
CBMM
2018
SUSTAINABILITY
REPORT

CITIC Tower - With 108 floors and measuring 528 meters, it's the tallest building in Beijing. Niobium structural steels enabled a design that is smarter, bolder and more sustainable, helping to earn Leed Gold and China Certificate designations.



Photo: Shutterstock

CBMM 2018 SUSTAINABILITY REPORT

www.cbmm.com

About the report
More about CBMM's reporting process, materiality and the GRI Content Index can be found on the company website

Digital
Scan the code to check out the digital version of CBMM's 2018 Sustainability Report

Learn more
about the United Nations' Sustainable Development Goals

Welcome

Companhia Brasileira de Metalurgia e Mineração (CBMM) is pleased to publish its 2018 Sustainability Report in accordance with Global Reporting Initiative (GRI) guidelines and assured by PwC. The United Nation's Agenda 2030 Sustainable Development Goals are also referenced in the document, which presents CBMM's performance and its vision for the future. GRI 102-56

In these pages you will find the main aspects of the organization that influence stakeholder decision making, including strategies applied toward entrepreneurship and the actions that underpin the insertion of niobium in the global market. Evident in the 2018 Sustainability Report is the unwavering commitment of CBMM leadership and employees to the social, environmental and economic aspects of the business.

The content of this year's report is separated into two blocks: CBMM and its Role in the Community and Niobium Technology.

Content

Welcome 3
Message from the CEO 5
2018 Highlights 6

CBMM and its role in the community 10
1.1 A sustainable enterprise 12
1.2 Governance 16
1.3 Financial performance 24
1.4 Development of processes and new products 28
1.5 Management efficacy and operational efficiency 32
Management and commitments 33
Occupational health and safety 37
Environmental indicators 40
1.6 Relationship with stakeholderss 52
Employees 54
Suppliers 62
The Araxá community 63
Biodiversity 68
Customers 73

Niobium technology 75
2.1 Strategy to develop technology and the market 76
2.2 Development of new applications and markets 82
2.3 The benefits of CBMM products in steelmaking processes 85
2.4 End products with niobium - advantages 88

About the report 100
Corporate contacts 102
Credits 102

Message from the CEO

STRATEGY ALIGNED WITH SUSTAINABILITY

CBMM achieved record results in 2018: 28,17% growth in the volume of ferroniobium sales and net revenue of R$7,4 billion, 55% higher than the previous year and corresponding to a 69% jump in net profits. This performance is a direct result of the strategy adopted in the early days of the company – grow the niobium market through investing in research and development and disseminating technical knowledge about the benefits that come with the use of niobium.

Our business expanded in all the sectors where we operate: structural, automotive, stainless and oil and gas. Structural was especially strong, but the application of niobium in automotive batteries deserves mention. We responded to the global electric vehicle trend by intensifying our activities around energy storage, including a partnership with Toshiba to develop this technology.

CBMM's governance is the foundation from which we conduct business and launch initiatives. In 2018 important steps were taken to improve our management.

Five committees were created to assist the Board of Directors in their decision-making processes, enabling improved alignment across the topics most relevant to the company.

A noteworthy accomplishment in 2018 was our work to increase the level of recirculated water, reaching a record 97%. Another achievement was the conclusion of the construction of a new tailings dam, where the most modern techniques were applied to prevent pollution and maximize safety. We also structured a business development unit that is responsible for identifying synergies that may exist with other elements and materials and our core business. That group is currently defining processes to identify the most promising opportunities.

Related to our people, among other activities, we are engaged in a restructure of our human resources department with an emphasis on succession planning for leadership positions, as well as the implementation of a more efficient performance evaluation model.

CBMM is adopting a new approach for our initiatives in the Araxá community. We have a long history of investing in programs and projects that support the development of the municipality. Now we've taken an important step in that relationship by building a model that prioritizes sponsorships and donations related to initiatives aimed at children, youth and adolescents in the areas of education, health, sports and culture. The intention is to significantly contribute to the formation of the next generation, one that is able to increase the capacity of the community to prepare a qualified workforce and to develop and grow beyond the activities that are linked to CBMM.

We are attuned to market trends and demands, like those related to new applications in nanocrystalline materials, in the aluminum industry and automotive batteries, for example. The niobium market will continue to grow in the coming years. To meet the expanding demand, we intend to increase our nominal ferroniobium production capacity from 90.000 tonnes to 150.000 tonnes by 2021.

A key goal in 2019 is to develop the actions necessary to expand production. To achieve that, we must adjust our structure and management model to support our activities in a way that is environmentally friendly, socially just and economically viable. GRI 102-14

Eduardo Ayroza Galvão Ribeiro
CEO

> In 2018 CBMM saw growth in the sale of niobium products in all the sectors where we operate: structural, automotive, stainless and oil and gas

2018 HIGHLIGHTS

SOCIAL INDICATORS

1.971
Employees

1.521
Indirect jobs and

9.099
jobs created from the **income effect**

7.702
Businesses comprise CBMM's supply chain

2.030
Suppliers contracted in 2018

More than
R$ 4,7 million
invested in the city of Araxá in 2018

OCCUPATIONAL HEALTH AND SAFETY INDICATOR

Rate of occupational illness = Zero

ENVIRONMENTAL INDICATOR

2.900
students and teachers from Araxá area schools participated in environmental education activities at CBMM in 2018

ENVIRONMENTAL INDICATORS



97%
of **water** was recirculated at CBMM production facilities – a company record

The specific use of water (m^3/t of niobium* products) **dropped by over 30%** between 2016 and 2018

Fresh Water Consumption

11,3 m^3/t
of ferroniobium produced



17,7 m^3/t
of niobium* products



Emissions

CBMM has been a member of the Brazilian Greenhouse Gas Protocol since 2013, with data available for public consultation

Greenhouse Gas Emissions

0,83 tCO_2e/t
of ferroniobium produced

0,93 tCO_2e/t
of niobium* products



Energy Consumption

20,0 GJ/t
of ferroniobium produced

20,6 GJ/t
of niobium* products

*Niobium products = ferroniobium + other niobium products.

PRODUCTION INDICATOR

FERRONIOBIUM
{in tonnes [t] 1 tonne = 1.000 kg}

82.929 t production

82.671 t commercialization*

*Parent company data.

FINANCIAL INDICATORS GRI 102-7

R$ 2,0 bi
Net assets

R$ 7,4 bi
Net revenue*

R$ 2,8 bi
Net profit

*Parent company data.

GENERAL INDICATORS

Technical
cooperation projects in 2018



137
partnerships with customers



27
with universities



15
with research institutes

Customer
satisfaction



95%
overall satisfaction

Compliance

Zero non-compliance with laws and/or regulations related to social and economic aspects in 2018

01



CBMM and its role in the community



1.1 A SUSTAINABLE ENTERPRISE

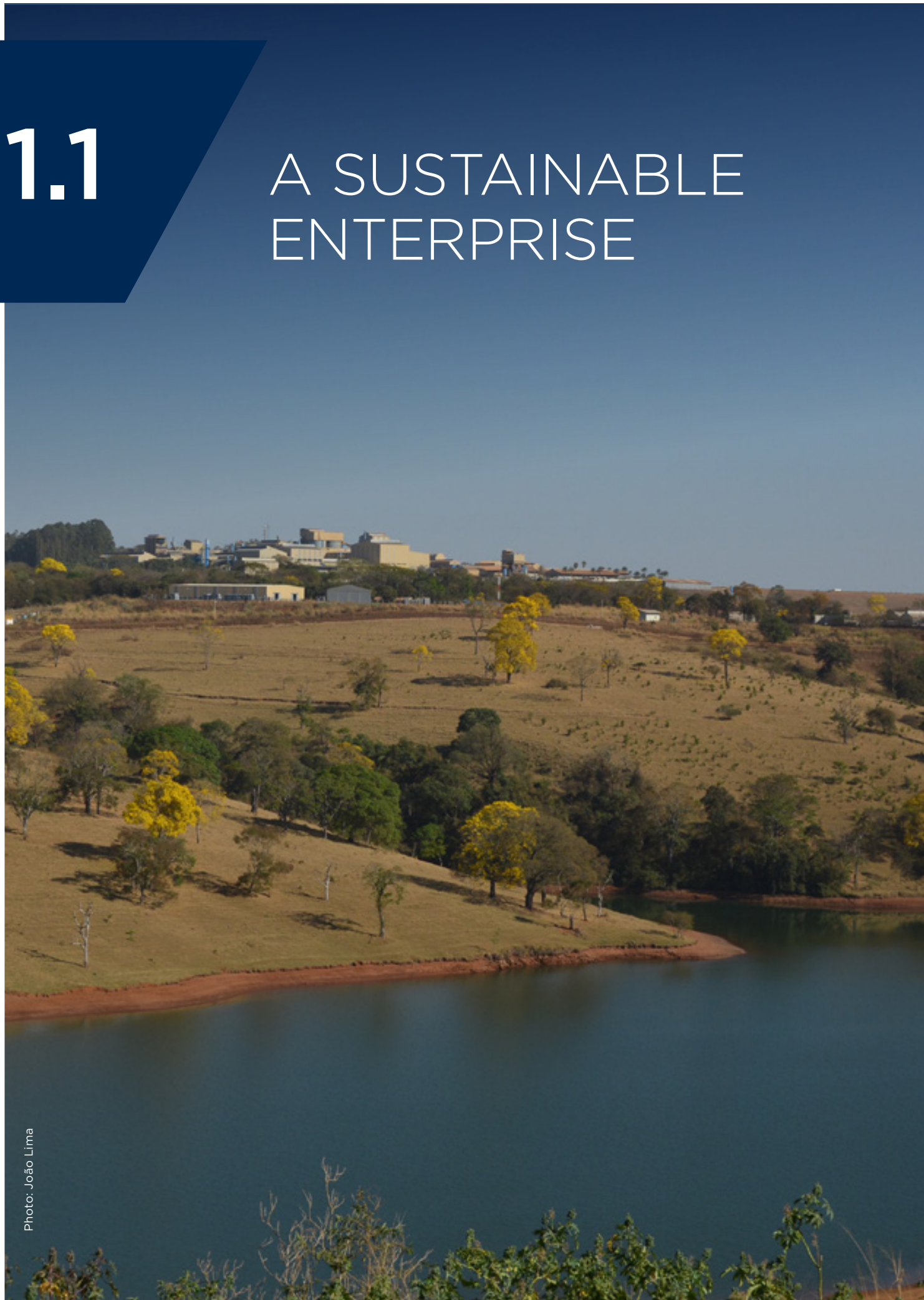


Photo: João Lima

CBMM

When Companhia Brasileira de Metalurgia e Mineração (CBMM) was founded in the 1950s, there was no market for niobium or even know-how to produce niobium products. Today, it is the only company present in all market segments, supplying 100% of Brazil's needs and nearly 78% of the global demand for niobium products. CBMM developed markets through implementing a niobium technology development program and promoting niobium's efficiencies, demonstrating the advantages that make niobium a unique addition in its main applications. This strategy has enabled the company to become the world's premier supplier of niobium products and niobium technology (*read more on pg 77*). GRI 102-1; 102-2

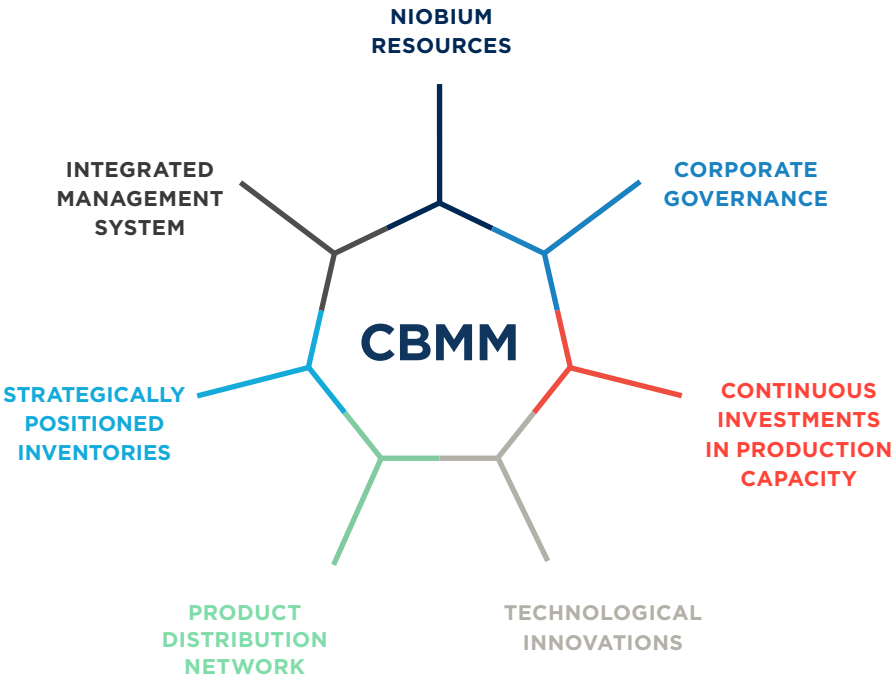
The practices related to mining and processing niobium ore, the benefits of niobium products in the modern world, continuous market development and its historical commitment to the environment, employees and society illustrate CBMM's sustainable character over its 60-plus-year history.

Fully integrated from the mine to the final products, CBMM meets the needs of customers around the globe. Ongoing investments in advanced manufacturing and management processes have resulted in continuous improvements in performance and in the progressive expansion of the company's production capacity at its mining and industrial complex located in Araxá, Minas Gerais, Brazil. GRI 102-3; 102-6

Characteristics and applications of niobium in final products

THE DISCOVERY OF NIOBIUM

Niobium was identified in England in 1801 by Charles Hatchett, who named it columbium. The current name was given in honor of Niobe, daughter of the mythical king Tantalus. The earliest information about the use of niobium dates to 1925, when it replaced tungsten in tool steels. Until the 1950s, the supply and uses of niobium were limited. It was only with the discovery of pyrochlore deposits like the one in Araxá, Brazil in 1953, that niobium gained importance in engineering materials.



GLOBAL PRESENCE

CBMM's products are distributed to the domestic Brazilian market by truck transportation. International markets are served via maritime shipping – products are first trucked to Contagem, Minas Gerais, then they are sent by rail to strategically located Brazilian ports.

CBMM is known for its production and delivery agility. The company built a logistics system that encompasses subsidiaries in Europe, Asia, North America and Brazil, two distributors and a network of 26 out-sourced supply warehouses positioned near consumers. These efforts guarantee that CBMM's over 300 customers in some 50 countries have stable access to high-quality niobium products without having to maintain buffer stocks of their own. GRI 102-4; 102-6

The subsidiaries responsible for the commercial program outside of Brazil are: CBMM Europe BV, located in Amsterdam, Netherlands; CBMM Asia Pte. Ltd., based in Singapore and CBMM North America Inc., located in Pittsburgh, Pennsylvania, USA. The distributors are CITIC Metal Co. Ltd., in Beijing, China and Sojitz Corporation in Japan and Taiwan. CBMM Technology Suisse is a subsidiary based in Geneva that is responsible for the management of projects to develop new applications for niobium products. GRI 102-4

To maintain a strong presence in markets that are growing rapidly, in 2018 CBMM opened two representative offices in China, one in Beijing and anther in Shanghai, and contracted Sojitz in India to act as a sales agent in that region. Additionally, the company began to structure a marketing department to address issues related to the promotion of niobium and its applications.

In 2019 CBMM will conclude the certification process to become an Operador Econômico Autorizado (OEA, Authorized Economic Operator) to function as a customs operator, which will make the process of exporting its products quicker and more agile.

> CBMM maintains subsidiaries, distributors and warehouses that are strategically located near customers



More than
300
customers
in some 50 countries

Check out the infographic – Solutions for a Sustainable Future

NIOBIUM MINERAL RESOURCES AND MINING ACTIVITIES

Araxá, Minas Gerais is the site of the world's largest known geological resource of residual ore of pyrochlore, with 829 million tonnes containing 2,5% Nb2O5, while fresh rock resources total 936 million tonnes containing 1,57% Nb2O5 (*Roskill Information Service – Niobium: Global Industry, Markets and Outlook to 2026*, 13th ed., 2017).

CODEMIG and CBMM constitute COMIPA, a joint-management entity that requires unanimity between CODEMIG and CBMM on decisions related to the partnership and for the overall management of COMIPA, to which both companies lease their mining rights.

In the 1950s, mineral rights to explore the pyrochlore reserve in Araxá were granted to both CBMM and the government of Minas Gerais (via CAMIG, today CODEMIG). Since then, a partnership was created between CBMM and CODEMIG that in 1972, at the request of the state of Minas Gerais, was transformed into an association to jointly explore the pyrochlore ore in the areas permitted to CBMM and to CODEMIG.

The association established for this new phase resulted in the constitution of a corporation (COMIPA) and a profit-sharing partnership (PSP).

COMIPA mines the pyrochlore ore from the two areas in equal parts and then sells the material exclusively to the PSP (at cost plus a 5% profit) who then processes and industrializes the ore and commercializes the products.

Within the PSP, CODEMIG is the managing partner and CBMM is a silent partner. In accordance with the association, CODEMIG receives 25% of the PSP's profits.

The niobium is mined in an open pit without the use of explosives. Mining operations are carried out by COMIPA in an area of approximately three-square kilometers using bulldozers, front-end loaders and trucks. The weathered ore pit will eventually extend to five square kilometers.



Photo: João Lima

Timeline
Learn more about the history of CBMM

1.2 GOVERNANCE

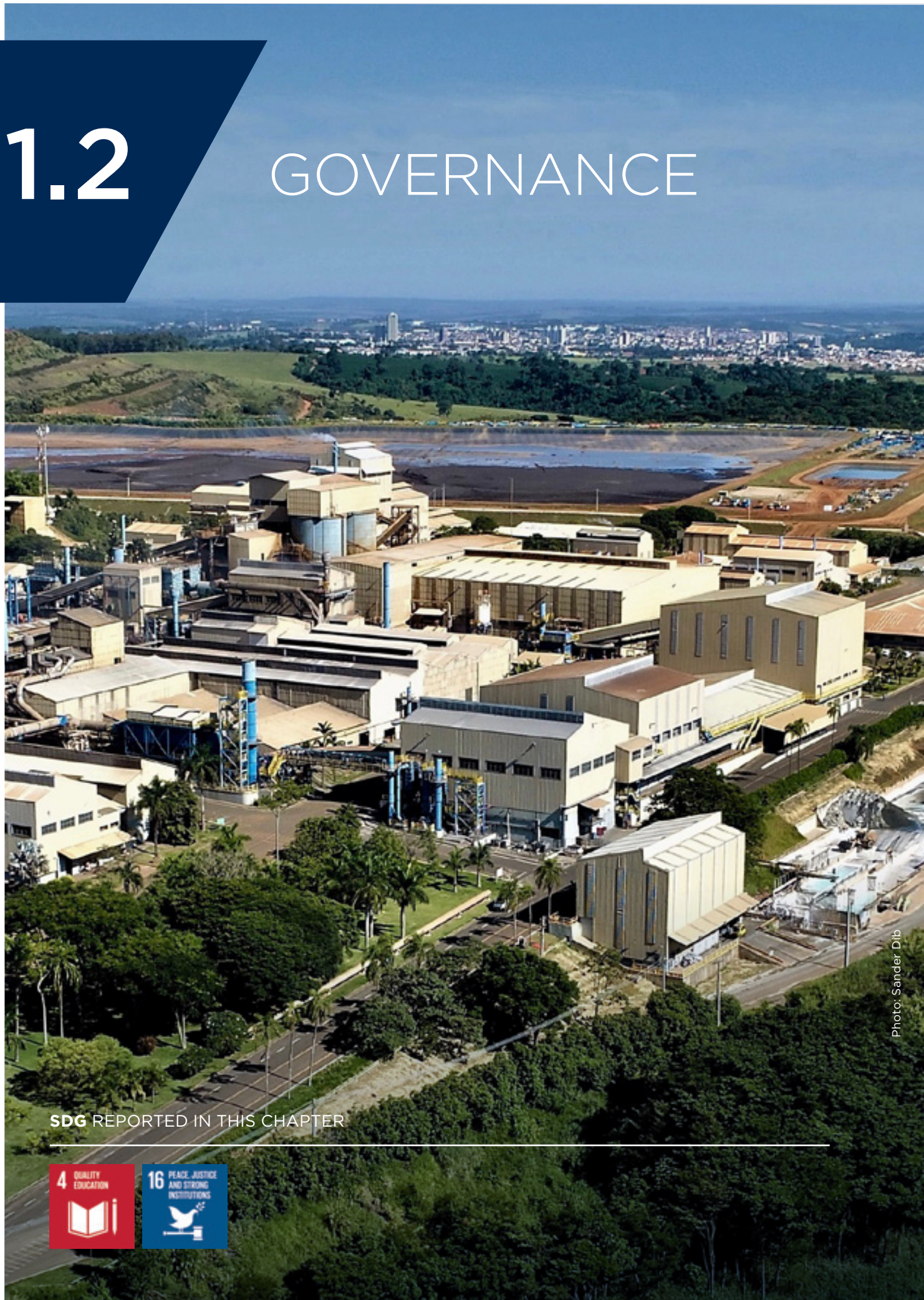


Photo: Sander Dib

SDG REPORTED IN THIS CHAPTER

Advances in management

CBMM is managed by an executive team supervised by a Board of Directors, and in line with corporate governance best practices. The Board meets regularly every quarter and extraordinarily when corporate matters dictate. Board members oversee and evaluate the company's global performance via periodic reports prepared by management.

The term for members is one year with the possibility of re-election. The Board approves the company's budget and strategic plan annually. GRI 102-18; 102-22

The selection process for Board members considers several aspects, such as independence and experience related to economic, environmental and social issues. GRI 102-19; 102-24

All procedures are carried out according to recognized international standards. Questions related to sustainability are part of the company's daily activities and are addressed through the engagement of employees and executive management. GRI 102-20; 102-27; 102-29

The primary responsibilities of Board members include: setting the overall direction and business strategy of the company; approving the income and capital budgets provided by management; electing, removing and defining functions of Board members; setting general compensation criteria and benefits policies; monitoring the conduct of company management and other duties as defined in CBMM's by-laws and current legislation. GRI 102-26

In 2018 five committees were created to assist the decision-making processes involving the Board and executive management. The five committees are People, Strategy, Technology, Audit and Risk, and Finance. Internal commissions were also implemented as a forum to discuss, define and monitor actions. These commissions address topics like human resources and tailings dam management.

> Five committees were created to assist in decision-making processes

COMPOSITION OF THE BOARD OF DIRECTORS GRI 102-22; 102-23

CHAIRMAN

Pedro Moreira Salles

VICE-CHAIRMAN

Fabio Colletti Barbosa

MEMBERS

Demosthenes Madureira de Pinho Neto
João Fernando Gomes de Oliveira
Mauro Agonilha
Mitsunori Okimura
Youngseob Jang
Maurício Novis Botelho
Chen Qun*
Sun Yufeng

*Replaced Li Dongwei in March 2018.

EXECUTIVE MANAGEMENT

Starting on February 20, 2018, CBMM's executive management team went from five to six members, all serving one-year terms with the possibility of renewal. In addition to overall management, the executive team is responsible for drawing up budgets that cover the management plan and for submitting financial statements to the Board each fiscal year. Members of the executive team must also keep the Board apprised of progress in business operations, among other duties described in CBMM's by-laws. GRI 102-18

Human resources, legal, compliance, institutional relations, risk and internal audit are all areas that report directly to the CEO. GRI 102-18

Changes to the composition of CBMM's executive management are reflected in the item below. GRI 102-18

> Addressing sustainability is part of the company's daily activities

COMPOSITION OF EXECUTIVE MANAGEMENT

CEO

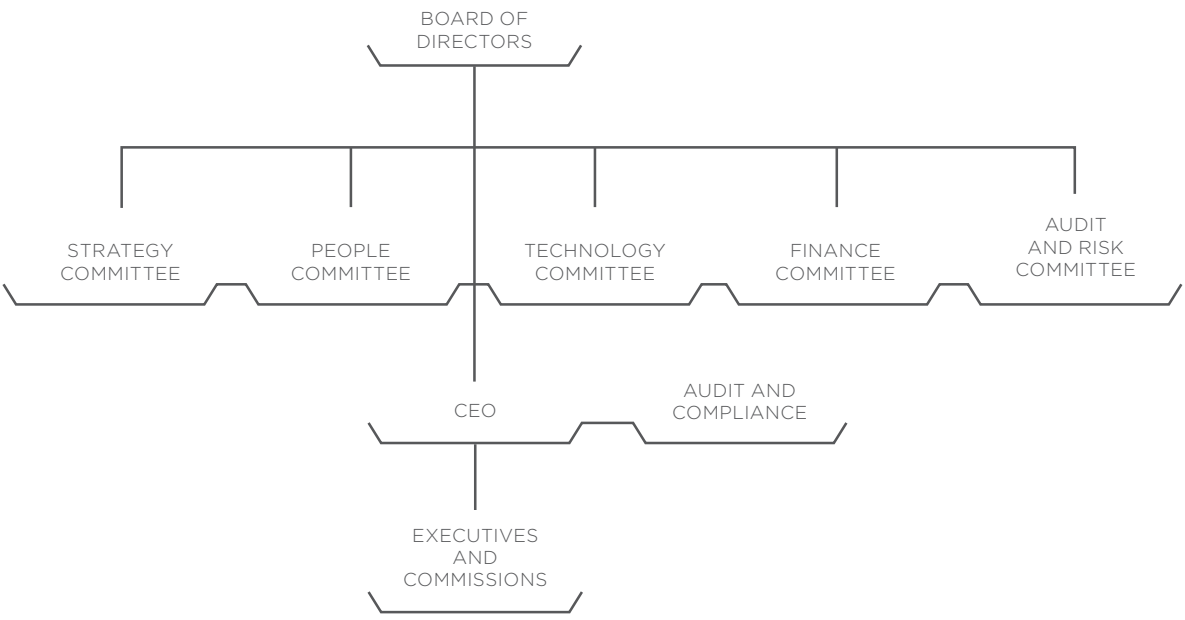
Eduardo Augusto Ayroza Galvão Ribeiro

DIRECTORS

Adalberto Guimarães Parreira
Carlos Alberto Bezerra de Moura
Marcos Alexandre Stuart Nogueira
Ricardo Fonseca de Mendonça Lima*
Rogerio Contato Guimaraes*

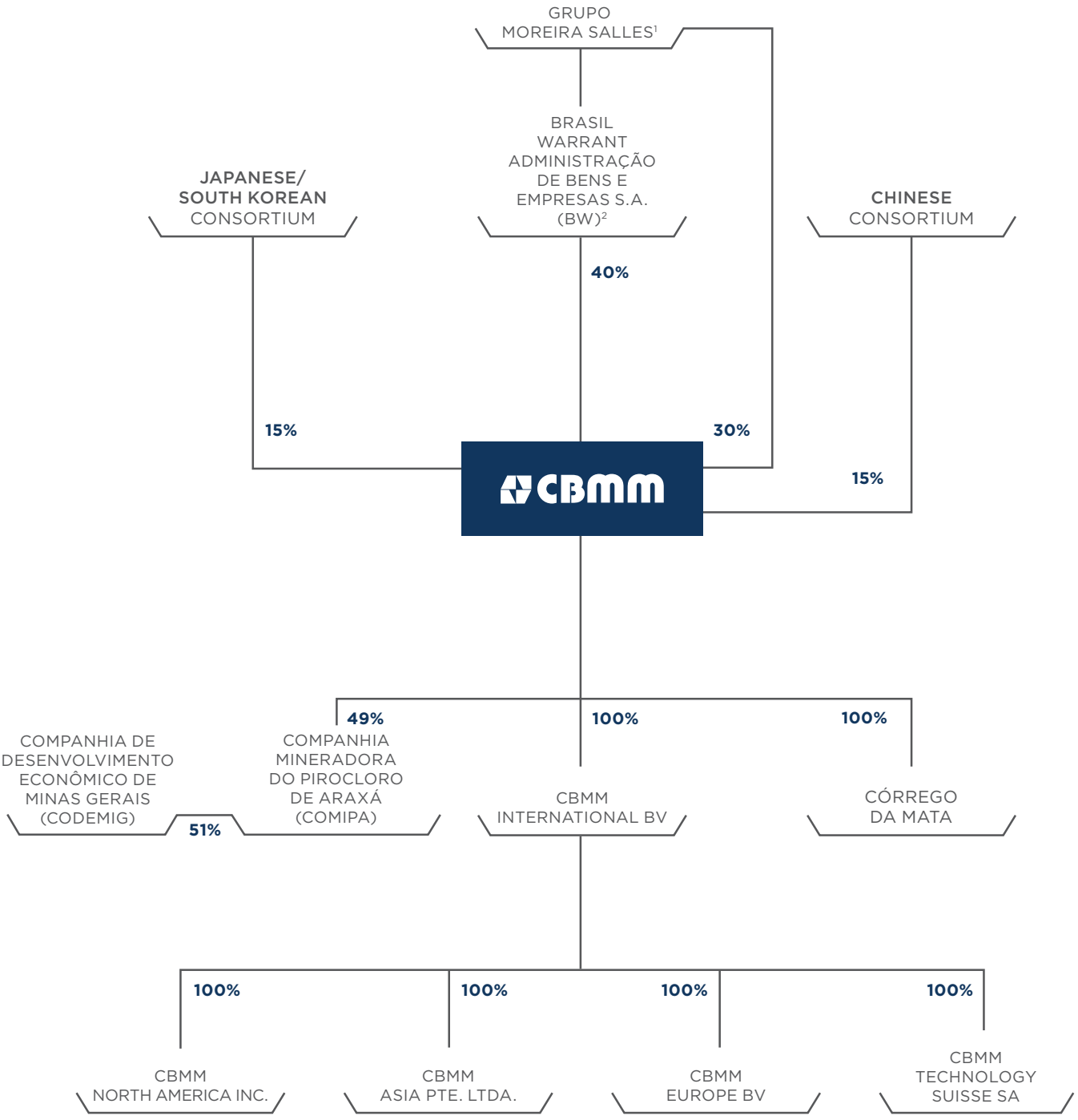
*Elected on February 20, 2018.

CBMM GOVERNANCE GRI 102-18



SHAREHOLDER STRUCTURE

CBMM is a privately held corporation GRI 102-5



1 Grupo Moreira Salles is controlled by Fernando Roberto Moreira Salles, Pedro Moreira Salles, Walther Moreira Salles Junior, João Moreira Salles, Lucas Espínola Moreira Salles and André Espínola Moreira Salles.

2 Brasil Warrant is controlled by Fernando Roberto Moreira Salles, Pedro Moreira Salles, Walther Moreira Salles Junior and João Moreira Salles, all of whom hold equal shares.


Photo: IPT Archive

Book launch – IPT archive.

PARTICIPATION IN ASSOCIATIONS GRI 102-13

CBMM has provided ongoing support to the Associação Brasileira de Metalurgia, Materiais e Mineração (ABM, Brazilian Association of Metallurgy, Materials and Mining) in its quest to disseminate best practices and technologies for the manufacture and use of materials, with an emphasis on steel. The company also maintains close relationships with Brazilian research institutes, such as the Instituto de Pesquisas Tecnológicas do Estado de São Paulo (IPT, Institute for Technological Research of the State of São Paulo) and the Centro de Inovação e Tecnologia (CIT/SENAI/FIEMG, Center for Innovation and Technology).
An agreement with the Central Iron and Steel Research Institute (CISRI) of China celebrated 39 years in 2018. CBMM maintains lines of research with CISRI to develop niobium-bearing steels for all market segments. These projects always directly involve CBMM's customers in China.

Technical consortia comprising CBMM's customers and universities are other important tools to develop the niobium market. The most active currently are with the Colorado School of Mines in the United States, Shanghai University and the University of Science and Technology in Beijing.
CBMM also sits on technical standards committees, foremost among them is ASTM (American Society for Testing and Materials) in the United States.

RISK MANAGEMENT GRI 102-11

The role of the Corporate Risk Management Department is to orient managers regarding risks, and to consolidate and inform the CEO of identified risks and mitigation activities. The basic purpose of risk management is to protect CBMM's reputation, assets and business against adverse events, thereby contributing to the company's sustainable growth. Besides reducing risks, risk management also:

- Strengthens the corporate governance structure;
- Increases the company's transparency by supporting the strategy of stakeholder relationships and communications;
- Fulfills long and short-term goals as determined in budgetary planning.

The risk management system has been implemented at the Dephosphorization Plant and in the IT Department. The company plans to expand the system to all areas and industrial departments by the end of 2019. When fully implemented, the risk management model will be integrated with the strategic vision of the shareholders and CEO to align the risks and the corporate objectives of the company.

Since 2017 CBMM has had an internal audit initiative, an independent activity that supports the Board of Directors and the CEO to strengthen CBMM's corporate governance.

CODE OF ETHICS AND CONDUCT

GRI 102-16; 102-17; 103|205

CBMM's Code of Ethics and Conduct includes a set of standards that prescribe ethical principles and guidelines for conducting the company's business. The code pertains to employees in Brazil and at the subsidiaries, as well as those who act on behalf of CBMM. Upon hire, employees receive specific training related to internal standards and the Code of Ethics and Conduct. Training is also conducted periodically on the Code and compliance policies for all employees.

In 2018 the Code of Ethics and Conduct was revised for a second time and the new version was distributed internally and externally. Employees received print editions, while the company's internet, intranet and compliance websites were updated accordingly. Among other topics, the new document considers concepts regarding public officials, undue advantage, harassment, conflict of interest and third-party contracting.

The Compliance Department provided online training that addressed the revised Code and continuing education on the Compliance Program as a whole. The training involves all 1.971 CBMM employees in Brazil and at the subsidiaries, with 1.399 having registered for the activities.

In 2018, the Compliance Program:



Provided online compliance training for all employees



Published the second revision of the Code of Ethics and Conduct



Conducted training on the Compliance Program's Antitrust Policy for CITIC, CBMM's distributor in China

COMPLIANCE PROGRAM

GRI 102-17; 103|205

In 2015 CBMM launched the Compliance Program, which is built on the principle that all employees and third-parties acting on behalf of the company apply the values of integrity, honesty, respect, ethics and transparency in their daily conduct.

Three years after implementation, the main results of the Compliance Program include the institutionalization of a Freebies, Gifts and Hospitality Policy together with an online registration system; Third-Party Contracting Policy; Donations and Sponsorships Policy; and launching a digital portal where all the information related to the program is centralized for easy access.

In 2018, as part of the Compliance Program's ongoing activities, the following were undertaken:

- Implementation of an Ethics and Conduct Commission, with duly approved operating procedures;
- Compliance Program training conducted at CITIC, CBMM's distributor and commercial agent in China;
- Initiation of work on three new policies to be instituted in 2019 – Conflict of Interest Policy, Anticorruption Policy and Policy on Interactions with Public Officials.

CBMM manages anticorruption efforts through internal policies; communications channels (Compliance Hotline) open to employees and the general public; third-party due diligence (high-risk cases are reviewed annually in accordance with the Third-Party Contracting Policy that has been in place and available on the intranet since 2017); specific training and anticorruption contract clauses. Additionally, CBMM has departments that are dedicated exclusively to the Compliance Program and to internal audits.

The company has a zero-tolerance policy regarding corruption and provides communications channels to report complaints of any type. These complaints are received and addressed by the Compliance Department. In 2018 there were no cases or legal actions related to corruption. GRI 205-3

Annually, an analysis is done regarding compliance risks, including corruption. Program performance, priorities and the need for new policies and procedures are also evaluated.

During 2019 CBMM plans to develop a specific policy to address situations involving conflicts of

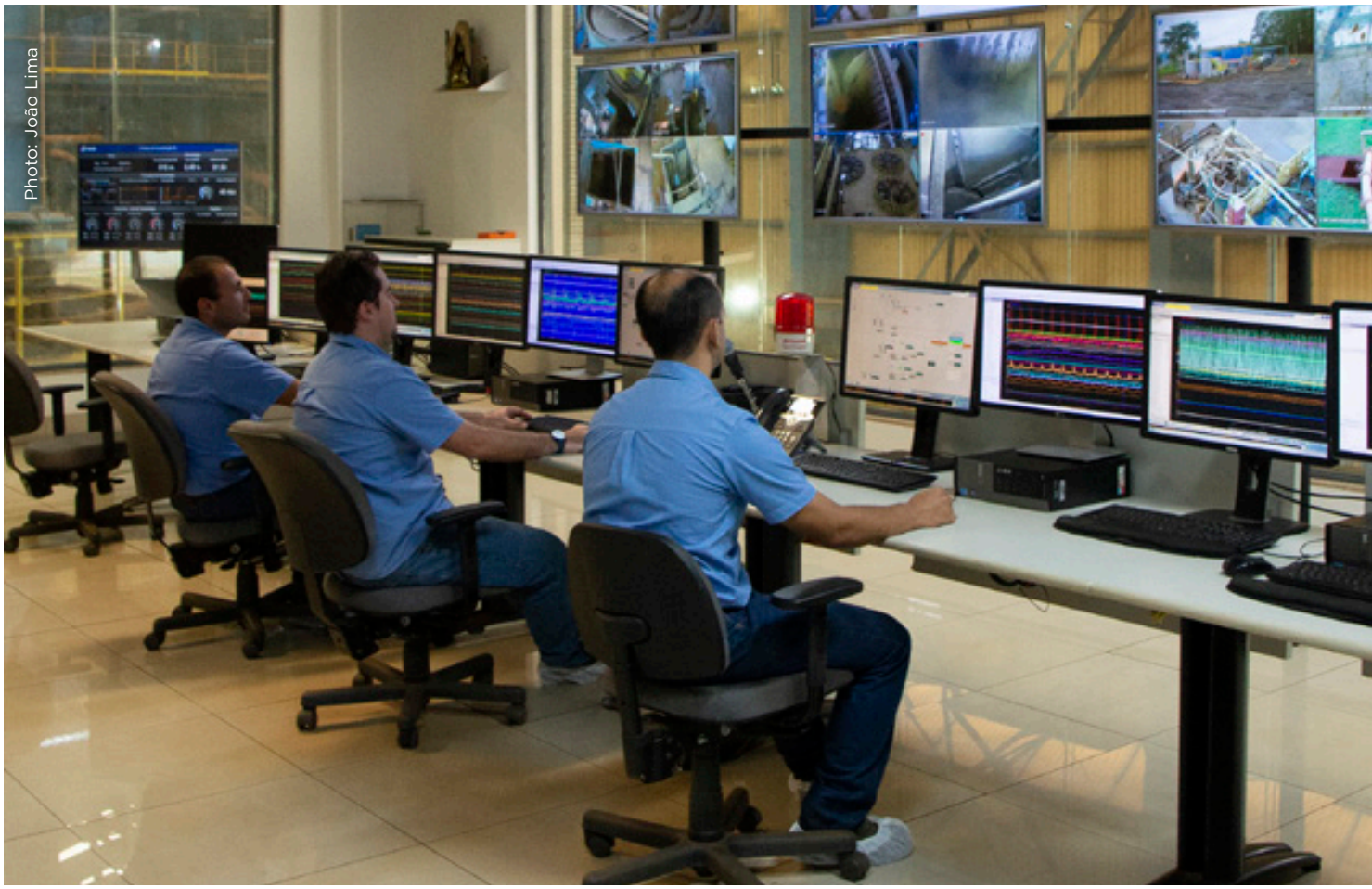


Photo: João Lima

interest with specific guidelines on reporting to superiors and Compliance Department approval.

SOCIOECONOMIC COMPLIANCE GRI 419-1; 103|419

CBMM did not register any instances of non-compliance with laws and/or regulations in social and economic areas initiated in 2016, 2017 or 2018. Here, non-compliance covers fines or penalties applied by responsible authorities as a result of violations related to slave labor, occupational health and safety, occupational medicine, the environment and products or services supplied by CBMM in Brazil or abroad. Excluded from the scope of this concept are amounts referring to previous lawsuits, tax contingencies, labor claims and other administrative or judicial proceedings existing in the normal course of CBMM activities.

Through its Integrated Management Policy and Code of Ethics and Conduct, the company illustrates its commitment to obeying all applicable legislation. The compliance team monitors adherence to global legislation and manages socioeconomic compliance.

The Compliance Program was instituted

three years ago

Compliance

Every year a compliance assessment is conducted that covers risks associated with corruption



COMPLIANCE HOTLINE CONTACT NUMBERS
Brazil: 0800 721 0754
Singapore: 800 852 3836
USA: 1 800 982 0934
Netherlands: 0800 022 2352
Switzerland: 0800 835 088

24 hours
a day

7 days
a week

WEBSITE
www.cbmmcompliance.com

E-MAIL
cbmm@cbmmcompliance.com

LETTER
Caixa Postal 521,
CEP 06320-971 - Brazil

IN PERSON
with a Compliance Department staff member

1.3 FINANCIAL PERFORMANCE GRI 102-7



Photo: Marcio Schimming

SDG REPORTED IN THIS CHAPTER

Growing worldwide demand for niobium had a positive impact on CBMM's results

Revenue in 2018 increased by

55%

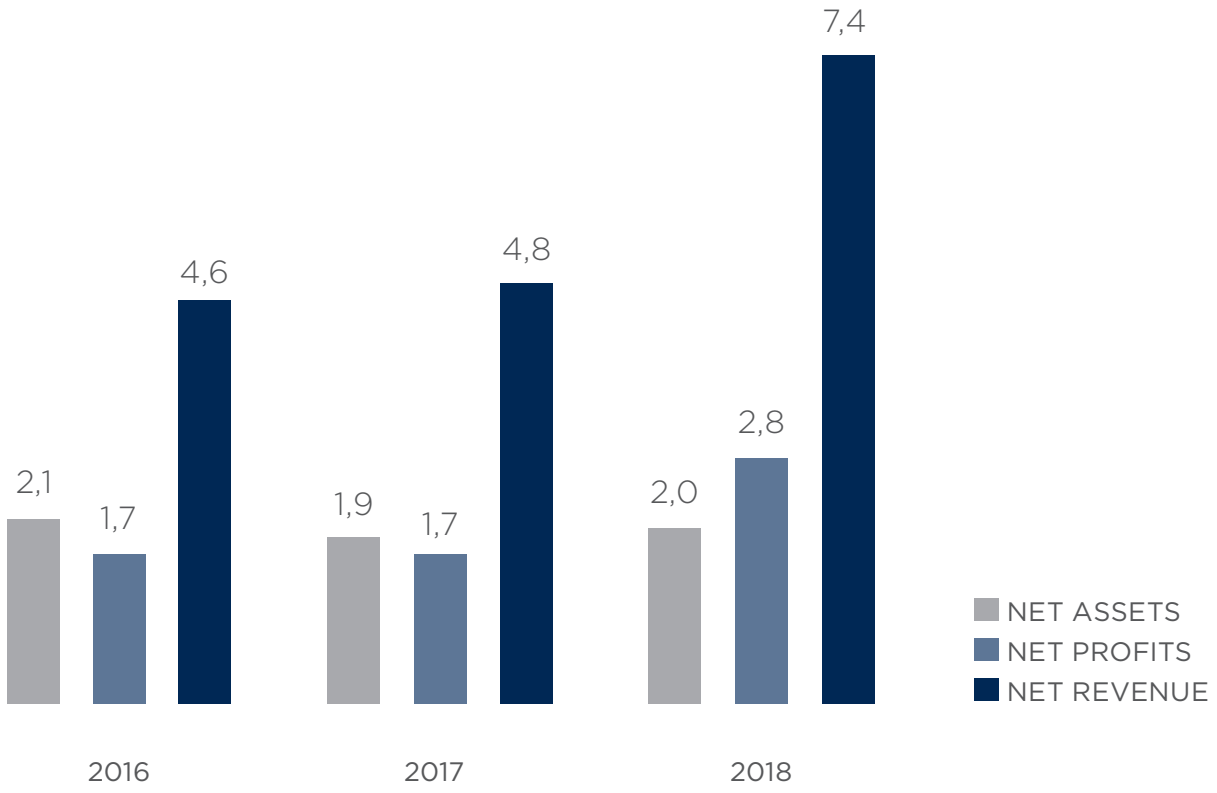
over the previous year

CBMM's financial performance in 2018 was favorable. The year saw a 28,17% increase in the volume of ferroniobium sales, climbing from 64.500 tonnes in 2017 to 82.671 tonnes in 2018, the result of an almost 30% growth in the demand for niobium products compared to the prior year. Notably, the production and consumption of steel jumped in China and India. There was a considerable increase in the price of elements that compete with niobium in certain applications, like vanadium and manganese, which prompted customers to migrate to niobium. Another highlight of 2018 was a hike in the sales of CBMM's special niobium products, including nickel-niobium and niobium oxide.

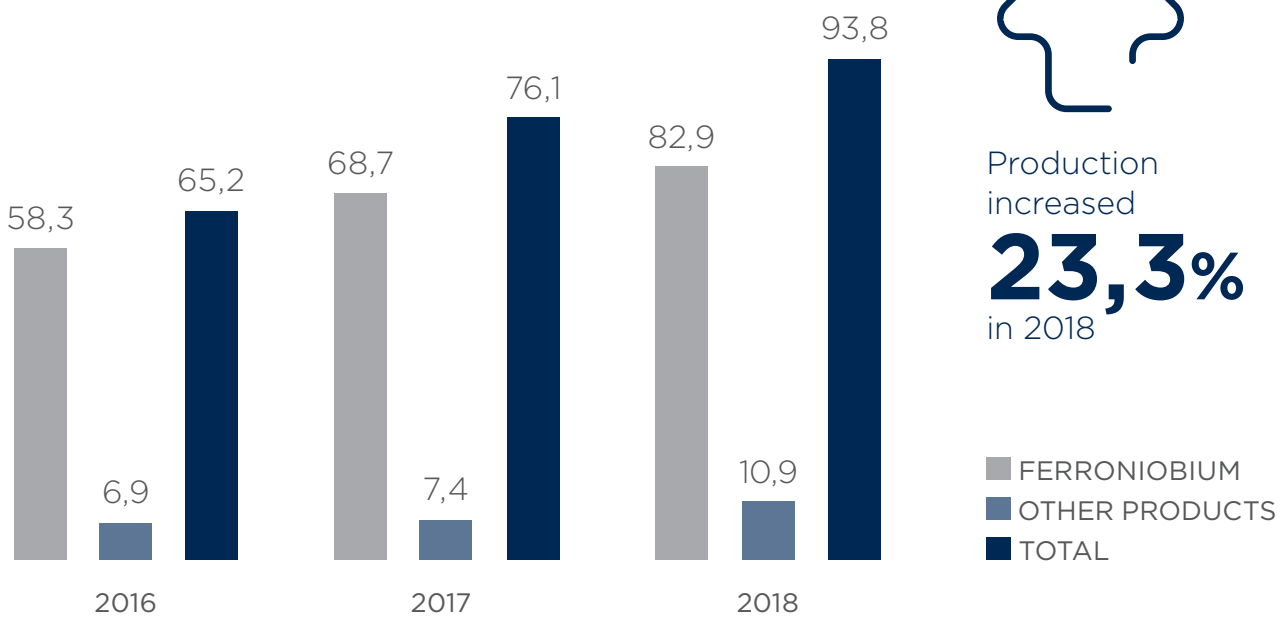
Also contributing to the company's financial results was the devaluation of the Brazilian real against the US dollar. Since CBMM exports 96% of the material it commercializes, the impact was significant. Compared to the previous year, revenue in 2018 grew by some 55% and totaled R$7,4 billion. Even with adjustments to production and increased commercialization, the company maintained costs and expenses in balance and closed 2018 with net profits of R$2,8 billion, 69% higher than the prior year.

KEY FINANCIAL INDICATORS

(R$ BILLION)



PRODUCTION OF FERRONIOBIUM AND OTHER PRODUCTS
(1.000 T)



EVOLUTION OF EXPORTS*
(T)

	2016	2017	2018
Ferroniobium standard	54.672	62.450	81.899
Other products**	3.154	3.351	5.029
TOTAL	**57.826**	**65.801**	**86.928**

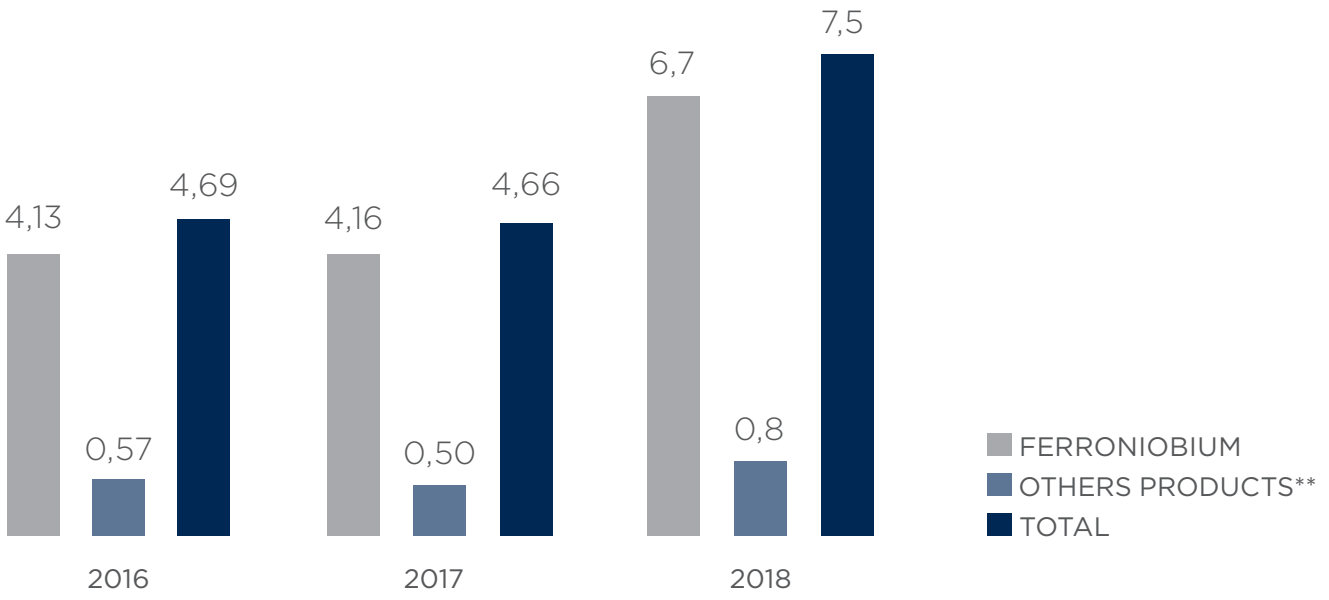
*Exports include sales to the market and to restock supplies for future needs.
**Mainly high purity niobium oxide, optical grade niobium oxide, vacuum grade ferroniobium, vacuum grade nickel-niobium, niobium metal, carbon ferroniobium and ferroalloy.

EVOLUTION OF SALES TO THE DOMESTIC MARKET
(T)

	2016	2017	2018
Ferroniobium standard	2.628	2.950	3.639
Other products*	131	56	569
TOTAL	**2.759**	**3.006**	**4.208**

*Mainly high purity niobium oxide, optical grade niobium oxide, vacuum grade ferroniobium, vacuum grade nickel-niobium, niobium metal, carbon ferroniobium and ferroalloy.

EVOLUTION OF REVENUE FROM EXPORTS*
(R$ BILLION)



*Sales to the market minus domestic sales.
**Mainly high purity niobium oxide, optical grade niobium oxide, vacuum grade ferroniobium, vacuum grade nickel-niobium and niobium metal.

LEARN MORE
Check out the Solutions for a Sustainable Future infographic

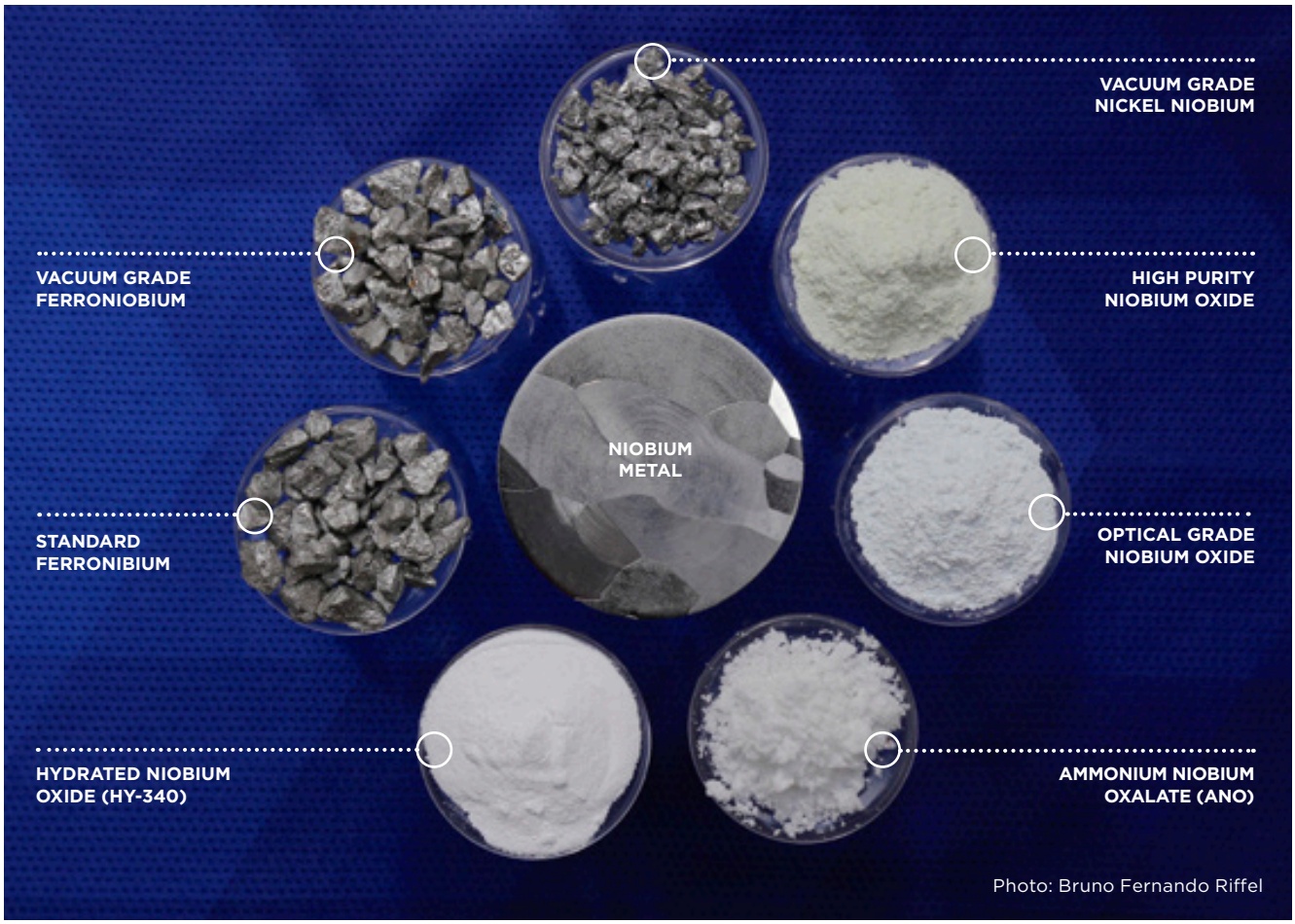


Photo: Bruno Fernando Riffel

1.4 DEVELOPMENT OF PROCESSES AND NEW PRODUCTS



Photo: João Lima

SDG REPORTED IN THIS CHAPTER

CBMM Technology Center

One of the most comprehensive niobium research centers in the world, CBMM's Technology Center in Araxá aims to optimize natural resources, input materials, ore processing and product industrialization. Currently some 130 researchers and technicians are developing 28 projects associated with innovative technologies linked to the niobium supply chain.

These developments reduce the environmental impact of the manufacturing process and also increase energy efficiency, with improved productivity and operational safety. Facilities include laboratories, pilot plants for ore processing and treatment (grinding, classification and flotation), pilot plants for metallurgical assays (pelletization, sintering and fusion) and pilot plants for chemical assays, in addition to infrastructure for environmental research and physio-chemical characterization of materials.

A Brazilian law to motivate innovation (#11.196 from 2005) has contributed to this development work. In 2018, resources from this initiative totaled some R$20 million, which was applied to research and development projects.

CBMM invested 1,6% of net profits towards technology and market development. There are 179 technical cooperation projects underway, including 137 with customers, 27 with universities and 15 with research institutes.

Establishing technical partnerships is the main strategy that CBMM has employed to develop new uses and applications for niobium. Currently, the partnerships are developed with the supply chain, mostly customers. However, the company has been seeking to invest more and more in initiatives that involve end users since it is understood that success will depend on understanding and meeting their needs.

The goal of CBMM's technology program is to increase sales by growing the global niobium market. In 2018, the niobium market grew by 19%, considerable growth that indicates that the company is on the right track. All the sales targets by segment were surpassed and 25% more ferroniobium was sold compared to 2017.

CBMM invested 1,6%
of net profits in research and development

> Establishing technical partnerships is the main avenue that CBMM has used to develop new uses and applications for niobium

SELECT PROJECTS DEVELOPED AT CBMM'S TECHNOLOGY CENTER IN 2018 BY AREA

Area	Project
Mineral	Development of alternative techniques for tailings disposal
	Technological characterization of CBMM's mine
	Technical investigation of improvements to the configuration of the flotation circuit
	Application of an advanced control system to optimize the flotation process
	Lean manufacturing applied at the Ore Treatment Laboratory
	Investigation of alternatives to improve the flotation process
Environment	Development of improvements to the treatment of industrial effluents, focusing on the performance of the niobium concentration process
	Implementation of an online monitoring system of water consumed throughout the industrial complex
	Study of the classification and management of new industrial waste
	Study of the dispersion of contaminant ions at the tailings dam
	Development of a new pH correction system at the tailings dam pond and industrial effluent treatment station
Chemical	Application of a raw material with low levels of niobium in the production of niobium oxide
	Studies to increase the niobium oxide production capacity
	Development of niobium oxide for application in automotive batteries
Metallurgical	Carbothermal reduction of niobium oxides
	Development of new ferroniobium alloys
	Study of different materials for ingot mold bases
	Development of a jigging process
	New ferroniobium production route
	Preliminary studies on ferroniobium granulometry
	Development of new suppliers of charcoal and iron powder
	Development of alternative routes to remove phosphorous from the ferroniobium production process

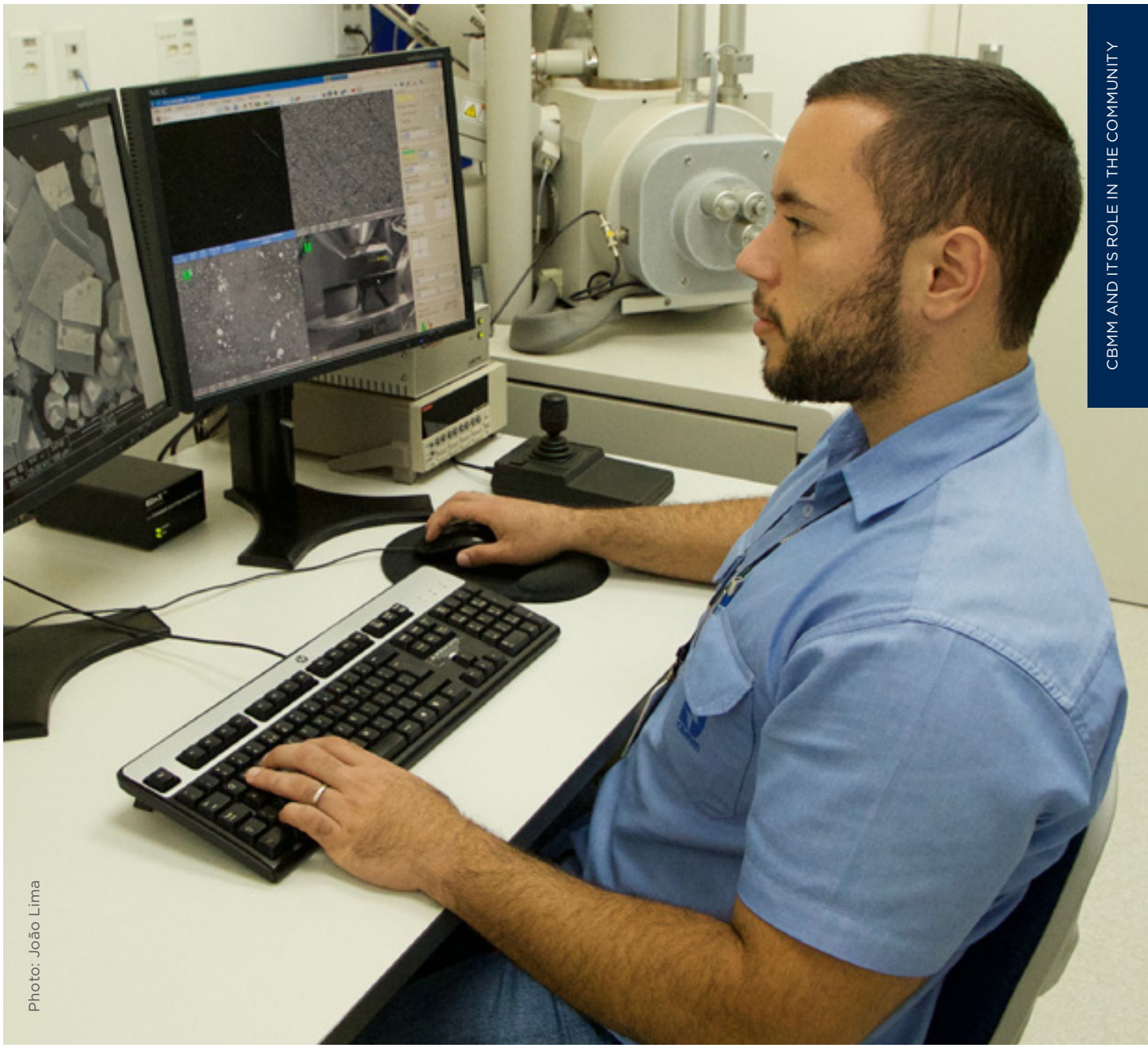


Photo: João Lima

VIM FURNACE – 2018 ACTIVITIES

CBMM's Metallurgical Processes and Materials Research Center (CPMPM) houses an innovative vacuum induction melting (VIM) furnace and uses processes that involve three new patents and accreditation by global aerospace regulatory authority, Nadcap. Unique in the world in scale, design and vacuum technologies, the center enables the development of superalloy prototypes, and consequently the rapid insertion of new innovative products containing niobium onto aerospace, energy generation and oil and gas markets. In 2018, superalloys like Inconel 718 were produced with extremely low levels of nitrogen (less than five parts per million) that are already being tested on the market. This superalloy increases fatigue resistance and reduces the risk of failures in aircraft turbines, thereby improving safety and the product's life span.

LEARN MORE

Watch a video about innovative superalloy manufacturing for aerospace applications

Accredited Nadcap™ Materials Testing Laboratory

1.5 MANAGEMENT EFFICACY AND OPERATIONAL EFFICIENCY



Photo: João Lima

Management and commitments





Pioneering

CBMM was the first mining and metallurgy company to earn ISO 14001 certification

CBMM anticipates environmental regulations and voluntary standards because this approach makes for a more efficient business. The company also applies the latest technologies to its endeavors.

As a result of implementing stringent environmental practices, CBMM was the first mining and metallurgy company in the world to earn the ISO 14001 certification, which entails strict compliance with environmental legislation, ongoing improvements to environmental performance, optimization of natural resources and prevention of pollution. The environmental aspects of the enterprise are duly licensed, and all conditions are promptly addressed.

The company's Integrated Management System was defined in 2008 and incorporates management systems certified by ABS-Quality Evaluations (*see box below*).

Management System	Scope	Certificate	Date of initial certification
ISO 9001	Quality	30898	07/05/1994
ISO 14001	Environment	32780	29/08/1997
OHSAS 18001	Occupational Health and Safety	70082	20/12/2002
ISO/IEC 27001	Information Security	70982	31/05/2006

The basic principles of the Integrated Management System are grounded in leading international standards and continuous improvements are made to the component systems: quality, environment, occupational health and safety and information security. CBMM uses the Legislation Control and Evaluation System (CAL®) to monitor environmental and occupational legislation applicable to its business.

A performance plan, implemented in 2017, aims to clearly define and communicate corporate strategy through annual targets for all management levels to align activities across the organization to achieve the expected annual results. The performance of managers in relation to the plan is linked to their variable compensation and the main dimensions include improvement to occupational health and safety, environment, quality, people management, risk management, finance, innovation, information security, governance and compliance and management maturity.



Photo: Shutterstock

The performance plan aims to clearly define and communicate corporate strategy through annual targets for all management levels to align activities across the organization to achieve the expected annual results

INTEGRATED MANAGEMENT POLICY

Through its Integrated Management Policy, CBMM commits to:

- **Prevent** pollution; occupational accidents, injuries and illness; and adverse environmental impacts resulting from the company's activities.
- Continuously **improve** the performance and efficacy of the Integrated Management System.
- **Respect** legislation and requisites defined by CBMM regarding its activities, products and services.
- **Optimize** the use of the natural resources entrusted to CBMM.
- **Encourage** employees and suppliers to adopt sound management practices.
- **Ensure** that the quality of products and services meet customers' needs.
- **Provide** resources for the implementation and maintenance of the Integrated Management System.

All employees are responsible for the performance of the Integrated Management System and for its continuous improvement. They are also responsible for maintaining the confidentiality, integrity and availability of information relative to CBMM's processes, products and services to which they have access.

Photo: João Lima



Staff recognition for developing process improvement projects.

R$6 million
of savings generated from cost management projects

MANAGEMENT TOOLS

Production Planning and Control primarily aims to analyze inventories, production capacities and sales demands to establish goals for each area. These goals are deployed for operations via Management by Procedures, a methodology that enables the calculation and distribution of targets in alignment with the company's strategy and signals the need to create action plans and/or projects (project management) in order to reach targets. These activities were implemented at CBMM in partnership with Falconi, a consultancy.

An integrated management workshop is held annually where diverse sectors of CBMM present improvement projects that achieved positive results.

In 2018 the projects focused on cost management generated a savings of R$6 million.

TECHNOLOGY CENTER: LABORATORY

At its Technology Center in Araxá, CBMM operates a complete laboratory capable of collecting samples, running environmental tests and analyzing all intermediate and final niobium products, in addition to participating in research and new process and product development. The laboratory is accredited by NBR ISO/IEC 17025:2005 and Nadcap.

The ISO/IEC 17025:2005 standard has been implemented since 2008 and currently the scope covers 68 assays (57 chemical assays and 11 samples) involving raw and residual water, atmospheric emissions, potable water and ferroniobium.

Nadcap accreditation was achieved in December 2017 for chemical and metallographic analyses in nickel alloys (Inconel), material developed at CBMM's Metallurgical Processes and Materials Research Center.

In 2018 lean manufacturing was instituted, resulting in significant gains in waste reduction and delivery time of results, in addition to a 23% jump in production capacity.



Photo: João Lima

REACH

CBMM satisfied the requirements of the Registration, Evaluation, Authorization and Restriction of Chemical Substances, known as REACH, in 2011. REACH is a European Union initiative that is concerned with the health and safety of the users of chemical products and requires from industry a higher level of responsibility in managing the quality of its products and the information it provides on the safety of the chemical substances they market in Europe.

CBMM's products were recognized by the European Chemicals Agency (ECHA) as safe and inoffensive to health and the environment. The reports emitted by reference laboratories – for 100% of CBMM products – were evaluated and authorized without restriction by ECHA.

Occupational health and safety

GRI 103|403

CBMM has adopted the guidelines of the OHSAS 18001 management system, including the active participation of employees in matters related to the occupational health and safety system, which has been certified by ABS-QE since December 2002.

The main initiatives that CBMM employs related to occupational health and safety are:

- The Integrated Management System;
- Mandated programs (hearing loss prevention, adequate ergonomics, work pace controls, occupational health and medicine, respiratory protection, environmental risk prevention, medical sharps risk prevention, health services medical waste management);
- Work instructions;
- Ministry of Labor regulations and other applicable legislative requirements.

Worker health and safety is monitored and evaluated using frequency rates reported monthly using the StratwsOne software, which is designed to control multiple indicators. Also part of the management of worker safety are formal committees that are integrated and work across all sectors of the company. These committees aim to prevent accidents and occupational illness and include (followed by their Portuguese acronyms): the Internal Commission for Accident Prevention (CIPA), the Safety Engineering and Occupational Medicine Specialized Service (SESMT), the Emergency Response Action Brigade (BARE) and the Occupational Health and Safety Facilitators.

SESMT, CIPA and the facilitators work together to disseminate health and safety activities. BARE is composed of a team of CBMM employees who have been trained to address emergency situations involving victims or damage to property or the environment. Their role is to prevent or minimize the impact of these incidents.



Photo: Bruno Fernando Riffel

Accidents are registered in the Integrated Management System via accident reports and are treated, depending on the case, through a corrective action report that analyzes the incident and establishes a plan of action. The procedure that CBMM follows for reporting and classifying workplace accidents are described in NBR 14280 and OHSAS 18001. The injury rate considers accidents without and with lost days (those that required medical attention). GRI 403-2

The rates of injuries and lost days for the past three years are described below. GRI 403-2

CBMM employees – types of injuries

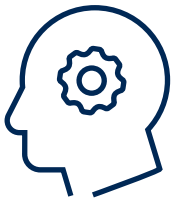
- **2016:** two accidents with no lost time and two with lost time (51 missed days). Of the four incidents, one was minor, two moderate and one severe;
- **2017:** seven accidents with no missed days and five with missed days (100 lost days). Of the 12 incidents, three were minor, eight moderate and one severe;
- **2018:** five accidents with no lost time and six with lost time (337 missed days).

Third-parties and apprentice program participants – types of injuries

- **2016:** four accidents with no missed days and five with missed days (206 lost days). Of the nine incidents, three were minor, four moderate and two severe;
- **2017:** two accidents without missed days and six with missed days (753 lost days). Of the eight incidents, three were minor, three moderate and two severe;
- **2018**: five accidents without missed days and four with missed days (333 lost days). COMIPA registered one accident without missed days.

In 2018 CBMM's injury rate dropped slightly, by 8,7%, compared to 2017. However, the lost day rate increased due to three accidents that generated an elevated number of missed days. These occurrences were duly addressed by tools in the Integrated Management System. The highlight for the year was an occupational illness rate of zero, and there was also a reduction in the absenteeism rate. Several actions were planned to improve safety performance, and these will be executed in 2019 and controlled via the Integrated Management System. GRI 403-2

All accidents involving CBMM and COMIPA employees and out-sourced service providers are recorded and evaluated to identify causes so that corrective actions can be implemented to prevent reoccurrence. GRI 403-2



The rate of occupational illness continues to be **ZERO**

EMPLOYEE[1] OCCUPATIONAL HEALTH AND SAFETY RATES GRI 403-2

	2016	2017	2018
Injury rate[2]	0,17	0,57	0,52
Occupational illness rate	0	0	0
Lost day rate[3]	2,19	4,7	15,9
Absenteeism rate[4]	20,74	41,14	32,08
Number of deaths	0	0	0

1 Calculations refer to CBMM employees, all of whom are located in the southeastern region of Brazil.
2 Injury rate is a frequency rate determined by (number of accidents x 200.000)/Number of man-hours worked.
3 Lost day rate is a severity rate determined by (number of lost days x 200.000)/Number of man-hours worked. Lost days are counted on the first day following the accident.
4 Absenteeism rate is determined by (number of missed days in the period/total hours worked) x 200.000. To standardize the calculations, the absenteeism rate reported in the 2017 Sustainability Report has been revised.

EMPLOYEE OCCUPATIONAL HEALTH AND SAFETY RATES BY GENDER AND REGION[1] GRI 403-2

Southeastern Region of Brazil	2016		2017		2018	
	Women	Men	Women	Men	Women	Men
Injury rate[2]	0	0,20	0,50	0,60	0	0,60
Occupational illness rate	0	0	0	0	0	0
Lost day rate[3]	0	2,40	42,80	1,00	0	17,50
Absenteeism rate[4]	29,00	19,90	159,50	29,70	50,20	30,3
Number of deaths	0	0	0	0	0	0

1 Calculations refer to CBMM employees, all of whom are located in the southeastern region of Brazil.
2 Injury rate is a frequency rate determined by (number of accidents x 200.000)/Number of man-hours worked.
3 Lost day rate is a severity rate determined by (number of lost days x 200.000)/Number of man-hours worked. Lost days are counted on the first day following the accident.
4 Absenteeism rate is determined by (number of missed days in the period/total hours worked) x 200.000. To standardize the calculations, the absenteeism rate reported in the 2017 Sustainability Report has been revised.

Health promotion

CBMM's Occupational Health and Medical Control Program establishes criteria for onboarding, periodic, return to work and dismissal examinations. The program also addresses health promotion through efforts to prevent and treat obesity, prevention of prostate cancer, tobacco awareness and cessation activities, women's health prevention, flu vaccinations, prevention and control of high blood pressure and diabetes and mental health treatment oversight.

Program planning is revised annually, or as needed, in parallel with the review of the Respiratory Protection Program that identifies and controls exposure to dust, fumes, metallic powder, chemical vapors, solvents and other risks.

The company maintains a Hearing Loss Prevention Program that monitors auditory acuity in workers to prevent and mitigate hearing loss. The Inorganic Lead Control Program is designed for workers exposed to risks in the industrial complex.

The Medical Sharps Accident Prevention Program aims to minimize exposure to needlestick risks for employees working in the company's health services through training on adequate techniques, materials and infrastructure. Through its Occupational Medicine and Hygiene Department, CBMM reinforces its commitment to zero occupational illnesses.



Ambulatory medical center.

Photo: João Lima

Environmental indicators



TAILINGS DAMS: CONSTANT VIGILANCE GRI 103|306

CBMM maintains eight dams at its industrial complex in Araxá. Three are used for sediment contention, one for fresh water contention and four are used for disposal of waste generated during the niobium concentration process.

The tailings dam projects were developed by specialized companies according to best engineering practices and included the participation of qualified professionals from Brazil and abroad.

During the implementation phase, dam construction is overseen by a specialized internal team and qualified companies. To further maximize the safety of the dam structures and guarantee adherence to the project specifications, the company that designed the structures maintains a technical team in the field.

During operation, the dams undergo periodic technical verifications, regular inspections, geotechnical monitoring and constant maintenance to ensure safety and expected performance levels.

Waste and tailings from the ore concentration process have been deposited into Dam 6 since 2006. This dam was built using the downstream method on compacted earth using clay material and overburden. The pond is completely lined with a layer of impermeable 1,5-milimeter thick high-density polyethylene (HDPE) material.

The impermeabilization system of the dams includes the application of a geomembrane, which maximizes dam safety, reduces water losses via soil infiltration and enables CBMM to recycle 97% of its process water.

To ensure continuity of operations, in 2018, CBMM finalized the first phase of construction on the implantation of a new tailings dam near its industrial complex and filed for the operation permit from the environmental agency. Dam 8 is being built using the downstream method on compacted earth using clay material and overburden. The pond is completely lined with a layer of impermeable 1,5-milimeter thick HDPE material.

Furthermore, sand and gravel drains were installed under the impermeable layer, allowing water to be carried under the dam and along its natural path. Pluvial waters in areas adjacent to the dam that do not come into contact with waste is directed toward existing streams.

In addition to the activities executed by CBMM's internal team, in compliance with the regulations established by the Conselho Estadual de Política Ambiental de Minas Gerais (COPAM, Minas Gerais State Council on Environmental Policy), an external Dam Safety Technical Audit is performed annually. In 2018, as in previous years, CBMM's dams were evaluated by external auditors and the respective Declarations of Stability were duly registered in the Environmental Declarations Repository of the Fundação Estadual do Meio Ambiente (FEAM, State Environmental Foundation).

The company also maintains emergency action plans (EAP) prepared in accordance with current legislation. These documents summarize general

> CBMM's tailings dams undergo periodic technical verifications, regular inspections, geotechnical monitoring and constant maintenance to ensure safety conditions and expected performance levels



Photo: Sander Dib

Dam 8.

information about existing structures, characteristics of possible emergency situations, a communication tree with action steps for all contacts involved in emergencies, general responsibilities, possible emergency situations and EAP training plan, in addition to defining the resources to be used in emergencies based on a hypothetical dam break study.

More than comply with current legislation, CBMM works proactively with entities, public agencies and the technical community to better control its operations and adopt measures for dam safety management.

As part of the company's program of continuous improvement, investments have been made for technologies to optimize the dam monitoring system to maximize structural safety and related to tailings thickening and filtration as alternative disposal methods. GRI MM3

RESPONSIBLE WASTE MANAGEMENT GRI 103|306

Waste that is generated by CBMM, both during the production process as well as administrative and maintenance activities, is managed through procedures, training and internal controls. Efforts are made to avoid the creation of waste in the first place. However, waste that is generated is recycled to extend the lifecycle, co-processed or adequately disposed of to ensure the prevention of pollution and eventual reuse in the future. Waste is segregated and stored separately in the production areas for later collection and storage at a temporary yard to coordinate final distribution for internal use, external use, donation or commercialization. CBMM systematically informs the relevant environmental agencies regarding the destination of each type of waste. GRI 103|305

Overburden, the mining material that does not contain niobium, is mainly used for construction projects on CBMM's grounds. Excess volumes are sent to locations duly licensed as overburden piles. An increase, starting in 2017, in the generation of overburden (non-hazardous, inert) compared to past years is the result of the construction of Dam 8 and Cell 4 for class-II waste.

The class IIA – not hazardous and not inert – waste from the ore beneficiation process is deposited in Dam 6, which is lined with a layer of HDPE. In 2018 CBMM generated a total of 9.605.254 tonnes of specific mining waste. This amount

increased over the previous year due to the larger volume of floated concentrate produced during the period. However, there was less overburden compared to 2017 because it was not necessary to remove as much of this material for the construction of Dam 8 and the waste cells. For CBMM, there is no risk associated with the generation of overburden and mining waste. GRI MM3

CBMM's class-I waste cell is covered by a sliding metallic structure. It is lined with two layers of HDPE sheeting, the upper is 2.5 millimeters thick and the lower is 1.5 millimeters thick. Between the two sheets is a layer of sand that permits the drainage of any type of leak that may occur, directing it to monitoring and control wells at the edge of the cell.

The class-IIA waste cells are lined with a bituminous geomembrane, or HDPE, that is 2.5 millimeters thick. Each cell has a rainwater drainage system that pumps the water to be used for ore processing. The surface and underground water quality downstream from the class I and II cells are monitored regularly.

Technicians from CBMM's Technology Center identified a way to recover aluminum from the slag generated during the metallurgical process. If implemented, this process would enable the reuse of up to 75% of aluminum waste that is currently deposited in the waste cells, which would result in a 45% decrease in the volume of class-II waste.

MANAGING IMPACTS GRI 103|306
CBMM's management systems (Integrated Management System, Laboratory Quality Management System) establish controls, programs and procedures for the responsible management of waste and effluents. In addition to tracking regulatory requirements, the company effectively implements a program of inspections, sampling and analyses to ensure environmental quality.

CBMM owns an area of about 6.890 hectares in Araxá, Minas Gerais. Within this area, mining permits have been granted for an area of approximately 986 hectares. Currently, mining activities occur in a 200-hectare area and the industrial complex is located five kilometers south of the city of Araxá.

To prevent spills and leaks, the company maintains procedures related to inspections and preventative maintenance. There were no significant spills or leaks of waste or liquids in 2018. GRI 306-3

Over the coming years, CBMM will initiate a process to uncover all the buried pipes on its property in order to better evaluate possible leaks or the potential risk of leaks. Additionally, the company will create an environmental inspection program at all plants and construction sites in 2019 to complement the maintenance inspections.

> CBMM's management systems establish controls, programs and procedures for the responsible management of waste and effluents



The generation of overburden dropped by almost

23%

NIOBIUM RECOVERY

In 2018 CBMM started a new industrial operation that transforms into a product what previously had been discarded as waste. The engineering group developed a process to recover niobium from metallurgical slag, leading to gains in productivity. With this, CBMM is more efficient in transforming ore into final products.

TOTAL AMOUNT OF MINING SPECIFIC WASTE GRI MM3

(T)

	2016	2017	2018
Overburden*	3.016.025	5.370.285	4.138.257
Ore beneficiation waste (includes sludge)**	3.453.660	3.745.230	5.466.997
Total	**6.469.685**	**9.115.515**	**9.605.254**

Note: Classifications based on ABNT's NBR 10.004/04.
**Overburden is non-hazardous, inert waste (class IIB).
**Ore beneficiation waste is non-hazardous and not inert (class IIA).

CONSCIENTIOUS USE OF WATER

GRI 103|303

Since the start of operations, CBMM has recirculated water used in industrial processes. Recirculated water is process water that is treated chemically and then submitted to a natural clarification process in the tailings dam to make it suitable for reuse in the manufacturing process.

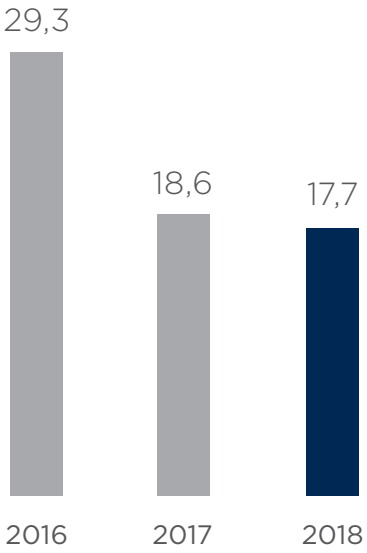
In October 2017, installation was finalized on 51 flow meters that are automated and unified in a water portal system where online tracking of fresh and industrial water usage is possible in each department.

There were two challenging goals in 2018: adjust/improve the water portal system and maintain the recirculated water rate. CBMM achieved the 2018 targets proposed in 2017 by reaching 97% water recirculation, a new record, in addition to reducing the specific consumption of fresh water. Even with an increase of 21% in the production of ferroniobium, which caused a jump of over 30% in the need for process water, it was possible to drop a percentage point in the consumption of new water, closing 2018 at 20 cubic meters of water per tonne of produced ferroniobium. The company was able to accomplish this thanks to the work of a multidisciplinary Water Commission, support from executive management and the commitment of CBMM employees (*see graph*). GRI 303-1; 303-3

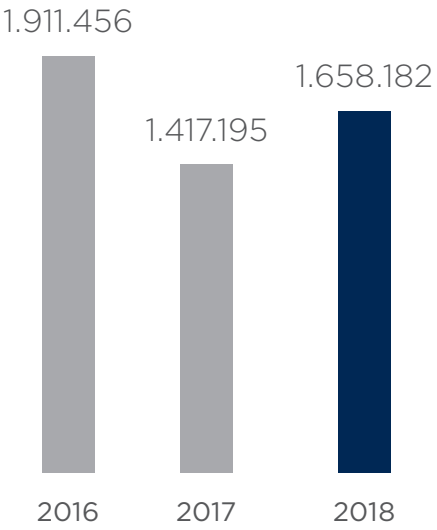
The goal for 2019 is to maintain a minimum level of water recirculation at 96%, even with the proposal to increase ferroniobium production by over 30%.

CBMM uses Dam 7 as a fresh water source. The volume of the reservoir is some 3.550.000 cubic meters. It is not located within a protected area, nor does it have high biodiversity or relevance to the local community. The reservoir is fed by the dammed Pirapitinga Creek and is located within CBMM's property. It is duly permitted, and the company pays a fee for exclusive withdrawal rights. Consumption from this source is considered relevant since withdrawals correspond, on average, to 5% or more of the annual volume of the water body. GRI 303-2

SPECIFIC WATER CONSUMPTION
(M³/T OF NIOBIUM PRODUCTS)



TOTAL WATER CONSUMPTION BY SOURCE* GRI 303-1
(M³)



*Since 2016 the source has been surface water.
**The amounts were directly measured by a specialized team.

97%
of water was recirculated at CBMM production facilities – a company record

Fresh water consumption
11,3 m³
of fresh water was consumed to produce 1 tonne of ferroniobium


Photo: Bruno Fernando Riffel

RECYCLED AND REUSED WATER* GRI 303-3
(MILLION M³)

	2016	2017	2018
Total volume of water withdrawn from source *	1,9	1,4	1,7
Total volume of water recycled and reused by the organization**	38,8	34,7	46,7
Percentage of water recycled or reused during the year	95%	96%	97%
Percentage of water withdrawn from source during the year	5%	4%	3%

*In accordance with an agreement established at the beginning of 2017 as part of the Water Commission deliberations, water used in the construction of Dam 8 is not included in the overall recirculation figure (276.603 m³).
**83% of this amount was measured via flow meters and 17% by mathematical models due to the large volume of processed material (granulation of metallurgical slag and floated concentrate).

RENEWABLE ENERGY

CBMM's total energy consumption increased by 20% in 2018 compared to the prior year, a direct result of the over 20% increase in ferroniobium production. GRI 302-1

The company's total energy consumption from scope 1 and 2 renewable sources was 1.379.315,50 GJ in 2018, above the amount recorded in 2017 (1.120.807,98 GJ), and included charcoal, biodiesel and energy captured from the national grid. GRI 302-1

Total energy consumed from non-renewable sources, scope 1 and 2, also increased in 2018 over 2017, registering 551.471,33 GJ (+13%). Of the sources quantified, there was an increase in the consumption of LPG (+28%), petroleum coke (+4%) and aviation fuel (+6,18%). There was a drop of 6% in the consumption of diesel fuel. GRI 302-1

In 2018 CBMM saved the equivalent of 250.710,23 GJ due to initiatives to conserve energy. GRI 302-4

In line with its Integrated Management System, the company seeks to optimize resources and processes. To that end, understanding and improving the use of resources by third parties is also important and is evaluated annually during the preparation of the sustainability report and for the Brazilian Greenhouse Gas Protocol. GRI 103|302

The main activities to reduce indirect energy consumption include:

- Promotion of tele and video conferences;
- Collective transportation for employees and promoting ride sharing;
- Internal transportation scheme involving vans with fixed itineraries to reduce the number of trips that previously were made by private passenger cars;
- Liberation of onsite concrete production to reduce costs and emissions associated with the transportation of concrete during construction activities at the industrial complex in Araxá;
- A mechanics shop for mobile equipment located within the industrial complex;
- Building a new water reservoir at an elevated point to reduce energy needed for pumping;
- Acquisition and use of high efficiency equipment.

GRI 302-4; 103|302

In 2018 CBMM consumed 2% more energy outside the organization compared to the previous year. GRI 302-2

CBMM strives to optimize the use of resources and continuously improves processes, practices that are part of the company's Integrated Management System

ENERGY CONSUMPTION WITHIN THE ORGANIZATION BY SOURCE GRI 302-1

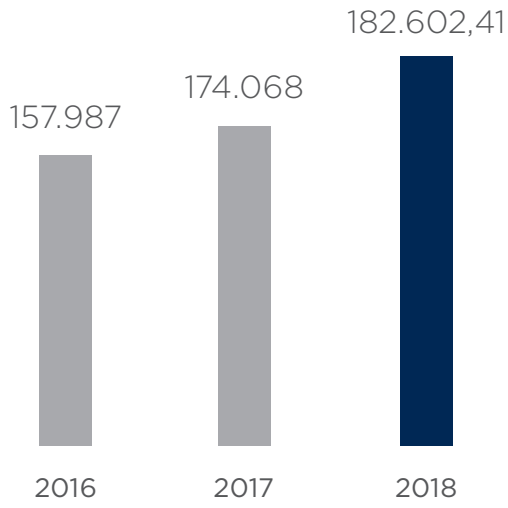
(GJ)

NON-RENEWABLE SOURCES*	2016	2017	2018
LPG	233.911,28	242.702,17	310.164,17
Petroleum coke	69.020,64	91.971,21	96.024,74
Diesel fuel	108.921,82	149.002,60	140.029,91
Aviation fuel	6.913,71	4.946,95	5.252,49
Total	**418.767,45**	**488.623,28**	**551.471,32**
RENEWABLE SOURCES*			
Charcoal	179.357,05	144.127,15	201.024,78
Biodiesel	8.198,42	11.894,00	14.540,32
Total	**187.555,47**	**156.021,15**	**215.565,10**
TOTAL ENERGY CONSUMED			
Fuel consumption from non-renewable sources	418.767,44	488.623,28	551.471,32
Fuel consumption from renewable sources	187.555,47	156.021,15	215.565,10
Energy consumed from the national grid**	896.592,83	964.786,83	1.163.750,40
Total	**1.502.915,74**	**1.609.431,26**	**1.930.786,80**

Note: The source of the conversion factor is the GHG Protocol.
*Scopes 1 and 2. The number reported in the 2017 Sustainability Report for total amount of energy consumed from non-renewable sources was revised based on updated figures for diesel fuel consumption.
**The Brazilian Greenhouse Gas Protocol tool and methodology were used.

ENERGY CONSUMPTION OUTSIDE OF THE ORGANIZATION* GRI 302-2

(GJ)



* For the calculation, third-party fuel consumption was quantified for CBMM activities and the energy conversion was made using conversion factors from the Brazilian Greenhouse Gas Protocol tool. The figures do not include fuel consumed during rail transport.

Energy consumption

20,0 GJ/t

of ferroniobium produced

20,6 GJ/t

of niobium* products produced

*Niobium products = ferroniobium + other niobium products.

REDUCTION OF ENERGY CONSUMPTION GRI 302-4

(GJ)

	2016	2017	2018
Replacement of high-humidity silica sand with aluminum slag recycled from the process, eliminating the need to burn LPG	1.225,00	-	-
PDCA and SDCA initiatives addressing electric power at the Dephosphorization Plant, leading to stabilized and reduced consumption	-	6.153.690,00	-
Green Belt initiative to reduce diesel fuel consumption in COMIPA equipment (diesel fuel - 102.000 liters in 2018)	-	-	3.623,12
PDCA initiative at the Dephosphorization Plant to reduce the consumption of charcoal (50,06 kg/t)	-	-	175.218,58
PDCA initiative to reduce the consumption of electric energy during remelting ferroniobium foam at the Metallurgical Plant – electric energy (168 kwh/t)	-	-	59.789,32
Black Belt initiative to reduce the specific consumption of LPG at the High Purity Oxides Plant – LPG (259.916 kg in 2018)	-	-	12.079,20
TOTAL	**1.225,00**	**6.153.690,00**	**250.710,23**

Note: The reduction values reported in the table refer to quantities of materials and fuel that were not consumed in the period due to the execution of the listed projects.

MONITORING AIR QUALITY

Air quality at CBMM's industrial complex and in downtown Araxá has been monitored systematically since 1997. The results demonstrate that the levels are well below legal limits. This impact is not significant since the quality of the air adjacent to the mine is about 30 microns per cubic. The secondary air quality standard is 150 microns per cubic meter – below that level minimal adverse effects are expected for the wellbeing of populations, fauna, flora and the environment in general. GRI 413-1



Photo: Cristiano Mascaro

The company further minimizes this insignificant impact through a variety of measures, including:

- Watering the roadways used by mining equipment to prevent the generation of particulate matter;
- A long-distance conveyor belt was installed in 1982 between the mine and the Concentration Plant. In 2012 it was adapted to connect the ore blending yard. This equipment provides diverse benefits by reducing truck traffic, fuel consumption, oil residues, noise and emissions of greenhouse gases. Plus, with the elimination of vehicular traffic, accidents are likewise reduced;
- Even with the increased production levels at the plants, and the consequent increase in the number of stacks in operation, reductions in the concentration of emissions have been seen since 1990;
- Inspections are realized at the entrance gate of the industrial complex in Araxá on all tank trucks that transport raw materials and products. These inspections are designed to ensure safety and lower the potential risk of leaks. Greenhouse gas emissions are also monitored, including on third-party equipment.

CBMM uses only ethanol, a renewable-source fuel, for its flex fuel vehicles and since 2015, the company has added hybrid (gas + electric) vehicles to its fleet. GRI 103|305

ELECTRIC SCOOTERS

CBMM has been using electric scooters at its facility in Araxá since 2014. These solar-powered vehicles are built with high-strength, low-weight frames made of niobium microalloyed steels

EMISSIONS GRI 103|305

CBMM regularly monitors emissions from stationary sources, notably parameters such as particulate matter and sulfur dioxide. Other parameters are absent or insignificant. Emission rates and hours of operation of each stack are considered. Projects involving new environmental controls are designed with limits that are much more restrictive than current regulations for fixed-source emissions.

CBMM does not emit substances that are destructive to the ozone layer. Gases in refrigerated equipment are properly maintained and during maintenance they are stored in pressurized tanks. Substances in older equipment are replaced with newer compounds: R22 refrigerant is being gradually replaced by R M099, which is less aggressive to the environment.

CBMM is a member of the Brazilian Greenhouse Gas Protocol Program and has made its inventory available to the public since 2013. Calculations cover scopes 1, 2 and 3, meaning that CBMM considers emissions related to its own production and energy consumption, as well as those of its main service providers.

Emissions management is monitored through audits performed by an INMETRO-certified company at CBMM facilities and at service providers.

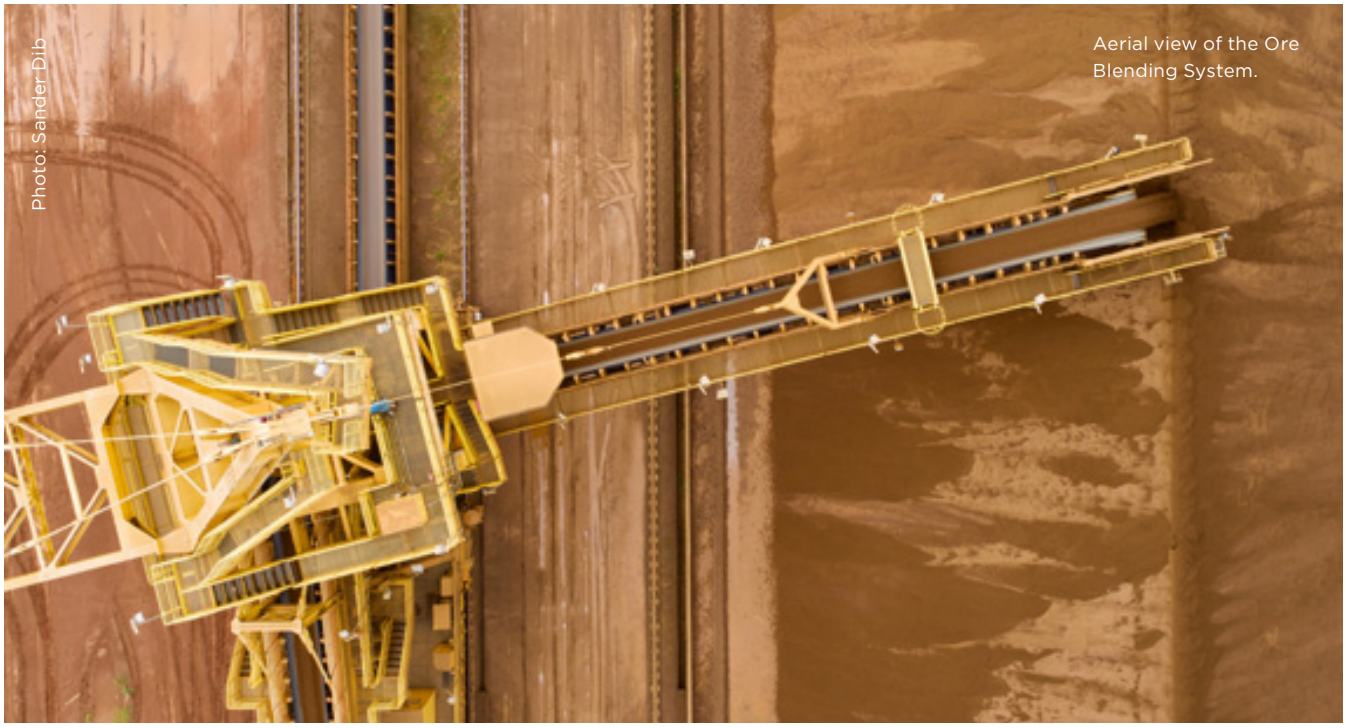


Photo: Sander Dib

Aerial view of the Ore Blending System.

The 2018 indicators show that total direct specific carbon dioxide emissions increased by 11% over the previous year. This rise is related to the expanded production of ferroniobium. GRI 305-1

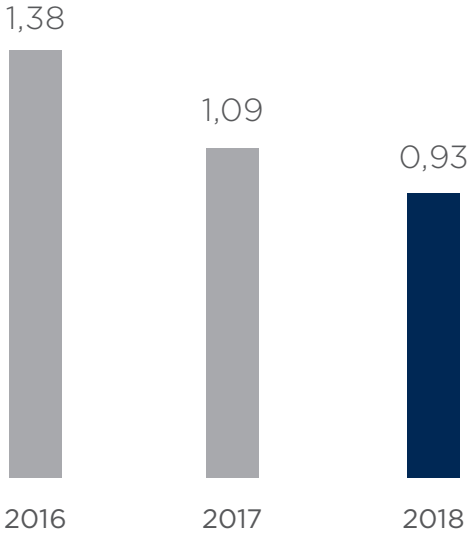
The electric energy consumed at CBMM is sourced 100% from the national grid, which saw a drop of 20% in its emission factor in 2018. Given that, even with the increased production of ferroniobium, CBMM's indirect greenhouse gas emissions from purchasing electric energy fell by 5,5%. GRI 305-2

A CBMM integra o Programa Brasileiro GHG Protocol, cujo inventário está disponível para consulta no Registro Público desde 2013

CLIMATE FORUM

CBMM is a signatory to the Open Letter to Brazil on Climate Change, a document through which the company assumes voluntary commitments in an effort to reduce carbon emissions. CBMM also participates in Forum Clima – Ação Empresarial sobre Mudanças Climáticas (Climate Forum – Business Action on Climate Change, www.forumempresarialpeloclima.org.br), which is a work group comprised of companies and two support organizations, with Instituto Ethos providing executive organization. GRI 102-12; 103|305

SPECIFIC GREENHOUSE GAS EMISSIONS
(tCO_2e/t OF NIOBIUM PRODUCTS)



Greenhouse Gas Emissions

0,83 tCO_2e/t

of ferroniobium produced

DIRECT AND INDIRECT GREENHOUSE GAS EMISSIONS BY SOURCE

(tCO_2e) GRI 305-1; 305-2

Direct emissions (Scope 1)*	2016	2017	2018
Generation of electricity, heat or steam	22.941,54	25.668,85	30.276,713
Physical-chemical processing	2.968,57	3.148,96	4.091,53
Transportation of materials, products, waste, employees and passengers	8.620,78	10.978,34	10.866,161
Fugitive emissions	4.648,40	3.473,73	2.891,663
Solid waste and effluents (category added by the Brazilian GHG Protocol Program – 2016 Inventory)	352,20	485,75	451,21
Change in soil use (category added by the Brazilian GHG Protocol Program – 2016 Inventory)	16.852,18	-	0,00
TOTAL	**56.383,66**	**43.755,63**	**48.577,280**
Biogenic emissions of CO_2 (from burning or biodegradation of biomass)	18.116,68	16.250,72	22.485,331
Indirect emissions (from purchasing electric energy) – Scope 2**	20.621,46	25.273,45	24.260,46

*For calculations of atmospheric emissions, the following were considered: CO_2 –carbon dioxide; CH_4 – methane; N_2O – nitrous oxide. The base year is 2013, corresponding to the first publication of CBMM's GHG inventory for the Brazilian GHG Protocol Program. Total emissions in the base year were 3.186.092,95 tCO_2 equivalent. New base-year emissions calculations were not necessary. The Brazilian GHG Protocol Program methodology was used and the consolidation approach for emissions was operational control.

** The Brazilian GHG Protocol Program methodology was used and the consolidation approach for emissions was operational control. Base year: 2013 – first publication of CBMM's GHG inventory for the Brazilian GHG Protocol Program. Total emissions in the base year were 25.058,48 tCO_2 equivalent. No alterations were made to the calculation since there were no significant changes in emissions.

OTHER INDIRECT GREENHOUSE GAS EMISSIONS (SCOPE 3)*

(tCO_2e) GRI 305-3

	2016	2017	2018
Upstream			
Transportation and distribution	8.125,69	8.334,08	5.780,58
Business travel	1.886,03	1.478,98	3.760,647
Employee commuting	638,13	536,98	638,71
Subtotal	10.649,85	10.350,04	10.179,941
Downstream			
Transportation and distribution	2.407,43	3.724,81	4.410,002
TOTAL	**13.057,28**	**14.074,85**	**14.589,943**
Biogenic CO_2 emissions	977,55	1.101,30	1.548,08

Note: Preliminary figures were used for reporting Scope 3 total emissions. The final, assured values will be available on the Public Register of Emissions platform (https://bit.ly/2UAmgBL).

* For calculations of atmospheric emissions, the following were considered: CO_2 –carbon dioxide; CH_4 – methane; N_2O – nitrous oxide. The base year is 2013, corresponding to the first publication of CBMM's GHG inventory for the Brazilian GHG Protocol Program. Total emissions in the base year were 13.950,74 tCO_2 equivalent. New base-year emissions calculations were not necessary. The Brazilian GHG Protocol Program methodology was used and the consolidation approach for emissions was operational control.

1.6 STAKEHOLDER RELATIONS

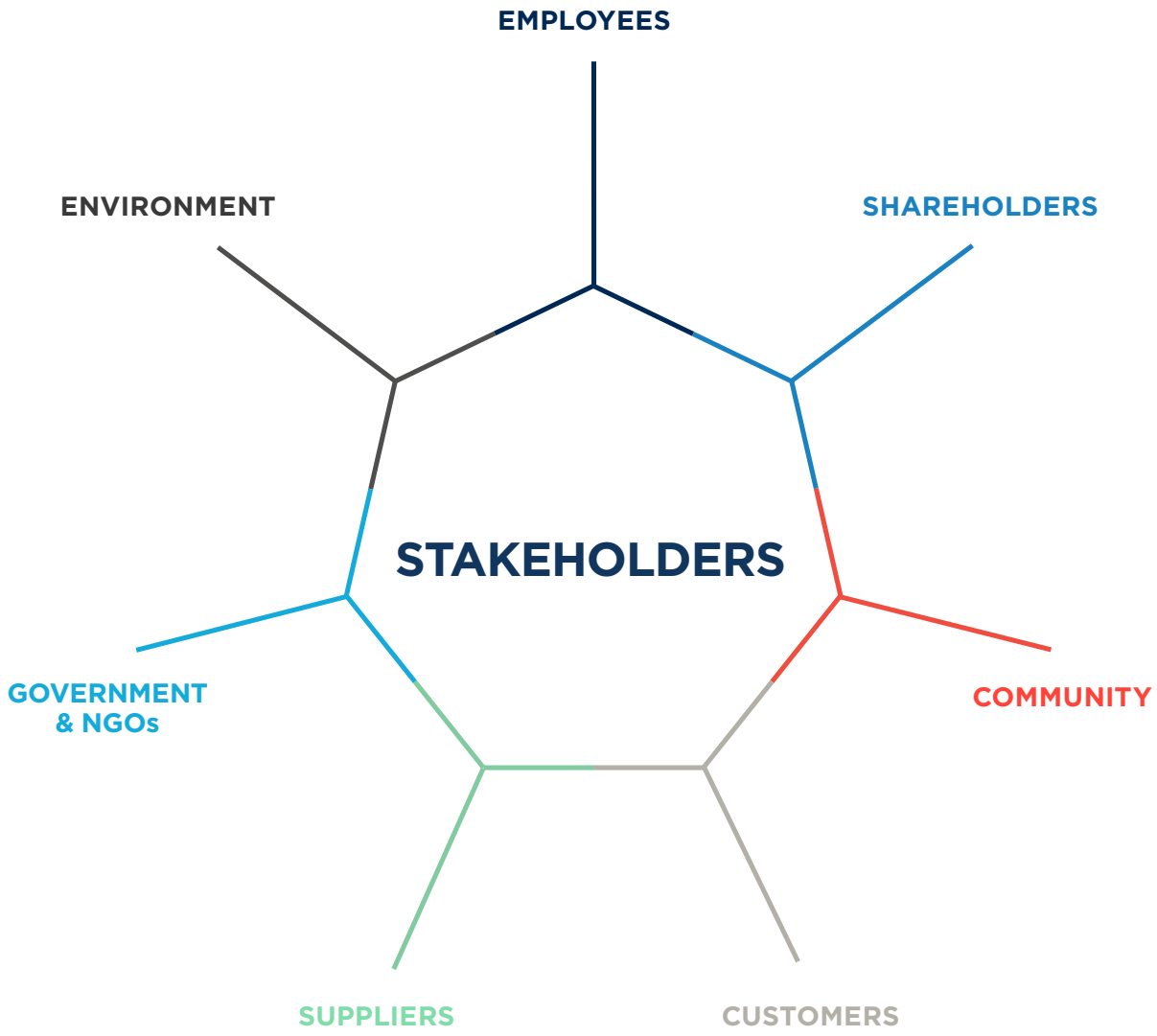


Photo: Ricardo Correa

CBMM maintains a close relationship with its employees, shareholders, the local community, customers, suppliers, the government and NGOs. In its various actions and initiatives, the company's preponderant role is generating and sharing value with all stakeholders.

This attitude is strategic for the performance of the company today and in the future. CBMM develops specific actions that involve sustainability aspects to engage each audience. The following pages illustrate the main initiatives implemented in 2018.

GRI 102-40; 102-42; 102-43; 102-44



Employees

VALUING EMPLOYEES

CBMM values and recognizes the importance of its team of professionals. Over its 60-plus year history, the company has built a culture that honors safety, quality and productivity, and provides a diverse set of benefits that addresses education, health, wellbeing and a pleasant workplace.

A people management policy adopted in 2015 addresses recruitment and selection, emphasizing internal recruitment and talent recognition through a more effective evaluation system. In 2017 the Human Resources Department incorporated its management programs into the SAP operational system, an important step in improving processes under development and optimizing internal activities. In 2018 the Job Classification and Salary Policy was revised to adapt and redefine existing job functions. In 2019 the company will invest to improve computerized systems for people management and performance evaluations based on organizational competencies. GRI 103|404

While CBMM does not have a specific policy that addresses hiring from the local community, the company has always prioritized local hires at all levels. A large majority of professionals, with the exception of specific skills not found locally, are hired from the Araxá or São Paulo areas. GRI 103|202

> CBMM prioritizes worker safety, environmental protection, quality and productivity



Photo: Bruno Fernando Riffel



COMMUNICATIONS CHANNEL

A portal on the company's intranet site is the primary formal channel of direct communication with CBMM's executive management team. Employees can make observations, provide suggestions or critiques anonymously using computers available at the company. Management responds through the same channel.

WORKFORCE BY LEVEL AND GENDER GRI 102-8

	2016		2017		2018	
	M	W	M	W	M	W
Board	8	1	10	0	10	0
Executive team	5	0	5	0	6	0
Management	23	1	24	1	51	10
Heads/coordination	63	17	60	17	34	6
Technical/supervisory	91	7	99	5	115	6
Administrative	280	68	268	77	268	84
Operational	1.064	54	1.040	50	1.095	48
Trainees	1	2	1	1	0	0
Third-parties COMIPA	186	9	185	8	170	9
Third-parties Other	15	0	0	0	0	0
Apprentices	24	25	9	12	26	17
Interns*	0	0	0	0	11	5
Total by gender	**1.760****	**184**	**1.701**	**171**	**1.786**	**185**
Total	**1.944****		**1.872**		**1.971**	

M = Men
W = Women
Note: CBMM considers an employee a person who has a working relationship with the company in accordance with national legislation or its application.
*In 2016 and 2017 CBMM did not have interns.
**2016 numbers have been revised.

NUMBER OF EMPLOYEES BY TYPE OF WORK CONTRACT AND GENDER GRI 102-8

Type of contract	2016			2017			2018		
	M	W	T	M	W	T	M	W	T
Time-limited	24	25	49	0	0	0	30	3	33
Open-ended	1.526	149	1.675	1.497	151	1.648	1.539	151	1.690
TOTAL	**1.550**	**174**	**1.724**	**1.497**	**151**	**1.648***	**1.569**	**154**	**1.723**

M = Men
W = Women
T = Total
*Since 2017, in line with the GRI definition of Employee, interns and apprentices are not included in the calculation. Data were compiled through SAP-generated reports.

NUMBER OF EMPLOYEES BY TYPE OF CONTRACT AND REGION* GRI 102-8

Region of Brazil	City	2017			2018		
		TL	OE	T	TL	OE	T
Southeast	Araxá (MG)	0	1.577	1.577	33	1.620	1.653
	São Paulo (SP)	0	71	71	0	70	70
TOTAL		**0**	**1.648**	**1.648**	**33**	**1.690**	**1.723**

TL = Time-limited
OE = Open-ended
T = Total
*Since 2017, in line with the GRI definition of Employee, interns and apprentices are not included in the calculation. Data were compiled through SAP-generated reports.


Photo: João Lima

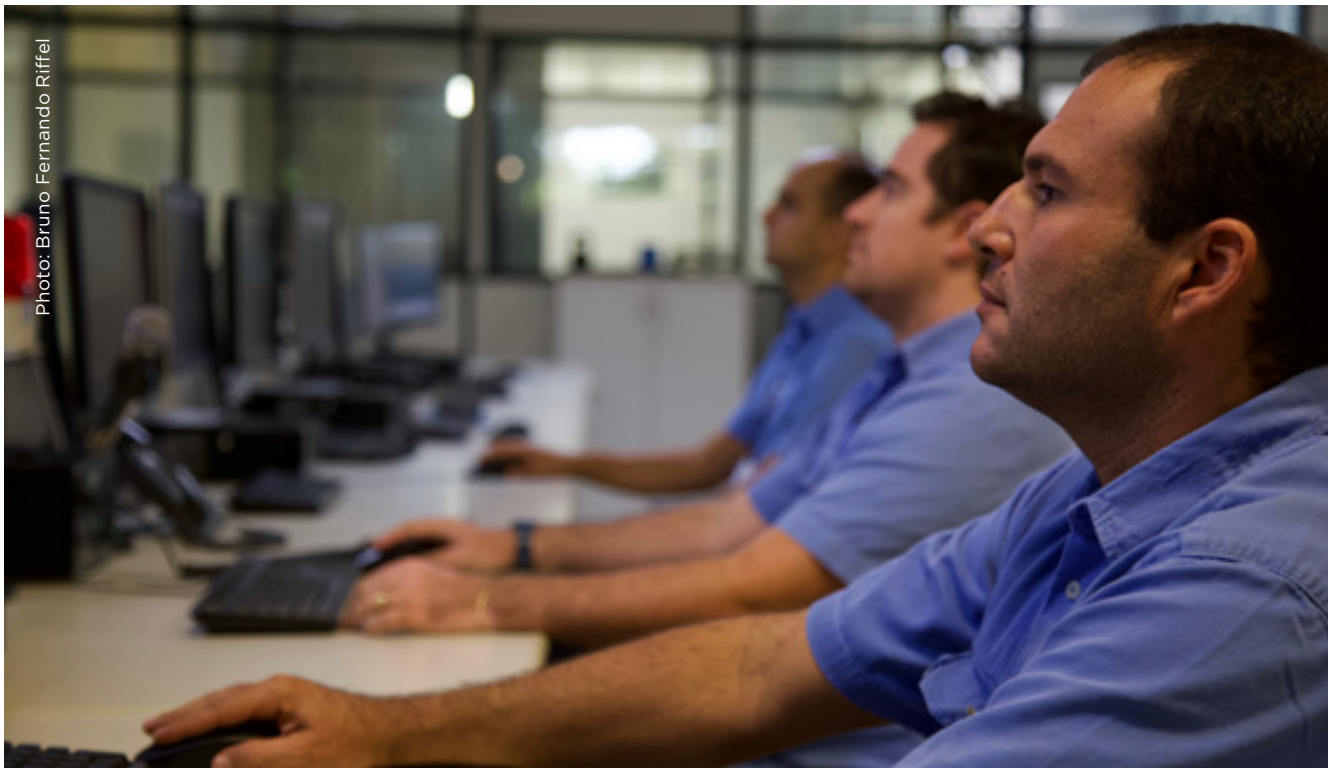


Photo: Bruno Fernando Riffel

NUMBER OF EMPLOYEES BY TYPE OF EMPLOYMENT* GRI 102-8

Type of employment	2016			2017			2018		
	M	W	T	M	W	T	M	W	T
Full-time	1.524	142	1.666	1.495	144	1.639	1.565	147	1.712
Part-time	26	32	58	2	7	9	4	7	11
TOTAL	**1.550**	**174**	**1.724**	**1.497**	**151**	**1.648**	**1.569**	**154**	**1.723**

M = Men
W = Women
T = Total
*Since 2017, in line with the GRI definition of Employee, interns and apprentices are not included in the calculation. Data were compiled through SAP-generated reports.

NUMBER OF EMPLOYEES BY AGE GROUP* GRI 102-8

	2017	2018
< 30 years	208	205
30 – 50 years	1.265	1.360
> 50 years	175	158
Total	**1.648**	**1.723**

MEMBERS OF UPPER MANAGEMENT RECRUITED FROM THE LOCAL COMMUNITY* GRI 202-2 (%)

	2017	2018
Number of members of upper management	8	6
Number of upper management hired from local community	6	4
Percent of upper management hired from local community	75	67

Note: For CBMM headquarters in Araxá, local community is defined as the state of Minas Gerais, while the state of São Paulo is considered local community for the São Paulo office.
*Upper management includes the executive team.

A ROBUST TALENT-RETENTION PROGRAM

CBMM provides a benefits package that covers health, education, retirement, housing and wellbeing

EDUCATION

One of CBMM's most significant employment benefits is educational assistance. Besides motivating staff to study, whether a technical course or for a university degree, the company also extends the coverage to dependents. For example, children of employees receive subsidies during every stage of their education through college graduation. Children from four months to five years of age have access to a methodology that stimulates language development, reasoning skills and socialization. For students in primary school, secondary school and college, CBMM contributes towards the cost of tuition (*see below*).

> The company offers educational benefits to the children of employees, from preschool through university

HUMAN DEVELOPMENT CENTER (CDH)

The CDH is an early education program maintained by CBMM since 1980. Currently the center has the capacity to serve 530 children from four months to five years of age. The pedagogical approach seeks the harmonious development of intellectual, motor, social and emotional aspects of students. Educational activities are designed around environmental awareness, reading and reasoning skills, while fostering imagination and creativity.



Photo: João Lima

CBMM INVESTMENTS IN EDUCATION FOR THE FAMILIES OF EMPLOYEES
(%)

Education assistance*	CBMM subsidy
Pre-school (CDH): from 4 months to 5 years of age	100
Primary education: 1st to 9th grades**	80
Secondary education including college entrance prep courses **	80
Private university**	80
Public university or university scholarship	***
Foreign language courses – starting in secondary school**	80

*Reimbursement of education-related expenses for the employee and his/her dependents.
**In 2018 reimbursement was 80% but capped according to an internal policy.
***Four or eight monthly minimum wages per semester, depending on the location of the university.

PRIVATE PENSION PLAN

CBMM's business principles ensure work conditions for employees that exceed the practices of the majority of companies, both in Brazil and abroad. This awareness, coupled with an understanding of the impact of increased longevity in society, makes social responsibility even more critical for sustaining CBMM's relationship with the community.

In 1992 CBMM implemented a private pension fund (Seguridade Sociedade de Previdência Privada), to which it contributes 5% of the employee's salary, including the thirteenth salary, and the employee contributes 2,5%. Participation in the plan is voluntary and open to all employees. Retirement eligibility is based on the fund's rules (55 years of age, a minimum of 10 years of contributions or no longer employed at the company).

To further increase the chances of a retirement free of financial worry, and to encourage the opening of savings accounts, CBMM began to contribute 5% of the profit-sharing bonus as well into the fund, while employees deposit their portion (2,5%).

Starting in 2011, retirees receiving benefits could voluntarily migrate to a new plan, which has individual accounts that permit each person to manage his/her fund and authorize the transfer of any remaining balance to heirs upon death.

Currently there are 2.145 participants in the fund, 388 of which receive the retirement supplement.

Mercer Human Resource Consulting is contracted to perform the actuarial analysis of the fund, and they confirmed its soundness in 2018, attesting to the fund's financial stability and capacity to pay out current and future benefits.

The year 2018 was marked by significant volatility in the domestic market, generated in large part by the uncertainties in the Brazilian political situation as well as the trade dispute between China and the United States. The environment remained challenging with current interest rate levels and CBMM, with its prudent management approach, maintained its investments in the fixed income segment and considerably exceeded its benchmark index (*see box on pg 60*).

Also in 2018, the fund implemented a Financial and Retirement Education Program to increase awareness of personal finance issues. Until now, 428 individuals (24,9% of the target audience) have completed the course that uses content prepared by the Estratégia Nacional de Educação Financeira (ENEF, National Financial Education Strategy), a multisectoral mobilization around the promotion of financial education actions in Brazil, instituted as a permanent state policy. Its main characteristic is to provide initiatives and material, free of charge, to support financial education.

PROFITABILITY OF RETIREMENT FUND COMPARED TO KEY ECONOMIC INDICATORS

(%)

	2016	2017	2018
Retirement fund	13,77	9,77	8,82
Actuarial target	10,84	6,47	7,97
Savings	8,30	6,80	4,62
INPC	6,59	2,07	3,43

Home ownership incentive

The company instituted a plan to stimulate home ownership through the development of residential areas. In 1978, CBMM inaugurated its first housing development with 54 (now 58) homes ranging from 70 to 100 square meters on plots that measured nearly 600 square meters. The second development was inaugurated two years later and included 154 units with Mediterranean-influenced design features.

Currently the housing incentive totals R$38.000 that can be used to purchase a home, pay off a mortgage or remodel an existing home. An employee must work at CBMM for at least three years to be eligible for this benefit.

House-raising project

The House-Raising Project was designed in 1990 as another initiative to address the housing deficit of CBMM employees. The collaborative project is carried out in partnership with CBMM and the Metallurgical, Mechanical and Electrical Material Labor Union of Araxá, and counts on the active participation of employees.

The first phase of the House-Raising Project was launched in 1991 with the construction of 89 homes. The second phase of the project, finalized in 2005, saw the completion of 57 homes that were built for retired CBMM employees as a supplement to their retirement benefits. Two additional areas were concluded in 2007 with 136 residential units. In 2014 another 110 residences were delivered to employees. The company also established an agreement with a financial institution for low-interest home loans for employees.

Employee development

GRI 404-2; 103|404

An internal policy addresses employee training and provides guidelines regarding courses, professional development opportunities and continuing technical education. Training plans aim to develop technical and other skills. A separate company policy establishes the procedures related to educational assistance for employees and dependents (*read more on pg 59*).

The company's main commitments regarding training and education involve development opportunities to help in the performance of job functions, new skills acquisition, and investing in specializations, like international education and foreign language training. In 2018, R$3,6 million was invested in actions related to skills and professional development of CBMM employees.

> The training management process will, from 2019, be measured by internal indicators, including criteria for courses, assessments and matrices



Photo: Sander Dib

Other benefits offered to employees comprise health insurance (including coverage for the cost of an attempt at in vitro fertilization or artificial insemination); dental assistance; life insurance; illness assistance; transportation subsidies; free uniforms and funeral expense assistance. For children, the company offers educational subsidies and access to a pharmacy run by an employee association that sells medication at cost for all dependents.

In 2018 CBMM formalized a retirement readiness program that will be implemented in 2019. Participants will include retired employees and those who are to retire in the coming two years. The program will address succession planning and will offer financial planning, psycho-social and other types of services relevant to a smooth transition from work life to retirement.

Labor union partnership

Maintaining a good working relationship with the Metallurgical, Mechanical and Electrical Materials Labor Union of Araxá is important to CBMM. Some 99,65% of employees are covered by collective bargaining agreements, the remainder are covered by executive statutes. The agreements between the company and the union are successful, including those involving profit sharing. Profit sharing has been in place since 2000 when Brazilian Law #10.101 was instituted that addresses employee participation in company profits. GRI 102-41

Over R$3 million

invested in improving and developing the skills of employees

Suppliers

VALUED PARTNERS

GRI 103|204

CBMM values local suppliers and seeks to positively influence improvements in their manufacturing processes and service delivery through providing professional and health and safety training for the employees of these firms. Meanwhile, the company requires certificates from its main suppliers that attest to their qualifications. Once a year an audit is performed at these key suppliers to verify that they are compliant with legal requirements.

Purchasing practices are monitored via internal and external audits. CBMM uses the SAP/R3 system to track performance and ensure alignment between fabrication costs and sales costs. Suppliers are also monitored through technical and commercial visits, market information, relevant entities and meetings to identify purchasing practices that may cause negative impacts in the chain. With this, the company is also able to track the origin and manufacturing conditions of raw and input materials.

In 2018 CBMM initiated a restructure of its supply chain, broadening the range of suppliers of materials and services and offering improved opportunities to local and regional suppliers. Another advance in procurement practices was the negotiation of longer-term contracts (one to five years) for raw materials and strategic inputs that provide both financial and risk mitigation benefits.

The supply chain comprises 7.702 businesses, including manufacturers, distributors, resellers and service providers. Of these, 879 are located in Araxá. For production, the main supplier is for pyrochlore ore and aluminum powder. In 2018, 2.300 suppliers were contracted, 427 of which were based in Araxá.

During the year, CBMM acquired 17,95% of products or services from suppliers in Araxá, totaling roughly R$1,6 billion. Although there was absolute growth in spending on local suppliers of some 20%, there was a relative reduction in this expense. The main explanation for this is the increase in production, which in turn increased the purchase of high value raw materials such as aluminum, iron and nickel, the production of which is entirely or at least mostly outside the city Araxá. GRI 102-9; 204-1

TOTAL AND PROPORTION OF SPENDING ON LOCAL SUPPLIERS* GRI 204-1

(R$)	2016	2017	2018
Total amount of budget allocated for suppliers	1.185.169.814,91	1.075.728.793,78	1.603.685.836,32
Total amount spent on local suppliers	249.358.247,24	239.493.318,13	287.836.971,45
Percent of budget spent on local suppliers	21,04%	22,26%	17,95%

*Only companies from Araxá, Minas Gerais are considered local.

CBMM purchased 88,6% of products in Brazil. Other suppliers are located in the United States, China, Russia and Mexico

The Araxá community



POSITIVE IMPACTS IN THE COMMUNITY GRI 203-1; 103|203; 103|413

In 2018, CBMM invested R$4.763.000 in activities and/or projects involving Araxá. Some of these include:

- Social assistance: Improve the quality of life of served communities;
- Sports: Stimulate involvement in athletic activities in the community;
- Health: Encourage providers to continue to do their best for the health of the served communities;
- Education: Promote high quality education for the residents of Araxá;
- Culture: Stimulate public interest in and knowledge of culture in general.

The expected benefits of the community investments made by the company are not measured directly, but the overall purpose is to enhance the quality of life in the Araxá region, whether through improving basic services like health and education, by offering cultural or sports activities or by aiding the neediest residents.

CBMM's Donations and Sponsorship Policy, in line with the company's Compliance Program and the Code of Ethics and Conduct, establishes the general rules to be practiced in relation to the internal and external publics. The Executive Committee reviews the requests to support cultural, social, educational, athletic, environmental, urbanization and health initiatives. Following the committee's pre-approval, the requirements laid out in the Donations and Sponsorship Policy are analyzed by the Compliance Department. After the completion of these steps, the legal process for donations and sponsorships is initiated per policy guidelines.

Monitoring the indirect economic impact of each sponsorship or donation is done on a case-by-case basis and may include the review of reports, site visits, event participation or social media coverage.

ARAXÁ – NIOBIUM CAPITAL OF THE WORLD

For over three decades CBMM has invested in the development of the Araxá region, with special emphasis on projects related to education, health, sports, infrastructure and culture. CBMM's relevance to the local economy goes beyond its contribution to municipal taxes, the company is an important generator of jobs and income. Based on the Banco Nacional de Desenvolvimento Econômico e Social (BNDES, National Economic and Social Development Bank) employment and income generation model, the company determined that during 2018, 1.521 indirect jobs and 9.099 jobs resulted from the income effect. The income effect is the outcome of transforming income from direct and indirect workers

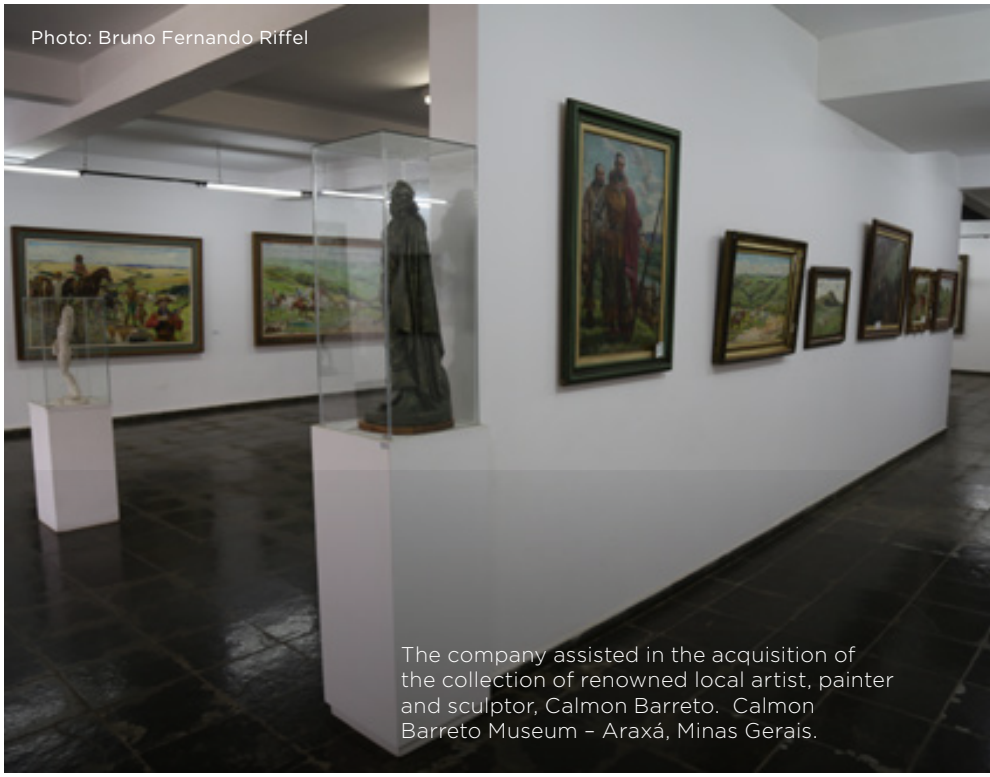


Photo: Bruno Fernando Riffel

The company assisted in the acquisition of the collection of renowned local artist, painter and sculptor, Calmon Barreto. Calmon Barreto Museum – Araxá, Minas Gerais.

into consumption, thus stimulating other sectors and driving employment growth. GRI 203-2

In 2018 the company built a new model to prioritize sponsorships and community donations. The goal is to transform Araxá into a more autonomous city. To that end, CBMM will concentrate its contributions on initiatives that are strongly linked to the development of children, youth and adolescents in the areas of education, health, sports and culture. The intention is to support the formation of a generation prepared to construct a more just, democratic and inclusive society in which qualified human capital develops and grows in ways independent of CBMM.

With this new perspective, the company built two new public schools in Araxá, and intensified sponsorships of athletic activities. In relation to cultural and artistic heritage, in 2018, CBMM contributed over R$2 million, via incentive laws, towards the restauration and recuperation of the Dona Beja Museum, reviving a piece of the culture and public patrimony of the city. In CBMM's view, activities that preserve civic heritage help to create civic pride in children, youth and adolescents.



More than R$2 million

Contributed towards the restoration of the Dona Beja Museum (incentive laws)

DEVELOPMENT AND IMPACT OF INVESTMENTS IN INFRASTRUCTURE AND SERVICES* GRI 203-1

(R$)

Project/ activity	Current or expected impacts on local communities and economies	Amount invested		
		2016	2017	2018
Social assistance	Improve the quality of life of served communities	3.972.545	467.669	723.089
Sports	Stimulate involvement in athletic activities in the community	561.000	283.000	20.000
Health	Encourage providers to continue to do their best for the health of the served communities	4.286.184	1.542.958	2.478.304
Education	Promote high quality education for the residents of Araxá	178.118	2.013.710	151.984
Culture	Stimulate public interest in and knowledge of culture in general	459.305	297.966	1.390.000
Safety	Provide peace of mind and protect the property of the served communities	652.246	180.000	-
Environment	Lower the impacts on the environment caused by society	140.000	-	-
Total		**10.249.398**	**4.785.303**	**4.763.377**

*Cash donations.



Photo: Ricardo Correa

Calmon Barreto Foundation.

Initiatives to improve the wellbeing of the Araxá population have always been a component of the company's strategic planning. Since its foundation, CBMM has actively participated in cultural, educational, environmental, urbanization and health initiatives. Over the last three decades, company investments have significantly contributed to improving the quality of life in Araxá.

GOVERNMENT

CBMM maintains a solid, productive partnership with the three spheres of government. With the Ministry of Mines and Energy and the Ministry of Science and Technology, the company addresses institutional issues like complying with norms and technological demands. The relationship with the municipal government focuses on the social and infrastructure needs of the city and involves educational, cultural and environmental issues.

ENCOURAGING THE DEVELOPMENT OF PUBLIC POLICY

Aware of the important role of social responsibility, CBMM participates in the development of public policy and has taken part in a wide range of forums, like Climate Forum, Mineral Forum, Research and Development Forum and CODEMA (Environmental Policy Council of Araxá). During its participation, CBMM defends the reduction of greenhouse gas emissions, better land use as it relates to mining, product and process development, resource optimization and the application of cleaner, less costly technologies. There is no difference between the manner CBMM manifests its views in these forums and how it publicly states its positions. The company participates in activities that encourage public commitments to sustainability, development and research without participating in any form of lobbying/advocacy.

A HISTORY OF INVESTMENTS IN ARAXÁ

GRI 413-1; 103|413

Since 1982 CBMM has actively participated in cultural, educational, environmental, urbanization and health initiatives in the Araxá community. The actions aim to improve the quality of life of residents.

- **Culture:** preserved historical and civic patrimony of Araxá. Thanks to local efforts and company resources, it was possible to renovate structures like the old city hall, Calmon Barreto Foundation, Tito Fulgêncio courthouse and the Grande Hotel de Araxá, as well as the São Domingos, Nossa Senhora da Graça (Barreiro), São Sebastião, Santo Antônio and Rosário churches. CBMM also invested in the revitalization of downtown Araxá, which included resources for the construction of the Araxá Cultural Center and Municipal Theater. Additionally, CBMM sponsors numerous cultural events in the city of Araxá in partnership with diverse institutions, including the city, Commercial Association and SESI/SENAI. Examples of some of the activities developed are: CBMM Cultural Circuit, Sempre um Papo (a literary event) and festivals related to scenic arts, music, dance and literature, in addition to a Christmas celebration.
- **Education:** built the SESI/SENAI Djalma Guimarães Complex in 1982, donating a parcel of land measuring 250,000 square meters and equipping the buildings, ultimately investing US$2.6 million in the project. Students at the complex can opt for one of many professional training courses offered in the areas of electro-electronics, boiler making, mechanical design, electricity, industrial machinery maintenance, hydraulics, industrial sewing and pattern-making, foundry and metallurgy.
- **Public health:** provided financial contributions to the main healthcare institutions in Araxá, including Santa Casa of Araxá, Asilo São Vicente, Unidades Integradas de Saúde (Uninorte, Unisul and Unileste), the José Marth Foundation (chemotherapy) and dental clinics. CBMM funded the construction of the Women's Service Center and the Children's Service Center, in addition to contributing toward the construction of the Casa do Caminho (Wayside Home). The company also sponsored the construction of a 22-bed floor of the Hélio Angotti Hospital. The Fazenda Senhor Jesus (Fazendinha or Little Farm) is a rural community that has served as a chemical dependency treatment center since 1990. In 1997 CBMM began to support the Fazendinha through investments in infrastructure and since then has been involved in the Rebirth Project (*read more on pg 70*).
- **Safety:** built the state highway police post on the Araxá-Franca highway and the military police barracks; renovated the federal highway police post on interstate 262; landscaped 10 kilometers of the Araxá-Franca highway; and donated vehicles to community police forces (military, civil, forestry, highway).

CASA DO CAMINHO (WAYSIDE HOME)

The Casa do Caminho began operations in 1980 to provide medical services to the underserved population in the region. It was founded by Jose Tadeu da Silva and as the work grew the efforts drew the attention of CBMM. In the 1990s the company made its first donation, which was sufficient to house 40 beds. Over the ensuing almost 30 years, CBMM has contributed to the construction of a 10,000 square meter day hospital that has made it possible to treat psychiatric patients.

ENVIRONMENTAL EDUCATION PROGRAM GRI 413-1; 103|413

The focus of CBMM's Environmental Education Program is to build a strong partnership with Araxá schools, a partnership that was created at the program's inception in 1992. Since then, thousands of students and teachers have discovered the value of their region, the Cerrado. In 2018 more than 2.700 students and 276 teachers from area schools participated in environmental education activities at CBMM.

The program is designed for fourth-grade students with the participation of teachers who are supported by specialists from CBMM's Environmental Development Center (EDC) and other partners, notably the Municipal Secretary of Education, which institutionalized the environmental education program in the Araxá school district as part of the common curriculum. Other important partners include the Uberaba Regional School District – Araxá área, Reserva Ecocerrado Brasil, Instituto Mineiro de Agropecuária (Agriculture and Livestock Institute of Minas Gerais), Polícia Militar de Meio Ambiente (Environmental Police), Tauá Grande Hotel, Sala Verde/ Instituto de Planejamento e Desenvolvimento Sustentável de Araxá, Calmon Barreto Cultural Foundation and Centro Universitário do Planalto de Araxá (UNIARAXÁ) all of whom have added value to the program through the participation of their specialists. GRI 102-42

CBMM's Environmental Education Program promotes observation, experimentation and documentation of experiences around proposed themes that come alive in the hands of teachers and students. The themes are related to Cerrado biodiversity (concepts, threats and conservation), fauna, vegetation and flora, medicinal plants, pollination, deforestation, fires, wild animal trafficking, in situ and ex situ conservation, as well as the local riches, sustainable development and the urban environment.

At the end of the cycle, a culminating event is held for the school community during which the results of the various experiments are presented, as well as the fruits of the students' work. Each year a contest is held to award standout works. In 2018 the Scientists of the Cerrado Project held an awards ceremony at the Araxá Municipal Theater to recognize, from the over 1,000 works submitted, the top ten projects of each of six categories, including prose, poetry, comics, design, pamphlets and parody.



Over 2.700 students

and 276 professors participated in environmental education activities at CBMM



Photo: João Lima

Biodiversity

The Environmental Development Center covers an area of

59.000 m²

within CBMM's industrial complex

CBMM developed pioneering, voluntary initiatives to preserve the biodiversity of the Cerrado. The activities are carried out by the company's Environmental Development Center (EDC) and include research projects, studies of plant and animal reproduction in this biome, fauna and flora management and environmental education. These activities are implemented via the Cerrado Fauna Conservation Program, the Green Agenda to Conserve Flora and the Environmental Education Program, all with the involvement of the Araxá community.

Located in an area covering 59.000 square meters within the company's industrial complex, the EDC is composed of the Conservation Breeding Program, Seedling Nursery, the Environmental Education Program and the Native Cerrado Species Arboretum.

To promote research and professional training in Cerrado biodiversity management and conservation, the EDC has offered exchanges and cooperative opportunities for faculty and students from Centro Universitario do Planalto de Araxá (UNIARAXÁ) and other educational institutions in Brazil since 1997.



Aerial view of the Environmental Development Center.

Photo: Sander Dib

Activities aim to preserve the biodiversity of the Cerrado, the biome of CBMM's facilities in Araxá

R$2,7 million
invested in biodiversity activities in 2018

SCIENTIFIC BREEDING CENTER
Conservation of Cerrado fauna is carried out at the Conservation Breeding Center, which is regulated by IBAMA, in accordance with Ordinance 169/08. The goals of the program include the captive breeding of Cerrado animals, scientific research, technical and animal exchanges with institutions in Brazil and abroad and professional training in Cerrado fauna management and conservation.

The center is home to an average of 130 specimens of Cerrado fauna and develops fauna preservation projects for the company's green spaces. To that end, surveys and monitoring are performed that result in a map of Cerrado fauna that is used to meet the legal demands of environmental agencies related to CBMM's new activities.

130 specimens
of Cerrado fauna are housed at the breeding center

The center's activities include captive breeding of Cerrado animals, scientific research, technical and animal exchanges with institutions in Brazil and abroad and professional training in Cerrado fauna management and conservation



Photo: Ricardo Correa

MANED WOLF CONSERVATION

In 1990 the first maned wolf was born at CBMM's Conservation Breeding Center, which is a pioneer in maned wolf reproduction and research in Brazil. The center is recognized as the leading institution for captive maned wolf births in Brazil, where 67 pups have been born. CBMM distributes the animals to other institutions to contribute to the gene pool of the species, and its conservation. From 1994 to 2018, 32 maned wolves were transferred to 17 institutions in Brazil, the United States and China.

GREEN AGENDA

Thirty-three species of flora in the Araxá region are protected by law, rare or threatened with extinction. Of those, 24 are routinely produced at the Seedling Nursery and destined to reforestation efforts on company grounds and in the community.

The Seedling Nursery was started in 1984 to conserve the flora of the Cerrado biome threatened with extinction, as well as endemic Brazilian species. Annual production capacity is 30,000 seedlings of nearly 200 species. The seedlings produced in the nursery are used to recover and maintain reforested areas and for landscaping, research and ceremonial plantings, both on company property and in the broader community. In 2018 an additional 20.000 seedlings were produced for reforestation activities in compliance with the Dam 8 permitting conditions.

REBIRTH PROJECT

Recovering addicts at the Fazenda Senhor Jesus produce seedlings of native Cerrado species to reclaim springs and riparian forests in the municipality of Araxá. Eucalyptus saplings are also cultivated to supply the demand for wood of small rural producers. Through a partnership between CBMM, the Municipal Agricultural Secretary of Araxá and the Cooperativa Agropecuária de Araxá Ltda., it is possible to provide seedlings to about 110 small farmers each year. From 2000 to 2018 over 1,4 million seedlings were distributed to help environmental mitigation in the Araxá region.

30.000
Seedlings are produced annually

CERRADO DENDROLOGY ARBORETUM

CBMM started and maintains the Cerrado Dendrology Arboretum that houses a collection of 125 live species of Cerrado flora that are rare, threatened or facing extinction. The collection is part of the EDC and serves as a tool in the company's environmental education, research and conservation efforts and also serves as a source of seeds to reproduce threatened species. Other arboreta have been started at schools and other institutions in the region in partnership with CBMM's EDC. The Illustrated Guide to the Cerrado Arboretum (UFMG, 243p) extols the importance and value of the biome that is home to CBMM's industrial complex.



Photo: Bruno Fernando Riffel

THE BARREIRO HYDROMINERAL COMPLEX GRI 203-1

The Minas Gerais state government, through the State Secretary of Sport, Leisure and Tourism and the Secretary of Science and Technology, together with Arafértil, CBMM, COMIPA, CAMIG (current CODEMIG), and Hidrominas, signed in June 1984 PROARAXÁ, a cooperative technical, financial and combined-forces agreement to protect the area of the Barreiro Hydromineral Complex.

As part of the agreement, CBMM assumed fundamental responsibility to build infrastructure, including dams and wells, and monitor hydrogeological investigations, in addition to implementing a preservation project for the Radium Hotel (in association with Arafértil) and planting and maintaining green areas on the eastern slope of Barreiro. The commitments also included the elimination of barium chloride contamination, which was identified in the early 1980s in ground water near Dam 4. Immediately upon detection, barium chloride deposition in the dam was eliminated and an appropriate remediation process was developed and implemented according to recommendations. And as a result, CBMM changed its production process and intensified the development of technological innovations. Results are presented in periodic activity reports that are sent to relevant environmental agencies, the city of Araxá and the public prosecutor's office.

On August 27, 2018, CBMM and the Ministério Público de Minas Gerais (MPMG – Public Prosecutor of Minas Gerais), through the Centro de Apoio Operacional do Meio Ambiente (CAOMA – Environmental Operational Support Center) and the Promotoria de Defesa do Meio Ambiente de Araxá (Environmental Defense Office of Araxá), signed a new agreement whose main purpose was to replace the Term regarding the remediation of underground water near Dam 4 and PROARAXÁ in order to consolidate into a single document the ongoing actions that date fom the start of the program until the present time.

The new agreement provides that the company will continue to operate the barium remediation system that has been effective so far, in accordance with the consensus of all environmental control agencies, and that further studies will be performed with the support of a specialized consultancy to evaluate the possibility of optimizations in the environmental remediation process carried out in the Barreiro region.

CBMM's commitment, expressed in the agreement signed with MPMG, to seek innovative techniques to assess whether it is possible to further optimize the environmental remediation process, is fully in line with CBMM's publicly stated

commitment to continue working to conclude the remediation process as soon as possible. That process is in the final phase. It is also worth noting that the Barreiro hydromineral complex in Araxá was not affected by the changes in soluble barium concentrations, target of the remediation, due to an efficient set of hydraulic barriers installed in the area since the 1980s. Through December 2018, CBMM has provided the necessary resources to ensure that the remediation process is successful.

Barium occurs naturally in the waters of the Barreiro alkaline complex of Araxá and in its areas of influence and preceded the initiation of any industrial mining activities in the region. Formed 90 million years ago, this geologic body presents high barium concentrations among its constituent minerals (barium carbonates and barite). Therefore, compared to other regions, it is expected that this complex would have higher levels of naturally occurring soluble barium in the water.

CBMM regularly reports its environmental activities to relevant agencies



Aerial view of the Grande Hotel: Barreiro Hydromineral Complex.

Photo: Paulo Nolli

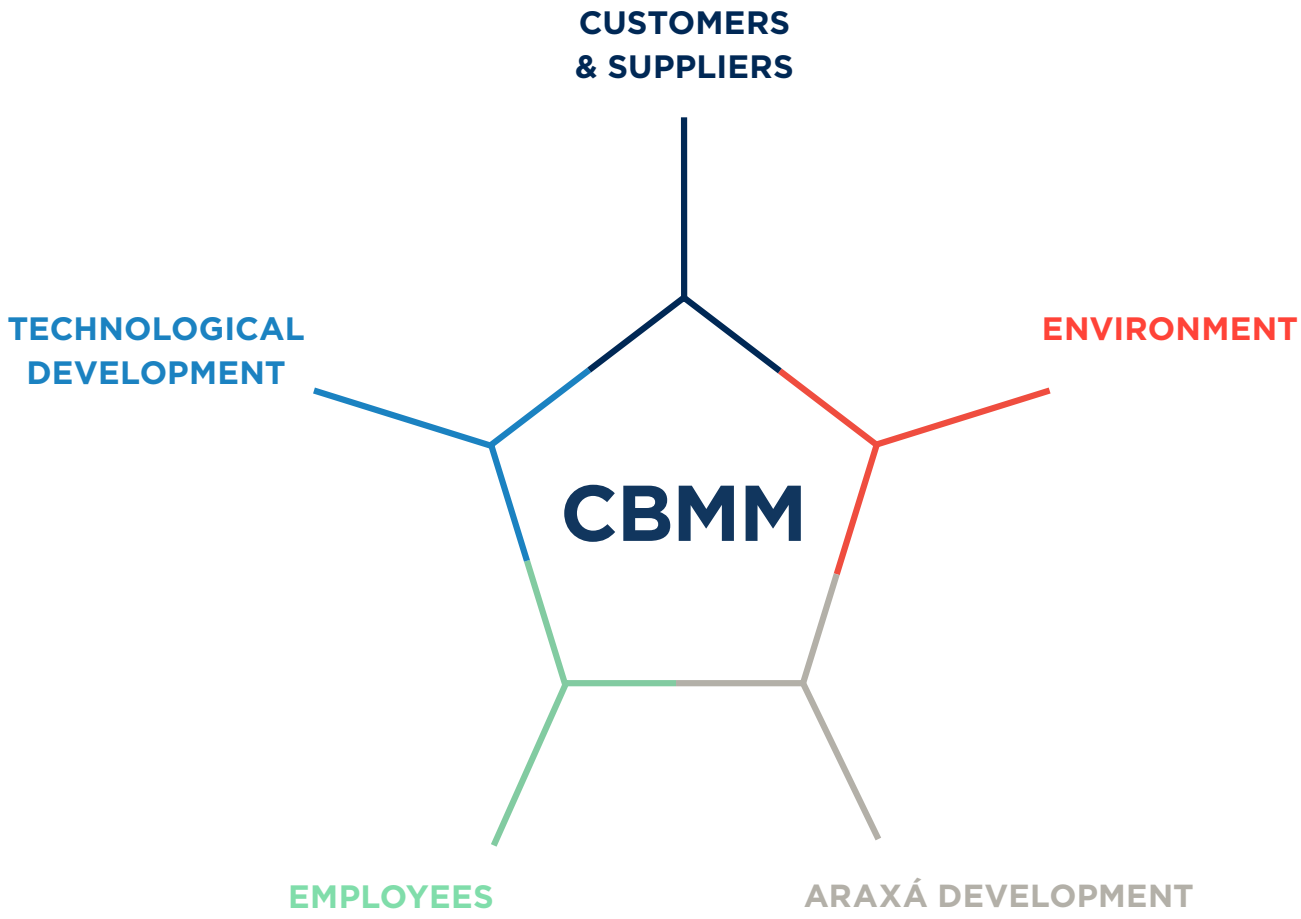
Customers

Customers are foremost in CBMM's strategy. Since the late 1970s, the company has held technical seminars to disseminate niobium technology and reinforce the sustainable aspects of niobium applications.

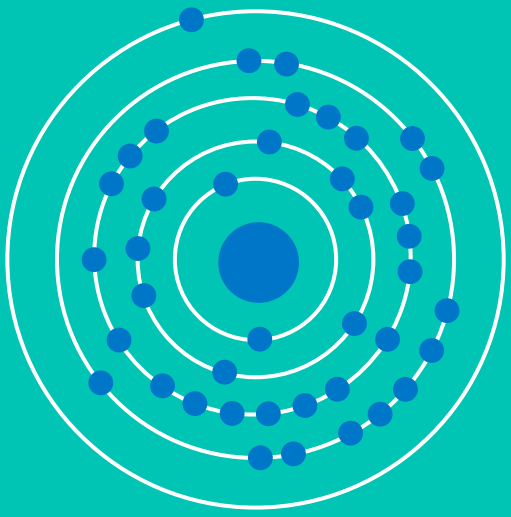
CBMM offers technical support to develop niobium products and also helps customers cut costs by maintaining inventories at strategic locations to ensure near immediate delivery, eliminating the need for customers to maintain buffer stocks. Customers visit the company's facilities in Araxá, and CBMM's commercial team makes periodic visits to customers.

Customer satisfaction is measured by analyzing information collected throughout the year in the manufacturing, laboratory, commercial and quality sectors. Complaints, technical visit reports and other information provided by customers are evaluated to measure their perception of the company. Every three years a formal customer satisfaction survey is conducted that helps to identify areas of strength and weakness. The seventh and latest survey was done in 2018 and included 45 customers from diverse markets and corresponding to roughly 50% of 2017 sales. Their overall satisfaction with CBMM registered 95%. GRI 102-43; 102-44

The approach to customers is broad and covers the topics presented in the following pages.



02



Niobium Technology

2.1 STRATEGY TO DEVELOP TECHNOLOGY AND THE MARKET

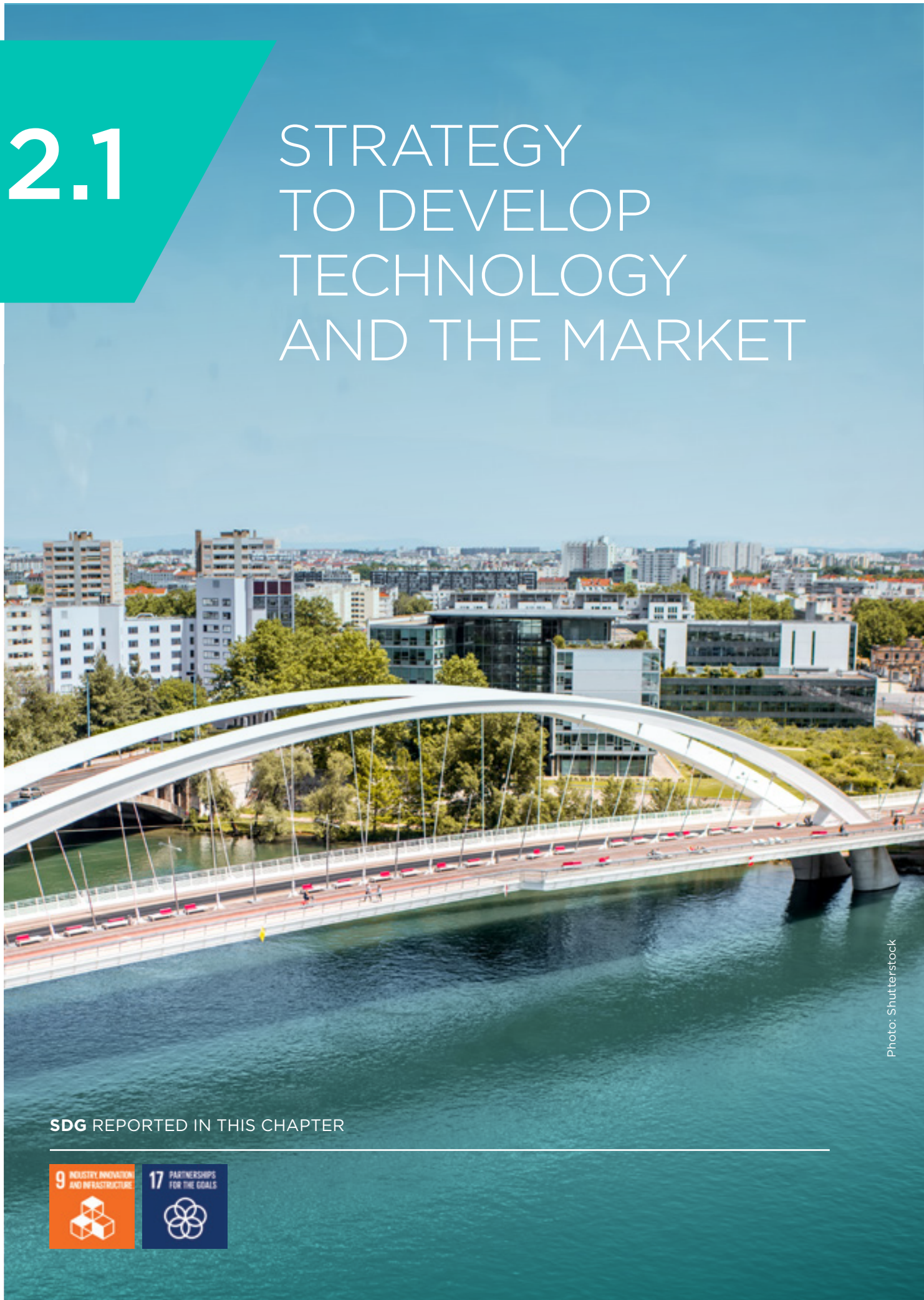


Photo: Shutterstock

SDG REPORTED IN THIS CHAPTER

A space dedicated to niobium was inaugurated in December 2018 at the MM Gerdau – Museum of Mines and Metal in Belo Horizonte, Minas Gerais. The new installation is interactive and shows the diverse aspects of the element, including the technology associated with its applications

CBMM aims to increase the global niobium market by developing new products and applications that have improved performance, lower costs and increased value as perceived by the market. The challenge is to demonstrate the technology and the value that niobium adds to the supply chain and to end products. The company executes this strategy through three pillars:

- **Technology and innovation:** invest in the development of new products;
- **Customer support:** partner with customers to develop solutions to improve steel properties and structures and help identify methods to produce high quality steel at a lower cost;
- **New business:** seek business opportunities in the market for other materials that have sustainable characteristics.

In 2018 CBMM increased efforts, investing more to disseminate technology, to provide technical support to customers, to foment innovation and to support projects that promote the use of new niobium products.

By being a technology supplier and a partner, the company can help customers to achieve different levels of product performance and competitiveness, which is especially important during difficult economic times when pressure to reduce costs and improve efficiency is the top priority of most companies. This is how CBMM maintains its strong position in the supply chain.



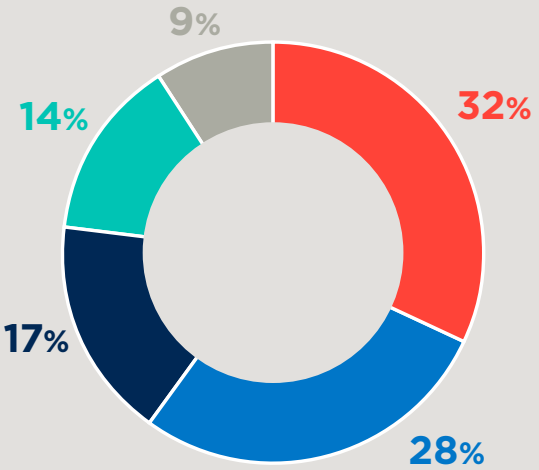
Challenge:
demonstrate the technology and the value that niobium adds to the supply chain and to end products

Uses of ferroniobium by industrial sector

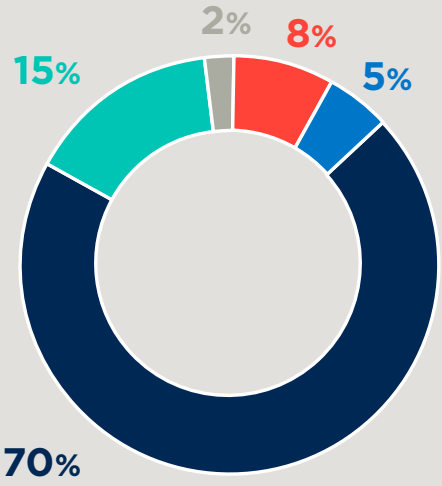
In 1975 CBMM sold the equivalent of 5.448 tonnes of ferroniobium, with 70% being used in steels for the transportation of oil and gas. Currently the application of niobium in steels is more evenly distributed across different industrial sectors, including automotive, stainless and structural.

- STRUCTURAL
- AUTOMOTIVE
- OIL & GAS PIPELINES
- STAINLESS
- OTHER

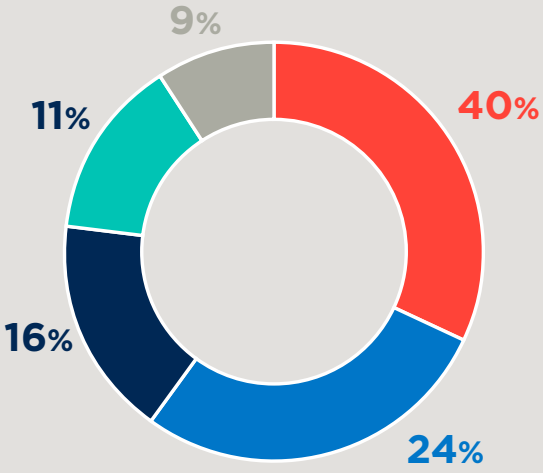
2017
SALES OF 65.400 TONNES OF FERRONIOBIUM*



1975
SALES EQUIVALENT TO 5.448 TONNES OF FERRONIOBIUM*



2018
SALES OF 82.671 TONNES OF FERRONIOBIUM*



* Data refer to sales to domestic and foreign markets.

THE FIRST MARKETS

CBMM entered the Chinese market in 1978 with the first exploratory visit to what was then called Peking (now Beijing). A long history of partnership was born. The first technical seminar on steels was held in 1979 with the goal of expanding frontiers for Brazilian niobium. Significant sales to customers in China only began in 2003 and since then the share of CBMM's niobium sales to the Chinese market has increased steadily. CBMM continues to organize seminars and visits to the major structural steelmakers in China. The Chinese adopted a steel specification with a higher niobium concentration (up to 0.11%, almost double the level of older specifications) for the construction of the pipelines that traverse the country.

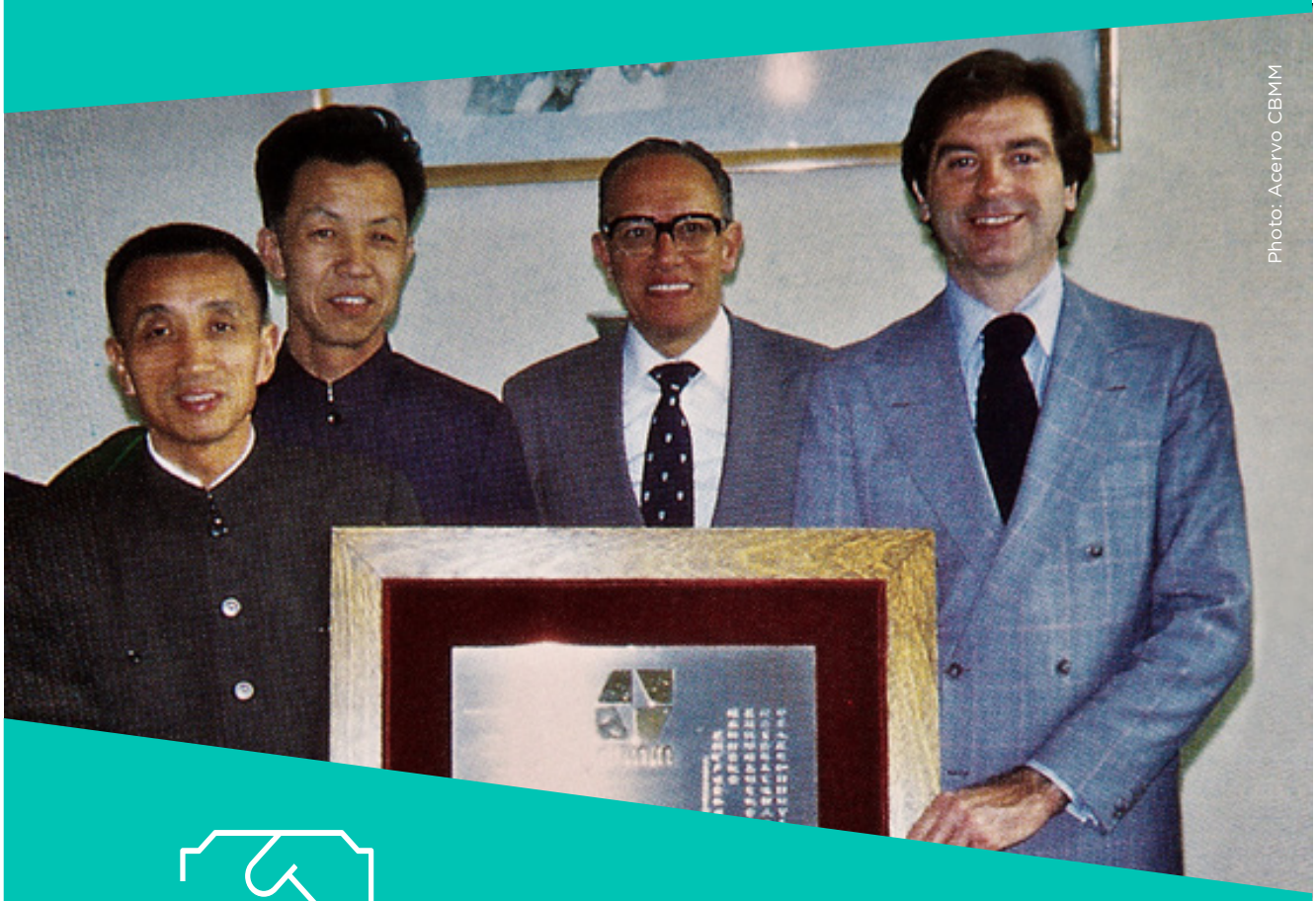


Photo: Acervo CBMM

CBMM has had
successful commercial relationships
in the Chinese and Russian markets for decades

CBMM arrived in Russia in 1977 at the height of the Cold War. At the time, the countries of the former Soviet Union led the world in steel production (142 million tonnes per year), ahead of the United States. In 1978 CBMM sponsored its first seminar in the region, which resulted in the signing of a technical scientific agreement. Ever since, Russian industry has used niobium from CBMM.

Activities to disseminate niobium technology

CBMM has actively disseminated niobium technology in markets and among perspective customers since the late 1970s. These activities include promoting symposia and roundtables and publishing technical-scientific papers. The events are held in Araxá, other Brazilian cities and in countries where the application of niobium technology is under study.

Use the QR code to learn more about CBMM's promotion of technical seminars, roundtables and other events. Check out the online Niobium Resource Center at cbmm.com/en/Niobium-Resource-Center



The president of IOM3 with 2018 Charles Hatchett Award winners.

CHARLES HATCHETT AWARD

The Charles Hatchett Award was created in 1979 and is bestowed annually on the authors of the best work published on the science and technology of niobium and its alloys. Renowned specialists comprise the selection committee.

CBMM has sponsored the award since its inception with the objective of publicizing niobium and its applications. London-based Institute of Materials, Minerals and Mining (IOM3) grants the medal, which is minted in niobium and bears the likeness of the man who discovered element 41.

In 2018, the 40th edition of the medal was awarded to a group of researchers from the Georgia Institute of Technology for their work related to the role of niobium in more efficient energy storage. The application of the promising technology will require the collaboration of the entire supply chain, including other materials suppliers, designers and manufacturers of batteries and end users, such as the automotive industry.

CHARLES HATCHETT AWARD WINNERS – 2016-2018

	Authors	Topic
2018	Dongchang Chen, Jeng-Han Wang, Tsung-Fu Chou, Bote Zhao, Mostafa A. El-Sayed, Meilin Liu	The role of niobium in the development of more efficient energy storage systems
2017	Ken Kimura, Kazuto Kawakami, Jun Takahashi	The mechanism by which niobium improves the high temperature properties of ferritic stainless steels used in automotive exhaust manifolds
2016	M. Nowak, L. Bolzoni, N. Hari Badu	Niobium as a grain refiner in cast aluminum

PROMOTING YOUNG SCIENTISTS

Organized by IOM3, the Young Persons' World Lecture Competition (YPWLC) is an annual event that seeks to promote the communication skills of engineers and scientists who are under 28 years of age. Held since 2005, the goal is for participants to present technical concepts in a concise and objective manner, sparking the audience's interest in topics related to materials science. Starting in 2011, CBMM became the main sponsor of the YPWLC and since then young Brazilian scientists have participated. In 2018, the 18th YPWLC was held in Port Elizabeth, South Africa where Kyle Saltmarsh, from Australia, Lin Guo, from Hong Kong and Ng Kay Lup of Malaysia were the top three finishers.



Photo: IOM3

2018 YPWLC participants.

2.2 DEVELOPMENT OF NEW APPLICATIONS AND MARKETS



Photo: Shutterstock

SDG REPORTED IN THIS CHAPTER

The subsidiary, CBMM Technology Suisse, is responsible for managing projects to develop new applications for niobium products, as well as new markets and new products. It plans and implements the technical program for niobium and develops tailored projects for CBMM customers to ensure the delivery of specialized technical support for each project.

The company counts on a team of professionals who are specialists in the structural, automotive and pipeline sectors, in addition to stainless steel, chemical, battery and energy generation experts.

In 2018, 179 technical cooperation projects were underway, an increase over the number of projects in 2017 (163). The 2018 projects involved:

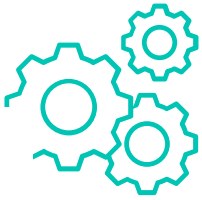
- 137 partnerships with customers;
- 27 with universities;
- 15 with research institutes.

Establishing joint technical projects is a key strategy that CBMM has employed to develop new uses and applications for niobium.

Currently, the partnerships are developed with the supply chain, mostly customers. However, the company has been seeking to invest more and more in initiatives that involve end users since it is understood that success depends on understanding and meeting their needs.

The goal of CBMM's technology program is to increase sales by increasing the global niobium market. In 2018, the niobium market grew by 19%, considerable growth that indicates that the company is on the right track. All the sales targets by segment were surpassed and 25% more ferroniobium was sold compared to 2017.

The following items describe some of the most relevant projects and activities developed in 2018 between CBMM and partners.



179 technical cooperation projects
were underway in 2018

CBMM Technology Suisse develops tailored projects for CBMM customers, offering specialized technical support

NIOBIUM OPTIMIZES THE CHEMICAL COMPOSITION AND PROCESSING OF STRUCTURAL STEELS

The insertion of niobium in the structural sector was the standout of 2018. CBMM developed a strategy to totally or partially replace elements like vanadium and manganese with niobium, which enables the fabrication of construction steels with higher quality and lower cost. As a result, sales of ferroniobium for structural steels jumped 45% over the previous year.

Additionally, niobium was inserted in construction rebar, which had previously applied vanadium or accelerated cooling after rolling.

China announced in 2018 a new standard for steel rebar used in construction. The new standard increases the quality of products by requiring the use of microalloyed steel, resulting in more uniform and resistant rebar. This will lead to safer buildings, especially for earthquake-resistant structures, which is important in a country with seismic regions. Through technical support with Chinese steelmakers, CBMM has shown that niobium represents the best solution for rebar by increasing mechanical strength, without losing toughness, at competitive costs.

NIOBIUM IN CAST ALUMINUM PARTS

In the automotive area, the highlight is the application of niobium in cast aluminum. CBMM made its first sale of niobium as a grain refiner in cast aluminum in 2018. This is a promising application and the company plans to introduce the concept in the manufacture of cast aluminum wheels used in passenger vehicles.

NEW WELDING CENTER

CBMM and its partner in China, CITIC, inaugurated the International Welding Technology Center (IWTC) in the city of Xian as part of the Tubular Goods Research Institute of the China National Petroleum Corporation. The center aims to study welding techniques to be used on gas pipelines that can extend to over 6.000 km in China. Proper welding is an important factor in pipeline safety, in addition to guaranteeing productivity during installation and operation.

NIOBIUM IN BATTERIES

CBMM engaged in a range of activities to understand battery technology and build its knowledge base on the subject to be better prepared to accelerate the use of niobium in this market. A partnership was signed with Toshiba for the development of niobium-based batteries to be used in electric cars. Toshiba has a patent on the application and stated that this development is part of its strategic growth plan for the coming years.

CBMM AT ABB FIA FORMULA E CHAMPIONSHIP

CBMM and Formula E consolidated a partnership in 2018 through an agreement to sponsor races in Punta del Este (Uruguay) and Rome (Italy). The international electric car competition takes races to some of the world's most famous and progressive cities with the aim to act as a platform to test and develop technologies relevant to the automotive industry, helping to refine the design and functionality of components and infrastructure to actively accelerate the transition and adoption of electric vehicles on a global scale. Given that niobium has several important and valuable applications throughout the automotive industry, enabling materials to become stronger, lighter, more robust, more reliable, and at the same time more sustainable, CBMM's relationship with Formula E represents an opportunity to raise public awareness about the use of niobium to create cleaner technologies for the future.



Photo: Shutterstock

2.3 THE ADVANTAGES OF USING CBMM PRODUCTS IN STEELMAKING PROCESSES

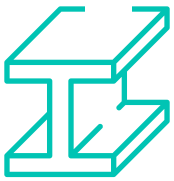


Photo: Ricardo Correa

SDG REPORTED IN THIS CHAPTER

Optimizing resources and reducing emissions

The lower amounts of raw materials and inputs needed by steelmakers to produce niobium steels reduces greenhouse gas emissions and lowers energy and water consumption



More with less

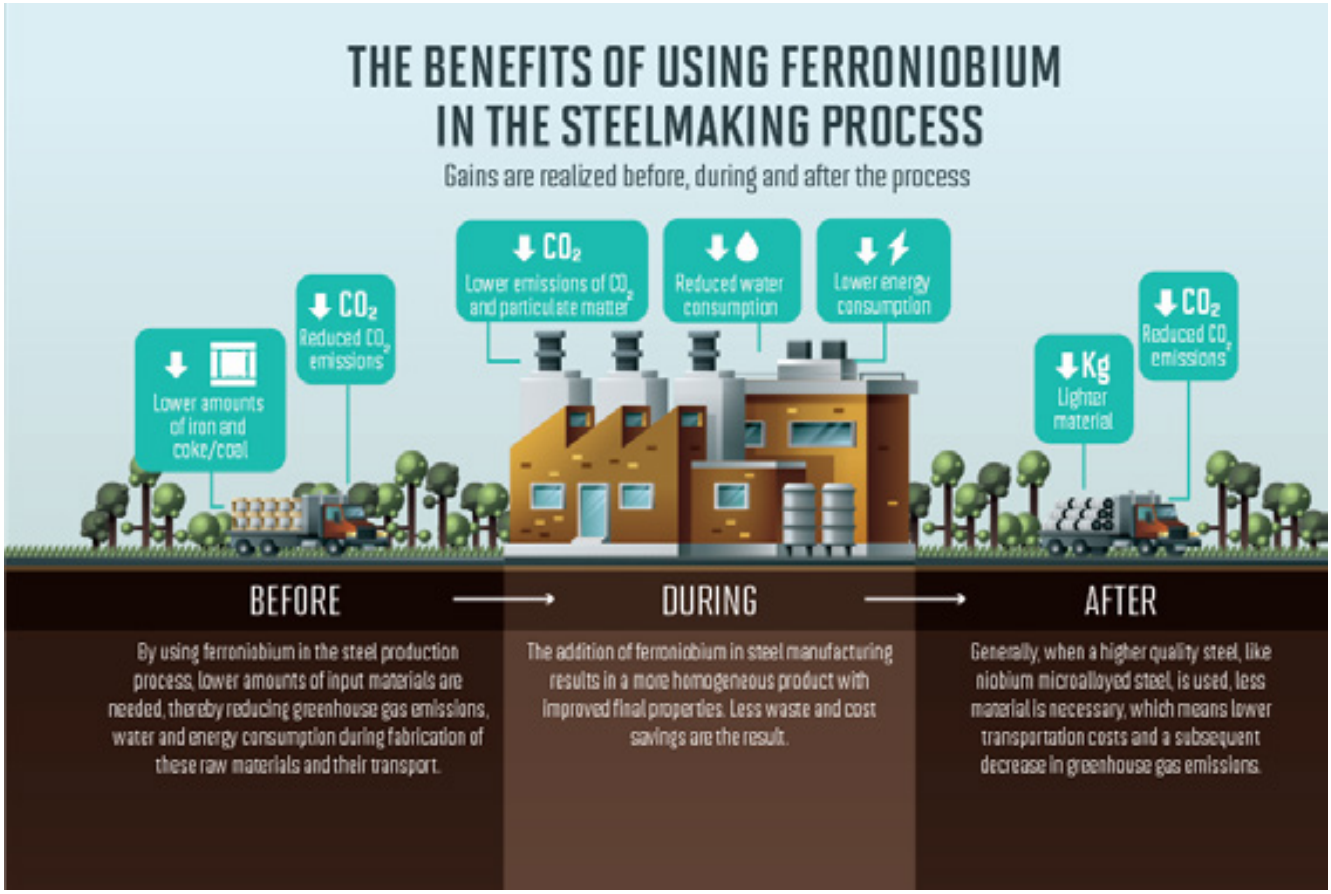
Niobium can be used in the optimization of steel processing, resulting in higher productivity at lower costs

Today's market reality requires businesses to build more, to build better but use fewer resources so that society and nature are not negatively impacted.

The lower amounts of raw materials and inputs needed by steelmakers to produce niobium steels reduces greenhouse gas emissions and lowers energy and water consumption. It is estimated – according to internal CBMM inventories and World Steel Association reports from 2018 – that by using CBMM products, the steel industry reduces by 480, 219 and 237 times, respectively, the carbon emissions, energy consumption and fresh water used by CBMM to manufacture its niobium products. GRI 103|305

Niobium can be used to optimize steel processing, resulting in higher productivity at lower costs. In steel, niobium is normally added in very small quantities - below 0,1% - and therefore the element is classified as a microalloy in these materials. The addition may be small, but the benefits are felt not only in the final properties of the material in terms of increased strength and toughness, but in its processing as well. In general, the use of niobium helps to obtain a more homogeneous product, contributing to a more stable process, which guarantees reproducibility of the final properties of the material.

To help customers attain these benefits, CBMM developed, in partnership with Spanish research institute CEIT, a modelling software called MicroSim to optimize and simulate hot rolling to predict, based on the chemical composition and processing conditions, a steel's final properties. This accelerates production improvements as it permits quick simulations of different conditions and the comparison between them, facilitating the identification of the most efficient routes. In addition to increasing productivity, companies



have been able to produce better quality products that meet specifications and have improved mechanical properties.

The software can also analyze the substitution of other elements used in the manufacture of steel, replacing vanadium and manganese with niobium, for example. The program can simulate partial or total substitutions of these elements in some types of steel used in the structural sector, obtaining an equivalent or higher quality final product at a lower cost. In some cases, the savings reach $10 per tonne of steel produced.

In addition to the optimization of the chemical composition, the program also allows adjustments to process parameters to achieve the desired mechanical properties, thus allowing more efficiencies in terms of time and energy.

The use of niobium also allows customers greater flexibility in their product portfolio, for example pipelines in sour service (hydrogen sulfide) environments. This harmful compound is found in many oil deposits, like the pre-salt reserves, and can lead to premature failure of components exposed to these corrosive environments. By adding niobium and lowering the manganese level, steel companies can manufacture steels that are much more resistant to these environments using the same equipment they use to make other material, thereby increasing the companies' market reach.

2.4 FINAL PRODUCTS WITH NIOBIUM – BENEFITS

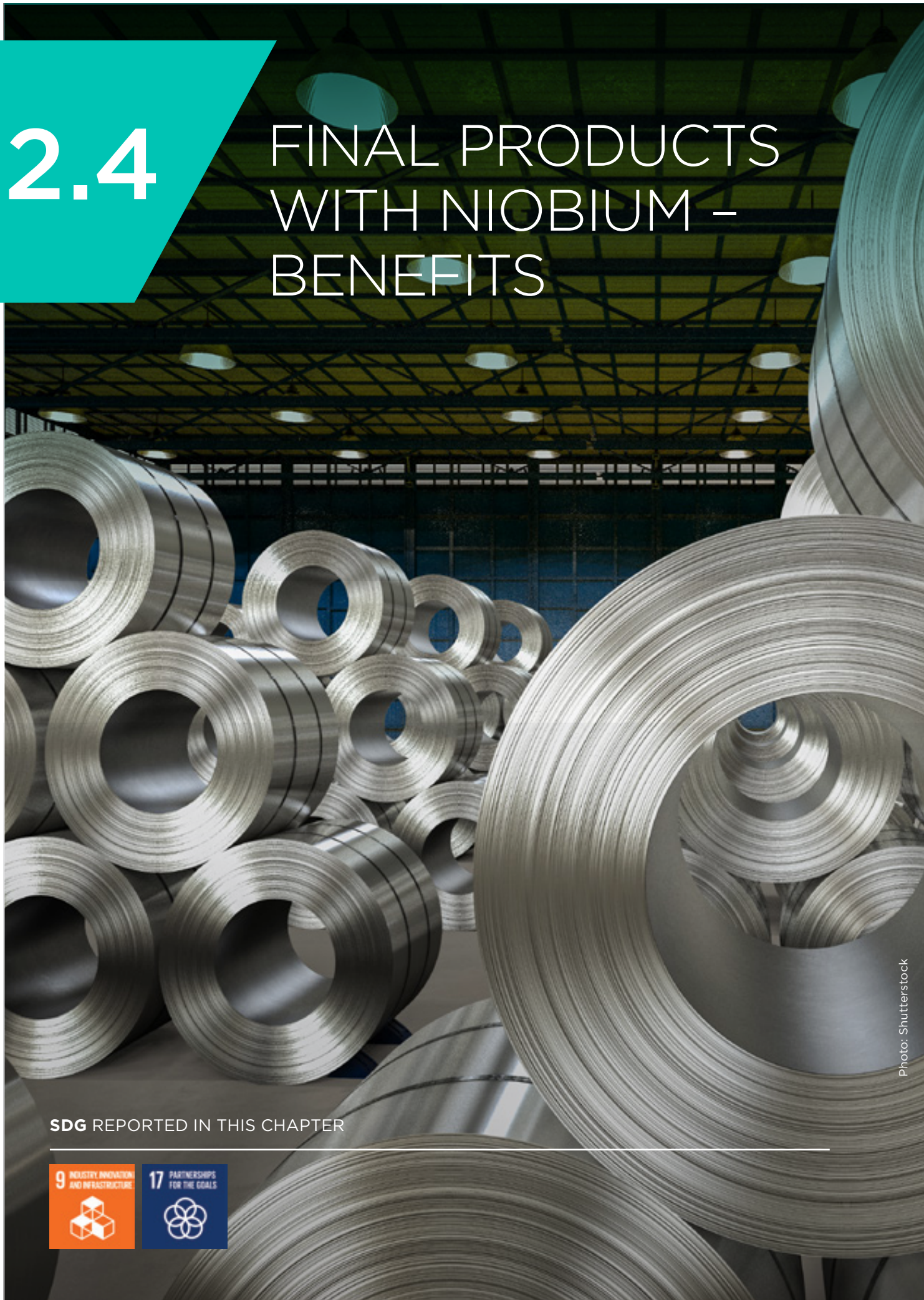
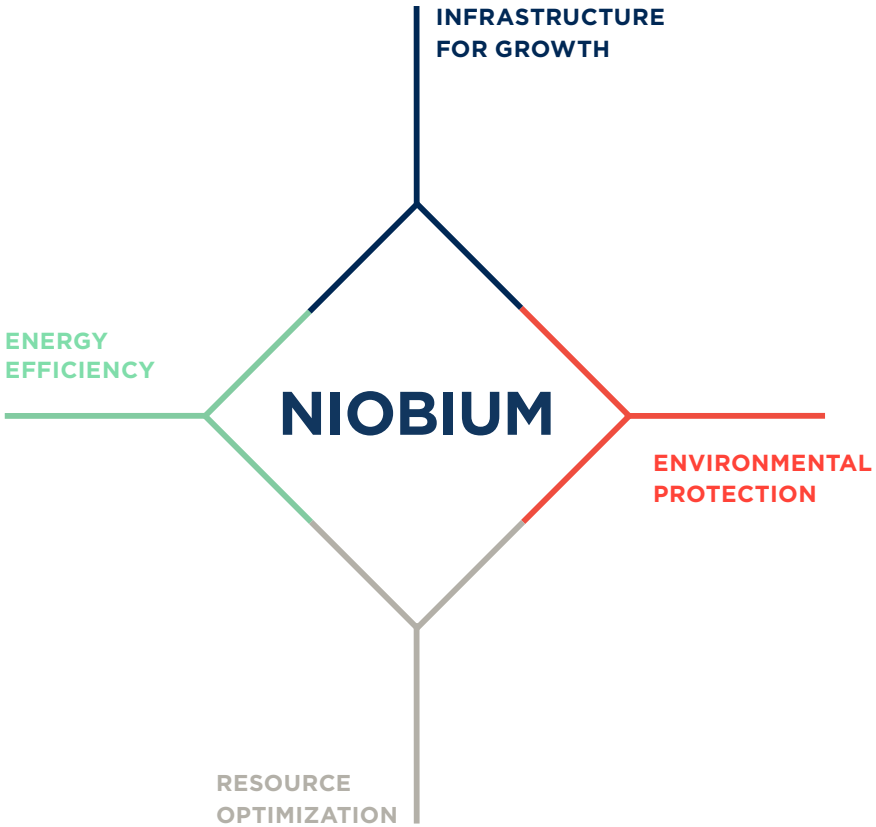


Photo: Shutterstock

SDG REPORTED IN THIS CHAPTER

Ongoing investments in niobium technology and applications have earned CBMM the position as the world's leading niobium supplier, providing a complete line of products and technical assistance. On average, the company invests 2% of revenue toward research and development activities.



Over its five-decade history, CBMM's technology development program has consolidated the use of niobium as a versatile player across a wide range of applications. Niobium enhances the properties of materials, increases performance and optimizes resources. Improved safety while at the same time reducing weight are benefits of niobium in automotive applications. Increased formability, weldability and uniformity without losing impact resistance are other advantages that niobium brings to materials. Further, thermal and wear resistance are additional properties that are enhanced by niobium.

The use of niobium also leads to higher returns on investment, not only because of lower fabrication costs, but also due to the longer life cycles of components and fuel savings.

There are advantages for the environment, too. In many applications, niobium helps to reduce the consumption of raw materials and fuel, thereby lowering greenhouse gas emissions over the life cycle of the component.

Niobium transforms the properties of steel, as well as cast aluminum, glass, batteries and electronics, finding broad application in the structural, energy and mobility sectors.

> Niobium can substitute toxic or more expensive elements, reducing risks and increasing the efficiency of materials



STRUCTURAL
IMPROVING PERFORMANCE COST-EFFECTIVELY



ENERGY
WORKING ACROSS THE ENERGY CHAIN



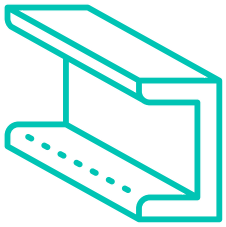
MOBILITY
CREATING VALUE

STRUCTURAL GRI 102-2

Niobium makes modern structural projects more efficient and helps solve complex engineering challenges cost effectively.

With niobium, stronger materials are produced, providing increased safety and reducing the emission of greenhouse gases since fewer materials are needed and consequently associated transportation is reduced.

Longer bridges and taller buildings are possible with the efficient use of niobium materials to maximize strength and resistance to deformation and corrosion.



Niobium microalloyed steel

Combines increased strength, improved toughness, higher formability and better energy absorption

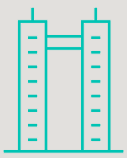
Niobium microalloyed steel offers the unmatched combination of increased strength, better toughness, higher formability and improved energy absorption for structural support in response to seismic events, fires and extreme weather conditions. The increase in strength and toughness of niobium-containing infrastructure steel enables leaner structural products, resulting in lower transportation, manufacturing and assembly costs; a reduced carbon footprint; and a more efficient construction.

STRUCTURAL
NIOBIUM IMPROVING PERFORMANCE COST-EFFECTIVELY



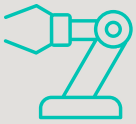
INFRASTRUCTURE

- BRIDGES
- RAILWAYS
- AIRPORTS
- ROADS



BUILDINGS

- SKYSCRAPERS
- STADIUMS
- MALLS



MACHINERY

- HEAVY EQUIPMENT
- INDUSTRIAL MACHINERY



SHIPBUILDING

- SHIP STRUCTURES

NIOBIUM IN BUILDINGS

Niobium can have a significant impact on building construction, the Empire State Building* can serve as an example. It was built with 57.000 tonnes of steel but had that steel been niobium-bearing, only 44.500 tonnes would have been needed. This result would have been accomplished with the addition of only 13,5 tonnes of ferroniobium (66%Nb) in the structural steels (0,02%Nb).

Other gains would also have been realized, like a reduction in the amount of energy, water and inputs needed to produce the material, in addition to lowered greenhouse gas emissions during the steelmaking process and for transporting the material given the substantial reduction in the weight of the steel.

*buildings.com



Photo: Shutterstock

ENERGY – NIOBIUM WORKING ACROSS THE ENERGY CHAIN GRI 102-2

Niobium plays an important role in different materials used in the energy chain, from generation to final consumer. Niobium helps to ensure the efficient and safe generation, transmission and storage of energy. Oil and gas pipelines, wind towers and turbines and energy storage technologies are a few examples of where niobium adds value to the energy chain.

Generation



OIL + GAS

- PRESSURE VESSEL
- TRANSPORTATION PIPES
- SEAMLESS PIPES
- PLATFORM STRUCTURE
- FLEXIBLE LINES
- OIL TANKERS



THERMAL

- TRANSPORTATION PIPES
- STAINLESS STEEL COMPONENTS



WIND

- TOWER
- MAIN SHAFT
- GEARBOXES
- YAM SYSTEM
- PITCH SYSTEM
- SCREWS



SOLAR

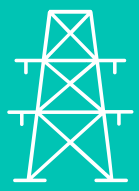
- STAINLESS STEEL TOWER



HYDRO

- TURBINES

Transmission



- TOWER STRUCTURE
- ANTI-SEISMIC
- STRUCTURAL STEEL
- WIRELESS CHARGER
- NANOCRYSTALLINE MATERIAL



- CONVERTERS
- TRANSFORMERS
- METERING SYSTEMS
- NANOCRYSTALLINE MATERIAL

Final users



- CAR BATTERY
- STORAGE BATTERY
- BIKE BATTERY
- FUEL CELLS
- SMART WINDOW NANOPARTICLES



Photo: Shutterstock

Modern wind towers reach

over 100 meters

Modern wind turbines are more than 100 meters tall to collect the most consistent wind resources at higher altitudes and to enable larger rotor diameters for slower blade rotation, resulting in more efficient energy production. Low carbon steels containing niobium enable the production of higher and lighter weight structural supports with base diameters capable of meeting transport requirements. Through lighter structural support steels, transportation costs and logistics problems can be mitigated. In addition to structural supports, niobium gear steels play a significant role in reliability and service life. Furthermore, wind farms allow the coexistence of pasture, agriculture, recreation and conservation areas.

Niobium steels increase the strength and toughness of pipelines, enabling transportation that is safer and faster over longer distances



Photo: Shutterstock



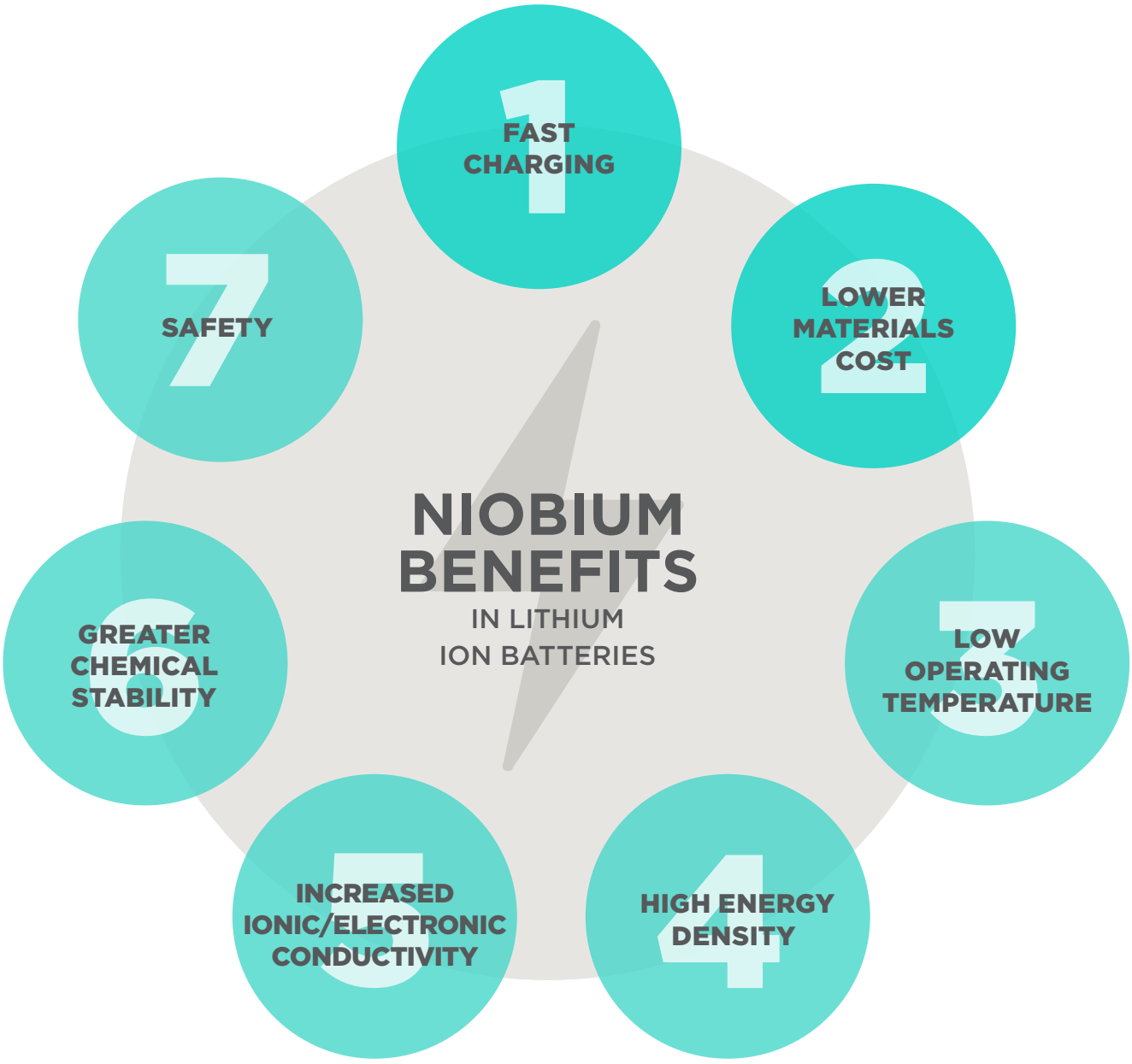
Photo: Shutterstock

Smart glass

Smart glass responds to weather in real time, equalizing temperature and light according to defined levels of comfort

Lithium-ion batteries for electric vehicles

Faster charging, safer, more powerful and higher energy storage



Niobium in end products can help

reduce

greenhouse gas emissions

Mobility GRI 102-2

Niobium is used in the automotive, aerospace and rail industries where safety, strength and wear resistance are important. Added to steels, aluminum and other materials, niobium transforms and supports innovation.

AEROSPACE

Niobium is an essential component of the superalloys used in commercial and military jet engines. The most common jet engine in service today contains about 300 kilograms of niobium. Niobium allows aircraft turbines to maintain stable performance and increase efficiency at extremely high temperatures in corrosive environments.



Photo: Shutterstock

RAIL

Niobium is used in steels for the production of high-speed rails and for train wheels. By adding strength and toughness, niobium steels are ideally suited to an industry requiring excellent weldability and resistance to wear and thermal fatigue.



Photo: Shutterstock



Photo: Shutterstock

AUTOMOTIVE

Niobium in glass, steel and aluminum helps cars to be safer, greener and more economical than ever, while also improving performance. Commercial vehicles need exceptional strength and durability, while also saving weight and costs. Niobium helps by reducing wear, adding strength to lower weight and increases payload, improving fuel economy and emissions control. Niobium use supports lightweighting, autonomy, electrification and vehicle affordability.



Photo: CBMM Archive

E-BIKE

Electric bikes are the world's most ecological form of transportation. They are the fastest-spreading, most common alternative-fuel vehicles around.

WHERE YOU'LL FIND NIOBIUM IN THE CITIES OF TODAY AND TOMORROW



*Under development

NIOBIUM ADDS VALUE TO PRODUCTS

INCREASED VALUE
Higher return on manufacturing costs, greater component durability and reduced fuel cost

BETTER PERFORMANCE
Weight reduction, formability, weldability, uniformity



CLEANER ENVIRONMENT
Reduced fuel and raw material consumption, lower life cycle emissions

ADVANCED TECHNOLOGY
Transforms properties of advanced steels, cast aluminium, glass, batteries and electronics

IMPROVED SAFETY
Resists wear and mechanical thermal fatigue and controls deformation

Audit report

Independent auditors' limited assurance report on the sustainability information included in the Sustainability Report for 2018

To the Board of Directors and Stockholders
Companhia Brasileira de Metalurgia e Mineração
Araxá - MG

Introduction
We have been engaged by Companhia Brasileira de Metalurgia e Mineração ("CBMM" or "Company") to present our limited assurance report on the compilation of the sustainability information included in the Sustainability Report for 2018 of CBMM for the year ended December 31, 2018.

Responsibilities of the Company's management
The management of the Company is responsible for the preparation and fair presentation of the sustainability information included in the 2018 Sustainability Report, in accordance with the criteria of the Global Reporting Initiative (GRI-STANDARDS), and for such internal control as it determines is necessary to enable the preparation of information free from material misstatement, whether due to fraud or error.

Independent auditor's responsibility
Our responsibility is to express a conclusion on the sustainability information included in the 2018 Sustainability Report based on our limited assurance engagement carried out in accordance with the Technical Communication CTO 01, "Issuance of an Assurance Report related to Sustainability and Social Responsibility", issued by the Federal Accounting Council (CFC), based on the Brazilian standard NBC TO 3000, "Assurance Engagements Other than Audit and Review", also issued by the CFC, which is equivalent to the international standard ISAE 3000, "Assurance engagements other than audits or reviews of historical financial information", issued by the International Auditing and Assurance Standards Board (IAASB). Those standards require that we comply with ethical and independence requirements and other responsibilities in accordance with those standards, including the application of the Brazilian Quality Control Standard (NBC PA 01) and, therefore, the maintenance of a comprehensive quality control system, including policies documented and procedures on compliance with applicable ethical requirements, professional standards and legal and regulatory requirements.

Additionally, those standards require that the engagement be planned and performed to obtain limited assurance that the sustainability information included in the 2018 Sustainability Report, taken as a whole, is free from material misstatements.

A limited assurance engagement conducted in accordance with the Brazilian standard NBC TO 3000 and ISAE 3000 mainly consists of making inquiries of management and other professionals of the entity involved in the preparation of the information, as well as applying analytical procedures to obtain evidence that enables us to issue a limited assurance conclusion on the information, taken as a whole. A limited assurance engagement also requires the performance of additional procedures when the independent auditor becomes aware of matters that lead the auditor to believe that the information taken as a whole might present significant misstatements.

The procedures selected are based on our understanding of the compilation and presentation of the sustainability information included in the 2018 Sustainability Report, other aspects affecting the engagement and our analysis of areas which might potentially present significant misstatements. The following procedures were adopted:

a) planning the work, taking into consideration the materiality and the volume of quantitative and qualitative information and the operating and internal control systems that were used to prepare the sustainability information included in the Company's 2018 Sustainability Report;

b) understanding the calculation methodology and the procedures adopted for the compilation of indicators through interviews with the managers responsible for the preparation of the information;

c) applying analytical procedures to quantitative information and making inquiries regarding the qualitative information and its correlation

with the indicators disclosed in the information included in the 2018 Sustainability Report;

d) comparing the financial indicators with the financial statements and/or accounting records.

The limited assurance engagement also included procedures to assess compliance with the guidelines and criteria of the Global Reporting Initiative (GRI-STANDARDS) applied in the preparation of the sustainability information included in the 2018 Sustainability Report.

We believe that the evidence we obtained is sufficient and appropriate to provide a basis for our limited assurance conclusion.

Scope and limitations
The procedures applied in a limited assurance engagement are substantially less detailed than those applied in a reasonable assurance engagement, the objective of which is the issue of an opinion on the sustainability information included in the 2018 Sustainability Report. Consequently, we are not able to obtain reasonable assurance that we would become aware of all significant matters that might be identified in an assurance engagement, the objective of which is the issue of an opinion. Had we performed an engagement with the objective of issuing an opinion, we might have identified other matters and possible misstatements in the sustainability information included in the 2018 Sustainability Report. Accordingly, we do not express an opinion on this information.

Non-financial data is subject to more inherent limitations than financial data, due to the nature and diversity of the methods used to determine, calculate and estimate these data. Qualitative interpretations of the relevance, materiality, and accuracy of the data are subject to individual assumptions and judgments. Furthermore, we did not consider in our engagement the data reported for prior periods, nor future projections and goals.

The preparation and presentation of sustainability indicators followed the criteria of the GRI-STANDARDS and, therefore, were not designed to assure compliance with laws and social, economic, environmental or engineering regulations. However, those standards require the presentation and disclosure of possible cases of non-compliance with regulations to avoid sanctions or significant fines. Our assurance report should be read and considered in this respect, in the context to the selected criteria (GRI-STANDARDS).

Conclusion
Based on the procedures performed, described herein, no matter has come to our attention that causes us to believe that the information included in the 2018 Sustainability Report of Companhia Brasileira de Metalurgia e Mineração has not been compiled, in all material respects, in accordance with the guidelines of the Global Reporting Initiative (GRI-STANDARDS).

Belo Horizonte, May 15, 2019

PricewaterhouseCoopers
Auditores Independentes
CRC 2SP000160/O-5

Andre Pannunzio Candido Oliveira
Contador CRC 1SP196603/O-1

Corporate contacts

CBMM – COMPANHIA BRASILEIRA DE METALURGIA E MINERAÇÃO
Córrego da Mata, s/n. 38183-903
Araxá, Minas Gerais, Brazil
+55 (34) 3669-3000
www.cbmm.com

Subsidiaries

CBMM TECHNOLOGY SUISSE SA
Avenue Pictet-de-Rochemont, 8
1207
Geneva, Switzerland
+41 (22) 318-4050

CBMM ASIA PTE. LTD.
10 Collyer Quay
#26-10 Ocean Financial Centre
Singapore
+65 6303-0290

CBMM EUROPE BV
WTC H-Tower - Zuidplein 96 /
1077 XV
Amsterdam, Netherlands
+31 (0) 20 881-3140

CBMM NORTH AMERICA, INC.
1000 Omega Drive, Suite 1110
Pittsburgh, PA 15205 USA
+1 (412) 221-7008

CREDITS

General Coordination
CBMM

Project Coordinator
Thiago de Souza Amaral

Project Management Team
Thiago de Souza Amaral, Paulo de Tarso Gonçalves Nolli and Dawn Kelly

Key Support
CBMM employees who provided valuable information and suggestions

Consultant
Bruno Fernando Riffel

GRI CONSULTING, EDITORIAL COORDINATION AND DESIGN
Report Sustentabilidade
www.reportsustentabilidade.com.br

English Translation
Dawn Kelly

Cover Design
Lápis Raro Comunicação

Photography
Acervo CBMM
Acervo IPT
Bruno Fernando Riffel
Cristiano Mascaro
IOM3
João Lima
Marcio Schimming
MLR Photo
Paulo Nolli
Ricardo Correa
Sander Dib
Shutterstock

Infographics
Cássio Bittencourt



Children at CBMM's nursery school in Araxá, Minas Gerais, Brazil.

Photo: João Lima

TRANSFORMATIVE RESULTS

Niobium enhances.
Sustainable development transforms.

cbmm.com

CBMM