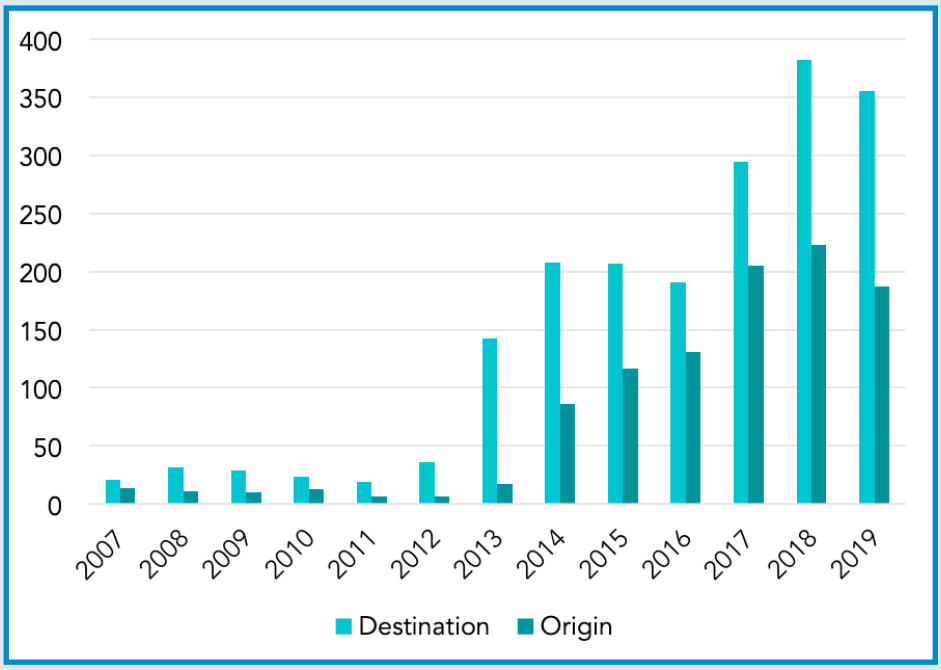
### 3.3.1. Logistics: General Characteristics and Shared-Use Aspects

To serve its mining operations and as part of the PGC, in 1981 Vale built the Carajás Airport (OACI: SBCJ; IATA: CKS) in Marabá (PA), in an area that is currently located in the municipality of Parauapebas (PA), which in 1988 became an independent municipality from Marabá (PA). It is located 28.5 km from the mine complex and 20 km from the center of Parauapebas (PA). The airport began its operations in September 1982. In March 1985, when Vale was still a state-owned company, the Brazilian government determined the transfer of the technical, administrative, commercial, and operational aspects of the airport from Vale to the Brazilian Airport Infrastructure Company (*Empresa Brasileira de Infra-Estrutura Aeroportuária* [INFRAERO]), also a state-owned enterprise (SOE), controlled by Brazil's federal government and responsible for operating most of the country's commercial airports.[88]

The Carajás Airport has a runway of 2,000 m by 45 m, which is suitable for planes used for domestic flights. There is a passenger terminal of 833.45 $m^2$. Although there is no cargo terminal, flights into and out of Carajás Airport have transported increasing volumes of paid cargo (see Figure 17). Vale operates a 660 $m^2$ hangar for maintenance and storage of its own aircraft, with a frontal patio of 900 $m^2$; there also are facilities operated by telecommunications, fuel, and car rental companies.[89]

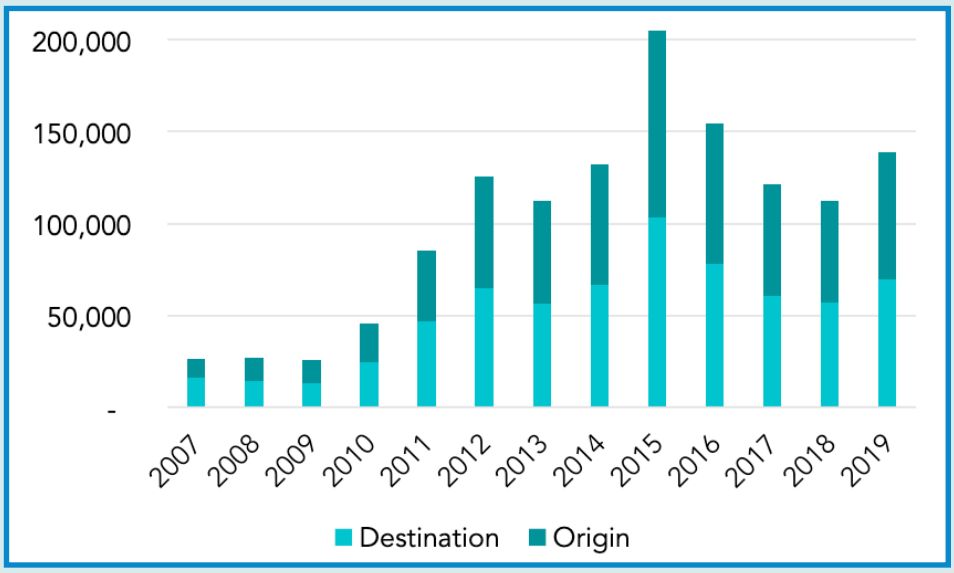
## Figure 17:
Metric tons of paid cargo transported to (destination) or from (origin) Carajás Airport (2007–2019)

**Source:** Prepared by the authors based on: ANAC. Dados Estatísticos do Transporte Aéreo do Brasil. https://www.anac.gov.br/assuntos/dados-e-estatisticas/dados-estatisticos/dados-estatisticos




## Figure 18:
Number of passengers flying into (destination) or out of (origin) Carajás Airport (2017–2019)

**Source:** Prepared by the authors based on: ANAC. Dados Estatísticos do Transporte Aéreo do Brasil. https://www.anac.gov.br/assuntos/dados-e-estatisticas/dados-estatisticos/dados-estatisticos



The Carajás Airport is strategically regarded as a highly important entry point of the region, serving Vale, its clients, investors, and visitors, as well as linking the region to other states and regions, and fostering economic growth in the state of Pará.[90] On average, there are four daily flights, operated by Brazilian airlines Azul and Gol, between Carajás and Rio de Janeiro (RJ), Belém (PA), Marabá (PA), and Belo Horizonte (MG). Vale also operates a private E-190 aircraft on Mondays and Fridays between Carajás and Belo Horizonte (MG).[91]

The airport has capacity for 300,000 passengers per year,[92] and in the last three years (2017–2019), an annual average of 124,000 passengers used the airport (see Figure 18). It is estimated that roughly 90% of the traffic at the airport is directly linked to Vale's businesses.[93] The increase in the annual number of passengers from 25,401 in 2009 to the peak of 204,874 in 2015 coincides with the ramping-up of Vale's S11D mining and logistics expansion project.

Shared-use benefits have also been generated by the use of Vale's helicopters by the Chico Mendes Institute for Biodiversity Conservation (*Instituto Chico Mendes de Conservação da Biodiversidade* [ICMBio]), the arm of Brazil's environment ministry responsible for managing the Carajás National Forest, in which Vale's Carajás mining complex is located. ICMBio agents use Vale's helicopter to monitor areas of difficult access in the Carajás National Forest and thus prevent illegal invasions and logging. Under the agreement concluded with ICMBio, Vale has annual obligations of flying over certain areas.[94]

### 3.3.2. Regulatory Framework Governing the Airport Infrastructure

Vale built the Carajás Airport in 1983, and on March 5, 1985, Brazil's federal government issued a ministerial ordinance transferring the technical, administrative, and operational jurisdiction[95] over the airport to INFRAERO. On March 12, 1985, INFRAERO formally received the Carajás Airport infrastructure built by Vale, and Brazil's aeronautics ministry signed with Vale a five-year agreement governing the transfer. Based on the agreement, the transfer appears to have occurred without payment of compensation to Vale, which took on obligations to make additional capital investments in the airport between 1985 and 1989.[96]

The federal government initially ceded the land where the airport is located to Vale, when it was still a state-owned company. The land right awarded is a perpetual and non-transmissible proprietary right to use, subject to termination at will by the government (*direito real de uso resolúvel*).[97] We understand from Vale that no consideration was paid for this land right. Based on the legal documentation relating to the transfer of the airport in 1985, it is unclear whether INFRAERO initially held any land rights to the airport. In 1997, Vale agreed to grant to INFRAERO, free of charge, a leasehold over the airport site, covering the land and all fixtures.

Over the years, Vale and INFRAERO have entered into a number of contractual arrangements relating to cooperation and coordination in the use of the Carajás Airport. Of particular relevance is an agreement dated April 22, 1997, between Vale, INFRAERO, and Fundação Zoobotânica de Carajás, a foundation responsible for managing the mining town of Carajás. Under this agreement, Vale assumed several obligations without requiring in exchange any payment by INFRAERO. In particular, Vale agreed to grant the abovementioned leasehold over the airport site, as well as to support INFRAERO in firefighting and emergency services, by making available its specialized fire brigades and equipment.[98]

## 3.4. Information and Communications Technology Infrastructure

### 3.4.1. Shared-Use ICT Infrastructure in the Carajás Corridor

***Shared-Use Benefits of Fiber-Optic Cables Along the EFC***

There are three fiber-optic cables along the EFC. Between São Luís (MA) and Açailândia (MA)—which is the half-way point of the railroad at km 513—there is a 48-fiber directly buried underground cable; 40 fibers belong to telecommunications company Oi, and 8 fibers are for Vale's exclusive use. Along the same tranche, there is a 24-fiber cable belonging exclusively to telecommunications company Embratel (now a subsidiary of telecommunications group Claro). The third one is directly buried underground fiber-optic cable between Açailândia (PA) and Parauapebas (PA) (where the Carajás mine is located) for Vale's exclusive use. Vale also has an aerial cable between São Luís and Carajás, in 70-km segments (not a continuous cable), which belongs exclusively to Vale and is used by the company as a physical contingency.[99]

Historically telecommunications companies have had strategic interests in sharing in Vale's infrastructure, particularly in the tranche between Açailândia and Carajás, passing by Marabá (PA), expanding publicly available telecommunications services in a large area with low population density. The region was originally poorly served by backbone infrastructure when Vale first developed the EFC and decided to lay fiber-optic cables along it. Telecommunications companies stated contacting Vale to acquire an easement for their fiber-optic cables, resulting in cost savings for the companies and decreased environmental impact as shared use would avoid additional deforestation. Increasing public access to telecommunications services was also of interest to Vale, to serve better the population around the mining area and along the corridor.[100]

Vale's understanding is that Brazil's telecommunications regulatory agency (*Agência Nacional de Telecomunicações* [ANATEL]) would not allow Vale to use its infrastructure to provide public services directly, because the provision of such public telecommunications services is subject to certain service-level agreements, must not be interrupted, and lie outside Vale's core activities as a private mining company. Accordingly, when entering into dialogues with interested companies regarding the potential shared use of its telecommunications infrastructure, Vale has routinely suggested establishing tripartite agreements between Vale, ANATEL, and telecommunications companies. Under such agreements, Vale's infrastructure—fiber-optic cables and equipment—would be shared between Vale, which would use it to provide private services for its mining and logistics operations, and a telecommunications company, which would be responsible for providing public services. Vale's infrastructure would thus not be directly associated with the provision of public services.[101]

Besides developing the infrastructure needed for its own operations—and, to some extent, allowing for its shared use by telecommunication companies that in turn provide public services—Vale has also contacted other service providers, highlighting the socioeconomic growth potential of the region as a result of the mine and encouraging those providers to build their own infrastructure and offer telecommunication services along the corridor independently of Vale's infrastructure. Diversifying pathways increases redundancy,[102] a desirable characteristic in telecommunications networks. Even though the pioneering character of Vale's ICT infrastructure made it strategic for the region, as its shared use reduced costs for the initial provision of public services by Oi and by Embratel/Claro, the development of telecommunications alternatives that now complement Vale's infrastructure makes it less strategic than it was originally.[103]

***Shared-Use Benefits of Brazil's First Private 4G/LTE Network***

In the context of the S11D project, operating autonomous mining trucks and blasthole drills will require reliable network connections capable of handling the traffic of significant amounts of data. Considering that it would be technically not viable to bring a fiber-optic cable into the mine, Vale has negotiated with telecommunications company Vivo—a subsidiary of the Telefônica group—the development of the first private 4G/LTE network in Brazil. The network will be available first in the Carajás mine, where three blasthole drills already operate and where autonomous trucks will soon begin to operate. It will also make it easier for Vale's employees to communicate within the mining area. Vale will make a capital investment of R$ 21 million by providing Vivo with shared infrastructure, including land and sheltered physical space for equipment, air conditioning, power supply, atmospheric discharge protection systems, power boards, telecommunications towers, and fiber-optic cables or other transmission media (depending on availability and traffic needs). Vale will also guarantee many corporate phone lines as a demand base for Vivo's service. In turn, Vivo has agreed to bring its 4G/LTE service into the mine in Carajás. The contract for the private 4G/LTE contract ensures the priority of traffic for Vale, ensuring that the uninterrupted operation of autonomous machinery.[104]

In addition to the private network, Vivo will also offer frequencies for public 4G/LTE service in the area covered by the private network. Telecommunications companies do not have a general legal obligation to offer public 4G/LTE service in the area, which encompasses only a few thousand geographically dispersed potential customers. Even assuming that it would be commercially viable for telecommunications companies to expand 4G/LTE service to the area, they would tend to obtain greater returns by investing in other regions—for example, urban areas with a larger customer base. Accordingly, in the absence of Vale's demand for a private system, expanding 4G/LTE coverage in the region would tend not to be a priority for telecommunication companies. With the Vale–Vivo negotiation to build a private system for Vale, it also makes economic sense for Vivo to seize this opportunity to offer public services. Vale will cover the bulk of the investment, built for the private network for industrial use. Still, once the infrastructure to be built with Vale's investment is in place, Vivo will also be able to use the same infrastructure to offer public 4G/LTE services and thus obtain greater returns.[105]

Vale is also in negotiations for a similar solution for the entire EFC. Currently, cellular service is offered by various operators along 40% to 50% of the extension of the railway, according to Vale's estimates. Should a private 4G/LTE network be built to serve the railway, potentially by one single telecommunications company, in the same model adopted for the S11D project, local communities would also indirectly benefit from public 4G/LTE coverage.[106]

### 3.4.2. Contractual Framework Governing Shared-Use ICT Infrastructure

On February 22, 1995, Vale entered into a 30-year joint-venture agreement with Telecomunicações do Maranhão S/A (TELMA), a company that later merged into Oi. Vale and TELMA agreed to pull together certain resources to install ICT infrastructure, and TELMA undertook to deploy fiber-optic cables and ancillary equipment along a section of the EFC between São Luís (MA) and Santa Inês (MA).[107] Resources contributed by Vale included the land (subject to the EFC concession) and existing ancillary railway infrastructure, such as conduits, trackside structures, and catenary. In addition to deploying the ICT infrastructure, TELMA agreed to provide towers, equipment shelters, access ways, fences, and all infrastructure necessary for the operation of repeater stations.[108]

Under the joint-venture agreement, TELMA was given exclusive use of the deployed ICT infrastructure. In return, it undertook to provide Vale with access to some of such infrastructure assets, to

be used in railway signaling and communication services. Specifically, TELMA agreed to make available to Vale eight fiber-optic cables installed in the EFC concession area, plus another four optic fiber cables installed elsewhere as a backup.[109] The ICT infrastructure made available to Vale may not be used for any other purposes besides railway operations.[110]

On April 25, 1997, Empresa Brasileira de Telecomunicações S.A. (EMBRATEL) entered into an accession agreement to the Vale–TELMA joint-venture agreement. Pursuant to the accession, Vale allowed, and EMBRATEL undertook to deploy an additional 24 fiber-optic cables along the EFC.[111] In return, EMBRATEL agreed to provide Vale with access to 18 fiber-optic cables.[112] As was the case with the ones allocated to Vale by TELMA, the fiber-optic cables made available to Vale by EMBRATEL may only be used on railway operations. The accession agreement further provided that the fiber-optic cables deployed by TELMA should total 48. Moreover, it expanded the area subject to the joint venture, allowing for the deployment of fiber-optic cables from São Luís (MA) to Açailândia (MA).

The joint venture agreement provides that no payments are due to Vale by the telecommunications operators for the use of the EFC infrastructure. Conversely, Vale is allocated the agreed ICT access capacity completely free of charge.

The above arrangements were made against a legal backdrop that is different from the one presently in force. At the time, the deployment of infrastructure along railroads by telecommunications companies was largely unregulated. Then, legislation enacted in 1997 made clear that telecommunication companies have a legal right to deploy their infrastructure along any public concession areas, including railways.[113] A subsequent act, enacted in 2015, prohibited railway concessionaires from charging telecommunications companies for sharing their railway infrastructure with telecom infrastructure.[114] Even so, concessions predating the enactment of such legislation were grandfathered from such prohibition.



# 4. Impacts of Shared Use Along the Carajás Corridor

This section presents the evolution and current status of social, economic, and environmental aspects of the municipalities along the Carajás corridor. For this purpose, census data for 1991, 2000, and 2010 was complemented with more recent studies, statistics, and estimates.

We acknowledge that many characteristics and dynamics of the Carajás region may be unrelated to the development of the corridor infrastructure and its shared use. Furthermore, we cannot compare how the region would have developed without shared-use access, given that there is no counterfactual example. We draw on the analysis undertaken in this section to provide some suggestions regarding the positive and negative externalities resulting from shared use.

## 4.1. Social Aspects of Carajás Corridor Municipalities

### 4.1.1. Population in Carajás Municipalities

Between 1970 and 2019, population growth in the states of Maranhão and Pará was higher than Brazil's national average of 2.5% per year. During that period, the population of Pará almost tripled (an average of 6% per year), and the population of Maranhão more than doubled (an average of 2.7% per year).[128]

The exploitation and transportation of ores in Carajás and other mines in eastern and southeastern Pará starting from the 1970s, the start of paper and aluminum industries, and the construction of the port of Itaqui in São Luís (MA) in the mid-1970s are among the factors that shaped the population growth trend in both states.[129] Most of the population growth in the period 1970–2019, particularly in Pará, occurred in the 1980s and 1990s, when new roads were built to connect the state capitals (São Luís in Maranhão and Belém in Pará) to the interiors, and the national and state governments implemented settlement programs (see section 2.1).[130]

Relatively new municipalities have experienced significant population growth in recent years due to mining and downstream activities (see Figure 19 and Table 4). Açailândia (MA) (established in 1981) is an agroindustrial pole, and exports of pig iron became one of its principal economic activities. From 1991 to 2019, Açailândia's population almost doubled, with an average annual increase of 2.7%; the municipality ranks fourth in population among those along the Carajás corridor. Parauapebas (PA), previously a village within the municipality of Marabá (PA), was established as an independent municipality in 1988. The population of Parauapebas—where the Carajás mine is located—increased 16.8% per year between 1991 and 2019, making it the third-largest municipality population-wise along the corridor. Canaã dos Carajás (PA) (established in 1994), saw a population growth of 9.5% per year between 1991 and 2019.



*Photo: Aerial view of Parauapebas (PA). Photographer: Ricardo Teles / Agência Vale*

| | |
|---|---|
| Curionópolis (PA) | -1.37% |
| São Pedro da Água Branca (MA) | 0.18% |
| Cidelândia (MA) | 0.32% |
| Arari (MA) | 0.66% |
| Pindaré-Mirim (MA) | 0.75% |
| Alto Alegre do Pindaré (MA) | 0.98% |
| Monção (MA) | 1.08% |
| Tufilândia (MA) | 1.25% |
| **Brazil** | **1.29%** |
| Bom Jardim (MA) | 1.29% |
| Santa Inês (MA) | 1.39% |
| Itapecuru Mirim (MA) | 1.46% |
| Vitória do Mearim (MA) | 1.52% |
| Igarapé do Meio (MA) | 1.60% |
| Bom Jesus do Tocantins (PA) | 1.62% |
| São Luís (MA) | 1.68% |
| Santa Rita (MA) | 1.75% |
| Anajatuba (MA) | 1.79% |
| São Francisco do Brejão (MA) | 1.88% |
| Açailândia (MA) | 2.05% |
| Miranda do Norte (MA) | 2.29% |
| Vila Nova dos Martírios (MA) | 2.38% |
| Bacabeira (MA) | 2.46% |
| Itinga do Maranhão (MA) | 2.53% |
| Bom Jesus das Selvas (MA) | 2.76% |
| Marabá (PA) | 2.95% |
| Buriticupu (MA) | 4.34% |
| Canaã dos Carajás (PA) | 4.73% |
| Parauapebas (PA) | 6.42% |

## Table 4:
Annual population growth rates in Carajás corridor municipalities (1991–2019)

**Note:** Census data (1991, 2000, and 2010) and estimates (2019).

**Source:** Prepared by the authors based on IBGE data.[274]

Census data is available for the years 1991, 2000, and 2010; for the year 2019, population estimates are available, prepared by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* [IBGE]). Because of Vale's S11D project, developed throughout the 2010s in Canaã dos Carajás (PA), the municipality has experienced significant growth, and the population in 2019 may be larger than estimated.

Marabá (PA) has a longer history: established in 1913, it already was one of the most important urban centers in the region when Vale began its operations in the area. Even so, Marabá has also seen large-scale immigration in recent years. The municipality ranks second in population among those along the corridor—only surpassed by São Luís (MA). Marabá serves today as an important logistical connection as it is cut across by the EFC, five federal highways, and a waterway.

Besides municipalities near the Carajás mine, other municipalities along the Carajás corridor experienced high population growth rates between 1991 and 2019, such as Buriticupu (4.34% per year) and Bom Jesus das Selvas (2.76% per year), both in the state of Maranhão.[131] It has been difficult for the local authorities to plan for and manage this influx of people with a lack of housing, infrastructure, and services available to meet domestic demand, leading to higher local inflation.[132] Data shows that inflation in Marabá was higher than in Belém (capital of the state of Pará) in 2018 and 2019. Housing and education expenses were among the main factors that explained the increasing prices in Marabá.[133]

### 4.1.2. Poverty Line in Carajás Municipalities

Some of the poorest municipalities in Brazil, historically and still nowadays, are located in Maranhão and Pará. In recent decades, however, extreme poverty has decreased in both states, and this process was faster and more intense in the municipalities along the Carajás corridor. From 1991 to 2010, extreme poverty[134] declined from 43% to 21% of the total population in the municipalities along the Carajás corridor, compared to a decline from 47% to 27% in the same period in Maranhão and Pará municipalities outside of the corridor. Even so, in 2010, 39% of the population of municipalities along the corridor still lived under the poverty line, compared to 15% nationwide and 47% outside the corridor.[135]

As of December 2019, 202,451 families in the 28 municipalities along the Carajás corridor—representing 30.9% of the 655,174 families estimated to reside in the area—were registered as recipients of support from the federal government through conditional cash transfers (the "Bolsa Familia" program[136]). While the proportion of families benefitting from Bolsa Família along the corridor (30.9%) is higher than the national statistic (roughly 22% of families throughout Brazil), it is lower than state-level statistics for Pará (41.96%) and Maranhão (50.73%).[137]

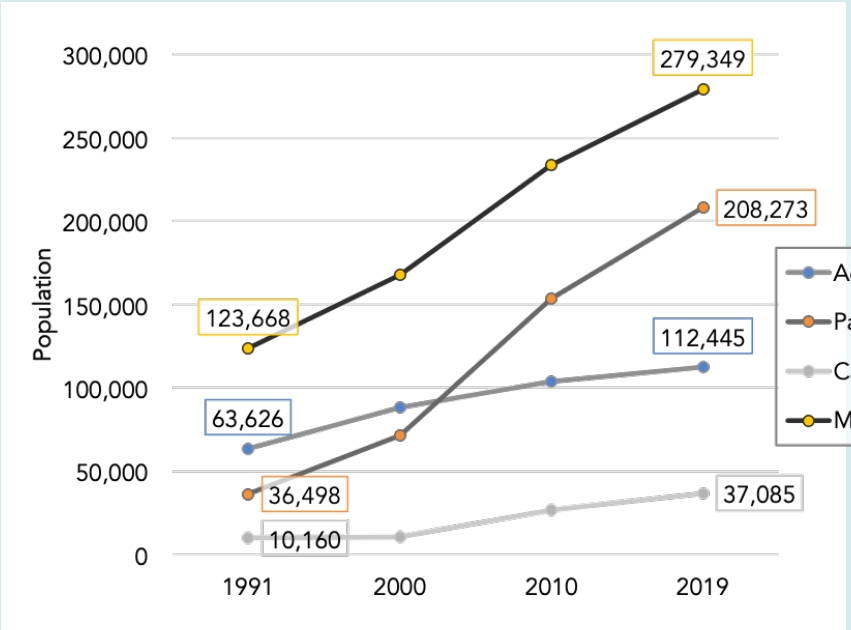
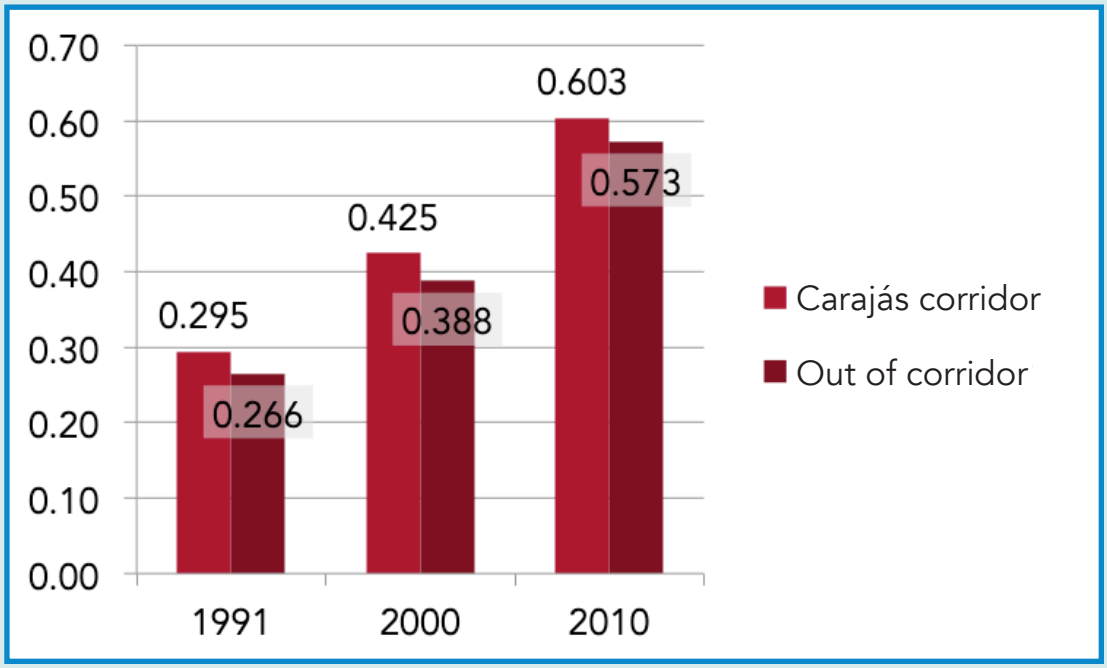



**Figure 19:** Population in selected municipalities in the Carajás corridor (1991, 2000, 2010, 2019)

**Note:** Census data (1991, 2000, and 2010) and estimates (2019).

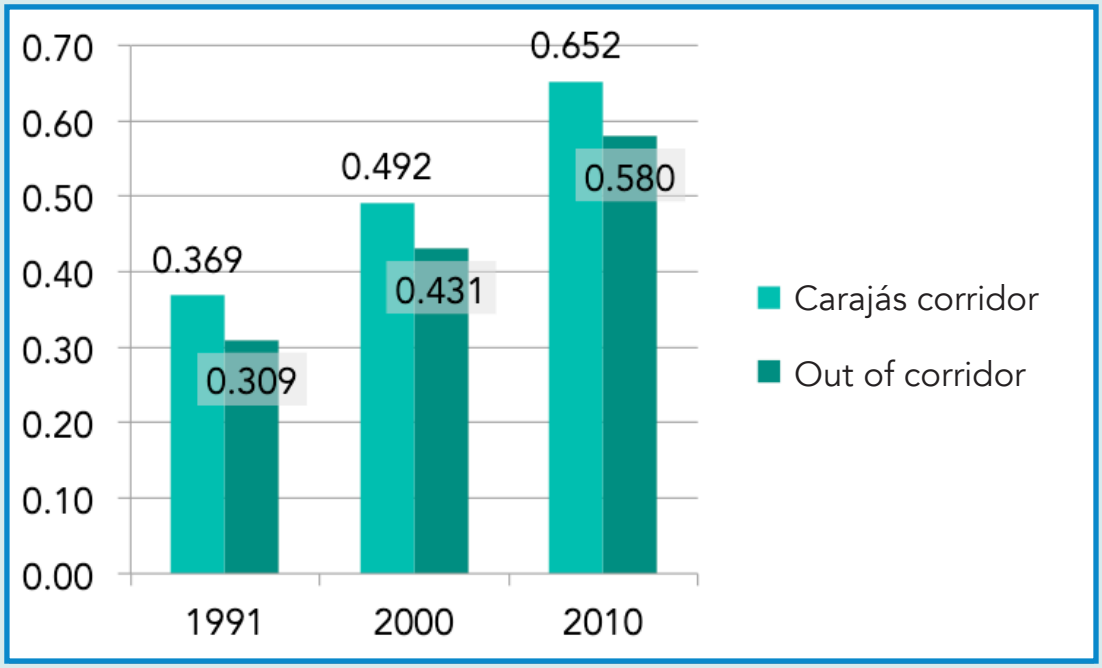
**Source:** Prepared by the authors based on IBGE data.[275]

**Figure 20:** Evolution of the Human Development Index (HDI) for Municipalities in Maranhão State (1991, 2000, 2010)




**Source:** Prepared by the authors based on IBGE data.[276]

**Figure 21:** Evolution of the Human Development Index (HDI) for Municipalities in Pará State (1991, 2000, 2010)




**Source:** Prepared by the authors based on IBGE data.[277]

### 4.1.3. Rural Population in Carajás Municipalities

In the 1990s, the rural population made up a quarter of the Brazilian population, while it represented half of the population along the Carajás corridor. The gap has continued over time but has narrowed: in 2010, the urban population accounted for two-thirds of the population in the corridor, while the country's urbanization rate reached 85%.[138]

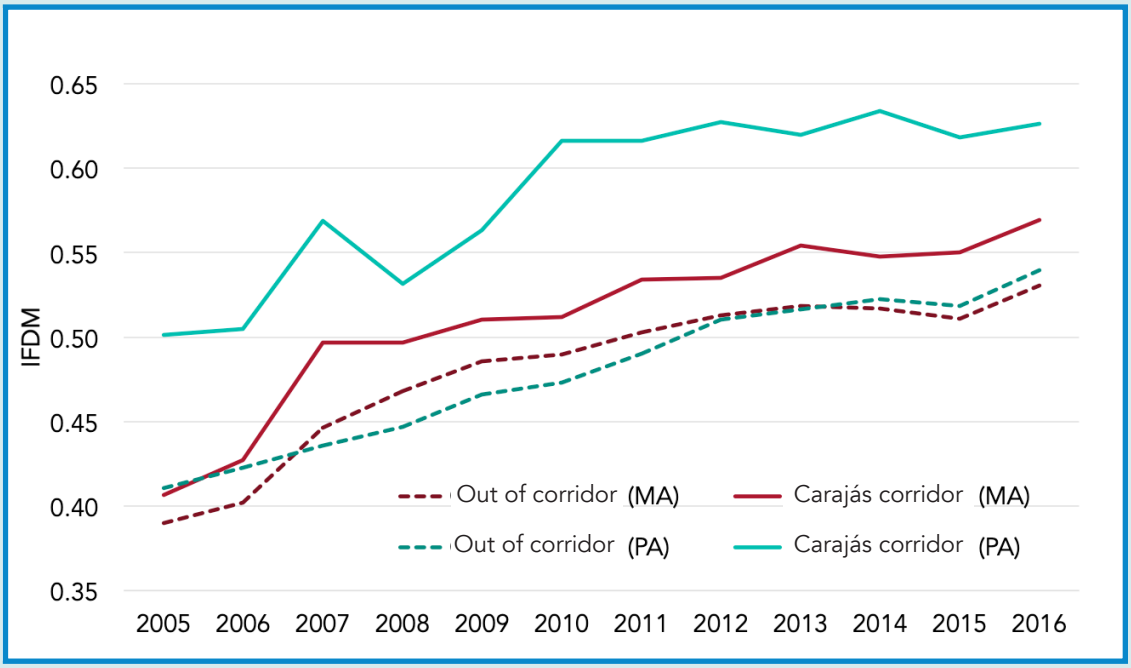
### 4.1.4. Human Development Index in Carajás Municipalities

As a composite index of life expectancy, education, and per capita income indicators, the Human Development Index (HDI) can be a useful measurement of socioeconomic development. Figure 20 (for the state of Maranhão) and Figure 21 (for the state of Pará) show the evolution of HDI for the municipalities along and outside of the Carajás corridor. From a low HDI level in the 1990s, municipalities in both states improved, reaching a medium level by international standards by 2010. On average, municipalities along the Carajás corridor presented a higher HDI than other municipalities in the two states in 2010.

To overcome the lack of more recent census data, the Industry Federation of the State of Rio de Janeiro (*Federação das Indústrias do Estado do Rio de Janeiro* – FIRJAN) publishes another development index, the FIRJAN Municipal Development Index (IFDM). IFDM is an annual proxy of the HDI for Brazilian municipalities making use of other public data rather than census data to assess income, health, and education.

IFDM data reveals the same pattern as the HDI, where municipalities along the Carajás corridor are better off compared to other municipalities in the Maranhão and Pará states over time (Figure 25).

**Figure 22:** Evolution of the FIRJAN Municipal Development Index (IFDM) for Municipalities in Pará and Maranhão States (2005–2016)




**Source:** Prepared by the authors based on FIRJAN data.[278]

### 4.1.5. Social Impacts of Passenger Trains on the Carajás Railroad

The passenger train has economic advantages when compared with other transport options, as shown in Table 5 below. For instance, considering a one-way trip from Marabá (PA) to São Luís (MA), the train is the cheapest transport alternative if compared with bus or flight options available (Table 5).

Apart from the economic perspective, the train journey is also safer. More accidents have occurred on the roads in Maranhão and Pará. Robbery attacks, particularly during the night, are also a threat and the reason why passengers prefer to take the train. The security and time consideration become stronger during the rainy season when the roads suffer from potholes and washouts.[139] However, such use has declined over time (see section 3.2).

### 4.1.6. Conflicts and Accidents on the Carajás Railroad

Many of the social conflicts along the area of influence of the Carajás corridor are related to land rights,[140] some of them dating back to the original PGC, as the railway cuts a relevant land extension, including lands in which Indigenous Peoples or Quilombolas (residents of communities formed by Afro-Brazilian slave descendants) have interests. These conflicts may be less closely linked to the development of the logistics corridor itself than to broader changes in the socioeconomic and environmental landscape of the Amazon region, particularly since the 1980s.[141] Given their complexity and sensitivity, these conflicts must be acknowledged, even if analyzing them in detail lies beyond the scope of this study, which focuses on the impacts of the shared use of the infrastructure.

Other sources of conflicts are related to environmental and health impacts of mining and logistics activities.[142] For example, conflicts involving Indigenous Peoples, Quilombolas, and local communities erupted during the 2010s due to the double-track expansion works of the railroad in the context of the S11D project.[143]

However, protests blocking the rail tracks and other interruptions are often motivated by conflicts or dissatisfactions unrelated to the EFC or Vale's operations in the region. For example, Indigenous Peoples, Quilombolas, and local communities block

**Table 5:** Cost and duration of a one-way trip between Marabá (PA) and São Luís (MA) by air, bus, and rail (2019)

| | Duration (hours) | Full fare (economy) (R$) |
|---|---|---|
| Air | 4.5<br>(not including layover) | 375.00 to 750.00<br>(depending on the time of year) |
| Bus | 19 | 155.41 |
| Rail | 16 | 75.00 |

**Source:** Prepared by the authors based on a Google Flights airfare search before the COVID-19 pandemic, https://www.buscaonibus.com.br for bus fares, and https://tremdepassageiros.vale.com/sgpweb/portal/index.html for rail fares.

the tracks to demand measures from the government, such as securing land rights, investing in urban infrastructure, and ensuring public safety.[144]

According to Vale, in 2018, the number of stopped trains due to conflicts was 156, resulting in 1,220 hours of stoppage. Vale estimated the cost of interruptions that year at R$ 24.29 million. Every time a delay is longer than 30 minutes due to outside intervention, such as community blocking, a crisis room at Vale is opened to anticipate potential impacts on operations.[145]

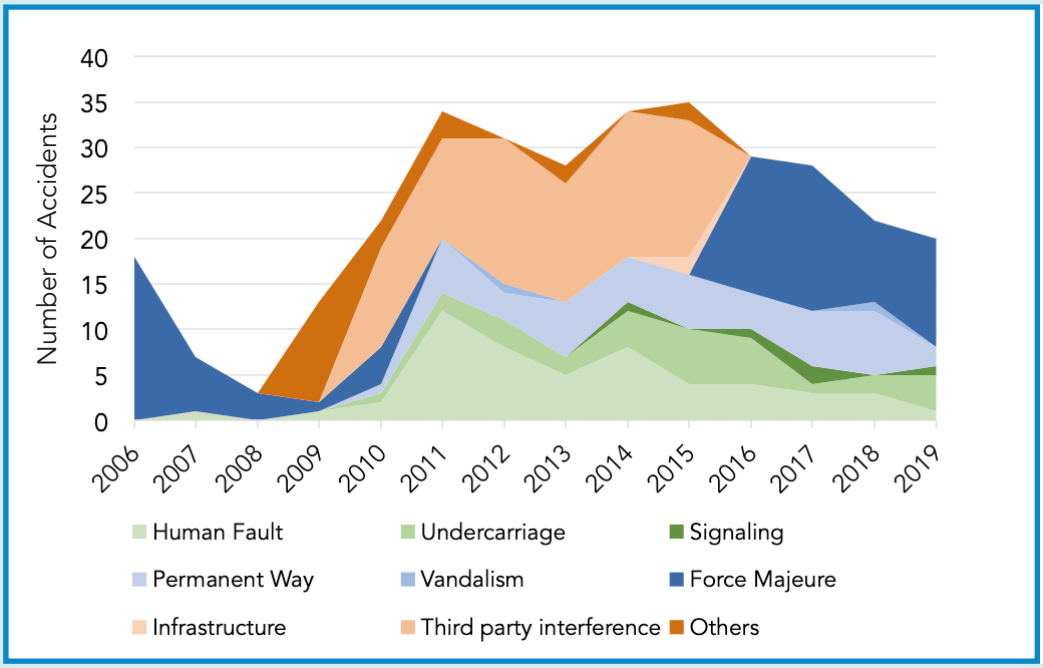
Shared-use infrastructure can help secure and retain the social license to operate. While train disruptions along the Carajas corridor have occurred since the inception of the railroad, the number and length of the interruptions would likely be higher if only iron ore trains would be affected. The more people benefit from the general cargo and passenger services on the railway line, the less likely this infrastructure will be targeted for disruption. Further research work could investigate this hypothesis.

As mentioned above (Section 3.1.1), the EFC has one of the lowest levels of accidents among Brazilian railroads. According to ANTT, the index of accidents[146] in the EFC dropped from 7.4 in 2006 to 1.7 in 2019, when 20 accidents were registered, half of which considered severe.[147]

Accidents along the EFC have occurred due to several factors, from undercarriage (derailment) to force majeure. Figure 23 shows how the number and causes of accidents have changed between 2006 and 2019. The most relevant factors for accidents in the EFC between 2006 and 2019 were force majeure (84 accidents), third-party interference, including community blocking (82 accidents); and human fault (52 accidents).

## Figure 23:
Number of Accidents, EFC (2006–2019)

**Source:** Prepared by the authors based on ANTT data.[279]



### 4.1.7. Vale's Corporate Social Responsibility Investments in Carajás Municipalities

Vale, including through the Vale Foundation[148] and the Vale Institute of Technology (*Instituto Tecnológico Vale* [ITV],[149] funds a range of corporate social (and environmental) responsibility (CSR) projects in Carajás corridor municipalities. These projects support local entities, traditional communities, and Indigenous Peoples, focusing on themes including culture, education, training, research, sports, wealth generation, job creation, urban infrastructure and mobility, and public health.

For example, in 2017, Vale created the so-called Social Railcar (*Vagão Social*) on the EFC, where one railcar in the passenger train is used to carry out activities such as educational lectures, workshops, recreation for children, cultural presentations, sales of arts and crafts, and the provision of medical assistance services. Around 18,000 people were involved in such activities in 2018 and 2019.[150]

The Health Station (*Estação Saúde*) program, carried out by Vale in partnership with the Maranhão State Health Secretariat, provides public health services between São Luís (MA) and Açailândia (MA). One railcar of the EFC passenger train is converted into a temporary healthcare facility, where healthcare professionals disseminate preventive health information to the general population along the railroad and direct potential patients to public healthcare service providers as needed. Topics include men's and women's health, mental health, nutrition, sexually transmitted diseases, oral hygiene, diabetes, and high blood pressure.. There were 14 editions of the program between 2014 and 2019. In 2019 alone, 5,600 of health kits were distributed (including oral hygiene products and condoms), and 3,100 fast tests were carried out for sexually transmissible diseases and Hansen's disease. For two days in October 2019, the program focused on the prevention, symptoms, and treatment of Hansen's disease, which is endemic in Maranhão State.[151]

An initiative for women entrepreneurship is another example

**Table 6:** Vale's voluntary expenditures on social and environmental programs in Maranhão and Pará states, in U.S. dollars (current prices) (2015–2019)

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Support to Entities | 439,010.05 | 376,334.57 | 920,665.66 | 375,733.06 | 900,870.79 |
| Traditional Communities and Indigenous Peoples | 17,187,293.81 | 16,758,735.80 | 13,434,916.25 | 22,400,435.89 | 25,406,473.33 |
| Culture | 2,140,864.62 | 7,928,172.00 | 5,338,721.73 | 3,005,351.98 | 6,558,887.81 |
| Education | 8,921,433.23 | 6,990,471.60 | 5,093,467.22 | 2,845,635.92 | 4,814,093.20 |
| Sports | 385,985.07 | 52,028.82 | 56,142.53 | 45,724.49 | N/A |
| Knowledge Station | 2,683,165.14 | 4,089,301.75 | 3,793,515.70 | 2,786,429.40 | 1,370,924.02 |
| Studies and Monitoring | 1,883,925.28 | 797,444.21 | 1,871,404.45 | 1,300,361.12 | 961,078.94 |
| Income Generation and Job Creation | 5,550,115.33 | 6,852,188.90 | 4,628,937.96 | 4,648,993.20 | 4,911,665.82 |
| Urban Infrastructure and Mobility | 30,668,016.22 | 44,525,779.75 | 46,900,813.53 | 35,082,856.63 | 4,329,752.90 |
| Health | 654,455.37 | 3,036,516.36 | 1,668,770.18 | 2,178,417.78 | 2,456,867.84 |
| Environment | 6,433,557.17 | 5,765,595.37 | 12,946,154.56 | 17,131,538.80 | 18,216,419.55 |
| Total CSR | **76,947,821.29** | **97,172,569.13** | **96,653,509.77** | **91,801,478.27** | **69,927,034.20** |

**Note:** Vale uses USD amounts in its company-wide reports, throughout the various countries where it operates. To do so, Vale converts BRL amounts into USD using an average exchange rate adopted at the start of each year and using it throughout the year. Accordingly, reduced amounts in recent years may result from currency depreciation trends rather than from actual reductions in CSR expenditures.

**Source:** Prepared for the authors by Vale.

of Vale's CSR project in the Carajás region. Starting from 2015, with the operation of the new passenger train, women from local communities where there are train stations and stops could no longer sell babassu oil products to the passengers through the windows of the train, which were now sealed because of the air conditioning. To ensure that they had alternative sources of income, improve their life and work conditions, and promote women entrepreneurship, Vale created the AGIR EFC program (Program of Support to Income Generation and Increase Along the EFC) to incubate businesses and provide consulting services to the women entrepreneurs. The initiative led to the creation of the Maranhão Women Network (*Rede Mulheres do Maranhão* [RMM], which fosters coordination among more than 150 entrepreneurs, most of them women, for the purchase of inputs and the sale of their products, including babassu oil, bread rolls, clothes, cashew nuts, and vegetables. RMM products are currently sold throughout Maranhão State, in other states in Brazil, online, and on the EFC's Social Railcar.[152]

Through its CSR expenditures, Vale aims at leveraging its presence in the region, helping to alleviate socioeconomic burdens to the communities. Table 6 shows Vale's total expenditures in social and environmental CSR projects in the states of Maranhão and Pará. These benefits represent the company's voluntary contribution to the communities along the corridor as an indirect source of revenue. While they do not result directly from the *shared use* of the corridor's infrastructure, they may be regarded as partial compensation for negative externalities resulting from logistics operations in the corridor.




*Photo: Social Railcar of the Carajás Railroad passenger train. Photographer: Ricardo Teles / Agência Vale*

## 4.2. Economic Aspects of Carajás Corridor Municipalities

### 4.2.1. Economic Activity in Carajás Municipalities

In 2017, slightly more than half (52.3%) of the adult population in the job market in the 49 communities along the Carajás corridor was considered unoccupied.[153] In the same year, the dominant economic activities along the corridor were agriculture (37.5%) and domestic services (31.2%) (Figure 24). Most of the value generated by agricultural production in 2017 in the Carajás municipalities resulted from temporary crops (R$ 27.8 million) and forest products from native forests (R$ 4.9 million) (Figure 25).

The characteristics of the soil and climate in the region indicate a potential for the development of small-scale agricultural activities,[154] such as:

- extraction and silviculture (roundwood, charcoal);
- aquaculture (fish);
- livestock (milk);
- poultry (chicken eggs),
- meliponiculture (honey);
- permanent agriculture (fruits); and
- seasonal agriculture (fruits and vegetables).

Considering that the general cargo transported along the Carajás corridor currently does not include the products of these activities, the shared use of the EFC has not served the small-scale agricultural sector of the region. This is because the railway is generally less suited to transport smaller and perishable agriculture goods that are supplied irregularly. Furthermore, Small agricultural producers are scattered along the railroad and may not have the resources or the necessary coordination to aggregate their production in higher volumes in a limited number of storage and loading or unloading points along the railroad. Including such cargo would lead to longer stoppage time of trains, reducing the efficiency of operations. One potential solution that has been practiced in the past was the addition of a general cargo railcar to the passenger train that allowed passengers to transport merchandise to be sold in São Luís (MA). However, this service has been discontinued, as it led to delays in the passenger services and was deemed uneconomic. With the introduction of the modern passenger train, passengers are only allowed to bring 35 kilograms of luggage, in accordance with Brazilian legislation in force.[155]

Figure 24:
Occupation by economic activity in Carajás corridor communities (2017)

**Source:** Instituto Tecnológico Vale (ITV), "Relatório de Atividades ITV Desenvolvimento Sustentável," ITV, 2019, http://www.itv.org/wp-content/uploads/2020/01/Relatório-de-Atividades-ITV-Versão-final.pdf.

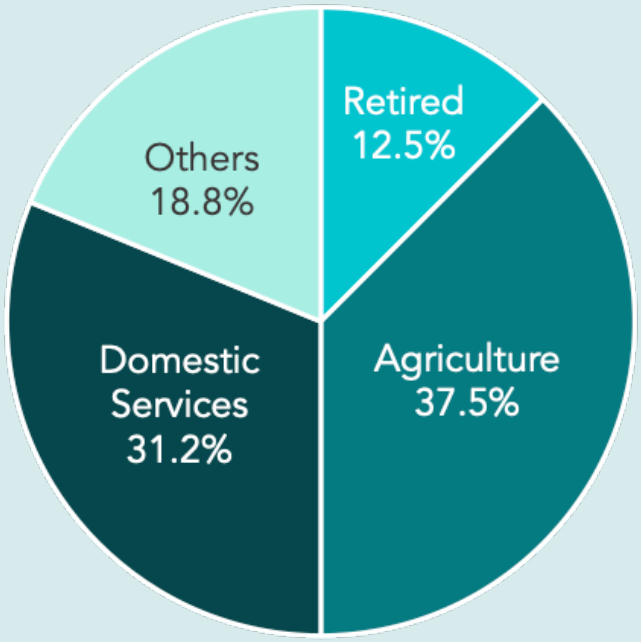
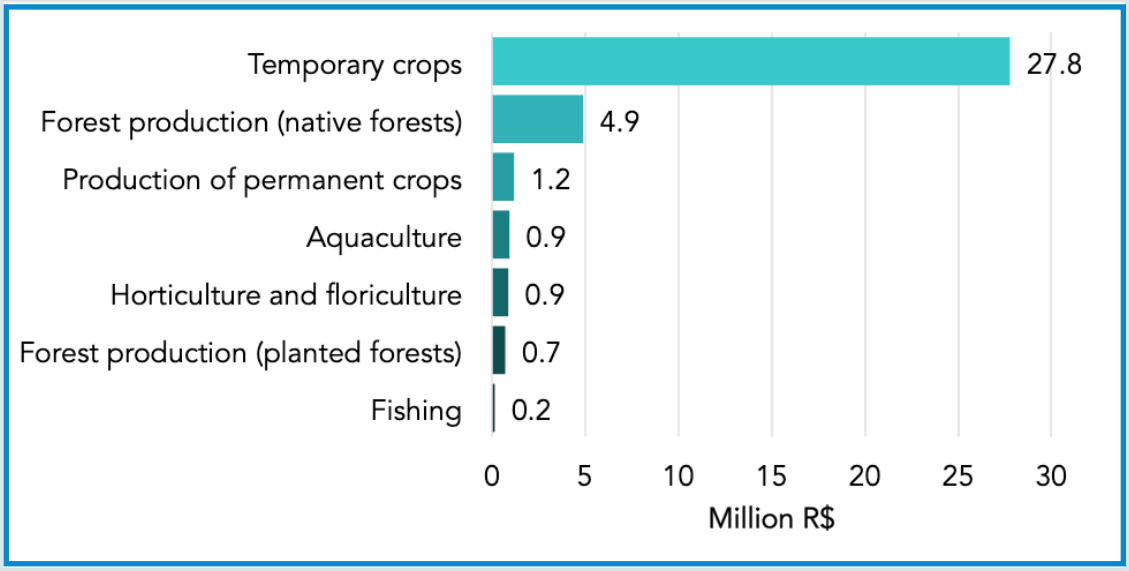


Figure 25:
Value of agricultural production in municipalities along the Carajás corridor (2017)

Source: Prepared by the authors based on IBGE data.[280]




### 4.2.2. GDP per Capita

In 2017, the GDP per capita of municipalities along the corridor that host direct mining activities—Canaã dos Carajás (R$ 113.457,46), Parauapebas (R$ 91.086,52), and Curionópolis (R$ 49.264,26), all of them in the state of Pará—was significantly higher than Brazil's GDP per capita (R$ 31,833.50). Disregarding those three outliers, the average GDP per capita of municipalities along the Carajás corridor in 2017 was R$ 11,346.68, roughly equivalent to 35.6% of Brazil's GDP per capita in that year (Figure 26). The wealth of the various municipalities differs widely, and those in the extremes of the corridor (closer to mining sites or to the port) tend to be wealthier than those along the corridor.

### 4.2.3. Royalties Paid to Railroad-Affected Municipalities in the Carajás Corridor

The distribution of revenues from mining royalties—in Portuguese, *Compensação Financeira pela Exploração Mineral* (CFEM)—is relatively concentrated in a few Brazilian states. In 2006, Pará state received over R$ 132.9 million in royalties, over 28.6% of Brazil's total royalties. Over the years, royalty revenues grew significantly due to a continuous increase in extraction and periods of high prices of iron ore in the late 2000s and the 2010s. In 2019, Pará's royalty revenues amounted to R$ 2.192 billion and accounted for 48.7% of national royalty revenues.[156]

**Figure 26:**
GDP per capita in Carajás Corridor municipalities in Pará, in Pará State, and in Brazil (2017)

**Source:** Prepared by the authors based on IBGE data.[281]

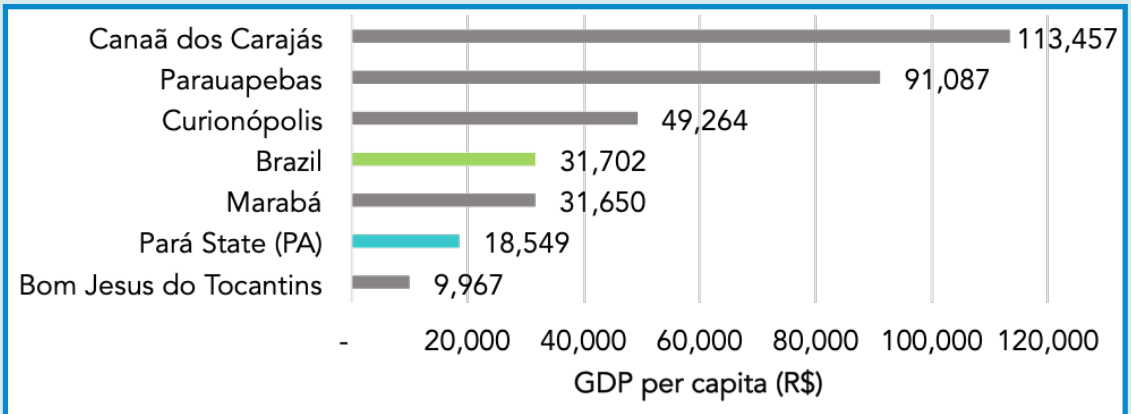
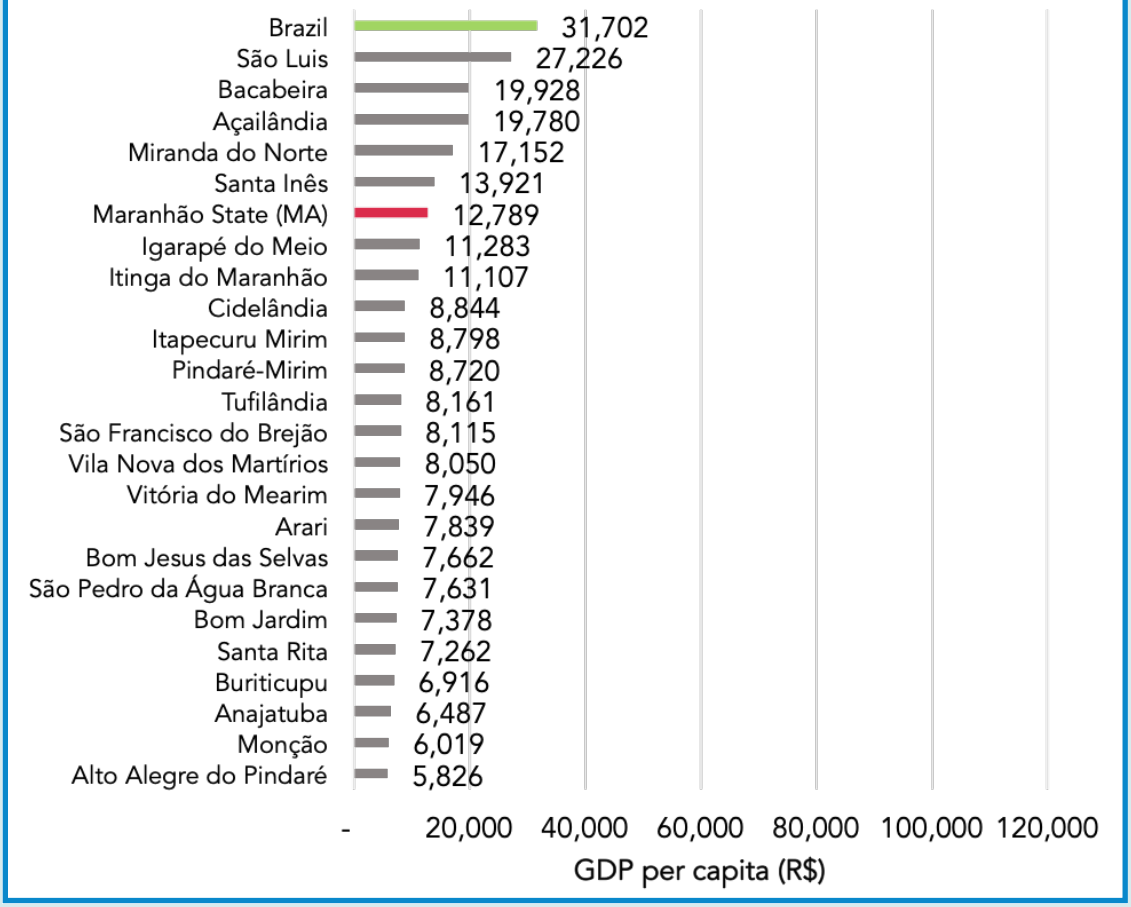



**Figure 27:**
GDP per capita in Carajás Corridor municipalities in Maranhão, in Maranhão State, and in Brazil (2017)

**Source:** Prepared by the authors based on IBGE data.[282]



Law 13,540 of 2017 altered royalty rates on mining products and revenue distribution to states, municipalities, and other public entities.[157] Most notably, it changed the criteria defining which municipalities are entitled to royalties. While municipalities where direct mining activities are carried out receive the largest portion of CFEM (60%), the new law determined that municipalities indirectly affected by the mining activities would receive 15% of CFEM royalties (see Figure 28); we hereafter refer to this 15% share as "CFEM-Affected." The mining-affected municipalities entitled to receive CFEM-Affected include those:

a) crossed by the infrastructure used for the railway or pipeline transportation of mineral substances;

b) affected by port operations and the loading and unloading of mineral substances; and

c) with sites for the waste piles, tailings dams, and mineral processing facilities, as well as other facilities included in the overall extraction plans.

## Figure 28: Royalty distribution formula to Affected Municipalities

Affected Municipalities
15%
(Law n 13,540/2017)

Revenue Compensation*
2%
(Decree n 9.407/2018)

Total Royalties $_{Affected}$
13%
(Decree n 9.407/2018)

Total Royalties $_{Affected}$
13%
(Decree n 9.407/2018)

1. Affected Revenues $_{Railway}$ = (TKU $_{m\text{-}railway}$ / TKU $_{t\text{-}railway}$ ) X (50% Total Royalties $_{Affected}$ )
2. Affected Revenues $_{Pipelines}$ = (TKU $_{m\text{-}pipeline}$ / TKU $_{t\text{-}pipeline}$ ) X (5% Total Royalties $_{Affected}$ )
3. Affected Revenues $_{Ports}$ = ($TP_m$ / TPt ) X (15% Total Royalties $_{Affected}$ )
4. Affected Revenues $_{Areas}$ = ($A_m$ / $A_t$ ) X (30% Total Royalties $_{Affected}$ )

$TKU_m$ - Average tonnes of the product multiplied by the extension (km) of the railway or pipelines crossing the municipality
$TKU_t$ - Total tonnes multiplied by the total extension (km) of railways or pipelines that transport the product
$TP_m$ - Average tonnes of the product moved at the port in the municipality
$TP_t$ - Total tonnes of the product moved at all ports that move such product
$A_m$ - Average area (ha) dedicated for minig structures and for industrial applications that give value to mining products in the municipality
$A_t$ - Total area (ha) dedicated for mining structures and for industrial application that give value to mining products in the country

* Decree No. 9,407/2018 defined that from the 15%, 2% would be distributed to municipalities that faced changes in their revenues as compensation after Law 13,540/2017.

* Decree No. 9,407/2018 defined that from the 15%, 2% would be distributed to municipalities that faced changes in their revenues as compensation after Law 13,540/2017.

**Source:** Prepared by the authors based on the applicable legislation.

Law 13,540 of 2017 came into effect in June 2018. Every April, Brazil's national mining agency (*Agência Nacional de Mineração* [ANM]) reviews the list of municipalities indirectly affected by the mining activities and the amount of the impact suffered in the previous year. ANM's database presents the aggregate total of CFEM-Affected royalties distributed to the affected municipalities in the period from June 2018 to April 2019, and for every month from May 2019 to February 2020. Between June 2018 and February 2020, the total amount of CFEM-Affected distributed to municipalities along the Carajás corridor was R$ 283.2 million. Figure 29 presents the total allocated to each beneficiary municipality along the corridor.

More than 80% of the CFEM-Affected revenues received were related to iron ore. São Luís (MA) is the only municipality that receives royalties from port activities; it receives 92% of its royalties from the port activity and the rest due to railway operations.

## Figure 29:
CFEM-Affected royalties distributed to the municipalities along the Carajás corridor (2018–2020)

**Source:** Prepared by the authors based on ANM data.[283]

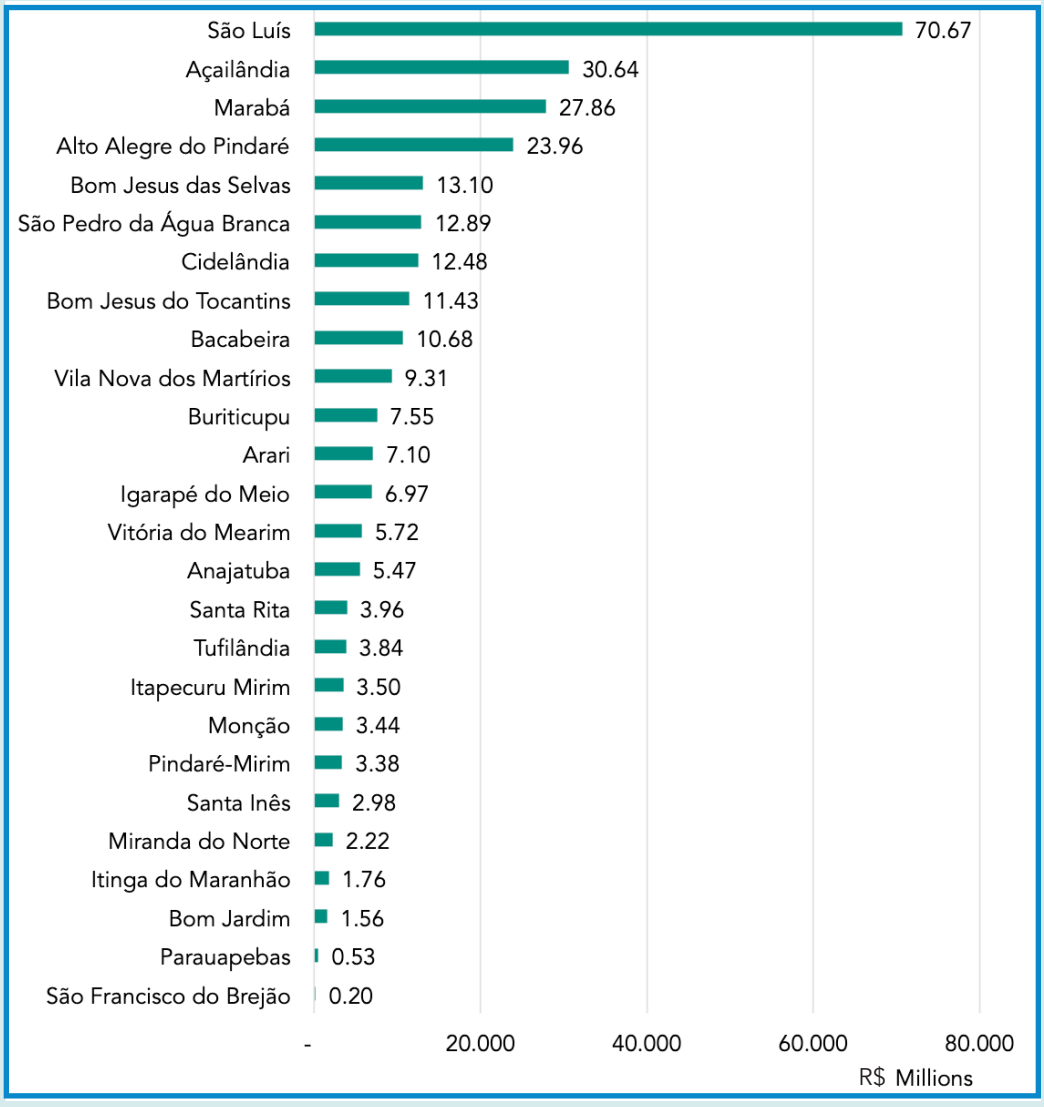


Table 7 presents, for each CFEM-Affected municipality along the corridor for which data is available, the yearly average, the public budget for the year 2018, and the proportion of CFEM-Affected in the municipality's budget. Particularly in the case of affected municipalities with a relatively low public budget, CFEM-Affected royalties can represent an important part of their total revenues (more than 5%). Note, for example, São Pedro da Água Branca (MA), where annual CFEM-Affected royalties represented almost a quarter of the municipality's annual public budget for 2018.

CFEM-Affected royalties contribute to the public budget of municipalities along the corridor as an indirect source of revenue. As is the case with Vale's CSR investment in the corridor municipalities, the royalties do not directly result from the shared use of the corridor but constitute compensation for negative impacts of the corridor's infrastructure.

The distribution of CFEM-Affected royalties to corridor municipalities cut by the railroad since 2018—33 years after the opening of the EFC—might not translate into improvements in the delivery of public services if the administrative capacity of local governments is low, if the amounts transferred are not commensurate with the socioeconomic imbalance accumulated over the years, or if governments do not use the revenues to build infrastructure and provide services that generate economic, social, and environmental benefits for the region.[158] Accordingly, once more data becomes available, further research is needed to assess the extent to which the CFEM-Affected royalties are effectively managed and used by municipal governments to foster sustainable development in the region, and the extent to which CFEM-Affected royalties as well as Vale's CSR expenditure make up for negative social and environmental impacts of the corridor.

## Table 7: CFEM affected royalties as percentage of public budgets of selected municipalities along the Carajás Corridor

| Municipality | Yearly average of CFEM-Affected royalties received | Public budget (2018) | Yearly average of CFEM-Affected royalties as a percentage of 2018 public budget |
|---|---|---|---|
| São Pedro da Água Branca | 7.367.729,19 | 29.983.338,99 | 24.57% |
| Alto Alegre do Pindaré | 13.693.946,17 | 72.519.218,40 | 18.88% |
| Cidelândia | 7.132.951,49 | 39.731.799,03 | 17.95% |
| Vila Nova dos Martírios | 5.318.939,93 | 30.702.162,84 | 17.32% |
| Bom Jesus do Tocantins | 6.533.454,30 | 38.614.894,81 | 16.92% |
| Bacabeira | 6.105.607,01 | 53.584.795,56 | 11.39% |
| Bom Jesus das Selvas | 7.483.216,10 | 74.617.409,67 | 10.03% |
| Igarapé do Meio | 3.981.178,67 | 45.660.135,52 | 8.72% |
| Tufilândia | 2.193.490,22 | 28.765.005,90 | 7.63% |
| Açailândia | 17.510.643,53 | 236.697.558,61 | 7.40% |
| Arari | 4.059.082,89 | 65.715.264,21 | 6.18% |
| Anajatuba | 3.127.275,57 | 56.597.579,28 | 5.53% |

**Note:** No data was available for the public budget of the municipality of Miranda do Norte.
Source: Prepared by the authors based on data from IBGE (public budget)[284] and ANM (CFEM).[285]

### 4.2.4. Fuel Prices in Carajás Municipalities

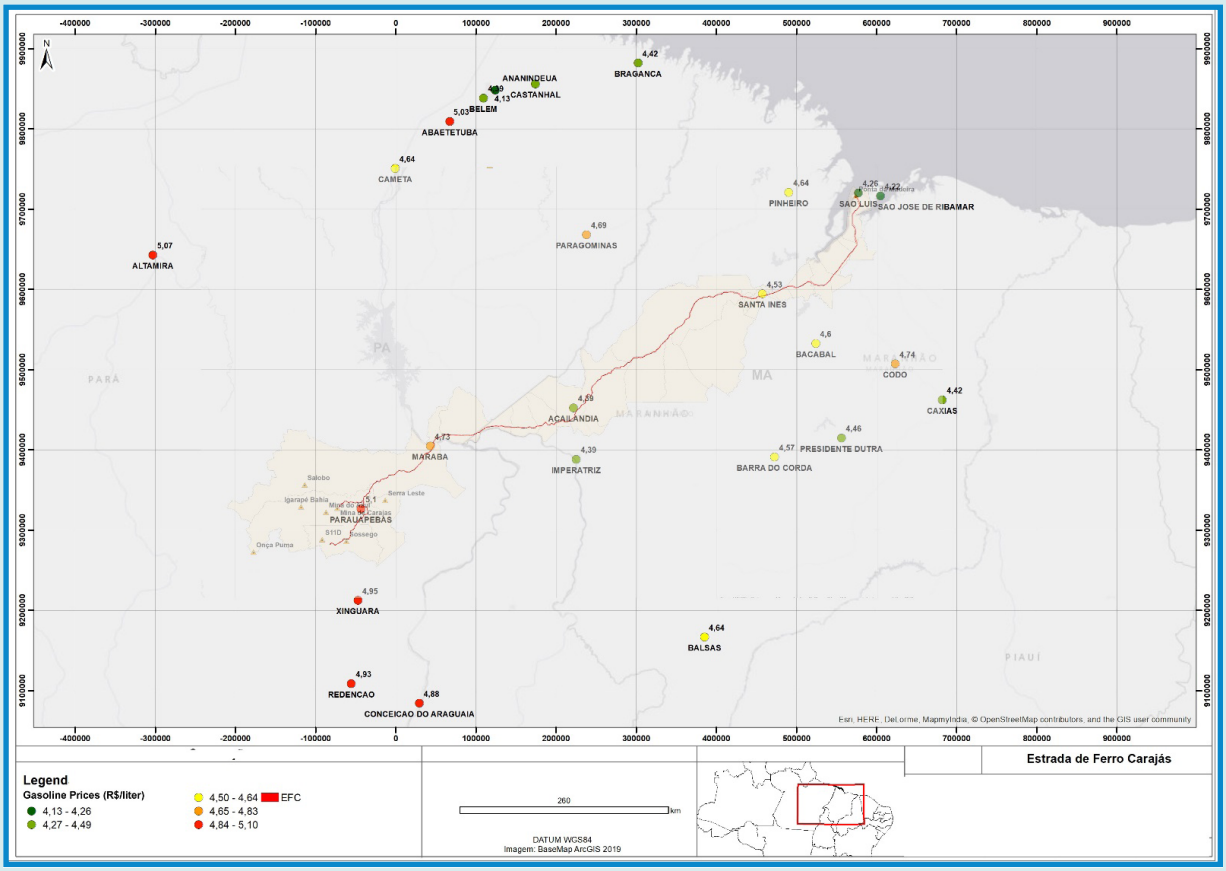
As shown in section 3.2., liquid fuels are also transported in the EFC. São Luis (MA) is a primary base for fuel distribution, while Açailândia (MA) and Marabá (PA) are secondary bases. The EFC is relevant in supplying these secondary distribution centers, contributing to lowering fuel prices in the interior of both states.

Figure 30 shows a comparison of gasoline prices among municipalities in Maranhão and Pará states. According to data from Brazil's petroleum agency (*Agência Nacional do Petróleo, Gás Natural e Biocombustíveis* [ANP]), municipalities that are closer to a distribution center and ports enjoy lower prices, while those in the interior of both states have higher prices. Gasoline prices in distribution centers are comparable to the national average. The same is true for other fuel prices, such as diesel.

According to experts interviewed, even considering that truck freight costs are relatively low in Brazil, using railway transportation lowers the cost of transporting liquid fuels to distribution centers by roughly 10% and leads to fewer fuel losses. However, an even more competitive alternative would be pipelines, which can lower transportation costs by 30% when compared to truck freight.[159]

As fuel is an important input into many activities ranging from mechanized agriculture to transport services, there is an indirect economic benefit to the region from lower prices. On the other hand, higher consumption due to lower prices has a negative externality on the environment.

## **Figure 30:** Gasoline average prices comparison in municipalities in Pará and Maranhão




Note: Average consumer price for September, October, and November 2019.

**Source:** Prepared by Vale using ANP data compiled by the authors.[286]

## 4.3. Environmental Aspects of Carajás Corridor Municipalities

### 4.3.1. Carajás: A Mineral-Rich and Environmentally Sensitive Area

In understanding the development of the Carajás mineral province and in considering how to leverage the shared-use potential of the associated logistics corridor, one must not lose sight of the uniqueness of the region. While harboring one of the richest mineral reserves, Carajás is located within the Amazon rainforest, one of the most complex and vulnerable biomes.[160]

As shown by many scientific studies in the 1980s and 1990s, deforested soils in the Amazon region are thin and relatively poor fertility and have therefore been deemed unsuitable for agriculture without heavy use of fertilizers, pesticides, and herbicides. Studies also showed that conversion into cattle pastures leads to lower than projected yields in both small and large farmers, frustrating earlier expectations as to the region's potential for cattle farming. Other studies also demonstrated that pig-iron smelting could only be considered economically viable in the Amazon region to the extent that charcoal resulting from deforestation of native rainforest was used as fuel, thus resulting in increasing deforestation pressure.[161] Furthermore, there has been increasing recognition of the critical role of forests—in the Amazon region and beyond—in achieving sustainable development and climate change goals by storing and absorbing carbon, generating jobs and income in the forestry sector, holding invaluable biodiversity, and generating ecosystem services.[162]

Even at an early stage of the development of the Carajás corridor, some studies already indicated its potentially high environmental impacts, particularly on biodiversity:[163]

> [T]he new economic corridor created by the Carajás–Ponta de Madeira railroad has provided an impetus to associated development beyond the control of Vale and the World Bank. The scale of the Carajas iron ore project's impact on the southeastern Amazon region as a whole was grossly underestimated because the effect of the [PGC]'s "integrated development" was not properly taken into account. Proposed development projects in the region of [PGC] include a series of hydroelectric units along the Tocantins, Araguaia, and Xingu rivers; aluminum and alumina factories; agricultural and colonization schemes; forestry development; and iron ore processing. This development will be concentrated in a region where there are insufficient safeguards against irreparable loss of biological diversity.

Therefore, although encouraged in the government's development plans for the Carajás region, particularly in the 1980s, large-scale agriculture and cattle farming, pig-iron smelting, and other economic activities causing increased levels of deforestation are not in line with principles of sustainable management of Amazonian forest resources. From a sustainable development perspective, caution should be exercised when considering recommendations on economic activities that could be developed to leverage the shared-use potential of the Carajás corridor.

### 4.3.2. Mining and Environment in the Carajás Region

When granting Vale land-use rights over 411,948.87 hectares (4,119.49 km$^2$) to develop the Carajás mineral province in 1986, Brazil's federal government imposed certain obligations on the state-owned company relating to the protection of the environment, water resources, and Indigenous Peoples.[164] After the Vale was privatized in 1997, in order to allow the continuation of mining activities by the company, the government replaced the earlier land-use rights with a conservation unit—the Carajás National Forest—in the same area,[165] covering parts of the present-day municipalities of Canaã dos Carajás (PA), Parauapebas (PA), and Água Azul do Norte (PA).[166] The decree creating the Carajás National Forest imposed obligations on Vale to support the environmental agency responsible for managing the national forest, nowadays the Chico Mendes Institute for Biodiversity Conservation (ICMBio).[167]

Throughout its operations in the Carajás region, Vale has consistently provided management support to ICMBio and taken measures to mitigate the broader negative environmental impacts of the company's mining activities, which occupy only 3% of the area of the Carajás National Forest.[168] For example, Vale has commitments and undertakes actions to preserve forested areas and to fund the Carajás National Forest protection program, which encompasses a staff of 80 park rangers, dwellings for ICMBio staff within the Carajás mining village, and a forest fire prevention strategy.[169]

While the creation of the Carajás National Forest allowed Vale to continue its activities in the area shielded from human occupation and third-party intrusions, it has also prevented the encroachment of cattle raising and logging on the forest,[170] and ensured a "high degree of preservation" of biodiversity,[171] with the result that "a large part of the area is conserved and intact."[172] According to satellite data obtained by the Program to Calculate Deforestation in Amazonia (PRODES) of Brazil's National Institute for Spatial Research (INPE), a total of 62.66 km$^2$ of the Carajás National Forest had been deforested by 2019, representing 1.6% of the total area of the national forest as monitored.[173]

Besides the Carajás National Forest, Vale supports ICMBio in forest conservation efforts in four adjacent conservation units: Tapirapé-Aquiri National Forest, Itacaiúnas National Forest, Tapirapé Biological Reserve, and Igarapé Gelado Environmental

Protection Area. Deforested areas accounted for 7.21% (328.4 km$^2$) of the total area of these four conservation units as monitored. The five conservation units form the so-called Mosaic of Conservation Units of the Carajás Region, totaling 8.679 km$^2$ (Figures 31 and 32).[174] Activities geared toward environmental protection supported by Vale in the mosaic units include deforestation monitoring, research, and prevention; fire prevention; and environmental education. In 2017, an agreement between Vale, ICMBio, and the Brazilian Institute of the Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* [IBAMA]) created the Carajás Ferruginous Fields National Park, to protect ferruginous rupestrian fields and associated endangered species.[175]

### 4.3.3. Deforestation in Municipalities Along the Carajás Railroad

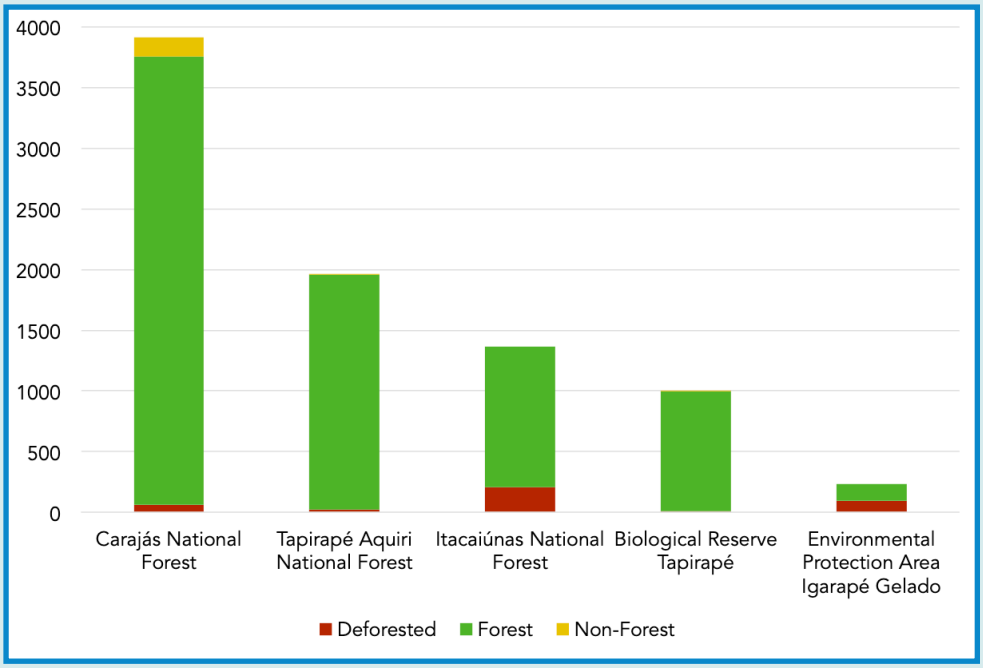
While deforestation indicators within the Carajás National Forest and other conservation units are relatively low, the same cannot be said about most Carajás municipalities. Most of the Carajás corridor is located within the so-called Arc of Deforestation ("Arco do Desmatamento"), where 75% of the deforestation in the Amazon region is concentrated; the arc is roughly defined as encompassing the east of the state of Acre, the state of Rondônia, northern Mato Grosso, southern and eastern Pará, and western Maranhão (see Figure 33).[176]

Within the arc, the trajectory of deforestation typically begins by illegal logging and forest fires, followed by the conversion of forest land in cattle pastures and soy, rice, and corn plantations. The occupation process is almost always illegal and results from flaws in the design or execution of policies, such as the provision of tax incentives for agriculture and cattle farming without taking into account environmental sustainability.[177]

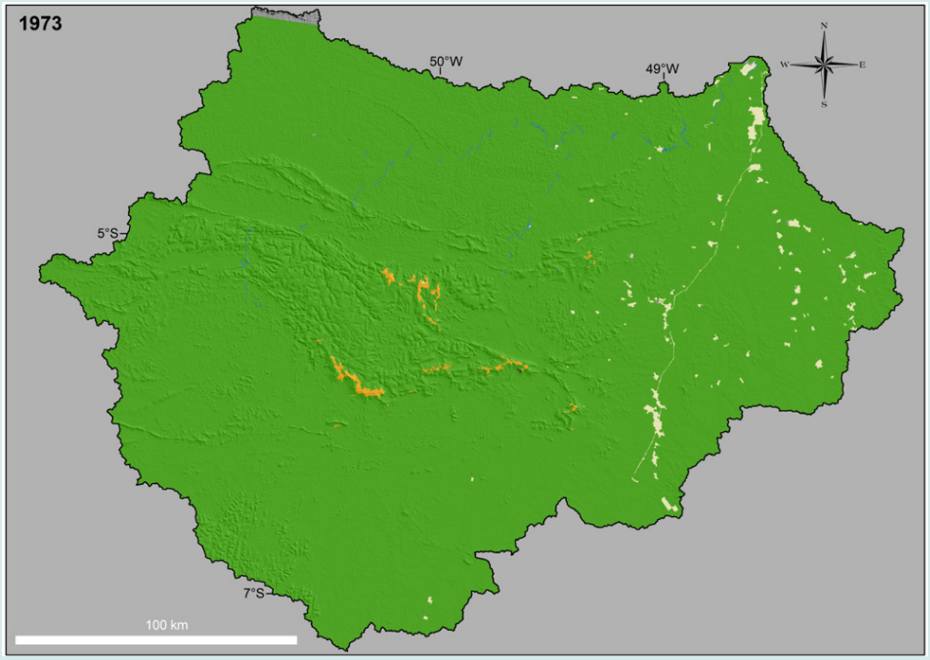
Based on satellite images, a study of land cover and land use between 1984 and 2014 along the area of influence of the Carajás corridor—an area within 50 km of the railroad—provides insights into deforestation rates in the region. In 1984, the area of influence had 69% forest cover and 24% non-forest cover; by 2014, the forest cover had dropped to 43%, with non-forest cover at

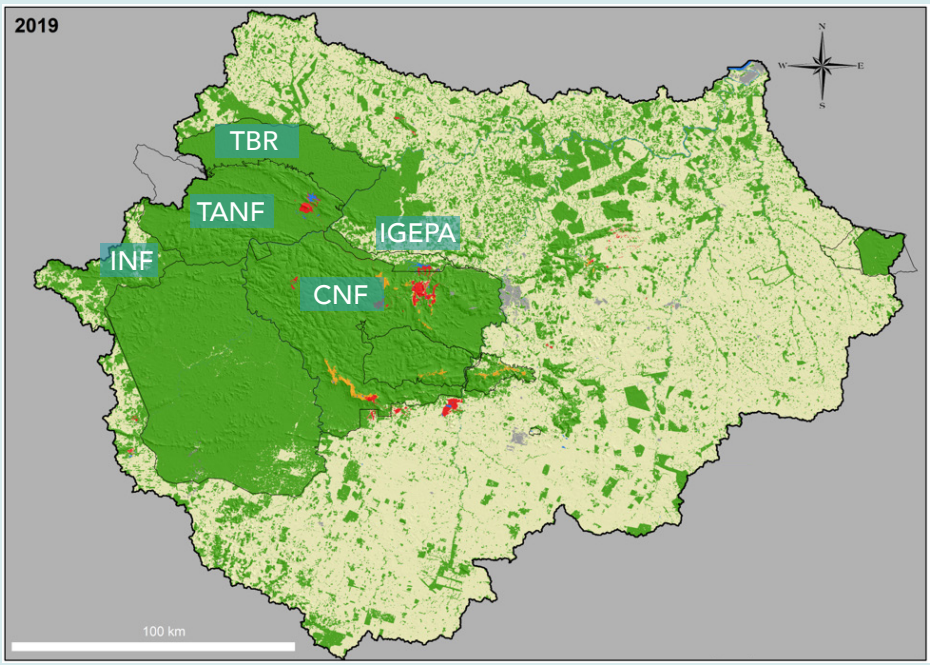
**Figure 31:**
Deforested areas and forest coverage in conservation units supported by Vale in the Carajás region (in km$^2$) (2019)

**Source:** Prepared by the authors based on INPE data.[287]



## Figure 32: Deforested areas and forest coverage in conservation units supported by Vale in the Carajás region (1973 and 2019)




- Canga vegetation
- Forest
- Mining area
- Pasturelands
- Urban area
- Water
- Protected area
- Itacaiúnas basin boundary

| | |
|---|---|
| TBR | Tapirapé Biological Reserve |
| TANF | Tapirapé-Aquiri National Forest |
| IGEPA | Igarapé Gelado Environmental Protection Area |
| INF | Itacaiúnas National Forest |
| CNF | Carajás National Forest |

**Source:** Prepared for the authors by ITV.[288]

46%. Forest cover outside conservation units and Indigenous lands decreased by almost 50%. Of the entire area studied, 51% was subject to human degradation, and only 6% exhibited signs of regeneration. According to the study, conversion into extensive pasture areas and road construction were responsible for 32% of the forest area cleared in the area of influence. The study also notes, however, that conservation units and Indigenous areas helped avoid deforestation, and that the land occupation model along the EFC railroad limited the ramifications of secondary roads, thus avoiding the "fishbone" occupation experienced in other parts of the Amazon rainforest.[178]

Satellite data obtained from PRODES for the year 2019 provides an understanding of the current status of deforestation rates within Carajás municipalities as compared to Maranhão and Pará municipalities located outside the corridor. In Maranhão, deforested areas correspond to 70.1% of the territory of corridor municipalities, compared to 35.3% in the non-corridor municipalities of western Maranhão that form part of Legal Amazonia. In the state of Pará, deforested areas amount to 51.4% of the territory of corridor municipalities, with forest coverage amounting to 46.9% of the territory; outside the corridor, deforestation represents 20.9% of the territory, with forest coverage at 67.4%. For comparison purposes, we recall that, within the Carajás National Forest, deforested areas account for 1.6% of the territory (Figure 34).




**Figure 33:** The Carajás Corridor and the Arc of Deforestation

**Source:** Prepared for the authors by Vale.

Though useful for comparison purposes, looking at percentage rates could create a distorted perception of the extent of deforestation in the Carajás corridor and broader regions in Maranhão and Pará states. Figures 35 and 36, which instead show total areas expressed in thousands of square kilometers, help puts deforestation rates in perspective. Carajás corridor municipalities represent only 4.5% of the territory of the states of Maranhão and Pará. Still, the deforested area across Carajás municipalities represents 11.1% of the total deforested area in the two states concerned. The area of the Carajás National Forest represents 5.75% per cent of the area of the Carajás corridor.

### 4.3.4. Beyond Deforestation: Other Environmental Impacts of the Corridor

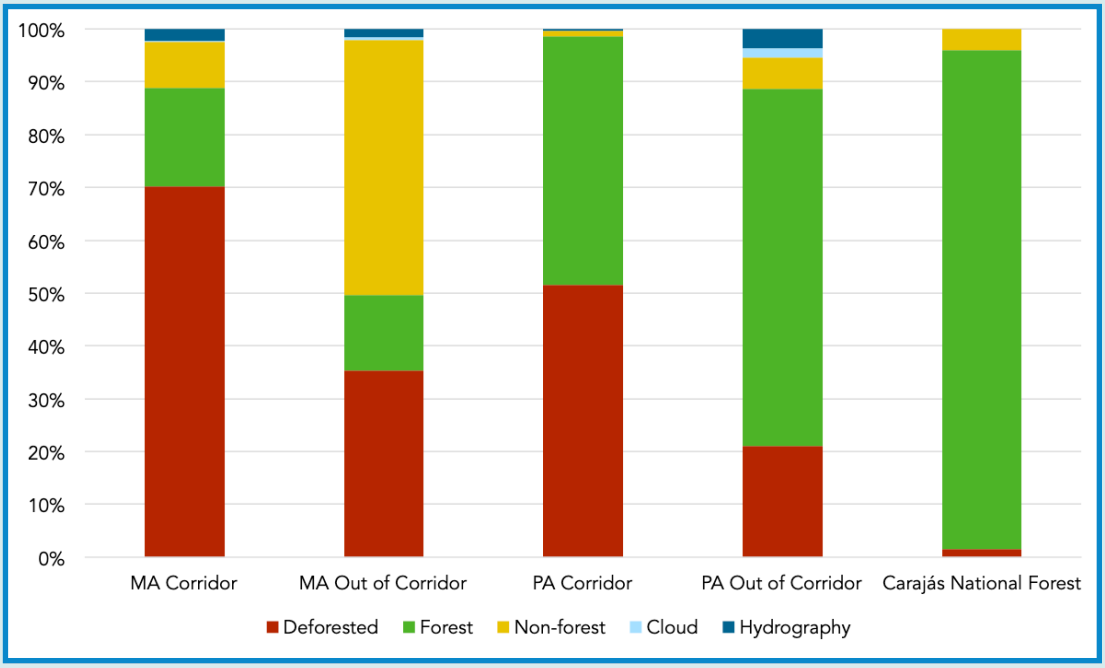
The negative environmental impacts associated with the Carajás logistics corridor and the economic activities that developed around it extend beyond the deforestation of areas of native rainforest and the resulting loss of biodiversity and carbon storage. Several surveys carried out with affected communities along the corridor highlight perceived negative impacts on local environmental characteristics:[179]

- Air, soil, and water pollution resulting from dust and iron ore particles that fall from the trains, possibly causing respiratory, ophthalmologic, and dermatologic diseases;
- Flooding resulting from rainwater drainage systems along the railroad that are insufficient given the high volumes of rain during the rainy season;
- Loss of wild and domestic animals hit by trains;
- Vibration damage in buildings, roads, and wells caused by the passing of heavy trains through urban areas;
- Noise pollution resulting from locomotives, power generators, and the passing of trains, attributed by community members as causing headaches, difficulty sleeping, and stress;
- Suppression of wetlands ("igarapés") for the building and maintenance of the railroad, affecting fishing by communities;
- Fragmentation of ecosystems cut through by the railroad.

The abovementioned reports also refer to significant levels of air, soil, and water pollution caused by pig-iron smelters, and resulting respiratory diseases.[180] Vale has been proposing clauses on environmental obligations when negotiating purchase and sale agreements with pig-iron companies to which it supplies iron ore, with limited success. Considering that ceasing supply of iron ore to smelters within the region would cause significant negative socioeconomic impacts, Vale and downstream partners are investing in developing new technology for green steel production.[181]

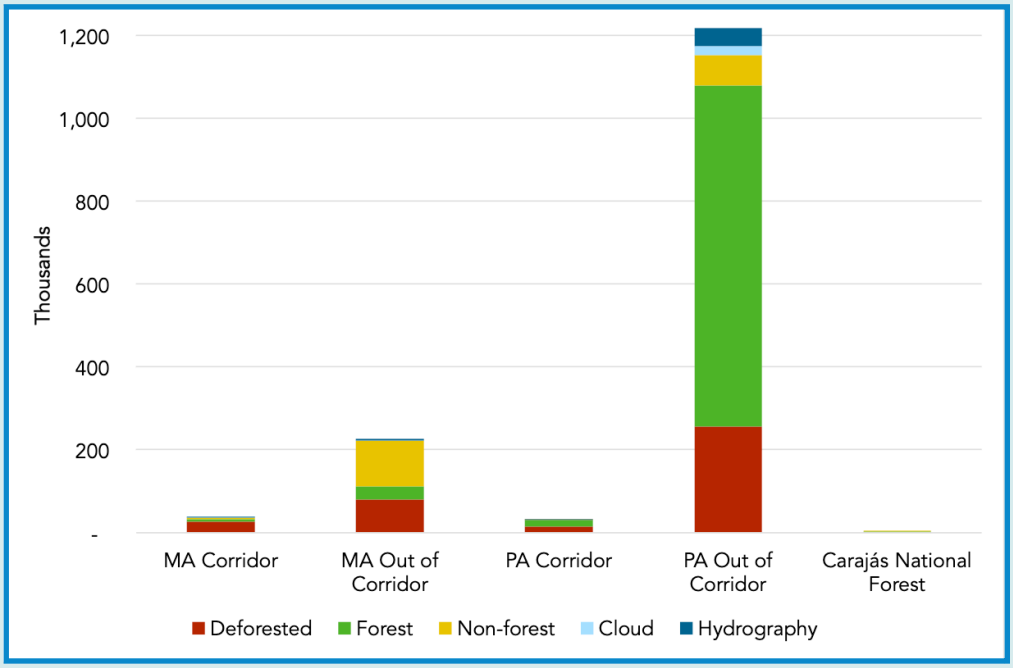
**Figure 34:** Percentage of deforested areas and forest coverage in Maranhão and Pará municipalities and in the Carajás National Forest (2019)

**Source:** Prepared by the authors based on INPE data.[289]



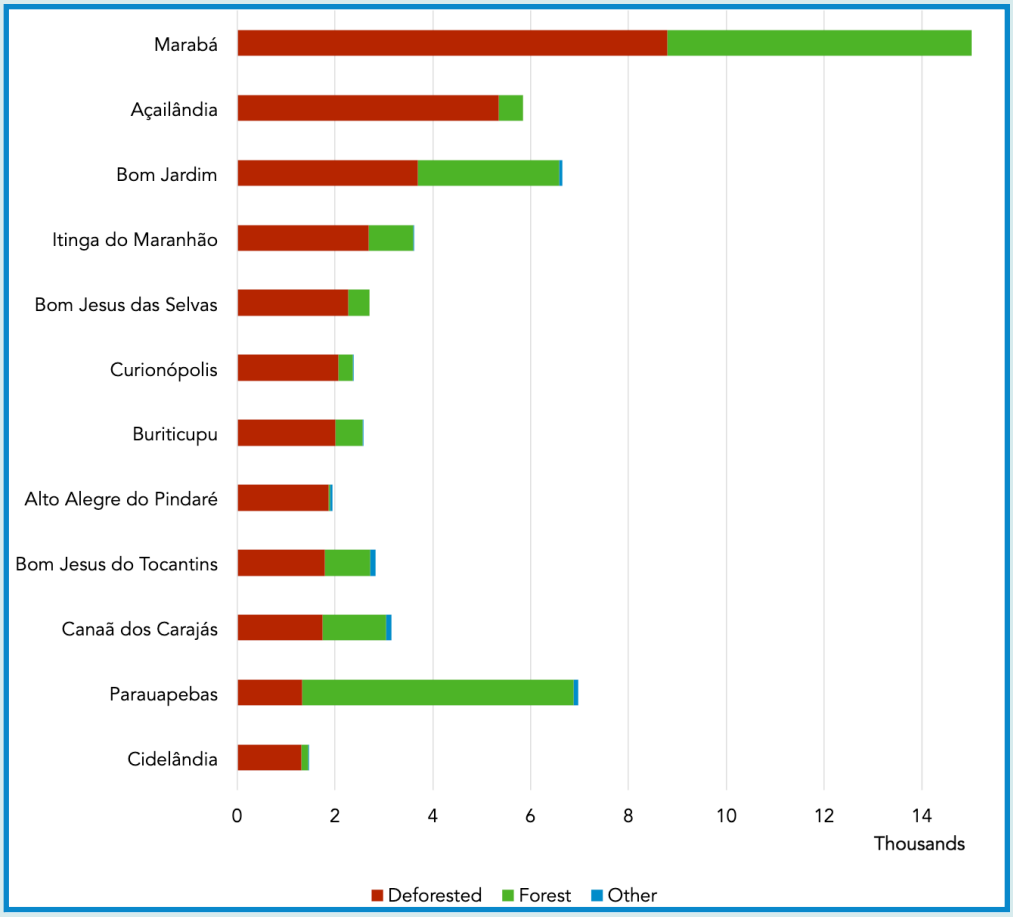
## Figure 35:
Deforested areas and forest coverage in Maranhão and Pará municipalities and in the Carajás National Forest, in thousands of km² (2019)

**Source:** Prepared by the authors based on INPE data.[291]




## Figure 36:
Carajás municipalities with more than 1,000 km² of deforested areas (2019)

**Source:** Prepared by the authors based on INPE data.[290]



## 4.4. Summary Assessment: Shared use and sustainability in the Carajás corridor

As shown in the above sections, shared use of the Carajás corridor infrastructure has brought direct socioeconomic benefits to municipalities along the corridor, such as affordable access to long-distance passenger transportation and fuels. Proximity to the railway corridor is also associated with lower poverty rates and higher socioeconomic indicators. These are still highest at the end points where mining activities occur[182] and the state capital São Luís (MA), where the port of Itaqui is located. Apart from the end points, urban centers such as Marabá (PA) and Açailândia (MA) perform better. These have benefitted from shared use on the corridor with downstream processing companies (pig iron and steel) and fuel distribution centers having set up there. However, most other municipalities along the Carajás corridor still lag significantly behind in development and welfare when compared to other parts of the country, as demonstrated by HDI, GDP per capita, and extreme poverty statistics. Social conflicts are still frequent, and some symptoms of the resource course appear to exist, including inflation at the end points of the corridor and unemployment.

Significant environmental impacts can also be associated with the development and use of the logistics corridor. Increased pressures to expand agricultural and cattle farming activities have led to significant deforestation along the corridor. Besides, communities affected by the EFC have reported higher levels of air, noise, soil, and water pollution, along with other negative impacts on local environments, resulting from both the passing of trains across their territories and the development of other economic activities, particularly the pig-iron industry.

Our analysis of the social, economic, and environmental aspects of the Carajás corridor in the previous sections shows that there still are opportunities to enhance the use of the Carajás corridor to benefit local communities and bring socioeconomic development to the region itself. Seizing these opportunities depends on enhanced long-term planning through improved coordination among relevant government agencies at federal, state, and municipal level, private sector stakeholders including Vale and VLI, and local communities along the corridor. In particular, it should be ensured that shared-use benefits are not only captured by economic actors external to the corridor municipalities—such as large-scale grain producers and other exporters—who gain railway access to the Itaqui port complex, leaving behind negative social, economic, and environmental impacts for corridor communities to bear. Finally, from a sustainable development standpoint, we recall our word of caution that any plans to leverage the shared-use potential of the corridor for local communities must—unlike early development plans formulated by the government—take into account the distinctive environmental characteristics and sensitivities of the region.



# 5. Lessons Learned from the Shared Use of the Carajás Corridor

## 5.1. What Has Been Successful?

Various positive economic, social, and environmental impacts illustrate the successes of the shared use of the Carajás corridor infrastructure from a sustainable development perspective:

- The 998-km double-track mine-to-port Carajás Railroad (EFC) has created a **safe, efficient, and reliable mode of transport** of passengers and cargo within a remote area of Brazil's territory, otherwise served by a limited number of poor-quality roads.

- For over 34 years, the EFC has provided a low-cost option for long-distance **passenger transportation** across two of Brazil's poorest states, including fare options accessible to low-income communities in western Maranhão and southeastern Pará. The quality of the passenger services has improved through time—with air-conditioned railcars as well as reduced interruptions, delays, and overcrowding—and a two-fold increase in the frequency of trains will be implemented upon the extension of Vale's railway concession.

- The design, construction, and maintenance of the 2.34-km **mixed road–rail bridge** across the Tocantins River by Vale have generated shared-use benefits, and the same is expected of the new road–rail bridge that Vale will build as part of the double-tracking project. The bridge serves as an important link between the center of Marabá (PA) and its rural districts, allowing easier human mobility and reducing the logistics costs of transporting food, fuel, and grains.

- Transportation of **third-party general cargo** on the EFC, in particular through its connection to the North–South-North–South Railroad (FNS) in Açailândia (MA), has reduced logistics costs and promoted economic development by giving producers along the corridor and in Brazil's central region access to the Itaqui port complex. Notably, beneficiaries include large-scale exporters of soybeans, soybean meal, corn, pulp, and pig iron.

- Shared-use benefits resulting from Vale's investments in **port infrastructure** for its private maritime terminal at Ponta da Madeira, including the general cargo pier now operated by VLI and Vale's signaling and dredging of the navigation channel, have also contributed to strengthening the Itaqui port complex and its vicinity as an export outlet.

- The **Carajás Airport** in Parauapebas (PA)—which Vale built and handed over in the 1980s to Brazil's state-owned airport infrastructure company, INFRAERO—provides commercial passenger and cargo services for the Carajás region. Vale's activities serve as anchor demand supporting economically viable commercial flights into and out of the region.

- Vale's provision of **helicopter services** and other forms of support to Brazil's environmental agencies, notably ICMBio, has helped avoid deforestation and illegal logging in the Carajás National Forest and other conservation units.

- The fiber-optic cables that telecommunications companies deployed along the EFC using Vale's right of way have reduced the costs of pioneering access to **ICT infrastructure** for telephone services and Internet connectivity in the large and sparsely populated area of influence of the corridor. Vale's project for a private 4G/LTE network will also generate third-party benefits, as the telecommunications company implementing it will seize the opportunity to build infrastructure that can also offer cellular services to the public.

- The **socioeconomic indicators** in the municipalities along the Carajás corridor are higher than those of Maranhão and Pará municipalities lying outside the corridor, attesting to development co-benefits generated by the logistics corridor and its shared use.

*Photo: Different types of railcar on the Carajás Railroad.*
*Photographer: Ricardo Teles / Agência Vale*

## 5.2. Why Has Shared Use Been Successful?

**Historical political factors have played a fundamental role** in guaranteeing that shared use has been prioritized along the corridor. Developing the Carajás iron ore deposits was a cornerstone for Brazil's federal government at the time, in order to populate and unlock the economic potential of the northern region of Brazil. **Vale, a state-owned company at the time**, was not only tasked to profitably extract and export the iron ore from Carajás, but also of helping achieve the government's economic and social objectives. As such, the transportation of agriculture commodities, the development of downstream pig-iron and steel industries that would benefit from access to the railroad, and passenger services were part of the plan. The **holistic planning** went beyond what could be transported along the railroad, as exemplified by the requirement to integrate a roadbed in the river crossing at Marabá (PA), one of the main transport bottlenecks in the region before the construction of the bridge.

The corridor was always **part of a larger national railway network plan** that foresaw coordinated investments, as well as the requirement to transport goods to and from the FNS railroad. This has ensured that the corridor plays an important role beyond the municipalities through which it runs. Today, most of the general cargo and non-iron ore port throughput comes from the northern Cerrado region, and the government has plans to further expand the railway network in Northern Brazil, with the Carajás corridor playing an important interconnection role.

**Stringent legal provisions governing shared use**—contained in federal laws and decrees, railway concession and sub-concession agreements, and other rules issued and enforced by pertinent regulatory agencies, as well as private contracts—have ensured that even after the privatization of Vale, passenger and general cargo services continue to operate on the EFC and that the ICT infrastructure continues to be maintained and further developed along the corridor. The access fee structure is publicly available, and the national land transportation regulatory authority, ANTT, has the mandate to mediate and intervene in case the private parties cannot reach an agreement on shared use. The draft concession extension agreement suggests that shared-use requirements on the corridor will be further strengthened. It foresees additional requirements linked to cargo coming from the FNS, the expansion of capacity if a 90% saturation of the railroad is reached, and the running of an additional passenger train on the corridor.

Vale built up its **expertise in logistics** that go beyond transporting iron ore from mine to market and has excelled at this task. At times during its history, the logistics branch of Vale was one of the most important revenue sources, not only operating trains with various cargoes but also running third-party transoceanic and coastal shipping services. While Vale today is no longer running logistics services that are not linked to its mining operations, the history and mindset of having to operate in a multi-cargo and passenger service environment is almost second nature. This is also the case in the Carajás corridor. Apart from being the largest iron ore railway in the world on which the logistics need to be coordinated with general cargo and passenger services, it is also one of the most efficient railways in Brazil performing amongst the top when it comes to speed and number of interruptions and accidents.

On the Carajás corridor, the contractual arrangements with Vale's **subsidiary VLI**, created to oversee third-party cargo has helped to avoid a potential conflict of interest that would have led to an abuse of monopoly position on the part of Vale. While still a shareholder of VLI, Vale is contractually bound to allow VLI to manage cargo on the EFC based on pre-agreed throughput quotas. If these are not met, Vale must pay penalties, which reduces the incentive to prioritize its own cargo. Vale has also put in place strong coordination mechanisms with VLI to minimize the disruption of shared use on the mining logistic chain.

One example of these mechanisms is the mutual access agreement between Vale and VLI's subsidiary governing transportation services with origin along the EFC and destination along the FNS or vice versa. This agreement determines that every year Vale and VLI meet to agree on an annual plan, with indicative allocations of capacity to each other's cargo, updating these allocations monthly based on demand forecasts. Each party undertakes to provide the other with access up to the capacity allocated in the annual plan, without assuming take-or-pay obligations, and divide freight rates between them pursuant to a pre-agreed formula.

Beyond the historical, political, and regulatory reasons that have required shared use along the Carajás corridor, the motivation for shared use also stems from the **social pressure** associated with the disproportionate role that Vale plays in the region. Vale is the largest investor in the region, and the towns around the mine sites have grown exponentially with people earning their living directly or indirectly due to Vale. However, for many residents of the towns along the corridor, Vale is negatively associated with the transit of 55 iron ore trains per day, each 3.5 km in length. Apart from noise disturbance, such high traffic constrains passage and increases the risk of accidents. As such, there has been pressure on Vale to show that the Carajás corridor also benefits communities and the broader economy.

## 5.3. What Have Been the Risks and Shortcomings of Shared Use?

Despite the successes highlighted above, the shared-use undertaking has not been an entirely positive experience for all stakeholders. It involves certain risks and negative impacts from an economic, social, and environmental perspective.

### 5.3.1. Economic Dimension

Shared use has not benefited the prevalent smallholding agriculture and farming and has not served to unlock the agriculture potential of the region along the Carajás corridor. Given those small agricultural producers are scattered along the railroad and often do not have the resources or the necessary coordination to aggregate their production in higher volumes, a targeted public and private effort to unlock this situation could have been instrumental in widening the beneficial impact of shared used to the municipalities not benefiting from the port or the mine.

For Vale, shared use has also involved costs such as cross-subsidizing passenger services and additional planning and coordination efforts with VLI to ensure minimum loss in efficiency along the logistic chain. While a state-owned company, Vale also handed out the airport and road–rail bridge to the federal government without compensation. These direct handouts appear no longer to occur after the company's privatization.

In addition to assessing the impact of shared use on the corridor connecting the pit to the port, it is also important to consider that this impact can be amplified when this corridor connects to and integrated with inland corridors or railway links that feed the corridor with general cargo and that can transport general cargo to remote areas. At the time of the construction of the EFC, Vale used a broad gauge, in compliance with the standard in force then and still today, but in divergence from most other railroads in Brazil that have narrower gauges. The lack of a long-term technical criterion and policy on track gauge in Brazil is problematic as the existence of different gauges prevents using the same rolling stock across railroads, increasing the costs of connecting networks of different gauges. When planning for a logistic corridor, it is important to consider that, given that part of the realization of the shared-use potential is through inland interconnections, gauges should be harmonized at the outset.

### 5.3.2. Social Dimension

Shared use has not harmonized the level of development between municipalities along the corridor, with end points (Parauapebas [PA], Canaã dos Carajás [PA], and São Luís [MA]) and other urban centers (Marabá [PA] and Açailândia [MA]) displaying much higher socioeconomic indicators—including HDI, GDP per capita, and extreme poverty statistics—than smaller municipalities in between. The latter continue to experience socioeconomic development indicators inferior to Brazil's national average. This appears to contradict the goals of shared use of expanding the benefits of mining and related economic activities to all communities situated between pit and port. Moreover, municipalities along the corridor have experienced high population growth rates without being able to serve this large influx of population with all the necessary infrastructure and services.

### 5.3.3. Environmental Dimension

At the same time as Vale helped prevent deforestation and illegal logging in certain areas, the development and shared use of the Carajás corridor is associated with significant environmental impacts in the corridor municipalities. These impacts include deforestation resulting from pressures to expand large-scale agriculture and cattle farming as well as from wood-based fueling needs of the pig-iron industry; air, noise, soil, and water pollution; and other negative impacts on local ecosystems resulting from the passage of trains and from economic activities that developed along the railway.

While historically encouraged in the government's development plans for the Carajás region and enabled by the railway corridor, economic activities leading to significant deforestation are incompatible with the principles of sustainable management of forest resources. Thus, the shared-use potential of the Carajás railway corridor is therefore constrained in light of the risks posed and impacts caused by a logistics corridor in an environmentally sensitive area.

### 5.3.4. Further Research on Quantification of Costs and Benefits

Due to the lack of time series data on costs and benefits of shared-use arrangements, we were unable to assess whether the shared use of the Carajás corridor has been a net positive for Vale or for local communities. In particular, it would be useful to analyze Vale's investment throughout the years in the shared-use components of the corridor infrastructure—including capital and operating expenditures on passenger and general cargo trains, the general cargo terminal and storage facilities at Ponta da Madeira, the Road–Rail Bridge of Marabá (PA), the Carajás Airport, among others—as well as to quantify the economic, social, and environmental benefits captured by municipalities and communities along the corridor. Subject to data availability, further research could focus on quantifying such costs and benefits.



# 6. Recommendations: How To Further Leverage Shared-Use Benefits Along the Carajás Corridor?

To further leverage shared-use benefits of the Carajás corridor—thus promoting sustainable development for the benefit of the communities of the region and helping Vale retain its social license to operate—the mining company, in collaboration with federal, state, and municipal authorities and other stakeholders, could consider adopting a series of measures and strengthening its existing efforts in various areas.

## 6.1. Planning and Public–Private Collaboration

While Vale has several CSR projects along the Carajás corridor, it is worthwhile to reassess the potential to further promote shared-use infrastructure opportunities to benefit the region. This requires a **closer collaboration between Vale's CSR department, the Vale Foundation, and Vale's and VLI's departments responsible for EFC and FNS logistics**. It also requires close coordination with the federal government, the state governments of Maranhão and Pará, and the governments of the 28 municipalities through which the corridor runs. This collaboration and coordination effort should include exploring the viability of unlocking the potential of the Carajás corridor for the long-distance transport of products that are currently carried in trucks, such as fertilizers imported into the Itaqui port complex.

The stakeholders mentioned above could prepare a **corridor-based development plan for the region to help identify synergies for private sector and government investments to improve development outcomes**. This plan should be data driven and could usefully leverage Brazil's collection of data and monitoring platforms relating to the Sustainable Development Goals (SDGs) to identify areas of intervention, coordinate activities, assess the impact of development interventions, and adapt these accordingly if unsuccessful.[183]

The development plan could include a coordination mechanism between Vale, VLI, and corporate users of the EFC and FNS railroads and the port infrastructure in Itaqui and its vicinity to make **joint investments along the corridor**. Corporate railway users could pool resources for and creatively explore the implementation of projects to improve the economic, social, and environmental conditions of Indigenous Peoples, Quilombolas, and local communities living along the corridor, which bear the negative impacts of heavier rail traffic.

## 6.2. Small-Scale General Cargo Services

It may also be worthwhile for Vale and VLI to assess **reintroducing general cargo railcars** on the passenger train to transport smaller cargoes. While small and irregular cargoes are not well suited for railway transport, in the past, Vale added a general cargo railcar to the passenger service. This allowed passengers to transport agricultural produce from their farms to sell in São Luis (MA) and bring back goods such as seafood to sell inland. This small-scale commerce is not possible since the introduction of the new passenger train and the associated weight restrictions. However, the train journey is the cheapest way to get from Marabá (PA) to São Luis (MA). As such, reintroducing this service could provide a lifeline to small-scale farmers and other local entrepreneurs to transport their products by rail. To address the efficiency challenges associated with such services, dry ports in strategic locations along the corridor could be setup that agglomerate and load the railcar before the arrival of the passenger train. As demand for general cargo railcars increases, Vale and VLI could also consider offering specific trains for **general cargo services**, at least every other day in each direction. As with passenger trains, general cargo trains can be scheduled between iron ore trains to minimize the impact on Vale's mineral logistics.

*Photo: Passenger train on the Marabá Mixed Road–Rail Bridge across the Tocantins River. Photographer: Ricardo Teles / Agência Vale*




*Photo: Vale employee Pedro Aderson loading the general cargo railcar attached to the passenger train in 1992.*

*Photo credits: Pedro Aderson's personal archives*

## 6.3. Additional Investments on the EFC

Vale could consider making further **safety- and environment-oriented improvements to the EFC**, such as upgrading railway stations and stops, building additional pedestrian overpasses, and implementing measures to reduce the encroachment of third parties on the no-build zone on each side of the railway tracks ("faixa de domínio"). Furthermore, in line with Vale's decarbonization efforts, the company should follow through with—and consider expediting—existing plans to electrify trains on the EFC railroad,[184] which currently run on diesel. These additional investments would help mitigate the negative environmental impacts of rail traffic perceived by local populations in urban areas.

## 6.4. Telecommunication Services

Another opportunity worth exploring is how Vale could play an important role in the further roll out of **telecommunication services in the region**, in collaboration with telecommunication companies. Vale already shared its right of way along the railroad with Oi and Embratel, considerably decreasing their fiber optic installation cost.[185] The expected sharing of Vale's private 4G/LTE network infrastructure for the provision of public cellular services by the telecommunications operators can also generate cost-savings opportunities. As Internet access will continue to gain importance in the coming years and can increase the efficiency of public services, these efforts could be usefully pursued. For instance, connecting public entities such as schools and hospitals could go a long way to help advance several SDGs along the corridor. Such a project would probably reach a larger number of people in the region than CSR activities in individual municipalities. Inputs would be required from a number of stakeholders including from the government, the telecommunications sector, Vale staff responsible for the telecommunications services, and CSR staff responsible for supporting health and education projects. Providing free WiFi and Internet access services to communities along the corridor, for example, at passenger railway stations, could also go a long way in **improving the social license to operate** for the company and generate benefits to people that currently are not seeing the railroad improving their standard of living.

## 6.5. Integrated Landscape Approach, Forest-Smart Mining, and Climate-Smart Mining

While historically in the Carajás region priority was given to economic development over environmental protection, Vale has grown more environmentally sensitive to the indirect impact that the development of the corridor has had on the increased deforestation rates in corridor municipalities. With the growing climate urgency and the growing deforestation of the Amazon rainforest, it is fundamental for Vale to reinforce its efforts and allocate all necessary financial resources to the following objectives:

1) Ensuring zero additional deforestation when it comes to its expansion projects.

2) Assessing all forest and general biodiversity conservation and reforestation potential—including beyond the Carajás National Forest and neighboring conservation units—in collaboration with local authorities and communities.

3) Targeting carbon neutrality of its operations by 2050 or sooner by embracing energy efficiency, electrification, and renewable energies.

4) Adopting a value chain approach, in particular with the shipping and steel industries, which are among the biggest local and global greenhouse gas emitters as well as being two of the "hard to abate" sectors.[186]

To achieve objectives (1) and (2), adopting the forest-smart mining approach developed by the World Bank's PROFOR program could be particularly effective.[187] This approach recommends conducting landscape assessments, strategic environmental and social impact assessments, and ecosystem services assessments, understanding "the ecology of the forest landscape and the diverse ways in which people interact with and depend on forest ecosystems (for example, for food, fuel, water, livelihoods)."[188] This approach also entails considering the direct, indirect, and cumulative impacts for forests and associated communities over time and wide areas and the systematic application of the mitigation hierarchy (avoidance, minimization, mitigation, and offsetting).

Implementing this approach requires cross sectoral collaboration within the company and constant coordination between the company, local authorities, their various environmental agencies, and communities. The PROFOR program has also evidenced that "strong property rights and land tenure systems that recognize both modern legal and customary rights are associated with lower impacts from mining on forests,"[189] as well as with stronger collaboration on the part of the communities for forest-smart actions and mitigation measures. While fixing the land tenure systems is certainly the government's responsibility, Vale could leverage its strategic position in the region to encourage and enable the government to do so by, for instance, transparently providing funding for external experts in land tenure rights.

Implementing Vale's climate change strategy, as stated,[190] will go a long way toward achieving objectives (3) and (4). Vale's progress towards the 2050 carbon neutrality target should be closely monitored and applied to each of the sites with no internal cross-compensation. Deforestation should count as adding emissions; offset programs should only be used as a last resort and may only count as reducing emissions if they follow the principles developed by the Business and Biodiversity Offsets Program (BBOP).[191] Many offset programs to date have been beset by poor design—leading to partial offsets only—and quickly abandoned.[192] Vale's targets aiming at carbon neutrality for Scope 1 and 2 should also apply to Scope 3,[193] and accordingly Vale should seek action-oriented partnerships with suppliers and customers to identify the technology solutions to decarbonize, in particular, in shipping and steel.



# Appendix 1: Background and Historical Context

## 1. Government Plans to Develop the Region[194]

The origins of the regional development planning around the Carajás corridor can be traced back to the creation of the Superintendence for the Economic Valorization of Amazonia (SPVEA) by the Brazilian federal government in 1953. The agency was responsible for planning the development of the Amazon region through five-year plans around extractive, agricultural, livestock, mineral, and industrial activities.[195] With the entrance of the military government in 1964, the program to populate and develop the Amazon region accelerated, as the authorities wanted to ensure control over its large territory. SPVEA was replaced by the Superintendence for the Development of the Amazon (SUDAM), which still exists under the same name today. SUDAM was set up within the Ministry of the Interior, highlighting the strategic geopolitical importance that the military government attributed to this project to control the region and secure territorial sovereignty.

Brazil's federal government offered fiscal exemptions and incentives to investors in agriculture, livestock, and industry, and handed out subsidized credits for land acquisitions.[196] International exploration companies flocked to the region, hoping to find mineral deposits. Among them was U.S. Steel, in the search for manganese. During an exploration flight for U.S. Steel on July 31, 1967,[197] Breno dos Santos discovered the Carajás deposit with 17 billion metric tons of high-grade iron ore. During that time, Alcan also discovered high-quality bauxite deposits in Pará that would enable a large-scale aluminum project.

Complementing the incentives, the federal government made road infrastructure investments. The most controversial of those was the Trans-Amazonian Road (Rodovia Transamazônica) project, a 4,000-km-long East–West road running across the Amazon region—passing by Marabá (PA), one of the main cities along the Carajás corridor—and some of Brazil's Northeastern states. The Transamazônica project led to large-scale deforestation, and the economic rationale behind the project has been put in question. The Land Redistribution Program (PROTERRA) and the National Institute for Colonization and Agrarian Reform (INCRA) played important roles in redistributing "unutilized" lands to agroindustry and farming along these infrastructure projects, and in helping with the settling of migrants from the Southern regions of the country where there was surplus labor.[198]

The allocation of land to small-scale migrant farmers gave way to promoting larger export-oriented investments in the 1970s. In December 1972, INCRA sold off 250,000 hectares to large-scale farmers around Marabá, with each plot size of 3,000 hectares. These were primarily sold for cattle farming purposes of producing beef for domestic and international markets. The allocation and re-allocation of land were accompanied by conflicts between the government, Indigenous communities, small-scale migrant farmers, and large-scale investors. These land-based conflicts continue into the present day.

The Second National Development Plan (PND II) for 1975–1979 promoted the production of beef, timber, and minerals with a geographical concentration in specific areas. To implement PND II, SUDAM proposed the POLAMAZONIA program, which foresaw 15 growth poles, including the Carajás growth pole around the Trombetas bauxite reserve and the Carajás iron ore reserves discovered in 1967. The importance to the government and the scale of the above outlined programs is best captured by the government spending increase from about 17% of GNP in 1947 to about one-third during the 1970s.[199]

The Greater Carajás Program (Programa Grande Carajás [PGC]) covered an area of close to 900,000 km$^2$—equivalent to the size of Great Britain and France combined. It is the largest "integrated" development scheme ever undertaken in an area of tropical rainforest.[200] At the time of the program, it was estimated that the private and public sectors would invest US$ 62 billion (in current prices) in the region between 1981 and 1990. At the core of the PGC was the Carajás iron ore mine, two integrated bauxite and aluminum projects, and the Tucuruí hydroelectric dam in Tucuruí (PA). The Japan International Co-operation Agency (JICA) provided significant support to the government and the

*Photo: Aerial view of Parauapebas (PA).*
*Photographer: Ricardo Teles / Agência Vale*

state-owned mining company Companhia Vale do Rio Doce (Vale) in developing the PGC. Japan at the time was one of the largest importers of Vale's iron ore[201] and therefore was interested in the development of the PGC. The PGC was formally established in November 1980 and included a series of incentives to attract investments in large-scale mineral, infrastructure, and agroforestry projects.[202] Initially, the federal government granted full corporate income tax exemptions, later modifying them to a 50% reduction.

Financing for the initial US$ 3.1 billion investment (in current prices) in the mine, railway, and port complex was raised by Vale issuing bonds and through domestic and international loans from the European Economic Commission, the World Bank, and Japan. The United States and the Soviet Union also provided loans for the PGC with offtake agreements signed for the iron ore, pig iron, and ferro-alloy production.[203] By 1987 the PGC council had approved twelve pig iron and five iron-alloy projects, which thereby benefitted from the fiscal incentives. **The railway was designed to also service these downstream industries and transport cargo and passengers along the corridor**. It was inaugurated in February 1985, and the Ponta da Madeira Maritime Terminal, in São Luís (MA), was officially opened in March 1986.[204]

Other projects were implemented in parallel to the development of the Carajás corridor, including the Tucuruí hydro project, the bauxite mines in Trombetas (PA) and Paragominas (PA), the large-scale alumina refinery and aluminum smelter in Barcarena (PA), and the aluminum smelter in São Luís (MA). All projects came on stream in the mid-1980s and were tied to the Tucuruí hydro project. Apart from receiving tax incentives, these investments benefitted from subsidized electricity prices.

As noted above, apart from the infrastructure and mineral/metallurgical sector development, the PGC also included plans to develop agriculture and forestry projects. Vale and Japanese consultants advocated for using the railway infrastructure to develop export-oriented agriculture projects. The studies culminated in the Programa Grande Carajás Agrícola (PGCA) of the Ministry of Agriculture with a budget of US$ 1.18 billion (in current prices). The plan foresaw 238,000 hectares for soybean cultivation, 12,600 hectares for sugar-cane production, close to 500,000 hectares for beef cattle, and 3.6 million hectares for eucalyptus plantations to feed the pig-iron complexes with charcoal. However, these large-scale plans never materialized due to challenges related to soil quality, topography, climate, lack of funding, and political wrangling between the Ministry of Agriculture and SUDAM. More than 90% of the soils in the region were classified as low fertility, with only 3% considered fertile enough for good crops. **As a result, only a few of the proposed agriculture projects in the corridor impacted region were implemented**.[205]

However, with the completion of the Carajás Railroad (hereafter referred to by its Portuguese-language acronym, EFC), the plan to build the connection of the FNS (hereafter referred to by its Portuguese-language acronym, FNS) from Açailândia (MA) to Anápolis (state of Goiás [GO]) also advanced. This helped unlock the grain production potential of the northern Cerrado region, which did not face the agronomic constraints of the Carajás region. The area impacted by the railway produced 1.5 Mtpa of grain at the time, with feasibility assessments suggesting that 100 to 180 Mtpa of rice, soybean, corn, and wheat production would be possible. The proposed railway line was integrated into the 1986–1989 plan for agriculture production.[206]

## 2. Carajás and the History of Vale as a Mining and Logistics Company

**In Vale's history, logistics has been a key component of the company's operations, allowing it to ship its production within the Carajás region, in other parts of Brazil, and internationally**. To circumvent the lack of efficient, coordinated domestic logistics systems, which increased the company's operating costs, and to improve its geostrategic positioning, Vale invested in maritime transport infrastructure and global logistics systems. Vale's shipping subsidiary, Vale do Rio Doce Navegação S.A. (Docenave), was established in 1962, with expansions of its transportation capacity in the late 1960s and throughout the 1970s, contributing to the company's commercial performance on foreign markets.

In April 1970, the Amazônia Mineração S.A. (AMZA) joint venture was established between Vale (51%) and Companhia Meridional de Mineração (49%), a subsidiary of U.S. Steel, which had the legal right of preference to explore the deposits it had discovered in 1967. AMZA was created to implement the US$ 930 million Carajás Iron Project (in current prices), covering an area of 160 million hectares and planning to extract 12 million metric tons per annum (Mtpa) of iron ore as of 1979, reaching an output of 50 Mtpa by 1985, to be exported to foreign markets. In June 1977, U.S. Steel exited from the joint venture after receiving compensation of US$ 50 million (in current prices), making Vale AMZA's sole shareholder.

The Carajás Iron Project foresaw the construction of a railroad to transport the ore to the Brazilian coast. Accordingly, an 892-km-long railroad would be built linking Marabá (PA) to Ponta da Madeira in São Marcos Bay in Itaqui, in São Luís (MA). At Ponta da Madeira, adjacent to the public port of Itaqui, a maritime terminal would be built to receive ore carriers of up to 280,000 deadweight tonnage (DWT). In 1976, the federal government granted AMZA the concession to build and operate the railroad through Decree No. 77,608. The mine, plant, railroad, and port were designed to achieve an overall output of 35 Mtpa, to be reached in three stages: 15 Mtpa in 1986, 25 Mtpa in 1987, and 35 Mtpa in 1987. **The project envisioned that the railroad would also transport passengers and general freight.**

As a state-owned company, Vale played a key role in developing the PGC. **Apart from assessing and developing the mining projects in the region, it also supported the federal government in planning agriculture and other infrastructure projects to develop the region.** Therefore, as a state-owned company, it was not only following profit-oriented objectives but also envisioning development objectives. This may help explain the route of the railway corridor to the export point São Luís (MA), instead of the port city of Belém, capital of the state of Pará, which would have been around 250 km shorter, and the origins of shared-use infrastructure arrangements.[207]

In the 1980s, Vale's diversified production included iron ore, pellets, pulp, aluminum, bauxite, and manganese, and by the 1990s, transoceanic shipping was also among Vale's primary income sources, through Docenave's fleet of ships transporting bulk cargo in all continents. The revenue obtained from transporting general freight—including soy, timber, limestone, drinks, fuels, and vehicles—covered 24% of the operational costs of the EFC in the last quarter of 1993 and fostered agricultural expansion in the Southern part of Maranhão state. In addition, with the opening of Pier II at Ponta da Madeira Maritime Terminal in April 1994, Vale benefitted from one of Brazil's biggest port complexes, which handled more than 35 Mtpa of 15 types of goods, including iron ore, pig iron, and soybeans. This allowed an expansion in the production capacity of the Carajás mine and guaranteed faster and safer exports. In 1995, a fiber optic telecommunications system was implemented along the railway. In 1996, Vale ventured into gold and copper mining.

In the 1990s and the 2000s, Vale's activities expanded around the world. The company was privatized in 1997 as part of Brazil's National Privatization Program. In 1998, the iron ore output at the Carajás Mine reached 45.8 Mtpa while the Carajás Railroad increased its freight transportation performance to 50.1 Mtpa. The company's shares were listed on the New York Stock Exchange in July 2000.

In 2001, Vale discontinued its long-distance (transoceanic) shipping operation, focusing instead on a tugboat and coastal shipping services. Docenave, then fully owned by Vale, handled 42% of Brazil's total container volume, and accounted for 4% of Vale's gross sales at the time. In 2002, the revenue obtained from intermodal services (transportation of containers by railroads and on the sea between the main ports of Buenos Aires, Argentina, and Manaus in the state of Amazonas, Brazil) grew by 44%, reaching R$170 million. In the same year, Vale acquired a stake in MRS Logística S.A., a railroad company with over 1,600 km of track linking the states of Minas Gerais (MG), Rio de Janeiro (RJ), and São Paulo (SP) in Southeastern Brazil. In 2003, Vale accounted for 16% of all cargo transportation in Brazil, 65% of bulk solids handled at the country's ports, and approximately 40% of Brazil's foreign trade transportation. By volume, this was a record 26.3 billion metric ton-km, up 5% from 2002, plus 26.5 Mtpa of cargo handled for third parties by the port terminals controlled and operated by Vale in 2003—up 35% from the previous year.

Pier III at Ponta da Madeira Maritime Terminal was opened in 2004, and new iron ore stockyards were added, enabling the terminal to export 74 Mtpa of ore and general cargo. By this point, Vale's logistics area benefitted from the strong performance of agricultural exports and general freight. For example, Vale accounted for 16% of all soy exported from Brazil in 2004, handling more than 5 Mtpa of soybeans and byproducts, and the total volume of general freight transported by Vale's railroads reached 28.7 billion metric ton-km. The gross annual revenue of Vale's logistics business increased by 42% from 2003, reaching R$ 3.02 billion.

Continuing the expansion of its logistics infrastructure, Vale acquired 5,414 railroad cars and 125 locomotives to transport its products and general freight for customers along its three railroads—the EFC, the Vitória–Minas Railroad (EFVM) and Centro-Atlântica Railroad (FCA). **This enhanced Vale's position as the leading supplier of logistics services in Brazil, accounting for 68% of the volumes transported in Brazil's railroads and 27% of the volumes handled in the country's ports**. In 2005, revenues of logistics services amounted to US$ 1.21 billion (in current prices). Following China's entry to the WTO in 2001, shipments of Vale's iron ore to the country more than quadrupled by 2006, making China the company's principal export destination.

In 2007, Vale rebranded itself as Vale S.A.[208] and continued to expand its railroad network. In the same year, Vale won a bid for a 30-year sub-concession to operate a 720-km stretch of the FNS between Açailândia (MA) and Palmas (in the state of Tocantins [TO]). Vale successfully developed a new corridor to transport general freight—particularly soybeans, rice, and corn—produced in Brazil's Center-North region. In the years following the 2008 economic crisis, Vale shut down some iron ore mines in Minas Gerais state and most of its pelletizing plants; it later sold its stake in kaolin mining operations and some of its aluminum operations. As Vale's operations in Brazil's Southeast region ramped down, the importance of the Carajás corridor increased.

To avoid supply reductions and rising shipping prices, Vale began buying and building its own vessels, including the highest capacity ore transporters in the world at the time, very large ore carriers (VLOCs) capable of transporting 400,000 DWT—called the Valemax vessels. This considerably lowered the transportation costs, and thus Vale managed to restore the competitiveness of Brazilian iron ore facing Australian and Chinese competition.

By the end of 2014, Vale's maritime fleet peaked at 32 of its own vessels, and 16 Valemax vessels leased under long-term contracts. However, in the same year, the company's new maritime shipping strategy began to emerge. Rather than owning and operating a low-cost fleet of vessels to ship iron ore from Brazil to other markets, particularly in Asia, Vale started focusing on "securing long-term shipping capacity and protecting against volatility in freight pricing through long-term contracts of affreightment, without incurring the costs relating to building, owning and operating the vessels."[209] Between 2014 and 2017, Vale sold all of its 19 Valemax vessels for a total of US$ 1.94 billion (in current prices). In 2018, Vale concluded long-term affreightment contracts with shipowners for 47 new fuel-efficient VLOCs capable of carrying 325,000 DWT to be delivered between 2019 and 2023.[210]

In addition to building up its worldwide iron ore competitiveness during the 2010s, Vale continued investing in logistics solutions for its customers, including intermodal logistics. **In 2010, Vale established VLI S.A. as a subsidiary to hold its general cargo business, thus separating it from the company's core (mineral) cargo operations, making it more efficient, and avoiding conflicts of interest with third-party users of logistics services**. The logistics assets transferred to VLI included Vale's interests in the FCA and FNS railroads. VLI was also given rights to the purchasing capacity of Vale's railroads (EFVM and EFC) and marine terminals (in Tubarão and Praia Mole, both in Brazil's southern state of Santa Catarina) to transport general cargo. VLI was also handed over the operation of Pier II of Vale's Ponta da Madeira Maritime Terminal—the only pier in Vale's port used for general cargo.[211] Starting with 4 inland terminals with a storage capacity of 220,000 metric tons in 2011, VLI grew to hold 8 inland terminals with a storage capacity of 795,000 metric tons in 2018. **Through railroads, inland terminals with storage capacity, and marine terminals and port operations, VLI provides integrated logistics solutions to third parties for general cargo**.[212]

Already in the first years of operation of VLI, Vale was sought outside funding through equity investors.[213] Between September 2013 and August 2014, Vale sold 62.4% of the VLI's share capital to Mitsui & Co., Ltd. (20%); the investment fund of Fundo de Garantia por Tempo de Serviço, a public employee benefits fund in Brazil (15.9%); and an investment fund managed by Brookfield Asset Management (26.5%). After the transactions, Vale entered into a shareholders' agreement with the other three shareholders and retained the remaining 37.6% of VLI's share capital.[214]

Also, during the 2010s, Vale began undertaking its most ambitious iron ore mining project, known as Carajás Serra Sul S11D, consisting of the development of a mine and processing plant—both started up in the fourth quarter of 2016—with an estimated production of 90 Mtpa. Located in Canaã dos Carajás (PA), in the southern range of Carajás, the mine was designed to increase efficiencies and reduce environmental impacts by using conveyor belts rather than off-highway trucks to move the ore. This reduces operating costs and generates lower carbon emissions, saving 77% on diesel each year and avoiding the replacement of truck tires. A total of 37 km of conveyor belts was installed in the mining area, using a 9.5-km trunk line between the mine and the processing plant, with a difference of altitude of 450 meters.[215]

The infrastructure component of S11D is called the Capacitação Logística Norte (CLN) S11D project, with an estimated total capital expenditure of US$ 11.4 billion (in current prices), aimed at expanding the estimated nominal logistics capacity of the Carajás corridor to 230 Mtpa.[216] The project consists in building a 101-km rail spur linking the S11D facilities in Canaã dos Carajás to the existing EFC (completed in 2016); duplicating or doubling (that is, expanding the single track to double track) approximately 570 km of railway (completed by 2020); expanding the fleet of railcars and locomotives in the EFC; and developing onshore and offshore expansions at the Ponta da Madeira Maritime Terminal, including by adding another iron ore pier (Pier IV) to the terminal to handle the additional production (completed in the last quarter of 2016).

At the time of writing, the EFC expansion project was complete, with additional rail and port infrastructure investments foreseen to complete the S11D logistics project by 2023.[217] In December 2018, in view of the expected increase in demand for high-grade ores, Vale announced an expansion of the S11D production from 90 to 100 Mtpa, and of the corridor's capacity from 230 to 240 Mtpa, with a start-up in 2022.[218]




# Appendix 2: Regulatory Framework Governing the EFC and FNS

The regulatory framework governing the EFC and FNS encompasses laws, regulations—particularly those issued by Brazil's independent regulatory agency of land transportation (*Agência Nacional de Transportes Terrestres* [ANTT])—and, more specifically, the concession and sub-concession agreements governing the two railroads. Other legal arrangements with relevance for shared use include a mutual access agreement between Vale and VLI's wholly-owned subsidiary Ferrovia Norte–Sul S.A.

## 1. Legislation

Key legislation relevant to the EFC and FNS railroads includes a statute generally regulating public service concessions,[219] a statute governing multiple sector specific regulators including ANTT,[220] and a decree specifically regulating railway operations.[221]

Law No. 8,987 of February 13, 1995, generally relating to public service concessions, includes provisions on quality of service, users' rights, freight rates, and fares, award process, terms and conditions of concession contracts, government responsibilities, concessionaire responsibilities, government step-in rights, and termination.

For service quality, services are required to be provided in satisfactory terms as regards regularity, efficiency, and moderation of freight rates. As concerns rates, besides providing that the ones initially applicable shall be those set out in the winning bid, it sets out the possibility of having contractual revision mechanisms. It addresses the issue of stabilization in case of unilateral changes by the government. The language in the law is similar to that used in the concession agreements to be analyzed below.

None of the concessionaire responsibilities mentioned in Law No. 8,987 relate to the shared use of public infrastructure. However, the provisions governing the award process give the government wide discretion to set out concession terms and conditions, which, therefore, may include shared-use requirements. Even so, offers of shared-use terms—for example, in the form of allocations of capacity to third parties—appear not to be a permissible differentiating factor for bids, since it is not among the list of possible award criteria specified in the provisions governing the award process.[222]

Furthermore, Law No. 8,987 contains an important provision concerning the use of the land subject to public service concessions for other purposes. Under this provision, the Government may authorize concessionaires to obtain revenue from the concession from sources other than the provision of the relevant public service.[223] This may include using railway infrastructure for other purposes, such as telecommunications or power transmission. Even so, federal legislation governing the telecommunications sector precludes railway concessionaires from charging telecommunications companies for deploying their infrastructure along railroads (see Section 3.4.2).

Law No. 10,233 of June 5, 2001, creates and sets out the role, mission, powers, and responsibilities of ANTT, the regulatory agency for all land transportation, including railways.

ANTT mission includes, notably, the promotion of economic and social development and Brazil's increased competitiveness in international markets.[224] However, its mandate is not entirely neutral as to how these goals should be achieved. For instance, ANTT is required to ensure, whenever possible, that users pay for the services received.[225] This mandate appears to restrict ANTT's ability to set access terms in concession agreements that would result in subsidization by concessionaires or anchor-clients.

Among the powers and responsibilities of ANTT are granting railway concessions, managing railway concession agreements, issuing regulations on the exploitation of railways, revising freight rates and rate caps (in accordance with applicable contractual provisions), authorizing investments, and developing studies about demand, pricing and the economic impact of railway services.[226]

*Photo: VLI's fuel railcars in Marabá (PA).*
*Photographer: Ricardo Teles / Agência Vale*

In exercising its powers to issue regulations, ANTT is charged with ensuring equal conditions in terms of access to infrastructure. However, the legal provisions do not define the concept of equality of access to infrastructure.[227]

In agreeing provisions for revision of freight rates or rate caps in concession agreements, ANTT is mandated to include as criteria the need to transfer to users any economic losses and gains caused by factors unrelated to the performance and responsibilities of concessionaires.[228]

Finally, Decree No. 1,832 of March 4, 1996, establishes regulations for the management of railways. Within the subject matters regulated are the setting of freight rates and fares and the operation of passenger trains.

The provisions on freight rates are generally consistent with those included in the concession agreements. Under said provisions, ANTT (on behalf of Brazil's federal government) must seek to revise freight rates and rate caps whenever permanent changes occur that affect the economic and financial balance in the provision of the relevant service.

With respect to passenger trains, Decree No. 1,832 provides for some very prescriptive requirements. **Of particular relevance in terms of shared use are the prioritization of passenger trains over all others except for rescue trains and the provision of free services to children under five who do not take a seat.**

## 2. Regulations

Key regulations relevant for shared use of the EFC and FNS railroads are contained in three resolutions issued by ANTT: Nos. 3,694, 3,695, and 3,696, all of July 14, 2011. Also of particular importance is ANTT Deliberation No. 362 of December 19, 2013. Lastly, ANTT Deliberation No. 2,695 of May 13, 2008 (as amended by ANTT Deliberation No. 5.405 of August 17, 2017) is relevant as concerns the use of railroads for ancillary purposes, such as the deployment of telecommunications infrastructure.

There are numerous areas of overlap between the provisions of the regulations issued by ANTT and those of the concession agreements for each of the EFC and FNS railroads, analyzed below (Section 3.1.2.3). Often, regulatory provisions are more detailed than contractual ones. Generally, they all appear to be consistent.

ANTT Resolution No. 3,694 of July 14, 2011, establishes regulations for users of railway cargo transportation services. These regulations include provisions on the scope of services provided by concessionaires, users' rights and obligations, concessionaires' liability, level of service, transport contracts' terms and conditions, freight rates, highly dependent users, investment by users, dispute resolution, and violations and penalties.

One matter covered by ANTT Resolution No. 3,694 but not by the concessions, of particular interest for shared use, is that of investment by railway users. **According to those provisions, third-party users have a right to invest in capacity expansions that are necessary to accommodate their demand for transportation services, notwithstanding opposition by the concessionaire.** The regulations include a detailed procedure, arbitrated by ANTT, for negotiations between the relevant user and concessionaire regarding such expansions.

Another matter relevant for shared use, which ANTT Resolution No. 3,694 covers in detail, is **that of users who are highly dependent on railway transportation. Under the relevant provisions, such users are entitled to require the allocation of capacity on a take-or-pay basis and subject to special freight rates to be determined by ANTT if the relevant user and concessionaire are unable to reach an agreement.**

ANTT Resolution No. 3,695 of July 14, 2011, establishes regulations for exercising access rights and mutual traffic on Brazilian railroads. These regulations include provisions on technical requirements for access, public disclosure of information on technical specifications, access contracts' terms and conditions, rates, expansion of capacity, transportation of hazardous materials, and dispute resolution.

The provisions on freight rates included in ANTT Resolution no. 3,695 are more prescriptive than the ones existing in the concession agreements for the EFC and FNS. Under such provisions, certain rules must be complied with in setting rates for third-party access and mutual traffic, notwithstanding the discretion of the parties to negotiate them. Rates shall comprise only two components: operational costs and capital remuneration. The operational costs component accounts for the costs incurred in connection with the granting of access or mutual traffic, whether fixed or variable. Capital remuneration is computed by applying a remuneration factor (set annually by ANTT for each concession) to the amount of capital investment in the relevant concession after deducting any depreciation.

Also of interest for shared use are the provisions in relation to the expansion of capacity. These cover issues such as the right to impose take-or-pay terms in case of investments by concessionaires, and reservation and resale of capacity in case of investments by third parties exercising access rights. However, unlike the provision on investment by users in ANTT Resolution No. 3,694, the provisions on the expansion of capacity in ANTT

Resolution No. 3,695 do not include a right to invest. Thus, any expansions appear to still require the agreement of the relevant concessionaire.

ANTT Resolution No. 3,696 of July 14, 2011, establishes regulations for the agreement with concessionaires of throughput targets. These include provisions on procedures for revision of targets, as well as for assessing compliance with those targets.

Only the concession agreement for the FNS includes provisions on throughput targets. The regulations in ANTT Resolution no. 3,696 serve the purpose of elaborating on how to comply with such contractual provisions. As for the EFC, its concession agreement does not include a similar provision, and we understand that ANTT has set no throughput targets for the railroad.

ANTT Deliberation No. 2,695 of May 13, 2008 (as amended by ANTT Deliberation No. 5.405 of August 17, 2017) establishes regulations for the authorization of construction works on railroads. With interest for shared use are the provisions governing the authorization of works by third parties for the deployment of infrastructure unrelated to railway operations. Under these provisions, an interested third party may express its interest to the railway concessionaire, and the concessionaire must petition ANTT on behalf of the third party, seeking authorization to build infrastructure unrelated to the railway operations. For instance, this may include authorization to deploy telecommunications infrastructure along the railway. Pursuant to the relevant provisions, no direct relationship needs to be established between the government and the relevant third parties. Instead, all relevant arrangements should be the subject of a contract between such third parties and the relevant concessionaire.

Lastly, ANTT establishes a minimum level of capacity for transportation of general cargo on the EFC.[229] **The same ANTT deliberation, taken in connection with the approval of expansion works, sets out at 19.9 Mtpa the minimum capacity that must be allocated to general cargo, corresponding to 8.65% of overall capacity**. Even so, Vale has indicated that, to date, the capacity effectively used to transport general cargo on the EFC has remained consistently below the minimum level. However, it appears that the situation has not triggered any enforcement action by ANTT.

## 3. Concession Agreements

The concession agreement for the EFC is dated June 30, 1997, and was signed between Brazil's federal government and Vale. In the case of the FNS railroad, there are two agreements: a concession agreement dated June 8, 2006, between ANTT (on behalf of Brazil's federal government) and VALEC – Engenharia, Construções e Ferrovias S.A. (VALEC, a state-owned company controlled by Brazil's federal government), as well as a sub-concession agreement dated December 20, 2007, between VALEC, ANTT, and Ferrovia Norte–Sul S.A., a fully-owned indirect subsidiary of VLI.

### 3.1. Review of the EFC Concession Agreement

The concession agreement for the EFC railroad dates back to the privatization of Vale. It grants Vale a 30-year exclusive concession to develop and exploit cargo and passenger services on the EFC railroad. The agreement is not particularly prescriptive or detailed. In general, the regulatory approach it takes is to establish general principles, leaving practical implications left to interpretation. For instance, Vale undertakes to provide its services without any discrimination between users or abuse of economic power, and in satisfactory terms, as regards regularity, efficiency, and moderation of freight rates:[230]

> These are obligations of the parties: [1 – Obligations of the Concessionaire] … VIII) Providing adequate service to users' satisfaction, without any kind of discrimination and without incurring in abuse of economic power, meeting the conditions of regularity, continuity, efficiency, safety, timeliness, generality, and courtesy in its provision and affordability of freight rates and fares.

Even so, certain important obligations are outlined in strict terms with respect to two relevant aspects of the shared use of the EFC: passenger services and third-party access.

With respect to passenger services, Vale is required to ensure the continuation of the services existing at the time the concession was granted, unless otherwise authorized by Brazil's federal government:[231]

> These are obligations of the parties: [1 – Obligations of the Concessionaire] … XXV) Ensuring the provision of current passenger services, which may only be altered with the prior authorization of the Conceding Authority.

No similar provision applies to general cargo trains. Indeed, as regards the provision by Vale of general cargo services, the concession agreement does not set forth any minimum service requirements.

As regards third-party access to the EFC, Vale is required to allow access to any third parties that so request, and to enter into access agreements with such third parties:[232]

> These are obligations of the parties: [1 – Obligations of the Concessionaire] [...] XXI) Guaranteeing mutual traffic or, if this is not possible, allowing the right of way to other rail transport operators, by concluding a contract, giving notice of such agreements to the Conceding Authority within 30 (thirty) days. The requirements that the Conceding Authority may make concerning the clauses of such contracts related to the control of the abuse of economic power and the safety of rail traffic shall be final.

**While Vale is generally free to negotiate the terms of any such access agreements, it must accept any determinations by Brazil's federal government with respect to avoiding abuses of market power**. Arguably, this governmental prerogative can be used to intervene in situations where conditions offered by Vale in access agreements are deemed too costly or otherwise result too cumbersome for the third parties seeking access to the railroad. While the concession agreement includes the obligation to allow access, it does not provide details as to how requests for access exceeding available capacity are to be handled. In particular, no provisions set a minimum allocated capacity for third parties or dealing with conflicting requests for access (either between Vale's and third party's trains or between multiple third parties).

Vale may set freight rates for its own cargo services. However, this right is subject to the important limitation that caps apply to the maximum amounts at which rates may be set.[233] The initial caps were set out in the concession agreement and made subject to automatic annual adjustment based on a specified consumer price index.[234] Moreover, Brazil's federal government has the right to revise applicable caps every five years, taking into consideration permanent changes in market conditions or cost base, provided the economic and financial balance is maintained. Vale may also request revisions to the caps, under the same conditions.[235] The concession agreement is silent about rates applicable to third-party access, although, as mentioned above, it provides that Vale is generally free to negotiate the terms of access agreements.

Vale enjoys less discretion in the case of passenger services. Fares charged to passengers must follow price schedules approved by ANTT.[236]

## 3.2. The EFC Concession Extension Process

By the initiative of Brazil's federal government, the holders of certain railroad concessions granted in the 1990s were offered the possibility of an early extension of their concessions in return for new investments. The EFC was included in the group of relevant concessions.[237] The conditions for the extension were defined by law.[238] Extensions are not conditioned on the making of new capital investments, but the government has the discretion to require them.[239]

In this context, while Vale's concession for the EFC is only set to expire on June 30, 2027, Brazil's federal government and Vale engaged in negotiations for the early extension of the EFC concession for an additional 30 years.[240]

When negotiating extensions of railway concessions, Brazil's federal government typically requires the concessionaire to present infrastructure investment projects. The government and the concessionaire then negotiate, in light of the government's priorities under the national logistics plans, the projects that the concessionaire must implement to be granted the extension of the concession.[241] In this context, early extensions allow the government to obtain concession payments as well as commitments from concessionaires to make additional investments in safety, additional capacity, and new technology,[242] while allowing concessionaires to obtain legal certainty about the renewal of their concession sooner, without an open tender.

As a condition for a concession extension, Brazil's federal government may require the concessionaire to make investments in its railroad or other parts of the national railway network ("cross investments").[243] In 2018, when first announcing the possibility of early extensions of Vale's railway concessions, the government suggested requiring Vale to invest R$ 4 billion in building a 383-km section of a different railroad as a condition for the extension of the concessions for both its railroads: the EFC as well as the Vitória–Minas Railroad (*Estrada de Ferro Vitória a Minas* (EFVM)], which serves Vale's operation in Brazil's Southeast. The section of the Center–West Integration Railroad (*Ferrovia de Integração do Centro-Oeste* [FICO]) that Vale would build, linking Mara Rosa (GO) to Água Boa (MT), would not link to the EFC or the EFVM. Neither would it be operated by Vale: after the company completed the construction works of the new section, Brazil's federal government would launch a tender for its operation.[244] On July 29, 2020, Brazil's national public news agency announced that the country's Federal Court of Accounts (*Tribunal de Contas da União* [TCU]) authorized the early extension of Vale's two railway concessions and that, as part of its payment for the extensions, Vale would pay R$ 2.73 billion (roughly US$ 500 million) into a fund for the construction of the FICO Railroad.[245]

The proceeding for the early extension of the EFC concession also serves to illustrate ANTT's role and independence as a regulatory agency. Given that the extension is part of government plans, which are politically determined by the ministry of transportation, in this case, ANTT acts in the concession extension proceedings with limited autonomy; it serves as the implementor of the ministry's plans. On the other hand, in technical matters, ANTT has greater autonomy; decisions made by ANTT on technical aspects of railway regulation are less likely to be revised in light of political decisions by the ministry. ANTT also takes decisions to harmonize the interests of government, concessionaires, and users of railway services, when these stakeholders fail to agree.[246]

We understand that the process to extend the EFC concession is at a near-final stage. On July 1, 2019, the draft concession extension agreement to be signed between ANTT (on behalf of Brazil's federal government) and Vale (as concessionaire), as well as other documents pertaining to the early extension, were filed with TCU for review, in restricted proceedings.[247] We review below the draft concession extension agreement filed with the TCU. A TCU decision of July 29, 2020, authorized Brazil's federal government to proceed with the extension of Vale's EFC concession, subject to some adjustments to the draft.[248]

## 3.3. Review of the EFC Draft Concession Agreement

The draft negotiated in the context of the extension of the EFC concession is meant to fully replace the existing concession agreement. Considerably more prescriptive and detailed than the existing one, it shows a higher level of sophistication, likely driven by accumulated know-how and experience on the part of both Vale as railway concessionaire and ANTT as a dedicated sector regulator. **Assuming that the current draft is executed, the extension of the concession should result in improvements in terms of the shared use of the EFC. Among the new contractual provisions that should have a positive impact on shared use are new obligations relating to passenger services and a more detailed regime for third-party access.**

As regards passenger services, Vale's obligations shall be increased from the sixth year of the extension onwards. Until such date, Vale shall be required to maintain the current number of passenger services of 0.5 pairs of trains per day, corresponding to the current frequency of passenger trains on the EFC (port–mine and mine–port on alternate days). Afterward, Vale shall be required to operate one pair of trains per day (mine–port and port–mine both every day).[249]

In terms of third-party access, the draft establishes obligations for Vale that are both more prescriptive and stringent. It expressly provides that access rights and mutual traffic shall be granted consistently with ANTT regulations.[250] Moreover, while Vale will still free to negotiate the terms of access agreements, the draft new concession agreement expressly prohibits it from imposing requirements that are more restrictive than the ones established by ANTT.[251] Vale shall also become contractually responsible for providing third-parties with all on-board equipment necessary for the interaction with the EFC signaling and communication systems, at prices consistent with said equipment's purchase price, together with all necessary training.[252]

Besides the rules as mentioned above generally applicable to all third-party access requests, **the draft new concession agreement grants special access rights to the sub-concessionaire of the South Section of the FNS, between Porto Nacional (TO) and Estrela D'Oeste (SP)**.[253] **The FNS sub-concessionaire will have an access right to access the Itaqui port complex in São Luís (MA).** Vale will be required to allocate capacity to such sub-concessionaire's trains, starting with 0.20 pairs of trains per day and growing within five years to 0.48 pairs of trains per day. The transit time for the route cannot be higher than 41 hours. Freight rates charged by Vale shall be subject to a cap of 9.54 R$/ton (at 2016 prices).

The new concession agreement would impose an obligation on Vale to maintain the "Railroad Saturation Index" below 90%. Accordingly, **whenever 90% of the capacity of the railroad is reached, the concessionaire is required to make investments to expand the capacity, always leaving 10% of available capacity.**[254] However, this obligation is less far reaching than it may appear at first. Since the "Railroad Saturation Index" only measures used capacity, as opposed to demanded capacity, it remains to some extent within the control of the concessionaire. For instance, if Vale refuses a request by a potential customer to carry out a transportation service (whether due to lack of capacity or otherwise), the capacity that would have been used by that customer is not computed in calculating the "Railroad Saturation Index."

The new concession agreement will bring a few significant changes to Vale's powers to set rates. For the most part, these changes go in the direction of allowing Vale increased discretion. However, they are balanced by some important new restrictions.

Vale's discretion will be enhanced in two ways. First, the draft agreement expressly permits Vale to charge different rates to its various cargo customers:[255]

> The Concessionaire may practice distinct Freight Rates and Right of Way Rates [or access fees] between Users, observing the Reference Rate and the Rate Dispersion Limit, and provided it is based on objective and isonomic contracting criteria, such as term, volume, seasonality, and payment conditions.

This provision shall apply to both Vale's own cargo services and third-party access. Second, there will no longer be fixed fares for passenger services, which shall instead be subject to caps.

Restrictions on Vale's powers to set rates under the new agreement stem from two constraints. First, as is already the case in the current concession agreement for cargo services, rates are subject to caps. The draft new concession agreement includes caps not only for cargo services but also for passenger services and third-party access. Initial caps shall be included in an annex to the agreement. Caps on rates shall be updated annually by ANTT based on a consumer price index. Unlike the current agreement, the draft contains no provision for revisions of caps on rates by either ANTT or the concessionaire other than to adjust for inflation. The second constraint on Vale's rate-setting powers consists of the introduction of a new concept of rate dispersion limit. This entails the application of both a floor and a cap on the rate Vale can charge any given customer. Said floor and cap are computed pursuant to formulae that factor in the average and the standard deviation in rates charged and ANTT caps on rates.

Although the early extension of the EFC concession is being done ostensibly in return for new investments, the draft new concession agreement does not require any immediate investments by Vale on outright capacity expansion. Instead, requirements to make such investments are conditional on used capacity reaching certain specified levels. Even so, the draft does impose obligations relating to maintenance levels and construction of new railway crossings that should have a positive impact on available capacity.

## 3.4. Review of the FNS Concession Agreement

The contractual structure for the FNS railroad is different in that, as mentioned above, there are both a concession agreement and a sub-concession agreement. The former grants to the state-owned enterprise VALEC a concession over the whole FNS railroad, while the latter grants to the private company VLI S.A. a sub-concession over the 720-km North Section of FNS, stretching from Açailândia (MA) to Palmas (TO). On the Palmas side, the sub-concession includes the terminal of Porto Nacional (TO). The concession was awarded for 50 years, while the sub-concession has a 30-year term.

The concession agreement for FNS grants VALEC an exclusive concession to develop and exploit cargo and passenger services on the entire FNS railroad. Transportation of a diverse array of cargo is specifically mentioned as being the goal of the concession, namely livestock, energy resources, mineral resources, and industrial products.[256] This agreement has some similarities with the one for the EFC. At times, it also adopts the approach of establishing general principles, leaving practical implications to interpretation. However, it is substantially more precise on a number of obligations, including some that are relevant for shared use. This may reflect the fact that this concession agreement was concluded ten years after the one governing the EFC.

Importantly, the FNS concession agreement differs from the EFC one in two ways: ANTT's wider discretion in setting rates, and the inclusion of cargo throughput targets.

The provisions relating to rates in the FNS concession mirror, for the most part, those applicable to the EFC. However, there are two important differences. First, in setting rate caps, ANTT is not constrained to do so only in view of permanent changes in market conditions or cost base.[257] This does not mean that ANTT has a free hand since its discretion is effectively limited by VALEC's right to the preservation of the economic and financial balance of the concession.[258] Even so, it gives ANTT greater freedom to use its freight rate regulation power to promote access. The second important difference relates to special rates for users who depend highly on railway transportation. Consistently with ANTT Resolution No. 3,694 of July 14, 2011, the concession provides for this type of user that, if they are unable to reach an agreement with VALEC, they can appeal to ANTT, which holds the right to make final determinations as to special rates applicable to them.[259]

As is the case with the EFC, the concession agreement provides that rates charged to passengers must follow price schedules approved by the ANTT.[260] However, differently from the EFC, VALEC is not required to operate passenger trains on the FNS railroad.

The concession specified throughput targets for cargo for the years 2006 to 2010. For each subsequent five-year period, ANTT and VALEC must agree on such targets based on market demand studies:[261]

> The Conceding Power shall establish new annual throughput targets to be agreed with the Concessionaire in each subsequent five-year period. As an input into the establishment of such targets, the Concessionaire shall submit to the Conceding Power, by June 30th of the penultimate year of the preceding five-year period, the projections of railroad transportation demand, duly substantiated by specific market studies.

Targets may be revised at VALEC's request but only in case of demand fluctuations:[262]

> In the event of a change in demand, the production targets established under item 6.1 may be adjusted to the new market reality, employing a technically substantiated statement submitted by the Concessionaire to the Conceding Power.

Repeated failure to reach targets may result in penalties to VALEC, to the extent attributable to it.[263]

As regards third-party access, the FNS concession is very similar to the EFC's. VALEC is required to allow access to any third parties that so request and to enter into access agreements with such third parties, without constituting an abuse of market power.[264] Likewise, no minimum allocated capacity for third parties seeking access for transportation of cargo is set out in the concession agreement. Nor are there any provisions dealing with how requests for access exceeding available capacity should be handled. However, contrary to what is the case for the EFC, minimum capacity is allocated for third parties running passenger services. Under the concession agreement for the FNS, VALEC is required to give right of way, to any willing rail operator, for at least two pairs of passenger trains per day, in sections with an annual traffic density of at least 1,500 metric tons per km.[265] However, this right appears to never have been exercised, as there are no passenger services on the FNS.

The FNS sub-concession grants VLI an exclusive concession to manage, exploit, operate, maintain, and improve cargo services on the North Section of the FNS.[266] The sub-concession does not cover passenger services. Also excluded from the sub-concession is the business of providing storage and loading facilities for cargo trains, which is retained by VALEC.[267]

The FNS sub-concession closely tracks the FNS concession, according to which the sub-concession is granted. Notably, the provisions on rates, throughput targets, and third-party access are substantively the same as those in the concession, with VLI assuming the same obligations as VALEC.

## 4. Mutual Access Arrangements between EFC and FNS

On June 19, 2006, Vale and VALEC entered into a mutual access agreement, designated in its original in Portuguese as a Specific Operational Agreement (*Contrato Operacional Específico*). The main purpose of the agreement is to establish arrangements for the movement of cargo from the EFC to the FNS and vice versa. When VALEC and VLI concluded the FNS Sub-Concession Agreement, the mutual access agreement was transferred to VLI. Subsequently, Vale and VLI entered into several replacement mutual access agreements. The agreement currently in force was entered into on May 22, 2015, and amended on January 22, 2019.

Under the agreement, Vale and VLI agree to provide each other with access to their respective railway concessions, respectively, the EFC and the FNS. The purpose is to allow the joint offer of transportation services with origin in one concession and destination in the other one.[268]

As a rule, Vale and VLI agree to provide each other access by way of mutual traffic. In practice, each concessionaire remains responsible for operating the trains in its concession area, with cargo being exchanged at a border terminal.[269] Thus, access of trains operated by either concessionaire to the other's railroad remains an exception.[270] For mutual traffic, exchanges of cargo and rolling stock take place at the Vale-operated terminal in Açailândia (MA).

Each year, the two parties meet to agree on an annual plan, with indicative allocations of capacity to each other's cargo. Allocations are updated monthly, based on each party's most recent forecasts of demand for services. Each party undertakes to provide the other with access up to the capacity allocated in the annual plan. However, neither party assumes take-or-pay obligations. Although each concessionaire is responsible for agreeing its terms with the customers, the division of freight rates between the two concessionaires is made pursuant to a pre-agreed formula.

One exception to the rule of providing access by way of mutual traffic relates to cargo loaded at the Itaqui port complex (including the Ponta da Madeira Maritime Terminal) and transported to a point along the FNS. In this case, VLI can load the cargo onto its own trains and transport it the whole way.[271] Access fees owed by VLI to Vale for exercising this access right are computed pursuant to a pre-agreed formula.

Furthermore, the agreement contains multiple provisions on technical matters relevant for exchanges of rolling stock, arrangements for the creation of a joint pool of railcars, arrangements for maintenance and leases of rolling stock, as well as arrangements for fuel supply and emergency rescue services.

## 5. Freight Rate Structure

The ANTT sets maximum rates for the EFC and FNS railroads pursuant to the legislative, regulatory, and contractual provisions described in the previous sections. As explained above, other than for passenger services on EFC, rates set by ANTT operate as caps only. The concessionaires retain discretion to charge lower rates for cargo.

In the case of the EFC, the most recent ANTT deliberation with respect to maximum rates is dated November 5, 2019.[272] Rates for the EFC include so-called fixed and variable components. The former is computed based on weight only, while the latter takes into consideration both weight and distance. The maximum rates for the EFC are indicated in Table 8.

As for the FNS railroad, the most recent ANTT deliberation with respect to rates was adopted on March 31, 2020.[273] As is the case with the EFC, rates for the FNS comprise fixed and variable components. The maximum rates for the FNS are indicated in Table 9.

### Table 8: Freight rates per type of cargo, EFC (2019)

| | Fixed component (R$) | 0-400 km (price per km) | 401-800 km (price per km) | 801-1600 km (price per km) | Above 1600 km (price per km) |
|---|---|---|---|---|---|
| Copper | 11.62 RS/ton | 0.0498 R$/ton | 0.0424 R$/ton | 0.0375 R$/ton | 0.0248 R$/ton |
| Fuels | 34.56 R$/m$^3$ | 0.1481 R$/m$^3$ | 0.1259 R$/m$^3$ | 0.1111 R$/m$^3$ | 0.0741 R$/m$^3$ |
| Pig iron | 17.93 R$/ton | 0.0768 R$/ton | 0.0654 R$/ton | 0.0576 R$/ton | 0.0385 R$/ton |
| Manganese | 8.16 R$/ton | 0.0351 R$/ton | 0.0297 R$/ton | 0.0263 R$/ton | 0.0175 R$/ton |
| Iron ore | 8.08 R$/ton | 0.0345 R$/ton | 0.0294 R$/ton | 0.0261 R$/ton | 0.0173 R$/ton |
| Other cargo | 17.93 R$/ton | 0.0768 R$/ton | 0.0654 R$/ton | 0.0576 R$/ton | 0.0385 R$/ton |

**Source:** Prepared by the authors based on applicable legal instruments.

### Table 9: Freight rates per type of cargo, FNS (2020)

| | Fixed component | Variable component |
|---|---|---|
| Manure and fertilizers | 52.37 R$/ton | 0.1293 R$/ton |
| Cement, lime and clinker | 32.65 R$/ton | 0.1273 R$/ton |
| Sugar | 26.05 R$/ton | 0.1939 R$/ton |
| Vegetable oil | 47.86 R$/ton | 0.1082 R$/ton |
| Grain and bran | 27.88 R$/ton | 0.0874 R$/ton |
| Fuels | 42.25 R$/m$^3$ | 0.4118 R$/m$^3$ |
| Cotton | 39.36 R$/ton | 0.1538 R$/ton |
| Container (20ft empty) | 233.32 R$/TEU | 1.7284 R$/TEU |
| Container (40ft empty) | 419.96 R$/TEU | 3.1111 R$/TEU |
| Container (20ft loaded) | 325.90 R$/TEU | 2.4135 R$/TEU |
| Container (40ft loaded) | 586.62 R$/TEU | 4.3445 R$/TEU |
| Other cargo | 25.86 R$/ton | 0.1238 R$/ton |

**Source:** Prepared by the authors based on applicable legal instruments.

## Endnotes

### 1. Introduction

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109 "A TELMA colocará à disposição da CVRD 08 (oito) fibras ópticas no trecho compreendido entre São Luís – Santa Inês, tronco principal, via ferrovia, e 04 (quatro) fibras ópticas no mesmo trecho, tronco alternativo, via rodovia, o qual será utilizado em caso de ruptura do cabo." (Clause 2.2 of "Convênio CVRD/TELMA", *supra*).

110 "Estás fibras ópticas estarão À disposição da CVRD exclusivamente para sinalização ferroviária e comunicações operacionais restritas ao trecho ao longo da ferrovia. Em nenhum hipótese a CVRD poderá utilizar as fibras à sua disposição para transmitir ou receber qualquer outro tipo de comunicação ou oferecer serviço de qualquer outra natureza além dos mencionados no cadastro acima estabelecido." (Clause 2.2 of "Convênio CVRD/TELMA", *supra*).

111 "[1] A EMBRATEL fará lançamento de Cabo Óptico com 24 (vinte e quatro) fibras ópticas em conjunto com Cabo Óptico da TELMA de 48 (quarenta e oito) fibras, entre São Luís e Santa Inês (km 213 da EFC), no Estado do Maranhão, pelo leito da ferrovia, sem qualquer ônus para a CVRD. [2] A EMBRATEL fará lançamento de cabo óptico com 24 fibras ópticas em conjunto com cabo óptico da TELMA de 48 (quarenta e oito) fibras entre o km 541 (Açailândia), no Estado do Maranhão, sem qualquer ônus para a CVRD" (Clauses 1.2 and 1.3 of "Primeiro Termo de Adesão ao Convênio CVRD/TELMA firmado em 22/02/95" dated April 25, 1997 between Vale, Telecomunicações do Maranhão S/A and Empresa Brasileira de Telecomunicações S.A.).

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## 4. Impacts of Shared Use Along the Carajás Corridor

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## Appendix 1: Background and Historical Context

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232 Translated by the authors from the original in Portuguese: "São obrigações das partes: [1 – Das Obrigações da Concessionária] [...] XXI) Garantir tráfego mútuo ou, no caso de sua impossibilidade, permitir o direito de passagem a outros operadores de transporte ferroviário, mediante a celebração de contrato, dando conhecimento de tais acordos à CONCEDENTE no prazo de 30 (trinta) dias. Serão definitivas as exigências que a CONCEDENTE venha a fazer com relação às cláusulas de tais contratos referentes ao controle do abuso de poder econômico e à segurança do tráfego ferroviário." (Clause 9.1 of "Contrato de Concessão [...] Estrada de Ferro Carajás", *supra*).

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250 "O compartilhamento da Infraestrutura ferroviária e dos recursos operacionais será realizado por direito de passagem e através do tráfego mútuo, respectivamente, nos termos da regulamentação específica da ANTT." (Clause 9.1.1 of "Minuta de Termo Aditivo ao Contrato de Concessão da Estrada de Ferro Carajás", *supra*).

251 "As condições para o compartilhamento da Infraestrutura ferroviária e de recursos operacionais serão estabelecidas entre a Concessionária e os terceiros interessados, vedado o estabelecimento de exigências mais restritivas que aquelas regulamentadas pela ANTT." (Clause 9.1.2 of "Minuta de Termo Aditivo ao Contrato de Concessão da Estrada de Ferro Carajás", *supra*).

252 "Deverão ser observados os seguintes critérios nas operações de direito de passagem: [1] A Concessionária é responsável por

disponibilizar equipamentos compatíveis com seus sistemas de sinalização e comunicação às locomotivas do terceiro interessado, às expensas do terceiro interessado. [2] A Concessionária deverá prover os equipamentos e sistemas necessários, em condições de preços compatíveis com os por ela adquiridos. [3] A Concessionária deverá, mediante remuneração a ser paga pelo terceiro interessado, fornecer qualificação técnica para a habilitação de maquinistas para operação nos trechos ferroviários compartilhados." (Clause 9.3 of "Minuta de Termo Aditivo ao Contrato de Concessão da Estrada de Ferro Carajás", *supra*).

253 "Deverão ser observadas as diretrizes constantes do Anexo 9 para o compartilhamento da infraestrutura ferroviária em direito de passagem com a Subconcessionária da Ferrovia Norte-Sul, no trecho compreendido entre Porto Nacional/TO e Estrela d ́Oeste/SP, sem prejuízo de que o compartilhamento possa ocorrer por meio de tráfego mútuo, a critério das partes." (Clause 9.4 of "Minuta de Termo Aditivo ao Contrato de Concessão da Estrada de Ferro Carajás", *supra*).

254 Os Investimentos condicionados à Demanda consistem em intervenções a serem realizadas pela Concessionária para adequação da capacidade operacional da Ferrovia à demanda por transporte ferroviário de cargas, de forma a manter o Índice de Saturação da Ferrovia (ISF) sempre abaixo de 90% (noventa por cento)." (Clause 1 of Appendix A to Annex 1 of Minuta de Termo Aditivo ao Contrato de Concessão da Estrada de Ferro Carajás", *supra*).

255 "A Concessionária poderá praticar Tarifas de Transporte e Tarifas de Direito de Passagem distintas entre Usuários, observando a Tarifa de Referência e o Limite de Dispersão Tarifária, e desde que baseada em critérios objetivos e isonômicos de contratação, tais como prazo, volume, sazonalidade, e condições de pagamento." (Clause 19.2.4 of "Minuta de Termo Aditivo ao Contrato de Concessão da Estrada de Ferro Carajás", *supra*).

256 "O presente contrato visa à oferta de transporte eficiente e de baixo custo, adequado ao trânsito do produto agropecuário, energético, mineral e industrial, para transporte em geral na região Araguaia-Tocantins, conforme referido no art. 1º do Decreto nº 94.813, de 1º de setembro de 1987 e na Lei nº 11.297, de 9 de maio de 2006, nos termos desta concessão e observadas as seguintes condições: [...]" (Clause 2 of "Contrato de Concessão [...] para Construção, Exploração e Desenvolvimento do Serviço Público de Transporte Ferroviário de Cargas e de Passageiros na Estrada de Ferro Norte-Sul" dated June 8, 2006 between ANTT (on behalf of the Brazilian Federal Government) and VALEC – Engenharia, Construções e Ferrovias S.A.).

257 "As tarifas de referência serão revistas pela CONCEDENTE a cada cinco anos." (Clause 9.2 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

258 "São direitos da CONCESSIONÁRIA: [...] V) Ter preservado o equilíbrio econômico-financeiro deste contrato de CONCESSÃO." (Clause 11 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

259 "A tarifa para o usuário com elevado grau de dependência do transporte ferroviário será estabelecida através de contrato operacional específico, firmado entre a Concessionária e o usuário. Caso não haja acordo, o usuário poderá solicitar à CONCEDENTE a fixação de tarifa específica, que leve em consideração os custos das operações envolvidas." (Clause 8, § 5 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

260 "Os serviços públicos de transporte de passageiros serão remunerados por tarifas aprovadas pela CONCEDENTE mediante proposta da CONCESSIONÁRIA e deverão obedecer ao padrão adotado pelas estradas de ferro brasileiras." (Clause 8, § 6 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

261 Translated by the authors based on the original in Portuguese: "A CONCEDENTE estabelecerá novas metas anuais de produção de transporte que deverão ser pactuadas com a CONCESSIONÁRIA a cada qüinqüênio subseqüente. Para servir de subsídio ao estabelecimento de tais metas, a CONCESSIONÁRIA deverá apresentar à CONCEDENTE, até o dia 30 de junho do penúltimo ano do qüinqüênio anterior, as projeções de demanda de transporte ferroviário, devidamente consubstanciadas por estudos específicos de mercado." (Clause 6.1, §1 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

262 Translated by the authors based on the original in Portuguese: "Na ocorrência de modificação da demanda, as metas de produção estabelecidas nos termos do item 6.1 poderão ser ajustadas à nova realidade de mercado, mediante demonstrativo tecnicamente fundamentado, submetido pela CONCESSIONÁRIA à CONCEDENTE." (Clause 6.1, §3 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

263 "O descumprimento das metas de produção e de redução de acidentes estipuladas na Cláusula Sexta deste Contrato implicará na aplicação de advertência ou multa, de acordo com os seguintes critérios: [1] Será considerada INADIMPLÊNCIA SIMPLES, passível de advertência, o não cumprimento de qualquer uma das metas, de Produção ou de Redução de Acidentes, num determinado exercício. [2] A reincidência de INADIMPLÊNCIA SIMPLES, por dois exercícios, consecutivos ou intermitentes, num período de até seis anos, implicará aplicação de multa pecuniária, entre o mínimo de 0,1% (um décimo por certo) e o máximo de 2,0% (dois por cento) da receita anual bruta de transporte, conforme estabelecida com base na seguinte equação: [...]"(Clause 19.11 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

264 "São obrigações das partes: [1 – Das Obrigações da Concessionária] [...] XXI) Garantir tráfego mútuo ou, no caso de sua impossibilidade, permitir o direito de passagem a outros operadores de transporte ferroviário, mediante a celebração de contrato, dando conhecimento de tais acordos à CONCEDENTE no prazo de 30 (trinta) dias. Serão definitivas as exigências que a

CONCEDENTE venha a fazer com relação às cláusulas de tais contratos referentes ao controle do abuso de poder econômico e à segurança do tráfego ferroviário." (Clause 10.1 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

265 "Assegurar, a qualquer operador ferroviário, durante a vigência do presente contrato, a passagem de até 2 (dois) pares de trens de passageiros por dia em trechos com densidade anual de tráfego mínima de 1.500.000 TKU/km." (Clause 10.1 of "Contrato de Concessão [...] Estrada de Ferro Norte-Sul", *supra*).

266 "O presente Contrato tem por objeto a SUBCONCESSÃO COM ARRENDAMENTO para prestação do serviço de administração e exploração da FERROVIA NORTE-SUL – FNS, no trecho de Açailândia, no Estado do Maranhão, até Palmas no Estado do Tocantins, compreendendo a operação, conservação, manutenção, monitoração, melhoramentos e adequação do trecho ferroviário, nos termos definidos no Edital Nº 001/2006 e em seus Anexos." (Clause 1 of "Contrato de Subconcessão com Arrendamento [...] para a Administração e Exploração do Serviço Público de Transporte Ferroviário de Carga na Ferrovia Norte-Sul-FNS" dated December 20, 2007 between VALEC – Engenharia, Construções e Ferrovias S.A.) and Ferrovia Norte Sul S.A., with ANTT (on behalf of the Brazilian Federal Government) as signatory interested party).

267 "Será [...] responsabilidade da VALEC: [...] II) Explorar comercialmente os Pólos de Carga no que diz respeito à cessão de áreas para a instalação, pelos usuários, de silos, armazéns, moegas e sistemas de carga e descarga entre outros." (Clause 10.1, §2 of "Contrato de Subconcessão com Arrendamento [...] Ferrovia Norte-Sul-FNS", *supra*).

268 "O presente CONTRATO está vinculado às concessões da FNS e da EFC, e tem por objeto o estabelecimento dos critérios e condições para realização e desenvolvimento das operações ferroviárias conjuntas e intercâmbio de material rodante, através da otimização das ações de cada uma das PARTES." (Clause 1.1 of "Contrato Operacional Específico de Uso da Infraestrutura Ferroviária" dated May 22, 2015 between Vale and FNS).

269 "Para fins do disposto neste CONTRATO, entende-se como tráfego mútuo a operação em que uma PARTE, necessitando ultrapassar os limites geográficos de sua malha para prosseguir ou encerrar uma prestação de serviço público de transporte ferroviário, compartilha os recursos operacionais, tais como material rodante, via permanente, pessoal, serviços e equipamentos, com a concessionária em cuja malha se dará o prosseguimento ou encerramento da prestação de serviço, mediante remuneração." (Clause 3.1 of "Contrato Operacional Específico de Uso da Infraestrutura Ferroviária", *supra*).

270 "As operações em direito de passagem de uma PARTE na malha da outra PARTE, somente poderão ocorrer fora da regra geral de tráfego mútuo aqui estabelecida, para atender um fluxo mensal específico e desde que tal fluxo tenha sido estabelecido nos programas de transportes já estimados e consensados [...] em uma das circunstâncias abaixo: (i) Inviabilidade econômica, entendida como falta de interesse comercial de uma das PARTES em realizar as operações na modalidade de tráfego mútuo, conforme pré-requisitos definidos nesta cláusula; (ii) Comprovada inviabilidade técnica e/ou operacional de uma das PARTES, caracterizada pela inadequação dos recursos exigidos e/ou em quantidade insuficiente para atender a demanda nos prazos estabelecidos; (iii) Quando o transporte de carga dos usuários de uma determinada PARTE tiver que ultrapassar os limites da sua ferrovia, nos casos em que os seus custos operacionais, no compartilhamento por Tráfego Mútuo, forem superiores aos custos operacionais do direito de passagem e comprovadamente inviabilizem o atendimento ao usuário." (Clause 9.2 of "Contrato Operacional Específico de Uso da Infraestrutura Ferroviária", *supra*).

271 "A VALE (EFC) confere o direito à FNS, de [...] coletar cargas nos terminais de Itaqui e de carga geral de Ponta da Madeira na modalidade de direito de passagem, para transporte até a malha sob sua sub-concessão, desde que: (a) a carga seja coletada por Trem-Tipo da FNS realizando fluxo de retorno de transporte ferroviário das cargas provenientes do trecho de sua sub-concessão, (b) tais cargas tenham seu destino final na malha da FNS e/ou (c) os fluxos não sejam de cargas próprias de empresas do mesmo grupo econômico da VALE, coligadas e controladas." (Clause 1.5 of "Contrato Operacional Específico de Uso da Infraestrutura Ferroviária", *supra*).

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