CETEM

MASTER PLAN

2011-2015

OFFICE OF THE PRESIDENT

MINISTRY OF SCIENCE AND TECHNOLOGY

CENTER FOR MINERAL TECHNOLOGY

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Presentation

The Center for Mineral Technology (CETEM) is a research and development unit under the Ministry of Science and Technology (MST) which started operating in 1978. CETEM was strategically designed by the Federal Government to support the implementation of an effective and long-lasting policy that aimed to replace the imports of mineral commodities as well as to provide technological solutions for the country's mining-metallurgical sector.

CETEM started its activities under the Ministry of Mines and Energy (MME), operating under the agreement signed between the Research Company for Mineral Resources (CPRM) and the National Department of Mineral Production (DNPM). In 1989, it became part of the MST's management system and started to be managed as one of the research units of the National Council for Scientific and Technological Development (CNPq). Since 2000, the center has been managed by MST's Undersecretary for the Coordination of Research Units (SCUP) as a Research Unit of this Ministry. Its personnel is composed of skilled researchers, technologists and technicians able to meet the demands of the mineral extraction sector, including the environmental area.

CETEM carries out research in order to innovate and develop technology applicable to the mining-metallurgical sector and to use it on behalf of society, contributing to the country's economic growth and social development.

The Center is located in an area of 60,000 m² on the campus of the Federal University of Rio de Janeiro, on the Cidade Universitária Island. Its laboratory infrastructure is composed of 18 laboratories, 3 pilot plants and a specialized library.

In the past years, CETEM has begun a policy of activities regionalization and should soon be able to count on new facilities in a regional center located in Itapemirim, Espírito Santo State, which will house a pilot plant, four laboratories and a library, in an area of 1,500 square meters. Three other advanced laboratories are under construction: the first one is located in Recife, in partnership with the Federal University of Recife (UFPE); the second one is in Teresina, in collaboration with the

state government; and the third one is in Criciúma, in partnership with the Federal Insititute of Santa Catarina.

At CETEM's headquarters, located in Rio de Janeiro, activities on research, development and innovation (RD&I) are performed having as their main focus chemical, mineralogical and technological characterization, mineral processing, extractive metallurgical processes for rocks, ores and industrial minerals as well as the development and application of environmental technology.

In this context, industry-support activities, such as the production of certified reference materials and economic and prospective studies as well as studies on the sustainability of the mining sector are performed.

In the environmental area, CETEM carries out activities of research and development on management and environmental technology, aiming at the rehabilitation of degraded areas, metals recovery, materials recycling, treatment of industrial effluents and wastewater, application of cleaner technologies (C+T) and bioremediation. In the Espírito Santo unit, CETEM's researchers develop projects related to the characterization and changeability of ornamental rocks and coatings as well as the processing of tailings and waste abundant in the region. In addition, the new infrastructure being implemented will enable the development of projects of regional interest in the field of limestone beneficiation, construction aggregates and other industrial minerals.

It is noteworthy that CETEM plays a significant role in the development of the country's mineral technology and in the dissemination of knowledge, which is a proven fact given its vast scientific and technological production plus the constant demand for the Center by both the public and the private sectors.

In this context, it is important to highlight the long-term growing interaction with large companies, such as Vale, Votorantim, Caraíba Mining, Criciúma Mining and Petrobras, which in this case specifically, occurs through the implementation of projects related to the environment and to the chemical and mineralogical characterization of the pre-salt layer.

A part of its technical qualification is dedicated to provide assistance to micro, small and medium-sized mining companies, individually or along with mineral-based local clusters. More recently, studies aiming at the effective use of alternative sources of minerals to reduce dependence on fertilizer imports, for both agricultural and biofuel production, have been included in CETEM's activities of RD&I.

Under the Federal Government, CETEM is the only research center linked to the Ministry of Science and Technology dedicated exclusively to mineral technology. Thus, it is our commitment that the institution will continue practicing excellence in its activities, acting in a decentralized and comprehensive way, nationwide, always oriented towards its mission.

This Master Plan was submitted to CETEM's Scientific and Technical Council, at a meeting held on November 11th, 2010, and was approved unanimously by those present.

José Farias de Oliveira
Director

Introduction

In 2010, the Center for Mineral Technology began its strategic planning for the period 2011-2015. This plan aims to improve CETEM's management process and to plan its future in a better way, so that the institution can successfully perform its mission and contribute to the development of the country.

This initiative is part of a broader project, which contemplates the accomplishment of the Strategic Planning of the Ministry of Science and Technology, of its Research Units (RUs), and the Social Organizations (SOs) linked to it.

In April 2010, CETEM created the Strategic Management Group (SMG) and hired the services of professional facilitators to improve the conduct of the Strategic Planning stages. The methodology established by the MST was adopted, which was conducted in a collaborative and systematic way, including a critical review of the previous Master Plan (2006-2010) as well as a broad reflection on the future of the Unit, its mission and goals, taking into account it is a public institution of the federal government, dedicated to the scientific and technological research for a better use of the Brazilian mineral resources.

This system enabled us to properly understand the changes occurring in the external and internal environment in order to identify and overcome the threats caused by these changes and to make good use of the opportunities arising from them.

The result of the Strategic Planning undertaken by CETEM is contained in this Master Plan, bringing together the key elements to guide the actions of the Centre over the next five years. In this plan, we describe CETEM's mission, its vision for the future, values and principles, premises for the implementation of the Master Plan itself, action guidelines, strategic axes to be pursued in the future as well as structuring issues, which are intrinsically linked to the national challenges.

The Center for Mineral Technology expects that this Master Plan will guide the development of future Terms of Management Commitment with the Ministry of Science and Technology and that the entire process undertaken during the year

2010 is aligned with the MST's Strategic Planning as well as with the Federal Government's Multi-Year Plan.

Besides marking the conclusion of the Strategic Planning, the publication of the Master Plan launches a new strategic management process, which now starts at CETEM.

CETEM's strategy for the period 2011-2015 will therefore seek, based on its consolidated training in RD&I, oriented towards the mining-metallurgical sector, increase the impact of its operations so that it has an impact on society, industry and the environment, grounded on three pillars:

- Present technological solutions to the national challenges related to mineral commodities.
- Concentrate efforts on priority strategic objectives and strengthen inter-institutional partnerships.
- Consolidate and strengthen the institutional excellence.

Based on this work, the Ministry will be able to monitor the implementation of the guidelines proposed, always aiming to optimize the Institution's management processes.

All this work was only made possible thanks to the unconditional support of CETEM's high management, represented by its director, José Farias de Oliveira, the coordinators and heads of departments, and the fruitful participation of a significant number of the Center's researchers. It should also be pointed out the aid offered by the MST's Undersecretary for the Coordination of Research Units, in the person of Undersecretary José Edil Benedito and the General Coordinator of the RUs, Carlos Oiti Berbert. The support received from Professors Joaquim Rubens Fontes Filho (Getúlio Vargas Foundation – FGV/RJ) and José Francisco de Carvalho Rezende (State University of Rio de Janeiro -UERJ) was also essential.

1. Mission

CETEM's Mission is:

"To develop technology for the sustainable use of the Brazilian mineral resources".

2. Vision for the Future

"To be the Brazilian reference in Research, Development and Innovation on Mineral and Environmental Technology, recognized by the society, government institutions, sector companies and international institutions, working in an integrated way through research groups and projects on strategic issues of national interest."

3. Values and Principles

Ethics and transparency: Have management committed to an ethical and transparent conduct, valuing employees and respecting diversity and/or working methods.

Organizational growth: Develop management that inspires creativity, innovation and knowledge sharing to improve institutional skills.

Technological Excellence: Run the actions of RD&I in all areas of operation, using methods and procedures guided by quality, consistent with interdisciplinarity and with an overview of the issues.

Enhancement of knowledge: Invest in its professionals' continuous training by encouraging and valuing skills.

Social responsibility: Act in line with the paradigms of sustainability, considering the social, economical, cultural, technological and environmental influences and consequences.

4. Premisses of the 2011-2015 Master Plan

The following premisses are considered essential and indispensable for the 2011-2015 Master Plan to be a strategic management tool to CETEM. It is expected that the Center is able to continue to play today's role in the future, that is, that of a promoter of technological development of the national mining-metallurgical sector and, consequently, of the quality of life in Brazil.

The non-observance of these premisses will require CETEM to review and readjust its main courses of action, which are oriented to face some of the challenges that hit the country, related to both the accelerated growth of the mining activity as to the shortage of agrominerals supply and of some strategic minerals.

One of the main factors for the implementation of the objectives contained in this Master Plan is based on the current shortage of human resources, considering that CETEM's structuring actions of RD&I will be performed in the medium and long terms.

4.1. Human Resources Reorganization and Expansion

Reorganization and Expansion of CETEM's personnel in the research, development and administrative areas is extremely important and urgent so that the objectives set in this Master Plan are achieved and the institution's future is preserved.

The table below compares CETEM's workforce when the center began operating in 1990 to today's.

	1990	**2010**
Researchers	22	22
Technologists	19	24
Analysts	26	9
Assistants	52	20
Technicians	27	24
TOTAL	**146**	**99**

CETEM's headcount staff is currently composed of 99 servers, from which 9 are working in the Itapemirim Advanced Campus (CACI), 2 are on a leave without pay

and 3 are ceded. Thus, CETEM's headquarters headcount staff is currently composed of 86 servers, from which only 6 work in the Administration: 1 in the Human Resources Area, 2 in the Finance and Budget Area, 2 in the Materials, Assets and Infrastructure Area, and 1 in the Maintenance Area. It is noteworthy that over the last twenty years only two servers have joined the Center's administrative workforce while 34 servers have left, 3 servers have passed away, 11 have been transfered and 20 have retired.

The contest held in 2009 to fill 15 vacancies, 8 of which aimed at the Itapemirim Advanced Campus, fell short of the Center's actual needs. One of CETEM's 2006-2010 Master Plan main goals concerning the Human Resources Area had anticipated an increase in the number of servers **from 90 to 152** by December 2010 (a fact that actually did not happen), which were the estimates identified as being the appropriate number of employees necessary to keep the Center's RD&I activities going on as well as to invest in emerging areas. Still, besides the aforementioned data, the latest survey conducted in 2010 by the Human Resources Service Center stated that 59% of the current servers (50 out of 85 servers) might retire by December 2015. These numbers include 11 researchers, 9 technologists, 3 Science & Techonology analysts, 13 middle-level technicians and 14 Science & Techonology assistants.

Such a scenario will practically make the 2011-2015 Master Plan impossible to achieve as it has been set, causing a drastic reduction on the Center's RD&I activities.

At the end of 2010, an order by the Brazilian Court of Audit which was submitted to the Ministry of Science and Technology (MST), in response to earlier administrations initiated by the MST, granted an extension of time equivalent to 24 months to meet the Term of Judicial Conciliation signed by the Attorney General of the Union (AGU), the Ministry of Planning, Budget and Management and the Ministry of Labor.

As a result of this new order (1021/2010-TCU/SECEX-8, process 016.954/2009-5), the fifteen (15) outsourced employees of CETEM's administrative area had their contracts renewed. As a result, the activities of administrative management –

Materials, Assets and Infrastructure, Human Resources and Financial Budget were not discontinued.

However, it is necessary that the Judgement number 1520/2006, related to the MST, is met before the expiration of the period allowed by the new order of the Court of Audit. Failure to meet the deadline will represent the loss of operational capacity of the Center's three main administrative sectors.

4.2. Resources Expansion for the Institutional Capacity Building Program (ICBP)

An increase of 55 new scholarships, which will meet laboratory staffing needs at CETEM and at the Itapemirim Advanced Campus, was requested in the 2010-2012 ICBP Project and forwarded to the Undersecretary for the Coordination of Research Units /MST in order to achieve the new RD&I guidelines set in CETEM's 2011-2015 Master Plan. Currently, there are 38 scholarships implemented, which are related to the fulfillment of the strategic objectives of the 2006-2010 Master Plan.

Among the main factors that can ensure the maintenance of skilled professionals is the establishment of competitive scholarship values. Therefore, it is necessary that the MST increases its contributions to the ICBP grants.

The increase in the Center's qualified personnel, using the ICBP, will therefore strengthen the research staff and enable CETEM to meet the demands and technological challenges that are imposed during this period.

4.3. Investments in Infrastructure Maintenance and Expansion

Meeting the needs of expansion and of continuous modernization of its laboratories is crucial for the Center to achieve its strategic objectives regarding further research and development. Most of the research, development and innovation projects that generate the indexes embedded in the goals of the Master Plan are strongly based on the implementation of experimental activities in the pilot areas as well as on bench-scale investigations, which are performed in the laboratories, raising frequent needs for expansions and adaptations, resulting in changes in building infrastructure and laboratory facilities.

The large number of CETEM's projects and partnerships in progress nowadays as well as its laboratories capacity to accommodate multiple users justify a continuous investment in building renovation, installation and maintenance of utilities essential to its operation (controlled atmosphere, quality energy , facilities and special areas, interconnected logic network). Likewise, continuous equipment maintenance is carried out, which is significantly costly. Therefore, the completion of these actions depends, primarily, on continued funding provision by the MST.

4.4. Increase of resources allocation for operations sustainability

CETEM's approach to the ornamental stone sector was a key factor to building the advanced center in Cachoeiro de Itapemirim. With the installation of this center for technology dissemination and extension, CETEM began to decentralize its operations and ensured that the transfer of technology to that sector's supply chain was more effective. With its operations beginning in 2011, there will be a need to increase CETEM's budget to fund the new facility's operations.

Thus, for CETEM to face the challenges to expand its capacity of decentralized operations, CETEM's budget allocation (capital and current expenditures) should increase by at least 80% over the next four years.

5. Reference Scenario

The scenario was set up based on the assessment of the major threats and opportunities identified during the course of examining the external environment. Thus, considering the nine critical issues involved in formulating the Institution's strategy, a reference scenario has been defined, as follows.

Mineral Production

Increased demand on services and projects focused on the development of mineral technology, due to the growth of both national and global economy, which could result in increased internal competition for service providers organizations, in contrast, however, with the shortage of professionals trained in the area to work in research and development and industries of the mining-metallurgical production chain.

Availability of funds for RD & I in the mineral area

Increased investments in the sector, through the contribution of additional resources allocated in sector funds and PETROBRAS' technological networks, but also as a result of transfers arising from revenue increases, both from the public and the private sectors.

Technological Innovation

Increasing investments in RD&I from the industry and the Government, concerning the necessity to expand the competitive capacity of the national mining extractive sector, facing international competitors.

Use of Information and Communication Technology (ICT) associated with mineral processing (including simulation, automation and process control)

Widespread use of ICT in big companies of the mining and metallurgical industry, but with moderate growth in micro, small and medium-sized enterprises (SMEs), due mainly to the costs of implementation, staff training and systems maintenance and updating.

Networking

Network expansion through strategic alliances to carry out high-impact multidisciplinary and structuring projects.

Requirements in metrological practices and certification in contracts/partnerships

Increased demand for accredited institutions and laboratories that have their tests and practices properly certified.

Application of biotechnological processes in the mineral area

Increased use of biotechnology in the beneficiation, extraction and treatment of waste and effluents, accompanied by an increasing adoption of biosecurity standards.

More efficient technological alternatives (C+T) and materials recycling

Increased demand for cleaner and more efficient technologies (C+T) regarding the consumption of energy and raw materials, according to the requirements to slow the consumption of nonrenewable minerals as well as environmental liabilities, in conjunction with the growing demand for the recycling of products and byproducts, seeking an alternative destination to waste and effluents.

Characterization and application of nanostructured materials

Increased demand for mineral-based nanostructured materials and products.

6. Strategic Axes

For CETEM to accomplish its Mission "***To develop technology for the sustainable use of the Brazilian mineral resources"*** and to be fully in line with the macro guidelines defined by the Federal Government, programs and targets consistent with the strategic axes of the Ministry of Science and Technology Strategic Planning were prioritized, which are aligned with the Strategic Objectives and Actions of the National Mining Plan - 2030, from the Ministry of Mines and Energy. These conditions ensure the sustainability of the institution as a public organization that seeks the social appreciation of the goods, services and products it generates. Therefore, the strategic axes found in this chapter are aligned with those in the Science, Technology and Innovation Plan of Action from the Ministry of Science and Technology. In each strategic axis, CETEM's courses of action and programs are identified. This alignment enables the public manager and society to see how the institution is committed and contributes to the MST's strategic axes.

6.1. Strategic Axis I: Expansion and Consolidation of the National System of Science, Technology and Innovation (NSSTI)

Course of Action 1: Implement mechanisms for competitive intelligence and knowledge management in the mining-metallurgical sector.

Programs

Prospective studies: carry out prospective studies of the mineral sector to subsidize the formulation of government and investment policies.

Education in mineral technology: promote initiatives related to education and training in the mineral area.

Exchange: Promote exchanges among national and international institutions and public and private organizations.

6.2. Strategic Axis II: Promotion of Innovation in Enterprises

Course of Action 1: Develop and optimize processes of mineral beneficiation, extractive metallurgy and recycling.

Programs

Industrial minerals: Optimize industrial minerals' functional performance for various industrial segments.

Environment and mineral production waste: perform studies on management and remediation of the environmental impacts of the mining-metallurgical sector and develop new processing routes to make viable an economic use of the waste generated.

Applied scientific computing: carry out studies on simulation, optimization and process automation in mining.

Course of Action 2: Prospect and carry out RD&I actions in emerging technologies applicable to the mining-metallurgical sector.

Programs

Biotechnological processes: Develop and apply biotechnological processes and cleaner technologies (C+T) directed to the extraction of minerals and to the remediation of environmental contamination.

Nanotechnology: Implement RD&I lines in nanostructured minerals.

Course of Action 3: Supply the need for technological services in the mining-metallurgical sector.

Programs

Certified reference materials: be among the national leaders in the production of certified reference materials of mineral samples.

Standardization of products testing and qualification: create standard operating procedures (SOPs).

Life cycle assessment: promote technological, environmental and energetic improvements on the production of mineral commodities.

6.3. Strategic Axis III: Research, Development and Innovation in Structuring Areas for the Development

Course of Action 1: Perform research and activities of scientific and technological development aimed at the mineral exploration in sensitive areas of national interest.

Program

Strategic mineral resources: develop RD&I activities to make good use of the country's strategic minerals bearing elements such as rare earth, lithium and coal.

6.4. Strategic Axis IV: Research, Development and Innovation in Natural Resources and Sustainability

Course of Action 1: Perform research and activities of scientific and technological development aimed at the exploration of mineral commodities with a focus on sustainability.

Program

Mineral resources of the Amazon, Pantanal, Serrado, Semiarid and/or others: Develop RD&I activities for the exploration of mineral resources in these regions with a focus on sustainability.

6.5. Strategic Axis V: Science, Technology and Innovation for Social Development

Course of Action 1: Act in the structuring and technological management of mineral-based local productive arrangements, regional centers and regional associated entities.

Programs

LPAs Network: provide and disseminate information as well as technical and scientific knowledge regarding economic, legal and political aspects of the mineral sector to MSEs of the mining-metallurgical sector.

Regional Centers: implement advanced regional centers to meet the needs of the Center.

Regional Associated Entities: implement associated entities under MST Ordinance No. 613, of July 23, 2009.

Course of Action 2: support transfer of mineral and environmental technologies to small and medium enterprises for sustainable development.

Programs

Ornamental rocks: develop production technology and use for better utilization of ornamental rocks and their waste.

Gems: implement laboratory tests and techniques aimed at adding value.

Industrial waste of the productive chains of non-ferrous minerals: develop technologies to generate aggregates (sand and gravel) for civil construction from tailings from gravel quarry or ornamental rocks as well as from the recycling of construction and demolition waste (CDW).

7. Guidelines

7.1 Guidelines for Operations, Research and Development

Guideline 1 Disseminate the scientific and technological knowledge generated at CETEM.

Courses of Action

Publications: Encourage a greater number of publications.

Guideline 2 Develop research projects of national and international cooperation.

Courses of Action

Cooperation: encourage national and international cooperation.
ST&I Networks: participate in ST&I networks gathering expertise.

Guideline 3 Develop processes, techniques, products and prototypes to meet the demands of the mining-metallurgical sector.

Courses of Action

Processes and Techniques: develop Processes, Techniques and Products.

Guideline 4 Increase the amount of patent applications and contracts for the transfer of intellectual property.

Courses of Action

Intellectual property: carry out and establish a mentality of intellectual property protection and negotiation.

Guideline 5 Promote social inclusion.

Courses of Action

Technological Diffusion and Extension of Social Interest: Promote the extension and dissemination of technology of social interest.

Guideline 6 Create internal standards and procedures for minerals analysis and processes management.

Courses of Action

Certification of processes and accreditation of laboratories and tests: Implementation of a management system for process certification and accreditation of laboratories and tests.

Proficiency tests: implementation of proficiency testing programs for mineral analysis.

Guideline 7 Strengthen the Regional Center of Cachoeiro (NUCI).

Course of Action

Regional Center: complete the construction and inaugurate the Regional Center of Cachoeiro, with the objective of acting as a center of regional diffusion of knowledge and mineral technology, especially in the area of ornamental rocks.

7.2 Guidelines for Organization and Management

Institutional Development

Guideline 1 Review the organizational architecture, including process flow and management model.

Courses of Action

Training and Diagnosis: Preparation of internal staff to elaborate the organizational diagnosis.

Modeling and Institutionalization: Propose, approve and settle the new organizational model.

Guideline 2 Adopt structured methodologies for planning, development and projects and processes control.

Courses of Action

Internal control: Establish a policy of internal control of projects and processes.

Projects Office: Monitor and assess the budget and physical execution of projects and processes.

Guideline 3 Adopt continued practices of management improvement according to the standards of the National Program of Quality.

Courses of Action

Quality management: Adopt continued practices of quality management.

Information management: Adopt continued practices of information management.

Guideline 4 Implement the tools for innovation management.

Courses of Action

Technological Innovation: Prioritize the use of own resources for projects with great innovative potential.

Advising on intellectual property and technology transfer: improve internal mechanisms of management and implement the articulation with the Technological Innovation Center – Rio (NIT-Rio)

Guideline 5 Promote the institutional image.

Courses of Action

Institutional image: Evaluate the institutional image.

Institutional promotion: Promote institutional publicity.

Human Resources

Guideline 6 Provide capacity building and training and propose a new human resources management policy.

Courses of Action

Capacity building and training: develop internal capacity building and implement training programs.

Organizational behavior and knowledge: continuous improvement of the human resources management policy.

Guideline 7 Expand and adjust CETEM's workforce.

Courses of Action

Staffing: implement actions that will suit the workforce to the institution's current needs through temporary workers or other types of hiring viewed as legal.

Financial Resources

Guideline 8 Improve the process of planning and budgeting

Courses of Action

Fund raising: Promote actions to increase the application of resources.

Budgeting: Totalize the budgeting.

Communication and Information Technology Management (CIT)

Guideline 9 Increase the range of solutions for Communication and Information Technology (CIT).

Courses of Action

CIT policies: Define policies for the use of CIT services as well as the related levels of security.

Modernization of the CIT Platform: carry out actions that provide an infrastructure capable of meeting the institution's needs.

Infrastructure

Guideline 10 Expand and modernize the physical and instrumental infrastructure.

Courses of Action

Adaptation and Modernization of Pilot Plants: promote actions to renovate, organize and modernize pilot plants facilities.

Utilities: adapt and modernize supply services, such as air conditioning, energy, wastewater treatment, exhaust system and gas treatment.

Property Security: invest in actions to improve the institution’s system of property security.

8. Issues and Structuring Projects

Considering the five strategic axes of the MST's Plan of Action on Science, Technology and Innovation and the courses of action of CETEM's 2011-2015 Master Plan, 11 courses of action that identify the Center's activities are presented as follows. The table below points out that CETEM's performance falls in the major global challenges that were identified in the final document of the International Year of Planet Earth, which was approved by the United Nations (UN), and which are accordingly considered as priority by the Brazilian Government. The table summarizes and highlights the courses of action that can be considered of national impact and are thus included as structuring issues of the Center.

NATIONAL CHALLENGES	***2011-2015 MASTER PLAN COURSES OF ACTION***			
Water	Environment and waste from mineral production Biotechnological processes			Prospective Studies
Energy		Strategic mineral resources		Prospective Studies
Employment and Income		Mineral resources from the Amazon, the Northeast and the Semiarid	Mineral-based LPA's newtwork	Education in mineral technology
Food	Agrominerals			Prospective Studies
Housing			Ornamental rocks Industrial waste from the productive chain of non-ferrous and non-metallic minerals and from construction and demolition	

In order to align CETEM's main RD&I activities over the next five years with the activities envisaged in the Program 9 - Energy and Mineral Resources of the MST 2011-2015 Plan of Action on Science, Technology and Innovation (PACTI-II), as well as with the Guidelines for Strategic Minerals, established in the MME National Mining Plan (NMP-2030), among the structural issues previously mapped, two of them were identified and considered by the Center as the basis for defining the Structuring Projects that will guide the main focus of the institution's activities: Strategic Mineral Resources for use in High Technology Products and Agrominerals.

Some minerals are considered strategic due, for example, to their use and application, to the country's dependence in relation to their imports or to their significance for the country's trade balance. Among these materials, those that will grow in importance in the coming decades due to their application in high-tech products are worth pointing out, such as, for example, minerals containing the elements rare-earth, lithium and silicon. On the other hand, agrominerals developed with national raw materials will have strategic importance to reduce the dependence on imported fertilizers and to increase the sustainability of local agriculture.

Structuring Project 1: Strategic Mineral Resources containing the Elements Rare-Earth (REE) and Lithium for use in High-Technology Products.

Nowadays, Brazil neither mines nor produces rare earth elements and compounds, being completely dependent on imports. There are several reserves and alternative sources associated with rare earths in Brazil. However, it is necessary to resume the development and the optimization of beneficiation processes, concentration, hydrometallurgical extraction and separation in order to facilitate exploration. In this sense, it is of interest that the mechanisms used for national and international technical-scientific cooperation are included. The use of other mechanisms, such as public-private partnerships can leverage the niches and opportunities for the production of high-tech products using rare earth compounds in the country.

Furthermore, at the same time, there is a high demand for lithium minerals, mainly caused by the increasing use of rechargeable batteries in portable devices. Despite the pressure from the automotive and electronics sectors, it is still necessary to invest

in research and technological upgrading on lithium production processes in the country in order to make a better use of the sources of lithium-carrier ores and reduce production costs of high purity precursor salts. It is desirable that the country establishes acts of international scientific-technical cooperation in the segment devoted to obtaining high-tech products, such as the manufacturing of lithium-based automotive batteries.

Program 1: Develop and optimize processes of beneficiation, concentration, hydrometallurgical extraction and separation of Rare-Earth Elements (REE)

Goal 1: Participate in a study to implement a productive chain of Rare Earth magnets in Brazil, more specifically, by developing activities related to the stages of technological characterization, beneficiation and proposition of hydrometallurgical routes to obtain rare earth oxides from monazite concentrate.

Goal 2: Carry out prospective studies and assessment of new occurrences.

Goal 3: Carry out mineralogical and technological characterization of alternative sources of rare earths.

Goal 4: Carry out studies on beneficiation, concentration, hydrometallurgical extraction, separation and obtention of high purity oxides.

Program 2: Develop and optimize new technological routes for the production of lithium and its compounds.

Goal 1: Produce $LiOH.H_2O$ directly through the alkaline route.

Goal 2: Purify lithium carbonate.

Goal 3: Characterize and recover lithium from water liquor of salt pans.

Goal 4: Carry out technological studies for the whole use of litiniferous pegmatites: spodumene, quartz, feldspar and mica.

***Structuring Project 2*:** Agrominerals

The mineral resources used in the manufacturing of fertilizers, agrominerals, may also be considered strategic for the country. Brazilian soils need nutrients to maintain productivity in the agricultural sector and the national geodiversity allows the use of several rocks as alternative sources and soil conditioners to achieve fertility patterns consistent with regional needs, promoting sustainable mechanisms of economic and environmental development. To illustrate, the dependence on external potassium, nitrogen and phosphorus is respectively around 90%, 70% and 50%, a weakness that must be overcome. The development of new products derived from national raw materials should be associated with regional demands where these products will be developed, requiring training of human resources and improvement of laboratory infrastructure.

Program 1: Carry out RD&I Projects to develop alternative technological routes on the use of agrominerals or waste from the mineral industry for the production of soil corrective and fertilizers.

> **Goal 1:** Characterize and beneficiate 5 rocks and industrial minerals to be used as slow-release fertilizers. The study aims at the use of greensand slate, amazonite, serpentinite and some feldspars as a source of potassium as well as the development of their processing routes.
>
> **Goal 2:** Define 2 routes on the use of phosphatic rocks, poor ores or wastes from phosphate mines. Improvements on the beneficiation processes used nowadays will be studied in order to a better use of low-content ores or wastes, such as the deposits of Itatiaia, Tapira and Catalão.
>
> **Goal 3:** Define 1 hydrometallurgical route for the application of the waste generated in the cutting of blocks of ornamental rocks from the Espírito Santo state as an alternative source for the production of potassium fertilizers.
>
> **Goal 4:** Perform two studies aimed at the utilization of biotechnological processes to enable the use of alternative mineral sources to obtain fertilizers, including waste from the cutting of ornamental rocks from the state of Espírito Santo and rocks (greensand slate and some feldspars).

9. Goals

Strategic Axis I: Expansion and Consolidation of the National System of Science, Technology and Innovation

Course of Action 1: Implement mechanisms of competitive intelligence and knowledge management in the mining-metallurgical sector.

Programs	Goal	Target date
Prospective Studies	Perform studies on technological prospection in the mineral area to get to know the new demands and drawbacks of the sector over the next 5 years.	Dec/15
	Head 1 prospective study on agrominerals and their use in the production of liquid biofuels, which will be consolidated with the release of a book on "Agrominerals for Brazil".	Dec /11
	Head 10 studies on Big Mines and mineral-based LPA and their impacts on the local community. Case study on 10 big mines in operation in Brazil and their effects and benefits on local and surrounding communities (social, economical, environmental and quality of life aspects).	Dec /12
	Develop report setting up markers for regional assessment on mining regarding sustainability. Evaluate the social, economical, environmental and quality of life aspects of the mining activity according to the country's regions.	Dec /12
Education on Mineral Technology	Develop actions aimed at education in the mineral area.	Dec /15
Exchange	Promote national and international institutional exchanges.	Dec /15

Strategic Axis II: Promotion of Innovation in Enterprises

Course of Action 1: Develop and optimize the processes of beneficiation, extractive metallurgy and mineral commodities recycling.

Programs	Goal	Target date
Industrial Minerals	Carry out 2 studies on the technological development of the red clay sector. Characterize raw materials (especially clayminerals) for their better use as well as provide technological support to small producers and productive associations from the states of Sergipe and Piauí.	Dec /15
Environment and Waste from Mineral Production	Develop 7 processing routes to make feasible the technical-economical reuse of waste generated in the mineral production, such as: waste from heap leaching of weathered copper ore, waste from flotation of the production processes of mineral sulphates of copper and nickel, waste from the production of mineral coal for the production of iron oxide-based pigments, aluminum extraction from wastewater treatment plants and recovery of precious metals and rare earths from the electro-electronic industry scrap.	Dec /15
	Carry out 4 studies aimed at the reduction of environmental impacts originating from the mining and use of coal. It is expected to optimize the beneficiation process in order to reduce its impacts, with a focus on the states of Santa Catarina and Rio Grande do Sul, and perform preliminary tests on the synthesis of zeolite phases in open systems from coal ashes in order to remove manganese from aqueous solutions through sorption processes.	Dec /15
	Perform 2 evaluation studies on environmental impacts associated with heavy metals. Special attention should be paid to mercury for it is closely related to mining activities.	Dec /15
Applied Scientific Computing	Carry out 1 study on simulation and optimization of mineral processes a year. Processes that need improvements on their unit operations will be taken as case studies, especially those that need to reduce energy demand (for example: optimization of comminution)	Dec /15
	Implement the automation of a mineral processing circuit. The automation of beneficiation circuits provides greater reliability of the data obtained from experimental bench- and pilot-scale work. For this reason, it is intended to equip a classic beneficiation circuit (crushing, grinding, gravity separation, flotation, dewatering, etc.) with appropriate instrumentation for control and acquisition of experimental data (online / on time)	Dec /15

Course of Action 2: Prospect and carry out RD&I actions on emerging technologies applicable to the mining-metallurgical sector.

Programs	Goal	Target date
Biotechnological Processes	Carry out 2 studies related to ore bioweathering including copper Bioweathering, pyritic gravity concentrate Bioweathering and mineral coal Biodesulphurization	Dec/12
	Perform 1 study related to the application of bioprocesses to treat soils multicontaminated with heavy metals and crude oil	Dec/13
Nanotechnology	Carry out 1 study aimed at the preparation and use of clays as nanomaterial	Dec/15

Course of Action 3: Supply the needs for technological services in the mining-metallurgical sector.

Programs	Goal	Target date
Certified Reference Materials (CRM)	Produce 8 CRM. The production of samples of certified reference materials aims to help standardize analytical methods and monitor processes. Reference samples of bauxite ore from Bahia, pegmatites and feldspar concentrates from the Borborema-Seridó region will be produced.	Dec/15
Tests Standardization and Product Qualification	Create 2 standard operating procedures for analysis and processes	Dec/15
	Participate in the elaboration of 5 test and/or products standards for the gems and jewelry sector to support ABNT (Brazilian Association for Technical Standards)	Dec/14
	Participate in the elaboration of 5 standards for technological tests for the sector of ornamental rocks supporting ABNT (Brazilian Association for Technical Standards) and producers	Dec /14
Life Cycle Assessment (LCA)	Create 2 methodologies to carry out LCA (Life Cycle Assessment) pilot studies on mineral commodities aimed at the construction of “green buildings”	Dec /13

Strategic Axis III: Research, Development and Innovation in Structuring Areas for the Development

Course of Action 1: Carry out activities on research and scientific and technological development aimed at the exploration of mineral commodities sensible to national interest.

Program	Goal	Target date
Strategic Mineral Resources	Carry out 2 studies related to improvements on the beneficiation process of national spodumene (route change from acid to alkaline) to obtain battery-grade concentrates.	Dec/15

Strategic Axis IV: Research, Development and Innovation in Natural Resources and Sustainability

Course of Action: Carry out activities on research and scientific and technological development aimed at the exploration of mineral commodities aimed at sustainability.

Program	Goal	Target date
Mineral Resources from the Amazon, the Northeast and the Semi-arid	Carry out 1 study related to a better use of the Amazon's mineral resources. Bauxites with high-silica content will be studied in order to make its use in the aluminum production chain viable, especially by the Bayer process.	Dec/15
	Carry out 1 study related to a better use of the Semi-arid's mineral resources, specifically from the Seridó da Paraíba Region.	Dec/15

Strategic Axis V: Science, Technology and Innovation for Social Development

Course of Action 1: Act in the structuring and technological management of mineral-based local productive arrangements and regional associated entities.

Programs	Goal	Target date
LPA's Network	Participate in the mineral-based LPA's in partnership with the Brazilian Institute of Information in Science and Technology (IBCIT) aiming at knowledge and technology transfer to Micro and Small Enterprises (MSEs)	Dec/15
Regional Centers	Implement NUTER (Piauí) to provide technological support and help for the development of the state's mineral sector activities through technical training of personnel and fulfillment of the sector's demands.	Dec /15
	Implement NUCRI Regional Center (Santa Catarina)	Dec /15
Associated Entities	Qualify and implement 2 Associated Entities according to MST Ordinance No. 613, of July 23, 2009, one of them with the Federal University of Pernambuco.	Dec /14

Course of Action 2: Support transfer of mineral and environmental technologies to micro, small and medium-sized enterprises for sustainable development.

Programs	Goal	Target date
Ornamental Rocks	Carry out 2 studies on a better use of waste from ornamental rocks (marble and granite) to reduce disposals on the environment	Dec/13
Gems	Perform 5 studies to add value to Brazilian gems	Dec /15
Industrial Waste from the Production Chains of Non-Ferrous Minerals	Carry out 2 studies aimed at the generation of aggregates (sand and gravel) for civil construction from tailings from gravel quarry or ornamental rocks, and also from the recycling of construction and demolition waste (CDW)	Dec /15

Guidelines for Operations, Research and Development

Guideline 1: Disseminate the scientific and technological knowledge generated at CETEM.

Program	Goal	Target date
Publications	Maintain the IGPUB - General Index of Publications - at a value equal to or higher than 1.5	Dec /15
	Maintain the IPUB - Index of Publications - at a value equal to or higher than 0.17	Dec/15

Guideline 2: Develop research projects of national and international cooperation.

Programs	Goal	Target date
Cooperations	Maintain the PPACI - Index of Projects, Research and International Cooperation Actions - at a value equal to 6	Dec /15
	Maintain the PPACN - Index of Projects, Research and National Cooperation Actions - at a value equal to 27	Dec /15
S,T&I Networks	Participate in 7 S,T&I Networks	Dec /15

Guideline 3: Develop processes, techniques, products and prototypes to meet the demands of the mining-metallurgical sector.

Program	Goal	Target date
Processes and Techniques	Maintain the PcTD - Index of Developed Processes and Techniques - at a value equal or higher than 0.9	Dec /15
	Maintain the ICPC - Deadlines and Contracts Compliance Index – at a value equal to or higher than 90%	Dec /15
	Maintain the IFATT value **-** Financial Index for Services and Technology Transfer – at R$ 70,000 per technician	Dec /15
	Maintain the APME value – Support Index to Micro, Small and Medium-Sized Enterprises – at 35%	Dec /15

Guideline 4: Increase the amount of patent applications and contracts for the transfer of intellectual property.

Program	Goal	Target date
Intelectual Property	Maintain the IPIn – Index of Intellectual Property – at a value equal to or higher than 0.06	Dec/15

Guideline 5: Promote social inclusion.

Program	Goal	Target date
Technological Diffusion of Social Interest	Maintain the IDTIS – Index of Technological Diffusion of Social Interest – at a value equal to or higher than 40	Dec/15

Guideline 6: Create internal standards and procedures for minerals analysis and processes management.

Programs	Goal	Target date
Certification of processes and accreditation of laboratories and tests	Implement a Management System compliant with ISO Guide 34 – a demand to maintain CETEM's certification as a producer of certified reference material	Dec/11
	Implement a Management System compliant with ISO Guide 43 – a demand to maintain CETEM's certification as a producer of certified reference material	Dec/12
	Maintain a Management System for the production of reference material and certified reference material from mineral samples, compliant with ISO 9001:2008	Dec/15
	Set up and implement a management system compliant with ABNT NBR ISO/IEC 17025 for the Laboratory of Gemology	Dec/13
	Accredit CETEM's Laboratory of Gemology to run 3 tests	Dec/13
	Set up and implement a management system compliant with ABNT NBR ISO/IEC 17025 for the Laboratory of Ornamental Rocks	Dec/13

	Accredit by INMETRO 3 tests contained in the technical standards set up for the sector of ornamental rocks	Dec/13
Proficiency Tests	Participate in 3 proficiency testing programs for mineral analysis	Dec/15

Guideline 7: Consolidate the Regional Center of Cachoeiro de Itapemirim (NUCI).

Program	Goal	Target date
Regional Center	Complete the construction and inaugurate the Regional Center of Cachoeiro - NUCI	Dec/12

Guidelines for Organization and Management

Institutional Development

Guideline 1: Review the organizational architecture, including management structure, processes and model.

Programs	Goal	Target date
Capacity Building and Diagnosis	Develop internal staff and carry out benchmark and organizational diagnosis.	Dec/11
Modeling and Institutionalization	Develop and implement an organizational model of the structure, processes, competences and positions	Dec/11

Guideline 2: Adopt structured methodologies for planning, development and projects and processes control.

Programs	Goal	Target date
Internal Control	Develop internal control policies to cope with the risks and the implementation of levels of authority and responsibility in decision making	Dec/15
Projects Office	Develop tools to establish and activate an institutional control system to monitor technical and administrative activities	Dec/15

Guideline 3: Adopt continued practices of management improvement according to the standards of the National Program of Quality.

Programs	Goal	Target date
Quality Management	Develop organizational diagnosis on level 1 of the quality public management system - GESPUBLICA	Dec/13
Information Management	Develop adjustments on SIGTEC compliant with SIAFI and for the automatic elimination of values planned and liquidated	Dec/11
	Develop improvements and expansion on the use of SIGTEC, keeping constant users' training and counting on CTI and SCUP support	Dec/15

Guideline 4: Implement tools for innovation management.

Programs	Goal	Target date
Technological Innovation	Disseminate the practice of technological innovation	Dec/15
Intellectual Property and Technology Transfer Support	Create an internal structure to implement innovation management	Dec/15
	Promote articulation with NIT-RIO	Dec/12

Guideline 5: Promote the institutional image.

Programs	Goal	Target date
Institutional Image	Conduct image survey in society to subsidize the elaboration of an institutional publicity plan	Dec/12
Institutional Publicity	Develop a permanent communications program (target, contents, medias)	Dec/15

Human Resources

Guideline 6: Provide capacity building and training and propose a new human resources management policy.

Programs	Goal	Target date
Capacity Building and Training	Maintain the ICT value – Index of Capacity Building and Training – at 2.0%	Dec/15
	Develop SERH's - Human Resources Services - capacity building to meet the demands of new models on staff management	Dec /12
	Develop and systematize procedures to assess the needs for capacity building actions	Dec /12
	Develop and implement a high management capacity building program	Dec /13
Organizational Behavior and Knowledge	Develop methodology and systematization of management competencies	Dec /14
	Develop and apply organizational climate survey	Dec /11
	Develop and implement policies to promote workers' health	Dec /13

Guideline 7: Expand and adjust CETEM's workforce.

Program	Goal	Target date
Staffing	Maintain the PRB value – Index of Scholarship Students' Relative Participation – at 40%	Dec/15
	Maintain the PRPT – Index of Outsource Staff's Relative Participation – at 50%	Dec/15

Financial Resources

Guideline 8: Improve the process of planning and budgeting

Programs	Goal	Target date
Fundraising	Develop actions with the Undersecretary of Research Units/MST (SCUP/MCT) to increase the capital budget at a rate of 100% for purposive action and 30% for administrative action	Dec/15
	Develop information gathering and consolidation on public sources of resources based on bidding announcements and sector funds aimed at the mining sector and innovation in general	Dec /15
	Promote interaction with the private sector to increase internal application of resources	Dec /15
Budgeting	Maintain the value ratio between own income and funding budget (RRP) at 50% or higher	Dec /15
	Maintain the APD value – Index of Application on Research and Development – at a value equal to or higher than 25%	Dec /15
	Maintain the IEO value – Index of Budgeting – at 100%	Dec /15

Communication and Information Technology Management (CIT)

Guideline 9: Increase and modernize the range of solutions for Communication and Information Technology (CIT).

Programs	Goal	Target date
CIT Policies	Define, with the Informatics Commission, the information security policy	Dec/13
Modernization of the CIT Platform	Develop project and implement wireless network	Dec/12
	Increase and restructure CETEM's website	Dec/15
	Develop project on the virtualization of network servers	Dec/12

Infrastructure

Guideline 10: Expand and modernize the physical and instrumental infrastructure.

Programs	Goal	Target date
Adaptation and Modernization of the Pilot Plant	Perform maintenance on physical infrastructure and existing equipment	Dec/11
	Invest in the automation of experimental units	Dec /15
Utilities	Replace fan coils in labs and researchers' rooms	Dec /12
	Install generators to supply emergency power	Dec /11
	Adapt to the operation of Wastewater Treatment Plant (ETE)	Dec /13
	Adapt to the operation of exhaust-gas treatment systems	Dec /13
Property Security	Invest in hiring projects to renovate and expand fire detection and fighting systems	Dec /11
	Install a new firefighting detecting and atmospheric discharges network	Dec /12
	Install a new network for grounding and protection against atmospheric electrical discharges	Dec /12
	Set up standards and monitoring tools for access and circulation aiming at collective safety and property security	Dec /13

Structuring Projects

Structuring Project 1: Strategic Mineral Resources containing the Elements Rare-Earth (RRE) and Lithium for use in High-Technology Products.

Program	Goal	Target date
Develop and optimize the processes of beneficiation, concentration, hydrometallurgical extraction and separation of Rare-Earth Elements (REE)	Participate in a study to implement a productive chain of Rare Earth magnets in Brazil, more specifically, by developing activities related to the stages of technological characterization, beneficiation and proposition of hydrometallurgical routes to obtain rare earth oxides from monazite concentrate.	Dec/15
	Carry out prospective studies and assessment of new occurrences	Dec/15
	Carry out mineralogical and technological characterization of alternative sources of rare earths	Dec/15
	Study methodologies for separation/purification of REE in aqueous phase employing hydrometallurgical operations, such as selective precipitation and/or solvent extraction and/or ion exchange in order to obtain individual elements or REE mixtures with grade of purity suitable to the next processing steps or to final use.	Dec/15
Develop and optimize new technological routes for the production of lithium and its compounds	Produce $LiOH.H_2O$ directly through the alkaline route.	Dec/15
	Purify lithium carbonate	Dec/15
	Characterize and recover lithium from water liquor of salt pans.	Dec/15
	Carry out technological studies for the whole use of litiniferous pegmatites: spodumene, quartz, feldspar and mica.	Dec/15

Structuring Project 2: Agrominerals

Program	Goal	Target date
Carry out RD&I Projects to develop alternative technological routes on the use of agrominerals or waste from the mineral industry for the production of soil corrective and fertilizers.	Characterize and beneficiate 5 rocks and industrial minerals to be used as slow-release fertilizers. The study on the use of greensand slate, amazonite, serpentinite and some feldspars as a source of potassium will be carried out as well as the development of their processing routes.	Dec/15
	Define 2 routes on the use of phosphatic rocks, poor ores or wastes from phosphate mines. Improvements on the beneficiation processes used nowadays will be studied in order to a better use of low-content ores or wastes, such as the deposits of Itatiaia, Tapira and Catalão.	Dec/15
	Define 1 hydrometallurgical route for the application of the waste generated in the cutting of blocks of ornamental rocks from the Espírito Santo state as an alternative source for the production of potassium fertilizers. Calcination/solubilization, zeolitization and thermal treatment routes will be tested.	Dec/12
	Perform 2 studies aimed at the utilization of biotechnological processes to enable the use of alternative mineral sources to obtain fertilizers, including waste from the cutting of ornamental rocks (granite) from the Municipalities of Nova Venécia and Vila Pavão, located in northern Espírito Santo.	Dec/15