

# BAUXITE IN BRAZIL

RESPONSIBLE MINING AND COMPETITIVENESS







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2. Reforested area - Norsk Hydro Brasil

3. Respect for community culture and values - Mineração Rio do Norte

4. Family Agriculture Program - Companhia Brasileira de Alumínio - CBA

April/2017

# Content

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<b>A word from the President</b>	<b>5</b>
<b>Introduction</b>	<b>6</b>
<b>1. Bauxite mining in Brazil</b>	<b>9</b>
Bauxite	10
The Industry	11
The companies	14
Economic performance indicators	17
<b>2. The Brazilian Aluminum Association (ABAL) and bauxite mining</b>	<b>19</b>
Technical and Market Committees	20
Contribution to revision of the Mining Code	20
Partnerships with other industry associations	21
Related entities	22
<b>3. Governance</b>	<b>23</b>
Ethics and transparency	24
Legal compliance	24
Legal requirements	25
<b>4. Social and economic benefits of bauxite mining</b>	<b>27</b>
Sustainable Juruti	28
Sustainable Territories Program	31
Companhia Brasileira de Alumínio - CBA mining	32
Performance indicators	34
<b>5. Respect and support for human rights, culture and community values</b>	<b>35</b>
<b>6. Environmental performance</b>	<b>39</b>
Bauxite mining and the environment - positive results	40
Environmental management	40
<b>7. Conservation of biodiversity</b>	<b>45</b>
Mining and biodiversity	46
Understanding to conserve	46
Biodiversity management and the rehabilitation of mined areas	49
Performance indicators	51
<b>8. Health and safety at work</b>	<b>53</b>
Safety programs	54
Well-being and quality of life	55
<b>9. Emergency preparedness</b>	<b>57</b>
Tailings dams in bauxite mining	58
Emergency plans	59
<b>References</b>	<b>61</b>

# A word from the President

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Global mineral commodity prices are recovering but in a highly volatile environment. Mining will play a key role in helping Brazil's economic recovery and ensuring macroeconomic stability. In this context discussions are being held about the revision of the Mining Code, the sector's regulatory framework in Brazil, which is essential to our industry's being able to invest and grow.

ABAL's report, Bauxite in Brazil - Responsible Mining and Competitiveness, describes what the sector is doing and its socio-environmental performance, promoting a cooperative environment among stakeholders interested in the bauxite mining industry. We believe that we are in this way helping people to understand bauxite mining and we are identifying sustainable paths to make better use of our country's mineral resources.

This report analyzes the Brazilian bauxite mining industry in 2015, describing the sector, its performance, challenges and opportunities, in a context of great difficulties faced by the entire production chain in Brazil, mainly in regard to primary aluminum, which has suffered a 50% reduction in production volume since 2008.

The Brazilian bauxite mining industry has adapted to this scenario, postponing some investments and looking to make the best of opportunities in the international market.

We believe that a fundamental part of the recovery of our industry will be to show the market the socio-environmental responsibility in our sector as a competitive differential in the international market.

We have partnered with other institutions, such as the Australian Aluminium Council (AAC), the International Aluminium Institute (IAI) and the Aluminium Stewardship Initiative (ASI) to define the standards and principles of responsible bauxite mining. Participants approved the first document in 2016 and, following this phase, analysis of the proposal will continue individually, with results in the medium and long term.

We face considerable economic, technological, social and environmental challenges but our responsibility and performance allow us to grow and achieve a larger global market share.

Best regards.



Milton Rego  
Deputy President  
The Brazilian Aluminum Association (ABAL)

# Introduction

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**M**ining is one of man's oldest productive activities. The extraction and processing of naturally occurring minerals has led to the development of an enormous variety of products that are part of modern life and which reflect society's progress. This is a simple definition but mining is a complex activity, involving huge investments, long-term planning, access to natural resources, and interaction and dialogue with a broad spectrum of stakeholders, from shareholders and investors, to regulatory bodies to communities that live near mines.

Another component that adds complexity to mining is that it is only possible in the places where the geological processes occurred, making the minerals available. That is, investment in mining is focused on wherever natural resources exist, which does not always mean that the necessary infrastructure for the operation has been established.

## **Mining is a catalyst for development**

Mining usually requires the participation of and investment by companies involved in access, energy and public goods such as sanitation, education, and healthcare, among others. This system is necessary to the implantation and operation of a mine, improving the quality of life for the local population, impacting the investment cost for these projects, without involving public compensation.

The setting up and operating of a mine becomes even more costly in remote areas with low levels of development. The feasibility and competitiveness of these projects may be compromised if there is no effective dialogue, planning and understanding of responsibilities, since business cannot replace government and must be globally competitive.



## Mining has a different impact on and makes different contributions to each mineral chain

One of the challenges in the bauxite mining industry is to provide more information that will allow the public to understand the particularities of mining. Each mineral and each value chain they are used in requires different techniques, processes, impacts and contributions.

- Each mineral requires a different mining process for its extraction, just as each region presents different technical, environmental and social challenges.
- Production chains, including processing and transformation, vary in size, complexity and added value. Bauxite is one of the most valuable metal minerals in the chain. For every real (R\$) obtained in bauxite extraction, a further R\$ 16 are generated throughout the production stages.
- The legal and regulatory frameworks in each country impacts on the cost and competitiveness of minerals, which are global commodities.
- A company's size, capacity and responsibility affect its performance and stakeholder expectations.

## Mining: responsibility and competitiveness

The life cycle of the mining industry and other industries that extract finite resources involve decades of activities, from exploration to decommissioning. It is only natural that, throughout these processes, society's expectations regarding the sector will evolve and will require more transparency and socio-environmental performance.

This is seen in the increasing demands made in the regulatory frameworks. Led by global organizations that engage a diverse range of stakeholders, these expectations become performance standards, most of which are voluntarily adhered to, and are ultimately demanded of companies and even regulatory agencies.

The sector's global competitiveness depends on its ability to manage this complexity, demonstrating commitment and performance in relation to these expectations. The bauxite mining industry in Brazil operates in a responsible manner, committed to this path.







Original image: MRN

# Bauxite mining in Brazil

## Bauxite

The name bauxite comes from the town of Les Baux, France, where geologist Pierre Berthier first identified the ore, in 1821.

It is the ore from which aluminum is made - the third-most common element in the earth's crust, after oxygen and silicon. In order for aluminum production to be economically viable, bauxite must contain at least 30% industrial-grade aluminum oxide ( $\text{Al}_2\text{O}_3$ ). It takes five to seven tons of bauxite to produce 2 tons of alumina (aluminum oxide), which is converted into one ton of aluminum.

Due to the weathering on aluminosilicates, bauxite has a reddish color and is found mainly in tropical and subtropical regions of the planet.

Experts estimate that the world's known reserves of bauxite total around 70 billion tons. Based on current consumption rates and levels of usage, the reserve is estimated to be sufficient to meet the demand in global markets for the next 250 to 300 years.

Brazil's bauxite reserves are of excellent quality (more than 40% of  $\text{Al}_2\text{O}_3$ ) and are among the largest in the world.

The life cycle of a bauxite deposit is illustrated in Figure 1 below.

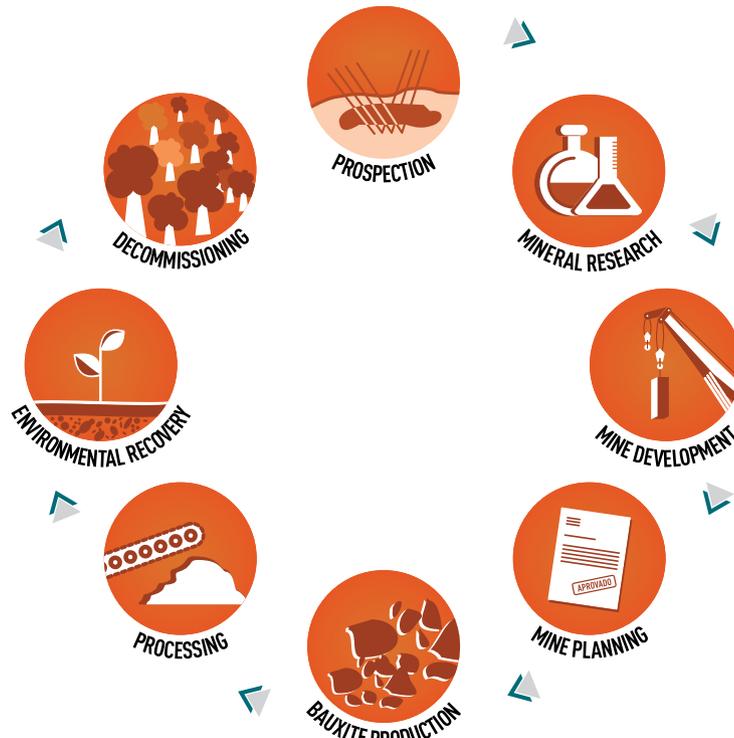


Figure 1

The legal and environmental requirements must be considered in every stage of the process. In Brazil, bauxite is extracted by the strip mining method (surface mining).

Bauxite ore processing varies according to the content of aluminum oxide ( $\text{Al}_2\text{O}_3$ ), but does not require the more elaborate treatment processes that other metallic minerals do.

Ore quality can be improved through washing, sieving and separation processes, reducing the total volume of material that will be transported to the alumina refineries.

In some operations, the ore is dried to facilitate handling and reduce transportation costs.

The bauxite mining area is covered by the vegetation typical of the biome where it is found, and the organic soil. Below that is the overburden, with little or no useful minerals, or accompanying ores which have no commercial applications.

This layer can be about 20 cm thick, as in the case at the Poços de Caldas plateau (Minas Gerais state) or up to about 8 meters, as in some mines in the state of Pará. The thickness of the body of ore also varies, depending on the geological formation.

The bauxite layer below the sterile ores is then removed by heavy equipment and loaded into wagons, trucks, or conveyors to be processed in the grinding and washing plants.

The responsible mining of bauxite involves the temporary use of the land and requires the careful removal of vegetation, organic soil and the overburden layer, so as to enable its reuse and the maintenance of the area's natural resources.

The soil will be reused in reforestation and the overburden will be used to rehabilitate the area.

Seeds and seedlings are collected and after germinating in nurseries run by the companies themselves are used in re-vegetation of the area.

The companies are committed to restoring the mined areas, not only to comply with the requirements laid out in the licensing, but as a commitment to the future use of the land, established jointly with the communities.

Bauxite mining companies in Brazil seek to maintain a ratio of 1:1 between rehabilitated areas and mined areas each year. The remaining area, used for infrastructure and permanent installations, will be decommissioned after the mineral reserves have been exhausted.

## The industry

Bauxite is the first link in the aluminum industry's production chain, as shown in Figure 2. It is the basis for the vertical integration of industrial alumina, aluminum, semi-manufactured and finished products.

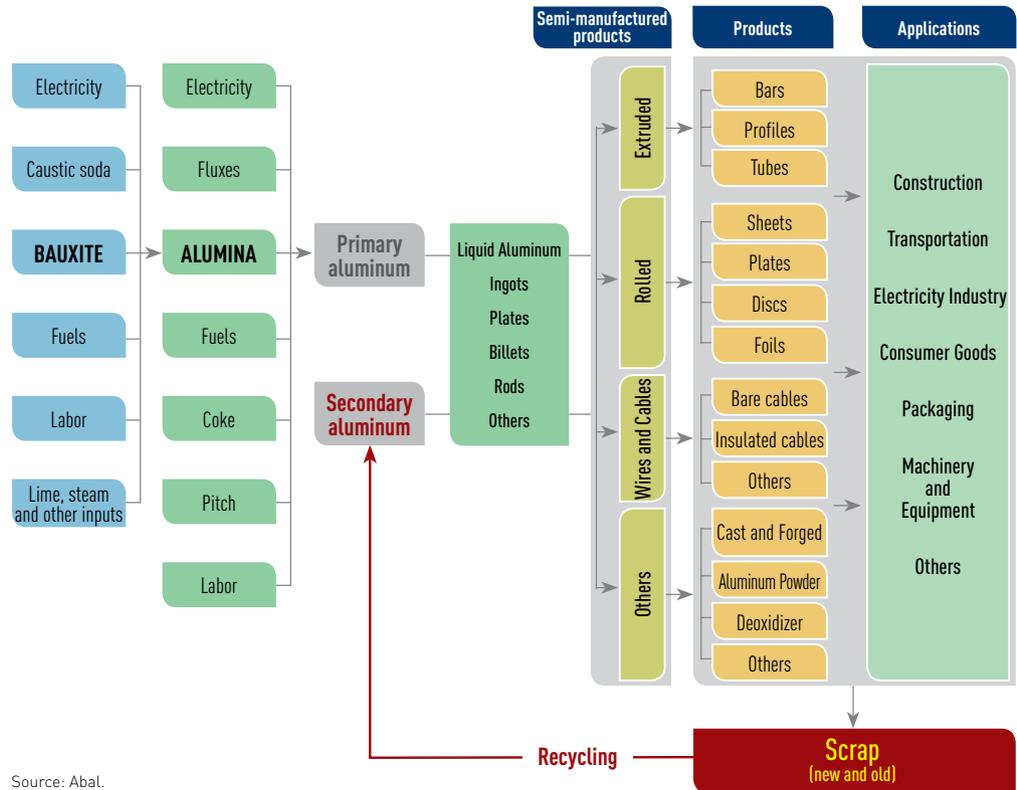


Figure 2

Bauxite is the third largest natural resource in Brazil, with about 37 million tons mined per year – after aggregates for construction (sand, crushed stone, gravel and cement), with about 772 million tons, and iron, with 411 million tons per year (Mineral Summary - 2015 edition).

On a global scale, Brazil's bauxite production in 2015 ranks third, behind Australia, at about 81 million tons per year, and China, at 65 million tons. Just behind Brazil are Guinea and India with 27.6 and 24.2 million tons annually, respectively (see Table 1).

China produces more than half of the world's primary aluminum and increased demand for bauxite, coupled with its declining reserves, has led it to seek other suppliers, encouraging some countries to rapidly develop their mining to export to China.

Indonesia, for example, accounted for 70% of China's bauxite imports, producing around 12 million tonnes per year (12% of the world volume) until the government decreed a halt in January 2014 due to socio-environmental and governance problems that have not yet been solved.

Ranking	Bauxite Reserves Million of tons		Production Thousand tons					
	Countries	Volume	Bauxite	Volume	Alumina	Volume	Primary Aluminum	Volume
1 <sup>st</sup>	Guinea	7,400	Australia	81,741	China	58,978	China	31,870
2 <sup>nd</sup>	Australia	6,200	China	65,000	Australia	20,097	Russia	3,454
3 <sup>rd</sup>	Brazil	2,600	Brazil	37,057	Brazil	10,452	Canada	3,209
4 <sup>th</sup>	Vietnam	2,100	Guinea	27,605	India	5,000	United Arab Emirates	2,471
5 <sup>th</sup>	Jamaica	2,000	India	24,219	United States	4,541	India	1,909
6 <sup>th</sup>	Indonesia	1,000	Jamaica	8,540	Russia	2,593	Australia	1,646
7 <sup>th</sup>	China	980	Malaysia	7,664	Jamaica	1,865	Norway	1,231
8 <sup>th</sup>	Guiana	850	Russia	5,432	Canada	1,561	Bahrain	971
9 <sup>th</sup>	India	590	Kazakhstan	4,802	Ukraine	1,481	United States	818
10 <sup>th</sup>	Suriname	580	Greece	2,100	Kazakhstan	1,448	Brazil	793
11 <sup>th</sup>	Saudi Arabia	210	Saudi Arabia	1,660	Spain	1,400	Iceland	764
	Others	3,490	Others	4,672	Others	7,284	Others	8,421
	<b>Total</b>	<b>28,000</b>		<b>270,492</b>		<b>116,700</b>		<b>57,557</b>

Sources: British Geological Survey, 2011 - 2015  
U.S. Geological Survey, Mineral Commodity Summaries, January 2017  
World Metal Statistics - March 2017

**Table 1**

With the halting of bauxite mining in Indonesia, Malaysia quickly became a major supplier to China. Part of the bauxite mining in that country is being done by small companies, which are not required to carry out environmental impact studies for areas under 100 hectares in size. This led to a series of social and environmental problems, such as dust and noise emissions into communities around the mines – which led to the halting of bauxite mining activities in Malaysia in January 2015.

It is uncertain whether these environmental and social problems will be remedied. However, it is clear that the aluminum value chain has global implications and China's demand creates economic, social and environmental consequences.

Table 2 shows an overview of the production and consumption of bauxite, alumina and primary aluminum in Brazil and some consequences of the fall in the production of primary aluminum in the country, such as increased exports of bauxite and alumina, leading to the country's importing of primary aluminum.

	Total production 2015 (thousand tons)	% for domestic consumption	Notes
Bauxite	37,057	66%	Volume grew by 2.1% and exports grew by 11.8% on 2014. The main buyers of Brazil's bauxite exports were the USA, Canada and China.
Alumina	10,452	19%	Production was the same as in 2014. Domestic consumption decreased by 14.7% on 2014. Exports grew by 3.5%. The main buyers of Brazilian alumina were Canada, Norway and the United Arab Emirates.
Primary Aluminum	772	61%	The volume produced was 19.7% down on 2014 due to the closure of plants, caused by increased production costs, mainly for electrical power.

**Table 2**

The state of Pará accounts for 91% of the production of bauxite for aluminum production in Brazil.

The main companies in bauxite mining in Brazil for aluminum production are shown in Table 3.

Company	Volume - 2015 (million tons per year, wet basis)	%	Location
MRN – Mineração Rio do Norte S.A.	17.82	48	Trombetas (PA)
Mineração Paragominas S.A. (Hydro)	10.06	27	Paragominas (PA)
Alcoa Alumínio S.A.	5.73	15	Juruti (PA) e Poços de Caldas (MG)
Companhia Brasileira de Alumínio -CBA	2.12	6	Itamarati**, Cataguases e Mirai (MG)
Outros *	1.33	4	
Total	37.06	100	

(\*) Hindalco, Mineração Curimbaba, Bauminas Mineração, Mineração Santo Expedito and Mineração Varginha

(\*\*) Closed down in 2015.

Source: ABAL Yearbook - 2015 edition

Table 3

## The companies

### Location of bauxite mines in Brazil

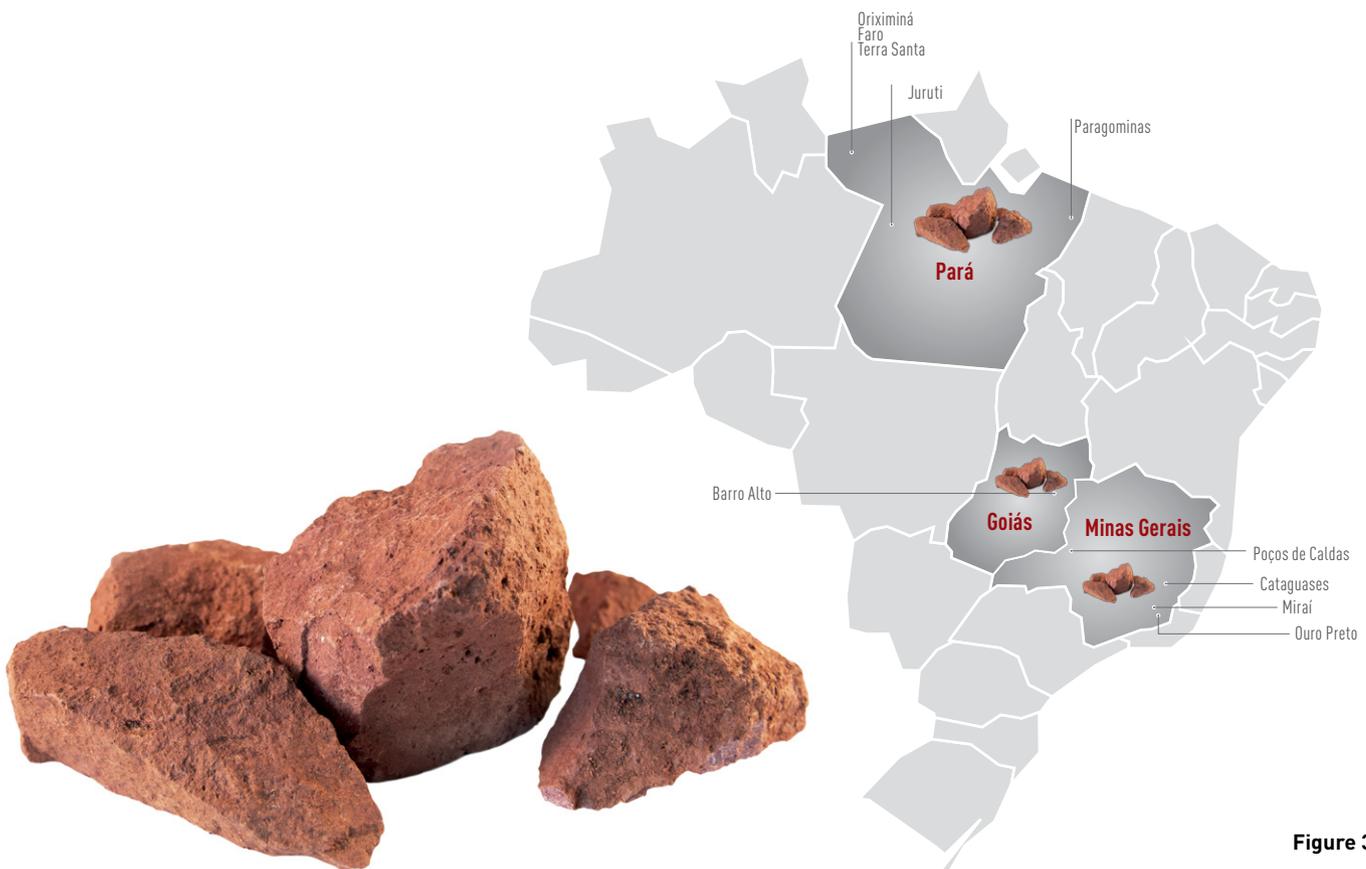
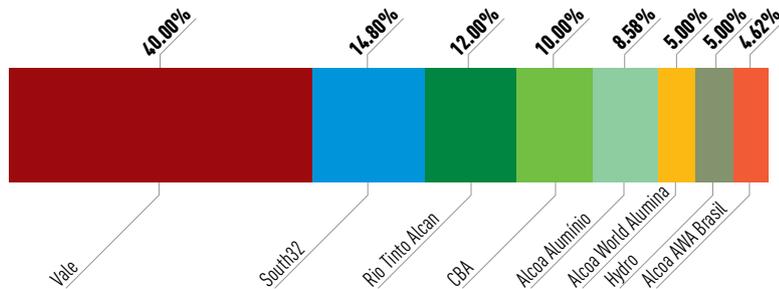


Figure 3

## Mineração Rio do Norte (MRN)

MRN was one of the first large-scale industrial projects in the Amazon. It started operating in the extraction and processing of bauxite in 1979 and today, Pará state is one of the most important ore producers in the world.

Figure 4 shows MRN stock holding.



Source: MRN website

Figure 4



Photo: MRN

**Mining is a catalyst for development**



Photo: MRN

The plants' capacity is 18.3 million tons per year. The bauxite is sold to the partners and transported by ship from the Port of Trombetas, which is managed by MRN. It also operates an 28-kilometer railroad to transport bauxite from the wash plant to the port.

The company's operations are in the Saracá-Taquera National Forest, in the municipality of Oriximiná - the fourth-largest in the world in land area.

This national forest is a sustainable conservation unit of 429,600 hectares, created by federal decree in 1989, and is managed by the Chico Mendes Institute for Biodiversity Conservation (ICMbio).

Through the agreement with this institute, financial resources are transferred for monitoring, inspection, scientific research, and environmental education and the conservation of natural resources.

Currently, the company also has mines and mining rights in the municipalities of Terra Santa, Faro and Nhamundá.

In the village of Porto Trombetas the company maintains the Hospital of Porto Trombetas (HPTR), serving the employees and their families, but also the communities nearby.

The hospital has ambulances equipped with mobile ICUs and professionals trained to provide emergency care.

### **Hydro Paragominas**

The bauxite mine in Paragominas is 64 kilometers from the urban area, in the northeast of Pará state, 350 km from the capital, Belém.

Controlled by the Norwegian company Hydro, Hydro Paragominas started operations in 2007 and transports all its bauxite along a 244 kilometer pipeline.

This pipeline, with a capacity of 15 million tons per year, is a global pioneer in bauxite transportation. It sends the ore to the municipality of Barcarena, in Pará, to feed the Hydro Alunorte alumina refinery.

### **Alcoa Juruti**

The Alcoa unit in Juruti, in the west of Pará state, started operations in September 2009 and its current production capacity is 5.3 million tons a year.

In addition to mining, other facilities at the project include a railroad built by the company, approximately 55 kilometers long, to transport the bauxite to the processing facilities and the port terminal on the banks of the Amazon River, located two kilometers from the center of the municipality.

By integrating operations with the municipality, the company adopted a new implementation model to boost local development, in partnership with the Center for Sustainability Studies at the Getulio Vargas Foundation (GVces) and the Brazilian Fund for Biodiversity (Funbio) - known as *Juruti Sustentável*. This model is based

on three fronts: the creation and integration of a space for social mobilization, the creation of indicators to monitor the social, environmental and economic transformation of Juruti and the region, and the creation of a fund to support local development projects.

### Companhia Brasileira de Alumínio - CBA

CBA, owned by the Votorantim group, operates in the municipalities of Poços de Caldas and Miraf, in Minas Gerais.

The Poços de Caldas unit has an installed capacity to process one million tons of bauxite a year. It began operations in 1955.

In 1992 operations began in Itamarati de Minas, which was closed in 2015. Its decommissioning plan is being prepared in accordance with the company's legal and policy requirements.

The Miraf Unit has an installed capacity of 2.4 million tons of bauxite a year. It started operations in 2008.

The company also owns mining rights in the municipality of Barro Alto, in Goiás, where it also buys bauxite from third parties.

CBA encourages best social responsibility practices and its operations are focused on local development and constant dialogue. To this end, it invests in community development, including the fostering of production chains, training local NGOs and supporting local administration.

### Economic performance indicators <sup>(1)</sup>

Indicator (base 2014)		
1	Gross revenues from bauxite mining in Brazil - R\$ million	2,313
2	Added value (GDP) from bauxite mining - R\$ million	705
3	Return on sales	9.9%
4	Net return on capital	3.6%
5	Share of export sales in the value of production	25.2%

(1) - Value Generation in Metallic Mineral Chains - EX Ante Consultoria Econômica - October 2016

Table 4





Original image: Dreamstime.com

# The Brazilian Aluminum Association (ABAL) and bauxite mining

The Brazilian Aluminum Association (ABAL), established in 1970, represents all the primary aluminum producers in the country, as well as manufacturing companies and consumers of aluminum, suppliers of inputs, service providers, and dealers.

It is a discussion forum for matters pertaining to aluminum and represents the sector to the government and other stakeholders related to the industry.

The member companies that mine bauxite for use in the aluminum production chain or which have an equity stake in MRN are ABAL affiliates (Alcoa, CBA, Hydro, Hindalco, Rio Tinto and South32).

## Technical and Market Committees

ABAL acts through Committees formed by executives from the leading companies in the sector in Brazil. These Committees meet regularly to address matters of common interest. Among the main themes are the global competitiveness of every stage of the production chain, as well as cross-industry issues, such as sustainability and standardization, for example.

The Committees also represent these interests to government bodies and represent aluminum's institutional image. They are committed to keeping the industry and society permanently informed in an objective and transparent way about the chain's productive processes.

The Bauxite and Alumina Market Committee and the Technical Sustainability Committee work in harmony to achieve ABAL's objectives related to bauxite mining.

Issues such as access to global markets, best practices, review of the legal frameworks, worker safety, dam safety and local development are among the themes often discussed at the association.

## Contribution to the review of the Mining Code

A key issue addressed by ABAL was the review of the Mining Code. It understands that its role is: to provide support to update the code - drawn up originally in 1967; to recognize the merit of aggregating value throughout the production chain; to ensure that any change Financial Compensation for the Exploration of Mineral Resources (CFEM) does not affect the competitiveness of Brazilian bauxite mining and the alumina and primary aluminum industries; to encourage Brazilian production and the mineral industry; to encourage competition in the free area, and to foster research in Brazil.

Only 5.7% of the value added in aluminum comes from the mining stage, while 46.4% is in the metallurgy stage (the production of alumina, primary aluminum and semi-manufactured products) and the 47.9% remaining in the companies that transform semi-manufactured aluminum products into metallic products - packaging, wire, frames, and so on.

## Partnerships with other industry associations

In July 2016, ABAL joined the Aluminium Stewardship Initiative (ASI), a global non-profit organization that sets standards for sustainability in the aluminum value chain.

As an ASI member, ABAL has the opportunity to be part of international discussions about responsible practices; to share the comparative advantages of Brazilian aluminum, such as clean energy and a low carbon footprint; to influence the drawing up of protocols and governance, and to participate in a Committee that specifically discusses sustainable mining.

In addition to accompanying and supporting the work done by the International Aluminium Institute (IAI), ABAL also participates in a joint initiative among leaders of aluminum associations in various countries to draw up standards and principles for responsible bauxite mining. At the group meeting in September 2016, ABAL presented a proposal for global responsible bauxite mining principles, which allows end customers and other stakeholders to recognize the differentials in mining.

It is also a member of the Global Bauxite Working Group (GBWG), created by representatives of the bauxite mining industries of Australia, Brazil, China, Russia, among others, to establish a scientifically based criterion to identify liquefaction conditions for ore, and with that ensure the safety of cargoes during shipping.

The GBWG has recently been recognized by the International Maritime Organization (IMO), which is a United Nations agency responsible for developing regulations for marine pollution safety and prevention in maritime transport.

Hydro and South32 are members of the International Council on Mining and Metals (ICMM), an international organization founded in 2001, dedicated to improving the social and environmental performance of the mining and metals industry. The ICMM wants to be a catalyst and agent of change in improving sustainability in the sector and so its members are committed to observing and implementing the 10 Principles of the ICMM. (See box on next page).



## The 10 Principles of the ICMM

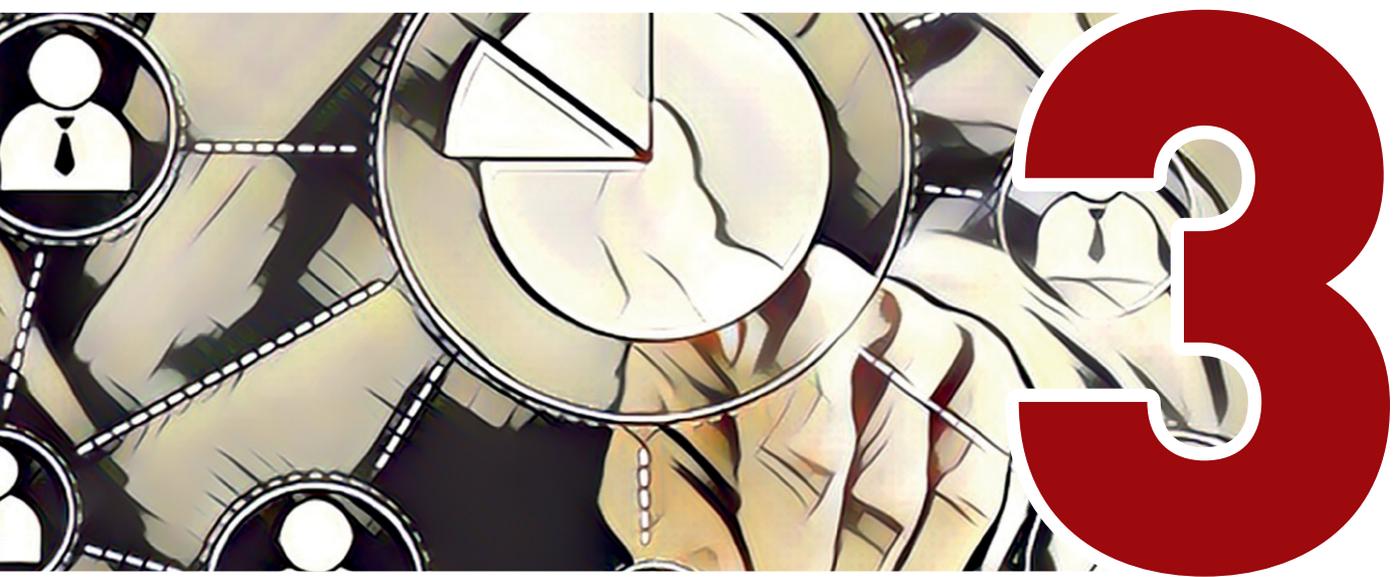
In May 2003 the ICMM Board of Directors made affiliated companies commit to the implementation and evaluation of their performance based on 10 Principles of Sustainable Development.

The 10 Principles were based on other global guiding standards that include: the 1992 Rio Declaration, the Global Reporting Initiative, the OECD Guidelines for Multinational Enterprises, World Bank Operational Policies, the OECD Anti-Corruption Convention, ILO Conventions 98, 169, 176, and the Voluntary Principles on Human Rights and Security. They are:

1. ▶ Apply ethical business practices and sound systems of corporate governance and transparency to support sustainable development;
2. ▶ Integrate sustainable development in corporate strategy and decision-making processes;
3. ▶ Respect human rights and the interests, cultures, customs and values of employees and communities affected by our activities;
4. ▶ Implement effective risk-management strategies and systems based on sound science and which account for stakeholder perceptions of risks;
5. ▶ Pursue continual improvement in health and safety performance with the ultimate goal of zero harm;
6. ▶ Pursue continual improvement in environmental performance issues, such as water stewardship, energy use and climate change;
7. ▶ Contribute to the conservation of biodiversity and integrated approaches to land-use planning;
8. ▶ Facilitate and support the knowledge-base and systems for responsible design, use, re-use, recycling and disposal of products containing metals and minerals;
9. ▶ Pursue continual improvement in social performance and contribute to the social, economic and institutional development of host countries and communities;
10. ▶ Proactively engage key stakeholders on sustainable development challenges and opportunities in an open and transparent manner.

### Related entities





Original image: Dreamstime.com

Governance

## Ethics and transparency

Governance as a subject has evolved in Brazil but the expectation is that recent cases of organizations being investigated for corruption, harassment, unethical conduct, fraud and environmental accidents have focused attention on understanding and implementing it.

Governance is indispensable, regardless of size or type of ownership structure because it refers to the way they are managed, monitored and encouraged, involving the relationships between owners, councils, the board and their relationships with other stakeholders, especially the government.

Companies in general but especially those in the mining sector, given the type of business they are in, need ethical and transparent policies and practices.

The companies that mine bauxite for metallic uses in Brazil operate according to the rules of governance established by their corporations, which require transparency and compliance. They include:

- Having a set of values and code of ethics applicable to employees, suppliers and relationships with authorities
- Publishing and distributing Codes of Ethical Conduct
- Conducting training on ethical conduct
- Providing communications channels available to employees and other stakeholders, so that they can report suspicions or complaints in this regard

Companies also publish their Sustainability Reports in accordance with globally accepted guidelines, such as the Global Reporting Initiative (GRI), by which detailed information about their governance can be obtained.



Figure 5

## Legal compliance

Legal compliance by bauxite mining companies has been managed for many years. It is considered to be a key activity and requires a complex and burdensome effort due to Brazil's regulatory complexity, especially when compared to other countries where mining takes place.

Bauxite mining companies in Brazil operate according to environmental management systems that follow the ISO 14001 standard and, among other requirements, seek to guarantee full legal and environmental compliance, which is substantiated in the requirements for licenses and constraints to be complied with throughout the life cycle of the operation.

## Legal requirements

The regulatory environment in Brazil is often referred to as strangulated, as its complexity is continuously deepened, so raising the risk of non-compliance.

The two main regulations for mining in Brazil are:

- The Mining Code, under the responsibility of the National Department of Mineral Production (DNPM) at the Ministry of Mines and Energy, Decree-Law 227, which has been in force since 1967, with amendments.
- The legal and environmental requirements under the responsibility of the environmental licensing and monitoring agencies.

The Mining Code is based on Article 176 of the Federal Constitution of 1988, which establishes that mineral resources belong to the government. Among the changes discussed in the review of this legal framework in progress in Congress, we can highlight:

- The creation of a National Council for Mineral Policy (CNPM) and the National Mining Agency (ANM), replacing the current National Department of Mineral Production (DNPM);
- Changes in the granting of Mineral Rights, with the public offering of areas based on public bidding procedures and contracts;
- A new calculation basis for Financial Compensation for the Exploration of Mineral Resources (CFEM), maintaining the distribution criterion, with 65% going to the municipalities, 23% to the states and 12% to the federal government.

ABAL follows the discussions about reviewing the Mining Code, always stressing the need for the proposed modifications to take into account the determinants of competitiveness in each link in the chain and the level of aggregation of value and potential leverage for other industrial segments, which vary from ore to ore.

In the environmental area, the main legal frameworks are:

- Environmental licensing, under the responsibility of the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), which oversees resolutions issued by the National Environmental Council (CONAMA) and other state and municipal laws, which set out the conditions for installation and operation;
- The National Conservation Unit System (SNUC) – Law no. 9,985, of 2000 – which establishes the payment of environmental compensation for

the projects considered, as regards licensing, which cause a significant environmental impact. This compensation is intended for the implementation and maintenance of the Conservation Unit;

- Forest Code (Law no. 12,651, of 2012) which establishes preservation areas in two formats: Legal Reserves and Areas of Permanent Preservation (APPs). The percentage of a property's area that has to be registered as Legal Reserve varies according to the biome and the region:
  - 80% on rural properties located in a forest area in the Legal Amazon;
  - 35% on properties located in Cerrado (tropical savanna) areas in the Legal Amazon;
  - 20% on properties located in forest areas, other forms of native vegetation or general field areas in any region of the country.

Brazil's environmental licensing process is very complex, time-consuming and burdensome, involving three stages that require the preparation of impact studies, public hearings, consultation with other agencies and the payment of fees to environmental agencies.

- Advance License (LP)
- Installation License - (LI)
- Operating License - (LO)

During the licensing process for mining activities, consultations and authorizations from various other government agencies are almost always required - such as:

- The Chico Mendes Institute for Biodiversity Preservation (ICMbio), when there is a potential impact on the Conservation Units;
- The National Indigenous Peoples Foundation (FUNAI), when there is a potential impact on indigenous communities on land that has been demarcated or otherwise;
- The National Historical and Artistic Heritage Institute (IPHAN), when the project may impact national cultural heritage (material or otherwise);
- The National Institute of Colonization and Agrarian Reform (INCRA), in cases that potentially affect areas involved in agrarian reform, such as settlements.

In terms of specific taxes and contributions, in addition to the CFEM, royalties must be paid to the owner of the lands where mining takes place, as well as Environmental Control and Inspection Fees established by IBAMA, according to the size and potential of pollution, and the degree to which the company uses natural resources.



Original image: MRN

## Social and economic benefits of bauxite mining

Much has been studied and discussed about the contribution made by investments and mining operations to national and local development. Some institutions correlate mining activity with an improvement in the Human Development Index (HDI) for the municipalities it takes place in and its respective components - income, education and life expectancy.

In Pará, Juruti and Paragominas, municipalities where bauxite mining began in the 2000s, are representative. They have some of the highest growth rates for the Municipal Human Development Index (HDI) in the state, concentrated precisely in the decade when bauxite mining began.

An attempt to establish cause and effect is inconclusive because of methodological difficulties, but for some researchers the idea of development is not only measured by HDI components, since there are particularities between countries and populations. The World Bank, for example, highlights the existence of four basic forms of capital needed for development: natural capital, physical capital, human capital, and social capital, with enormous quantification difficulties. That is, it is clear that mining benefits the community but the full development of a community depends on several other factors.

The impacts of mining can be positive and negative, direct and indirect, local and national, and are fundamentally inter-generational, as they occur distinctly at each stage of the mine's life cycle, which can last for several decades, from prospecting to decommissioning.

In this impact scenario, a number of variables are also present, such as geographic location, local governance and capacity, climate, demographic density, cultural aspects, and local infrastructure.

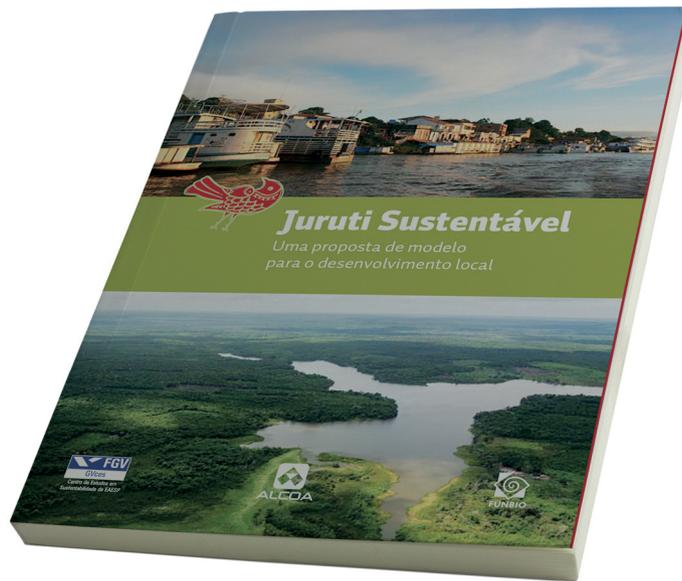
There is a general understanding that while mining contributes to development, it can create or intensify local socio-environmental problems, and specific actions are required for communities located around mining developments. Even in locations far from urban centers, a mine is potentially a stimulus to regional development.

Overcoming the dichotomy between the overall benefits of the activity and its local impacts remains one of the major challenges for mining, especially in regions where development levels are still low.

Bauxite mining companies have sought, through structured and innovative programs, to make the activity a major catalyst for local development. The following are some business experiences inspired by this objective, which go beyond the obligations established in Brazilian law.

## **Sustainable Juruti**

In the municipality of Juruti, in western Pará, Alcoa started to set up a bauxite mine in 2006 which went on to become an innovative case study, recognized nationally and internationally.



**Figure 6**

Alcoa has established partnerships with the Getulio Vargas Foundation's Sustainability Center (GVces) and the Brazilian Fund for Biodiversity (Funbio), in which it is committed to making this venture an inducer of regional development and establishing a new paradigm in relation to mining projects. The objective of the partnership is to draw up a development plan with the broad and effective participation of society, called "Juruti Sustentável", based on a tripod of initiatives:

- The creation and integration of a space for social mobilization, the Sustainable Juruti Council (Conjus);
- The creation of indicators to monitor the social, environmental and economic transformation of Juruti and the region;
- The setting up of a fund to support local development projects, the Sustainable Juruti Fund (Funjus).

With Alcoa's proposal for an operation integrated with the municipality, the population of Juruti today has some important instruments of development, learning and awareness at its disposal. Among the instruments is an online tool for measuring development over time, the "Juruti Indicators".

In addition to the obligations established in the conditions for licensing, which involved more than 6,000 people in public hearings, Alcoa assumed a positive agenda with the municipality through a set of voluntary initiatives to improve infrastructure, and actions for development and quality of life in the municipality. This agenda has been implemented in partnership with the Juruti City Hall and the City Council, covering 54 projects in the areas of healthcare, education, social assistance, security and justice, culture, leisure, sport, tourism, urban infrastructure, rural infrastructure and the environment. Also part of this process are the investments

## Social Responsibility



Foto: Divulgação Alcoa



Alcoa's volunteer program. Above, PET bottle recycling; adjacent - re-painting a public school in Juruti.

in community projects by the Alcoa Institute and Alcoa Foundation, the company's social responsibility arms.

The numbers are significant. Since 2006 Alcoa has contributed:

- R\$ 230 million in taxes and CFEM to the municipality of Juruti;
- R\$ 41 million to the Association of Communities in the Juruti Velho region (Acojurve) as a share in mining results;
- R\$ 69 million in investments for a positive agenda;
- More than R\$ 537 million in purchases from suppliers in the municipality;
- More than R\$ 7 million in projects run by the Alcoa Institute and Alcoa Foundation.

Another interesting factor that illustrates its contribution to local economic dynamism is that 41% of the company's employees were born in or are resident in Juruti - 86% of the employees are from Pará and 12.3% are women.

## Sustainable Territories Program

In 2015 Mineração Rio do Norte (MRN) joined three organizations from civil society to implement an innovative and long-term initiative in the Amazon region: the Sustainable Territories Program.



· GESTÃO INTEGRADA NA AMAZÔNIA ·

**Sustainable Territories: Integrated Management of the Amazon**

The objective of the initiative is to promote sustainable territorial development in Oriximiná, Faro and Terra Santa, municipalities in western Pará. A territory with more than 12 million hectares (the size of Portugal), where about 88,000 people live in urban and rural areas, forest reserves and riverside communities. They are farmers, riverside communities, indigenous people and *quilombolas* (descendants of freed slaves), among other citizens.

The program is funded by MRN and is executed by three organizations with recognized experience in the areas of the environment, economy, public management and strengthening society:

- Public agenda
- Amazon Conservation Team (ECAM)
- Institute of Man and the Amazon Environment (Imazon)



The program is developed along four axes and is expected to last 15 years:

- **Public Management:** support for the management of city halls and departments in planning of public policies and services; in training employees; fundraising and management of resources to implement projects that can benefit the entire population in the areas of healthcare, education, and infrastructure, among other activities.

- **Social Capital:** support for communities and leaders, seeking to effect their participation in councils and conferences, helping the population to exercise their rights and duties, also developing their role in social oversight.
- **Economic Development:** support for the development and growth of the economy through potential and already developed production chains, always considering the conservation of protected areas and the preservation of traditional cultures.
- **Environmental Management:** support for environmental departments to ensure conservation, licenses for new activities in municipalities and the Rural Environmental Registry (CAR).

The program is implemented in a participatory and collaborative manner with all the social stakeholders and local public authorities involved.

The first activities in the program in the territory involved municipal diagnoses, which indicated the opportunities for economic and social development for each municipality, trying to reduce their dependency on federal and state government funding via increased local revenues while pursuing quality, planning and effectiveness in public spending.

The process has been participatory, involving municipal governments and society, in order to ensure the continuity of actions in the long term.

## Companhia Brasileira de Alumínio - CBA mining

The CBA's strategy is to contribute to the development of the regions it operates in through structured actions and continuous relationships with the communities. The company works on the creation of a social action plan in each locality, with well-defined objectives and projects established on four main axes:

- **Human capital:** contributing to citizenship, stimulated by new opportunities and perspectives.
- **Institutional capital:** trains public managers and organizations, contributing to their being more effective agents for the real development of communities.
- **Social capital:** fosters the formation and development of networks and alliances, leading to social dialogue and greater engagement with communities.
- **Economic dynamism:** values and encourages work by local entrepreneurs, stimulating initiatives to generate income and reduce inequality and economic dependence of the places supported.

Priority municipalities are studied in depth in a process called "Social Characterization", which considers mainly the territorial, economic, socio-environmental and cultural dimensions. In this process the profile of the unit and its impacts, risks, interdependencies and influences on the community in the territory are analyzed.



Photo: CBA

CBA with the Community: above, Association of Parents and Friends of the Exceptional (APAE) Cataguases; below, guidance on fire prevention



Photo: CBA

The next step is a proposal for a social agenda, at which time the challenges and opportunities consolidated in the “social characterization” process are shared with the community.

In the next phase, the focus is on planning and defining macro-partnerships, objectives, actions and monitoring indicators.

The last stage is drawing up the investment plan (multiyear and annual plans), which includes actions to be implemented in the medium and long term.

Social planning follows the company's strategic planning cycle and makes projections of up to ten years ahead, as defined in the company's Sustainability Strategy.

## Performance indicators

### Bauxite mining's contribution to social and economic development

	Indicator	Value
1	Number of direct jobs, Brazil, in 2015 <sup>(2)</sup>	4,739
2	Remuneration for direct employees (salaries + benefits + bonuses), Brazil, in 2014 - R\$ million <sup>(1)</sup>	437.81
3	Salaries and social contributions, Pará, in 2014 - R\$ million <sup>(1)</sup>	366.52
4	Collection of CFEM by bauxite mines, Brazil, in 2014 - R\$ million <sup>(1)</sup>	59.00*
5	Bauxite mining's share of GDP, Brazil, in 2014 <sup>(1)</sup>	5.7%
6	Bauxite mining's share in municipal GDP, Pará, in 2012 <sup>(3)</sup> <ul style="list-style-type: none"> <li>• Juruti</li> <li>• Oriximiná</li> <li>• Paragominas</li> </ul>	36.4% 17.8% 20.1%
7	Taxes and contributions (FGTS, INSS, PIS, COFINS, ICMS, other taxes and charges), Brazil in 2012 - R\$ million <sup>(3)</sup>	288.35
8	The share of CFEM from bauxite mining in the total collected in municipalities in Pará in 2014 <sup>(3)</sup> <ul style="list-style-type: none"> <li>• Juruti</li> <li>• Oriximiná</li> <li>• Paragominas</li> </ul>	8.8% 9.0% 4.4%
9	Variation in the Municipal Human Development Index (HDI) in municipalities in Pará (2010/2000) <sup>(1)</sup> <ul style="list-style-type: none"> <li>• Juruti</li> <li>• Oriximiná</li> <li>• Paragominas</li> </ul>	52.0% 20.5% 37.0%

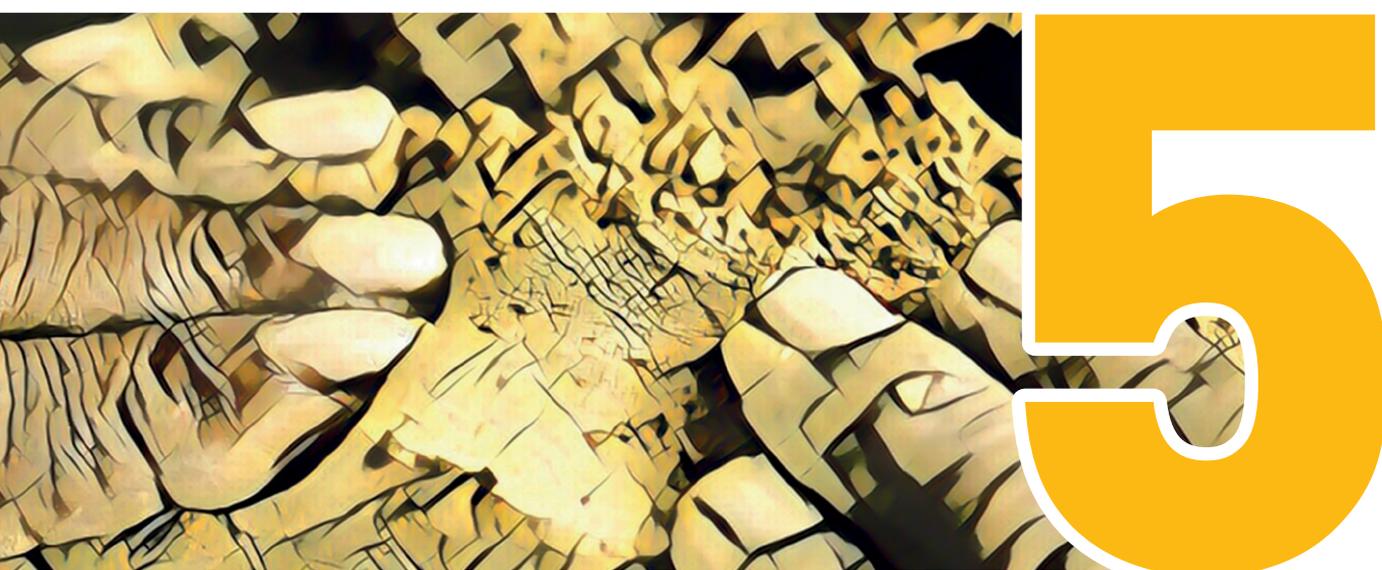
(\*) - Source: National Mineral Production Department

(1) - Study of Value Generation in Metallic Mineral Chains - EX Ante Consultoria Econômica - October 2016

(2) - Annual Social Indicators Report (RAIS) and General Register of Employment and Unemployment (CAGED) at the Ministry of Labor and Employment

(3) - The aluminum industry in Pará - Economic benefits and potential for employment and income generation - Ex Ante Consultoria Economics - March 2015 Table 5

Table 5



Original image: MRN

Respect and support for  
human rights, culture  
and community values



Corporate responsibility to promote and respect human rights is well defined in the “Guiding Principles on Business and Human Rights: Implementing the Protect, Respect & Remedy Framework”, a UN Human Rights Council document adopted in 2011.

However, this responsibility needs to be implemented through policies and procedures that establish mechanisms to prevent violations and establish the proper path to treatment, should they occur.

Bauxite mining companies operating in Brazil are convinced that more than an obligation and a guiding principle, this theme is a key factor in competitiveness and can have important repercussions in terms of loss of customers and reputation in the event of breaches.

Companies' practices are based on their codes of ethical conduct and are the subject of periodic training for employees. They focus on:

▶ **Complaint and suggestion mechanisms - ombudsman or hotline**

- Companies maintain channels to receive, analyze and resolve issues from surrounding communities. As ombudsmen or hotlines, these mechanisms are available to employees, contractors, suppliers, customers and communities.
- The issues are looked into in an impartial and confidential manner, adding credibility to the process. Companies keep records and release the results in their sustainability reports.

▶ **Supplier evaluation**

- Bauxite mining companies in Brazil implement supplier evaluation systems, demanding compliance with the law, be it labor, tax or environmental in scope.
- In supply contracts there are specific clauses covering child or forced labor, the maintenance of a safe and healthy working environment, and non-discrimination.

- Statistics on these programs are disclosed in the company's sustainability reports.

▶ **Labor and human resources practices**

- The principles of free association, collective bargaining, the prohibition of child labor and forced labor, non-discrimination and open dialogue with employee representatives are respected by bauxite mining companies. They are incorporated into their administrative procedures and are worked on in training.

▶ **Traditional populations**

- Special attention is paid to traditional communities with a rich cultural identity, such as *quilombolas* (descendants of freed slaves) and riverside communities.
- There are ongoing issues with some of these communities, regarding land demarcations, beneficiary identification, and compensation and mitigation measures. These are complex issues, aggravated by the situation of land tenure in the Amazon and the absence of government.



Photo: MRN



Photo: MRN

► **Support for cultural events**

- Companies only integrate with the communities by taking part in the social and cultural context they are part of. This is achieved by appreciation and support of cultural events and the way programs that the companies support, such as malaria programs and family farming, are run.

These programs are implemented and monitored through partnerships with local associations, educational institutions, local governments and specialized non-governmental organizations.

Photo: CBA

▼  
**Serra Gastronomy Festival**

The District of Pirapanema (Muriaé - Minas Gerais), near Serra do Brigadeiro, is part of the Atlantic Forest and hosts the Serra Gastronomy Festival, held by the Muriaé Culture and Arts Foundation (Fundarte).

Supported by CBA, the event seeks to generate business opportunities for the district, and enhance culture through rural tourism and quality music for the community.

Among the attractions are town squares with restaurants offering a variety of food, and jazz and blues shows played over the four days of the Festival, which attracts an average of 10,000 people a year.

The Festival also offers gastronomy workshops taught by nationally respected chefs trained in the region. During the activities, the public can try dishes that bring out the best from the ingredients and learn about regional cuisine.



Rural producers' stalls



Chefs at the event



Gastronomy workshop for children



Food reuse workshop



Original image: Hydro

## Environmental performance

## Bauxite mining and the environment - positive results

Mining has a strong connection with the environment, starting with the citation expressed in paragraph 2 of article 225 of the Federal Constitution of 1988: "Anyone who exploits mineral resources is obliged to rehabilitate the degraded environment, according to a technical solution required by the competent public body, in accordance with the law".

This link is even more important when the origin of most bauxite in Brazil is considered: the state of Pará. With an area of 1,247,689 km<sup>2</sup>, equivalent to almost 15% of the entire national territory and 24% of the Legal Amazon, the state of Pará has a large number of protected areas, such as Conservation Units and Indigenous Lands, and a significant part of the population that depends on natural resources and ecosystem services.

Considering the growth of many regions in the Amazon, which is disorderly and with little government participation, responsible mining, throughout its life cycle, is fundamental to the establishment and maintenance of conservation areas, land title regularization, and the generation of economic resources that reduce dependence on disorganized exploitation of the forest.



Photo: CBA

The "Welcome, family!" project from CBA: integration and awareness

## Environmental management

Bauxite mining companies adopt environmental management systems and other tools to meet all their commitments.

In addition to the rehabilitation of the mined areas and the conservation of biodiversity discussed in section 6, the companies' programs cover the following topics:

- Management of water resources
- Energy usage
- Greenhouse gas emissions
- Waste

## Water resources

For bauxite mining, water is a strategic resource, and must be managed throughout the entire life cycle of the mine.

From the studies of technical and economic viability of mineral exploration, through the hydrological context in which the ore seams are located, to the processing and transport of the ore through pipelines, water is essential.

Bauxite mining companies set targets to reduce water consumption, reuse water, avoid contamination in the bodies of water their effluent is disposed of into, and maintain monitoring programs.

Tailings dams supply a large part of the water needs through recycling and recirculation processes, which also helps in security for these reservoirs.

The water recycling / recirculation index in bauxite mining is 77% on average.

As there is no chemical change, the water in the dams has similar characteristics to the watercourses near the mine.

The projects in these disposal areas consider containment and drainage necessary to support significant volumes of rain, avoiding escape into the environment.

Since the beginning of its activities, in 2008, the Miraf unit owned by Companhia Brasileira de Alumínio (CBA) has had a strict water resources management system. Currently, the unit recycles 98.9% of its industrial water.

It periodically monitors the quality of the watercourses where the project is, avoiding interference with the environment. Positive results lead to dialogue with stakeholders. In 2015, more than 90 collection points were sampled, as well as instrumentation inspections at the dams:

- 74 surface water points
- 9 effluent points
- 3 groundwater points
- 5 biological monitoring points
- 22 water level indicators
- 19 piezometers



Planting of seedlings in the Capiranga community

Photo: Alcoa

At MRN the water monitoring network has 153 points distributed as follows:

- 57 surface water points monitored monthly
- 71 springs monitored quarterly
- 12 sediment points monitored six-monthly
- 13 piezometers

## Performance indicators

### Water consumption and reuse in bauxite mining

Volume of water captured by source (base 2015)	thousand m <sup>3</sup>
Surface	40,736
Underground	480
Public utility	6
<b>Total</b>	<b>41,321</b>
Volume of water reused or re-circulated	142,749
% reuse	77%

Table 7

## Energy usage

Bauxite mining, considering all the processes in the aluminum value chain, is the least energy intensive.

Whether by self-generation or the use of electric power from local utilities, reducing energy consumption boosts the company's results and the conservation of natural resources.

In the case of MRN, its own oil-powered power station serves the whole industrial complex, mine, support infrastructure and residential area.

The implementation of a project to change the location of the Waste Disposal Area in 2015 reduced fuel consumption as it optimized the logistics for water and energy trucks to feed bauxite scrubbers.

## Performance indicators

### Energy consumption in bauxite mining

Source (base 2015)	GJ
Electricity	3,121,321
Fuel oil	878,075
Diesel oil	67,335
GLP	437,056
<b>Total</b>	<b>4,503,787</b>

Table 8

Considering the total volume of bauxite produced in 2015 of 37.057 million tons, the energy intensity in bauxite production in Brazil was 0.12 GJ / ton of bauxite.

## Greenhouse gas emissions

Aluminum produced in Brazil, of which bauxite mining is the first step, contributes to the reduction of greenhouse gas emissions, both through recycling rates, which in the case of cans is over 95%, and its application in products whose use will reduce energy consumption, especially in buildings, transport and packaging.

According to a survey by the Brazilian Mining Institute (IBRAM), GHG emissions from bauxite mining represent about 4.23% of total mineral emissions in Brazil. Pelletizing and iron ore account for about 67%.

As the industry improves its life cycle studies to quantify and show its competitive advantage, companies maintain their corporate emissions inventories in accordance with the GHG Protocol, developed by the World Resources Institute / World Business Council for Sustainable Development (WRI / WBCSD), in the IPCC 2006 guidelines and the NBR ISO 14064-1:2007 Standard.

In mining operations, the main emissions are concentrated in the generation of energy, vehicles and, in some cases, drying processes.

## Performance indicators

### Greenhouse Gas Emissions (GHG)

Emissions (base 2015)	CO <sub>2</sub> e ton
Direct emissions (scope 1)	445,541
Indirect emissions (scope 2)	20,754
<b>Total emissions (scopes 1 + 2)</b>	<b>466,295</b>

Scope 1: Direct emissions from sources of the organization making the inventory or controlled by it.  
Scope 2: Indirect emissions from the acquisition of electric and thermal energy that is consumed by the company. This category includes GHG emissions related to the generation of electric energy purchased by the organization.

Table 9

Considering the total volume of bauxite produced in 2015 of 37,057 million tons, the intensity of greenhouse gas emissions (scopes 1 + 2) for bauxite production in Brazil was 0.012 ton CO<sub>2</sub>e / ton of bauxite.

## Waste

The largest volume of waste from a bauxite mining operation is in the tailings.

They are just clay, without any chemical additives. They are stored in dams until the particles settle and the water is reused.

Adequate disposal of hazardous and non-hazardous waste in regions where urban and industrial collection, separation and final disposal services are not yet available is a challenge for companies.

Begun in 2015 at the Alcoa unit in Juruti, the Cleaner Production program

Photo: CBA



Training for contributors: Waste Management Protocol

aims to identify, analyze, minimize and eliminate problems in the processes that cause waste and a loss of efficiency in environmental quality and production.

It served as a basis for the company to establish a 15% reduction target for hazardous waste (Class I), 20% for non-hazardous waste (Class II) and 40% for landfill, in order to achieve its long-term environmental objectives.

## Performance indicators

### Waste generation in bauxite mining \*

Waste (base 2015)	ton
Hazardous (Class I)	2,930
Non-hazardous (Class II)	7,954
Total waste generated	10,884
Sent to landfills	3,938

(\*) Does not include tailings

Table 10



Original image: Hydro

# Conservation of biodiversity

## Mining and biodiversity

The United Nations (UN) has declared 2011 to 2020 to be the Decade on Biodiversity. For bauxite mining companies in Brazil, this subject gets a lot of attention and presents important results.

Loss of biodiversity has become better understood with an improvement in the understanding of the functioning of ecosystems and the environmental services they provide, which are essential for the quality of life, the business and the functioning of the economy itself.

Economic activities in forest areas, including mining, have an impact on biodiversity, whether through deforestation, access to natural resources, emissions, soil conservation, or population growth.

It is in this scenario that bauxite mining companies adopt management practices in order to understand and conserve the biodiversity of the places where they operate, to maintain the habitats for species diversity, genetic diversity and ecosystems.



Photo: Alcoa

Lake Jará, in the municipality of Juruti, Pará

## Understanding to conserve

A biodiversity hotspot is a region with a high incidence of endemic species, under threat of impacts caused by human action. A lot of these are in the tropics.

An important part of bauxite mining occurs in the Amazon, the largest rainforest in the world. Part of the operation is in environmental preservation areas, such as the Saracá-Taquera National Forest and the Trombetas River Biological Reserve (Rebio), where Mineração Rio do Norte (MRN) operates.

These two biomes, covering more than 400,000 hectares each, are rich in fauna and flora and count on MRN's participation in conservation actions, through agreements and partnerships with the Chico Mendes Institute for Biodiversity Conservation (ICMBio) and Tapajós Integrated Universities (FIT), which apply the resources passed on by the company in inspection, research and environmental education.



Photo: MRN

In Juruti, Alcoa works in partnership with local organizations and Conservation International (CI) on the Strategic Conservation and Sustainable Use of Biodiversity Plan. This initiative includes the creation of reserves, such as the Lago Mole Wildlife Reserve, an integral protection conservation unit with an area of 652 hectares.

Hydro has established strategic partnerships to develop research and techniques for restoring biodiversity to ensure a sound scientific basis for its activities in Paragominas. The Brazil-Norway Biodiversity Research Consortium, established in 2013, includes the Emílio Goeldi Para Museum, University of Oslo, Federal University of Pará and Federal Rural University of Amazônia, as well as the company itself.

With the research projects proposed by scientific institutions, forest and ecosystem rehabilitation is improving and getting better results. Such a situation, in addition to being aligned with Hydro's corporate aspirations and guidelines, avoids reworking in the future, such as new interventions in reforested areas, and adds credibility with environmental and oversight bodies. This guarantees the continuity of the company at a regional level.

Hydro will finance 12 research projects over the next three years to study, monitor and research a variety of functional groups with an important role to play in the synergy of the local ecosystem and in determining their integrity (such as pollinator organisms, herbivores, detritivores and predators), as well as groups that are sensitive to changes in the environment and which, based on the current state of knowledge of the Amazonian biota, can be used to determine the occurrence of species of conservation interest.



Photo: MRN



The target groups are: Mycorrhizal Fungi; Mammals of conservationist interest (with the aid of camtraps); Insect Vectors; Birds; Aquatic Biota (fish, crustaceans and aquatic insects); and herbivorous insects.

In addition, the soil, chemical compounds of stored, decomposing wood, greenhouse gas emissions and sink holes related to the different land use linked to mining, botanical biodiversity, among several other lines of research, will also be studied in detail in the areas of forests that are mined and reclaimed by Hydro Paragominas.

Hydro also participates in the Cross Sector Biodiversity Initiative (CSBI), of the International Council on Mining and Metals (ICMM), Equator Principles and the Global Association for Environmental and Social Affairs of the Oil and Gas Industry (IPIECA).

The Education and Socio-environmental Communication Program (PECA) run by the Mining Units of Companhia Brasileira de Alumínio (CBA) has achieved transformative results over 15 years. Contributing to environmental conservation and awareness, the initiative has already helped 108,000 people in 12 municipalities in the Zona de Mata [Forest Area] and in the south of the state.

Of great relevance to the community, teachers, students, employees and families, the Program awakens people's critical awareness of nature conservation.

Among the projects carried out are "Knowing CBA", which teaches university-level students about the company in talks, and community orientation actions about the dangers of fire in dry times of the year.

The Environmental Education Update Course has already trained 2,000 teachers

in the regions where the PECA is run. It trains teachers on how to implement environmental conservation projects in their schools.

PECA also helps CBA employees, such as the “Welcome, Family” project, which offers artistic and leisure activities on environmental themes for employees and their families. “Environmental Education for Employees” seeks to improve the environmental performance of the company’s processes.

## **Biodiversity management and the rehabilitation of mined areas**

Bauxite mining is planned and executed to reduce its impacts and enable the rapid recovery of impacted areas. Strip mining allows the mined area to be rehabilitated soon after bauxite has been extracted, as the overburden removed is used to fill in the strip next to it, which has been mined and where organic soil will be replaced, thus preventing erosion and accelerating reforestation.

In reforestation, innovative methods to accelerate the process of natural soil formation are applied. One example is the nucleation technique, developed by Alcoa, and also applied by Hydro, which leads to a reduction in greenhouse gas emissions. Plants that have been rescued from the original vegetation and seedlings grown in the company’s own nurseries are used, from seeds of native species collected and sold by riverside communities.

In order to reduce the possibility of silting rivers, lakes, igapó and igarapé flooded forests, MRN uses a system of clay depositing that is a pioneer in the world. Reservoirs are built on already mined plateaus, large enough for the tanks until the mines are exhausted. After natural drying and surface preparation for reforestation, planting of native seedlings with legume species, bacteria and fungi helps fix nitrogen in the soil and the plants’ ability to capture micronutrients.

Brazil-Norway Biodiversity Research Consortium (BRC): biodiversity monitoring at Hydro’s bauxite mine in Paragominas, Pará



Photo: Hydro

Companhia Brasileira de Alumínio (CBA) rehabilitates mined areas in the municipalities of Miraf, Itamarati and Poços de Caldas, in Minas Gerais. The initiatives replace the original vegetation, often improving the quality of soils and plantations.

Through partnerships with the Federal Universities of Viçosa and Lavras, new practices are developed for rehabilitation processes. One example is the bio-indicators project, which evaluates the effectiveness of the rehabilitation of these areas through the analysis of bio-indicators, such as soil seed banks, natural regeneration, seedling mortality and plant litter production and decomposition (the layer formed by the deposition and accumulation of dead organic matter). The initiative has so far concluded that the rehabilitation efforts made by the company have enabled the rapid recovery of native forest cover and the natural enrichment of the mined areas over time, thus demonstrating the competitiveness of the bauxite mining activity in the region.

The management of biodiversity by bauxite mining companies is based on four axes:

- **Flora Conservation and Management Program:** the removal of vegetation is carried out with the collection of important native species such as epiphytes (orchids, bromeliads and araceae), which are cultivated in nurseries and orchids maintained by the companies, until their reintroduction, in rehabilitation and reforestation of mined areas. One highlight is the chestnut germplasm bank.
- **Wildlife Management Program:** involves the rescue and scaring away of species, as well as the monitoring of fauna in the reforested area. In this



Photo: Alcoa

Mining - mining area

program the preservation of endangered animals such as the anteater, the caterpillar, the giant otter and the Amazonian manatee, and primates of the species sauím (*Saguinus martinsi*) and cuxiú (*Chiropotes sagulatus*) are to be highlighted. Sustainable management of turtles in the region is also run through the Quelônios Project.

- **Water Management and Monitoring of Water Resources.**
- **Socio-environmental Education Program (PES).**

## Performance indicators

### Biodiversity in bauxite mining

	Indicator (base 2015)	Ha
1	Total area changed and not yet rehabilitated - cumulative until the end of the previous year. Considers areas of mining, administrative and operational infrastructure and support areas	9,036
2	Altered area during the year	941
3	Rehabilitated area during the year	940
4	Total altered area and not yet rehabilitated - balance (1+2-3)	9,036

Table 6

The companies ended the year 2015 with a 9,036 ha of altered areas not yet rehabilitated, including mining areas, administrative infrastructure areas, operational areas and support areas.

During the year they rehabilitated about 940 ha, maintaining the objective of a 1:1 ratio between areas altered and rehabilitated per year.



Photo: Alcoa

Rehabilitation of Alcoa's mined area in Juruti (Pará)





Original image: Dreamstime.com

Health and safety at work

Brazil's Ministry of Labor (MT) has set up Regulatory Norm NR-22, specific to Occupational Safety and Health in mining, which shows how important the subject is.

In addition to complying with legal requirements, bauxite mining companies in Brazil, associated with ABAL, make health and safety a material theme in their principles and believe that there is a strong correlation between safety performance and operational excellence.

The commitment is strong, to the point that executives at these companies have part of their variable remuneration tied to safety targets.

To achieve these, the companies run innovative programs with results that can be considered worldwide references.

ABAL's Technical Sustainability Committee serves as a forum for the exchange of best practices, taking the view that continuous learning is key to preventing accidents.

## Safety Programs

In addition to traditional activities such as inspections, meetings, procedures and safety training, companies in the industry identify critical risks and maintain ongoing processes to eliminate and control them. They invest in safe conduct and improvement to create and maintain a culture of safety and appreciation of life.

In 2015, the Alcoa unit in Juruti achieved a rate of 1.15 recordable accidents<sup>1</sup> per one million hours worked. MRN achieved 1.12 in 2014.

The prevention programs adopted by the companies are extended to the workers at sub-contracted companies, who are also encouraged to report risks. One way to do this is through the use of cards distributed to employees so that they have the authority to identify and even stop a task the moment they perceive a risk to themselves or their colleagues.

Records of occurrences and continuous learning about safety have enabled companies to identify the following risks as critical, and to establish more robust systems to mitigate or eliminate them:

- Blocking and isolation of power
- Work at height
- Hand tools
- Confined spaces
- Light vehicles and mobile equipment
- Digging
- Electrical installations
- Dangerous chemicals
- Machine protection

<sup>1</sup> Recordable accidents are those that involve time off work, restriction of work or medical treatment.



- Suspended loads
- Pressurized systems
- Venomous animals

At Companhia Brasileira de Alumínio (CBA), safe conduct, compliance with safety standards, careful observation of any risk and active care make each employee a protagonist in the pursuit of zero accidents and safety an absolute priority.

In 2015 Alcoa's Poços de Caldas unit celebrated eight years without accidents resulting in time off work, demonstrating the commitment to its beliefs and values.

## Well-being and quality of life

Through programs to encourage healthy eating and physical activity, improved sleep quality and the prevention of smoking, companies invest in well-being and improved quality of life for employees, which also contributes to the low rates of accidents.

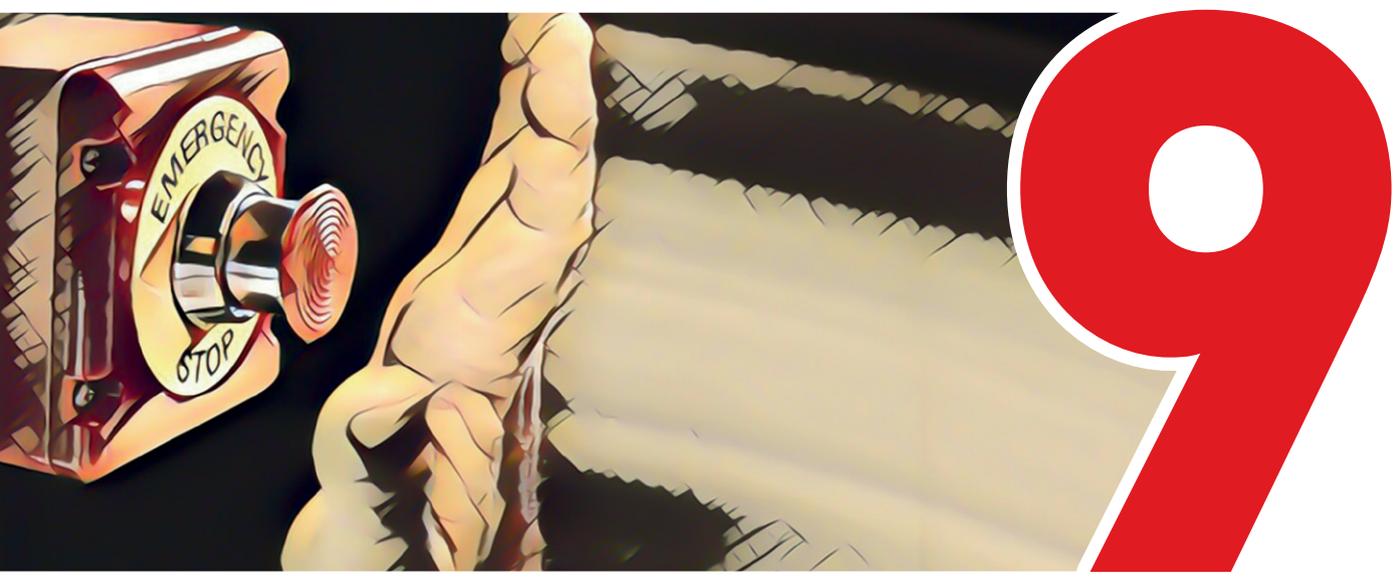
One of the actions implemented that have made an important contribution to safety is the program to prevent the misuse of alcohol and drugs.

The Renewed Health Program at CBA, which began in September 2015, encourages professionals to adopt a healthier lifestyle. It is intended for people with a Body Mass Index (BMI) above 30 and with chronic diseases, such as diabetes and hypertension.

The employees who participate in the program get support from a health professional in monthly consultations, monitoring treatment, especially weight loss and disease control.







Original image: Dreamstime.com

# Emergency preparedness

In 2006 the cracking of a bauxite tailings dam owned by Rio Pomba Mineração, in Miraf (Minas Gerais state) caused a leakage into the Fubá river, which flows into the Muriaé river, one of the tributaries in Paraíba do Sul, impacting the surrounding cities.

A more recent case that had a national impact, in November 2015, was the collapse of the iron ore tailings dam owned by Samarco, in Mariana (Minas Gerais state). It was the worst environmental disaster in the last 100 years, considering the volume of waste – 50 to 60 million cubic meters of tailings and overburden from iron ore processing - and the area covered, in excess of 600 kilometers.

The consequences of such accidents are related to topography, the volume and the nature of the material, and proximity to communities. The causes of these accidents may vary but they are a constant warning to companies, authorities and communities of the need to be prepared in emergencies and to take preventive measures. Tailings dams are complex structures that require careful design, construction, and operation to minimize the risks associated with potential cracks and failures.

## **Tailings dams in bauxite mining**

In bauxite mining and processing, dams have significantly smaller structures and dimensions than those in iron mining. But the risk is similar, and as such the industry takes steps to minimize it.

The bauxite mining companies associated to ABAL operate their dams in compliance with the regulations set out in the National Dam Safety Policy, established by Law n. 12,334 of 20/09/2010 and DNPM Ordinances (416/2012 and 526/2013).

In the primary stage of ore processing, still in the mines, the only waste from the bauxite washing is clay, which has no chemical additives. This waste is deposited in dams where it is compacted and part of the water recovered from this process is reused. In addition to reuse, reducing the volume of water contributes to reducing the risk of an accident or minimizing its effects. For this reason, in addition to reusing water, companies adopt equipment and processes, such as the use of filter presses, thickeners and dry stacking.

Over time, this clay settles and dries in the reservoir. The residual water is eliminated and after consolidating the solids, re-vegetation of the surface allows the reintegration of the areas to the environment in the region.

These tailings deposits are inspected by state and federal public agents. The companies keep their processes properly documented and licensed according to the legislation in force.

The tailings deposits are monitored by technical teams at the companies and this is part of their daily routine. External inspections by specialized consultants and inspections by public bodies are also carried out.

The best practices in bauxite mining in Brazil consider that all waste deposit areas should have a long-term master plan that covers everything from a detailed engineering design (construction and operation of the dam), to monitoring until the decommissioning of the area. That is to say, until the ending of operations and the

## Bauxite ponds and waste areas are safe and an important part for the recycling of water in the process



Photo: Alcoa

rehabilitation of the site, leaving the area ready for other uses and allowing nature to take over.

The safety of dams depends on the careful execution of all the stages of their life cycles, from design to decommissioning.

The Dam Safety Management System implemented by the companies to manage this risk includes a set of actions documented in the Dam Operation Manuals, such as:

- Defined responsibilities
- Conceptual, basic and executive technical project documentation
- Description of the process and operation, including water management
- Inspection and operational monitoring records
- Audits and stability assessments by specialists
- Training
- Dam Operation Manual
- Decommissioning plan
- Emergency plans

### Emergency plans

The bauxite mining companies have updated their Emergency Plans in accordance with Ordinance n. 526/2013, informing the Civil Defense, Department of State for the Environment, and local communities.

These plans define:

- Responsibilities, organization and coordination for response to an emergency
- Emergency situations
- Evaluation of areas and effects
- Communication and warning systems
- Evacuation procedures
- Duration of emergency and follow-up
- Updating the plan

With continually trained teams and the ever-updated plan, companies are qualified to ensure the safety and integrity of their workers and communities around the dams.

The preparation of documents for benchmarking of the processes throughout the production chain is standard in the aluminum industry.

In June 2015, international bodies - the International Aluminum Institute (IAI) and European Aluminum Association (EAA) - jointly published a Bauxite Management Best Practices document, the content of which is shared with companies.

Prior to this report, the International Council on Metals and the Environment (ICME) had published Best Waste Management Practices in Mining.





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