



# National Strategy for Science, Technology, and Innovation (ENCTI - 2024-2034)

For a fair, developed,  
and sovereign Brazil



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For a fair, developed,  
and sovereign Brazil

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## Presentation

The development of a National Strategy for Science, Technology, and Innovation, against a backdrop of profound global transformations, demands more than just technical planning: it requires a vision for the future, collective commitment, and the affirmation of a national vision. This document fits into this framework by reaffirming that scientific and technological autonomy is not merely a sectoral issue, but a fundamental element of national sovereignty.

In an international landscape marked by the growing centrality of knowledge in geopolitical disputes, the rapid advancement of emerging technologies, and the restructuring of production chains, the ability to produce, master, and apply knowledge becomes decisive in shaping the course of development. In this sense, strengthening science, technology, and innovation means expanding Brazil's capacity to determine its own destiny, reduce strategic vulnerabilities, and develop solutions aligned with its social, economic, and environmental priorities.

Thus, the National Strategy for Science, Technology, and Innovation (ENCTI) 2024–2034 is not merely a planning tool: it represents the country's commitment to sustainable development, national sovereignty, and tangible improvements in the lives of all Brazilians. It reflects the maturity of a broadly participatory process and the understanding that planning the future of Brazilian science is, at the same time, shaping the future of Brazil and its people.

This movement is taking place against the backdrop of a strategic return to science as the central pillar of national development. In recent years, there has been a growing recognition that science cannot be treated as a peripheral activity, but rather as the foundation of the country's ability to produce solutions, generate wealth, and address its structural challenges. It is not merely a matter of producing academic knowledge, but of putting science into practice and placing it at the service of national sovereignty and social transformation.

This Strategy reaffirms science as an essential infrastructure for national development—as critical as energy, logistics, or defense. By recognizing the central role of the National System for Science, Technology, and Innovation, this document sets forth an agenda that integrates knowledge, production, and social well-being, guided by a long-term vision and an unequivocal commitment to building a fair, sovereign, and developed country.

Its development is, in and of itself, an expression of this vision. It is an effort that reflects the collective intelligence of a broad national mobilization, which has placed science back at the center of public debate. The convening of the National Conference on Science, Technology, and Innovation, after a 14-year hiatus, has reopened a strategic space for democratic participation and policy formulation,

bringing together contributions from different sectors of society. This process was complemented by mechanisms for informed public engagement, such as a national public consultation and targeted dialogues with strategic sectors, ensuring technical rigor, a diversity of perspectives, and alignment with the country's needs.

The result is the systematization of a body of historical, social, and institutional knowledge that lends legitimacy and consistency to science, technology, and innovation policy for the coming decade. By organizing priorities, aligning challenges, and charting a course, the ENCTI 2024–2034 establishes a common foundation for action by the government and society, reaffirming the role of science, technology, and innovation as drivers of structural transformation.

Thus, this document not only sets out directions but also affirms a principle: there is no sovereignty without the generation of knowledge, nor sustainable development without a national capacity for innovation. It is based on this conviction that this Strategy is structured—as a state policy, an expression of a national pact, and the foundation of a new cycle of development for Brazil.

**Luciana Santos**

Minister of Science, Technology, and Innovation



# Executive Summary – ENCTI 2024–2034

## 1. Context and justification

The National Strategy for Science, Technology, and Innovation (ENCTI) 2024–2034 is the primary instrument for long-term strategic planning of the national Science, technology and innovation (ST&I) policy. With a ten-year horizon, it establishes structural guidelines to strengthen the National System for Science, Technology, and Innovation (SNCTI) and consolidate ST&I as a state policy oriented toward sovereignty, sustainable development, and social justice.

The ENCTI was developed based on contributions from the 5th National Conference on Science, Technology, and Innovation (5th CNCTI), held in 2024 after a 14-year hiatus in national conferences, reaffirming the participatory and democratic nature of ST&I policy-making.

The document begins with the recognition that Brazil is part of an international context characterized by:

- rapid technological transformations, including artificial intelligence, digitalization, and emerging technologies;
- geopolitical realignment around knowledge, escalating tensions, and disputes over critical technologies;
- the climate emergency and the need for a just energy transition; and
- structural challenges related to reindustrialization on a sustainable and innovative basis.

In this context, science, technology, and innovation play a fundamental role in consolidating scientific and technological sovereignty, reducing external dependencies, strengthening productive competitiveness, and promoting social development.

ENCTI asserts that strengthening the SNCTI—through stable and predictable funding, coordinated governance, robust scientific infrastructure, and the training of qualified human resources—is a necessary condition for transforming knowledge into national capacity, productive innovation, and collective well-being.

Its implementation will take place through the five-year Action Plan for Science, Technology, and Innovation (PACTI), which will detail intermediate goals, instruments, institutional responsibilities, funding sources, and monitoring and evaluation mechanisms.

More than just a policy document, the ENCTI 2024–2034 establishes science, technology, and innovation (ST&I) as a strategic infrastructure for national development, reaffirming the government's role as a catalyst, coordinator, and guarantor of long-term public policy.

## 2. Mission and Vision

The ENCTI 2024–2034 establishes that:

### Mission:

To transform knowledge into technologies that serve society and to make innovation a tool for social justice, promoting a fair, developed, and sovereign Brazil.

### Vision:

To support the National System for Science, Technology, and Innovation (SNCTI) to make Brazil a fair, developed, and sovereign country by integrating ST&I into industrial transformation, the energy and ecological transition, and the promotion of social well-being.

The core values of the Strategy are:

- Fairness – overcoming inequalities and democratizing access to knowledge;
- Development – sustainable economic growth based on innovation;
- Sovereignty – scientific, technological, productive, and informational autonomy.

## 3. Strategic Framework

The ENCTI is organized into three main sections:

### Part I – Fundamentals and Context

Presents:

- the history of the SNCTI;
- recent advances and setbacks;
- structural challenges related to funding, human resources, innovation, and infrastructure; and
- international trends in ST&I.

Among the challenges highlighted are:

- increasing domestic investment in Research and Development (R&D) to 2% of the Gross Domestic Product (GDP);
- ensuring budgetary predictability, especially through the National Fund for Scientific and Technological Development (FNDCT);

- reducing critical technological dependencies; and
- integrating science into the productive sector.

## Part II – Structural Axes

ENCTI's core activities are organized around four strategic axes:

### Axis I – Expansion, Consolidation, and Integration of the SNCTI

Strengthening the national scientific base, infrastructure, talent development, and collaboration among stakeholders. It classifies areas according to three criteria:

- Global leadership (e.g., renewable energy, bioeconomy, health);
- Establishing scientific excellence; and
- Strategic intervention (e.g., AI, quantum computing, new materials).

It also defines cross-cutting vectors:

- education;
- the Amazon; and
- international cooperation.

Axis I covers the strategic objectives, action guidelines, and a definition of what Brazil needs to put in place institutionally and technologically, as well as the time frame extending through 2030 and 2034.

### Axis II – Business Innovation and Reindustrialization

It aligns the ENCTI with the six missions of the New Industry Brazil (Nova Indústria Brasil – NIB) policy, promoting:

- digital transformation of industry;
- strengthening of the Health Economic-Industrial Complex;
- bioeconomy and decarbonization;
- sustainable agro-industrial chains;
- sustainable urban infrastructure; and
- technologies for national sovereignty and defense.

The main focus is on increasing business investment in Research, Development, and Innovation, strengthening innovation ecosystems, integrating science with the productive sector, and reducing critical technological dependencies.

Axis II is structured around clear objectives, strategic guidelines, and the identification of the productive and technological capabilities that Brazil needs to develop, as well as the definition of timelines through 2030 and 2034.

### Axis III – Strategic Projects for National Sovereignty

It classifies areas according to their vulnerability level (high, medium, or low), prioritizing:

- semiconductors and Information and Communication Technologies;
- strategic minerals;
- active pharmaceutical ingredients (APIs);
- fertilizers;
- radioisotopes;
- nuclear program; and
- space sector.

It seeks to reduce critical dependencies, consolidate technological autonomy, and strengthen integration among science, industry, and defense.

Axis III includes strategic objectives, guidelines to reduce vulnerabilities, a definition of the national capabilities to be consolidated, and a timeframe extending through 2030 and 2034.

### Axis IV – Science, Technology, and Innovation for Social Development

It harnesses science and innovation to address structural challenges such as:

- food security;
- health and well-being;
- productive inclusion;
- mobility and safety; and
- the promotion and advocacy of science.

It reaffirms social innovation as a complementary dimension to technological innovation and strengthens the link between ST&I and public policies.

Axis IV is structured around objectives, guidelines, a definition of the necessary actions and capacities to expand the social impact of ST&I, and a time frame extending through 2030 and 2034.

## 4. Governance and Implementation

The ENCTI clearly distinguishes between:

- Ten-Year Strategy (2024–2034) – guiding and structuring;
- ST&I Action Plan (Five-Year PACTI) – an operational tool with goals, indicators, funding, and monitoring mechanisms.

Among the implementation challenges, the following stand out:

- financial stability and predictability;
- modernization of the legal framework;
- distinguishing between investment and expenditure in ST&I;
- strengthening federative coordination; and
- articulation among science, industry, and defense.

## 5. Key Strategic Directions

The ENCTI 2024–2034 marks a paradigm shift:

- ST&I as the infrastructure of national sovereignty;
- mission-oriented planning;
- green-digital convergence;
- sustainable reindustrialization;
- strengthening the state as a catalyst and coordinator; and
- strategic international engagement and South-South cooperation.



## Part I:

# Foundations and Context of the National Science, Technology, and Innovation Strategy





**Part I of this document consists of an introduction (Chapter 1) that describes the various aspects that guided the development of this ENCTI, followed by a summary of the main recent advances and challenges in national ST&I policy (Chapter 2).**

**Part I concludes with an overview of the current international landscape, including an analysis of the ST&I strategies of various countries (Chapter 3).**





# Introduction

*This chapter describes the vision, mission, and methodological strategy of the National Strategy for Science, Technology, and Innovation (ENCTI) 2024–2034 and highlights the main challenges of implementing the strategy over the next ten years. The chapter concludes by distinguishing between the Ten-Year Strategy and the Action Plan for Science, Technology, and Innovation (Five-Year PACTI), to be developed following approval of the ENCTI 2024–2034, and by outlining what the reader will find in this document.*

## 1.1 Science, Development, and Sovereignty

Brazil is at a decisive moment in strengthening its scientific and technological foundation, amid a global landscape marked by new technological revolutions, accelerated digitalization, and the restructuring of global supply chains. In addition to serving as the foundation for enabling and sustaining national development projects increasingly driven by innovative knowledge, the field of science, technology, and innovation (ST&I) has become a focal point of geopolitical tensions and disputes worldwide, with the growing adoption of unilateral measures to restrict and block scientific and technological progress.

The 5th CNCTI, held in 2024—14 years after the last edition in 2010—reinforced the view that Brazil needs to consolidate a development model based on technological sovereignty, endogenous innovation, and sustainability. To this end, we must move forward in consolidating a National System for Science, Technology, and Innovation (SNCTI) with solid governance and effective coordination, linked to major international transformations and urgent national demands.

Before presenting its key axes, the ENCTI 2024–2034 addresses a range of topics focused on the fundamentals, the international context, and the contemporary challenges of ST&I. This approach aims to situate the Strategy within a broader geopolitical, technological, environmental, and productive context, thereby deepening understanding of the strategic choices that will guide national ST&I policy over the coming decade. The ENCTI thus presents the strategic foundations of a state policy, organized by axes and guided by a long-term vision and evidence. Details regarding indicators, intermediate targets, evaluation frequency, monitoring mechanisms, governance, and funding arrangements will be provided in the Action Plan for Science, Technology, and Innovation (PACTI), to be developed subsequently, which will operationalize the Strategy, ensuring coherence between guidelines, implementation, monitoring, and evaluation of public ST&I policies.

The technological revolution, artificial intelligence (AI), the climate crisis, and new geopolitical dynamics are redefining the rules of competition and widening social and technological disparities and

inequalities, both between and within nations. In this context, investing in science and innovation is essential to promoting economic growth, a cornerstone of inclusion, sustainability, and social justice.

In Brazil, as in other countries, economic and social demands call for integrated public policies that combine increased competitiveness and productivity in the national economy with reduced inequality. This requires a robust and dynamic National System for Science, Technology, and Innovation (SNCTI), capable of integrating scientific excellence, promoting technological innovation, and applying knowledge to address the structural challenges facing Brazilian society. To this end, it is crucial to strengthen transdisciplinary science committed to addressing social needs and transforming national reality. All of this must be combined with a robust science education program that promotes the defense and popularization of science as a tool for social inclusion and development.

In this context of rapid change, Brazil possesses strategic advantages that, through the adoption of appropriate strategies and public policies, can foster its development. As highlighted in the debates at the 5th CNCTI, the transition to a sustainable development model and a low-carbon economy represents a historic opportunity for Brazil, given its clean energy mix and unique biodiversity. The Amazon, with its megadiverse wealth, can be a key driver of this process, provided that policies are implemented to ensure both environmental protection and value generation for the national economy.

Despite the strategic advantages outlined above, there remains, however, a disconnect between the country's scientific capacity and its innovative application in business activities. Increased investment in technological innovation for decarbonization must be accompanied by effective policies, such as incentives for adopting low-emission industrial processes and the development of sustainable technologies based on Brazilian biodiversity. Brazil needs to establish programs and initiatives that ensure its bioeconomy is integrated into high-value-added production chains.

From this perspective, the digital transformation of industry and the need to expand workforce training for this new reality also stand out. Countries in the Organization for Economic Cooperation and Development (OECD) have already implemented advanced Industry 4.0 programs, while the U.S., through the CHIPS Act, seeks to reduce its dependence on foreign semiconductors. Brazil, for its part, launched a robust and bold AI program at the 5th Conference, but it needs to move forward with a strategic plan for the development and production of semiconductors and advanced manufacturing, ensuring that digitalization does not exacerbate social and regional inequalities.

Scientific data and public databases play a strategic role in innovation, economic development, and the formulation of evidence-based public policies. The ENCTI recognizes data sovereignty as an inseparable dimension of scientific and technological sovereignty, ensuring that the State has the capacity to regulate, access, use, and protect data generated with public resources, in accordance with

current legal frameworks and national interests. This approach strengthens the country's autonomy in the production and use of knowledge, while enhancing its international standing and its capacity to respond to complex social, environmental, economic, and technological challenges.

In this context, it is essential to clarify the relationship between science, technology, innovation, and the world of work. The transformations associated with digitalization, automation, AI, and the ecological transition require integrated policies for technical training, professional retraining, and the creation of skilled jobs to ensure that technological advances translate into productive inclusion, reduced inequalities, and regional development.

About its international integration, in addition to strengthening international cooperation in science and technology, Brazil needs to reinforce its strategic direction, focusing on issues and priorities where the country can make a difference in the world. Asian countries, such as South Korea and Japan, have built models of industrialization based on innovation, combining intellectual property protection with incentives for technology exports. Brazil should capitalize on its regional advantages by strengthening scientific and technological cooperation with Latin American countries on strategic issues, such as the sustainable use of biodiversity, which is crucial to regional development, the protection of biomes, and the maintenance of sovereignty and peace.

Access to international markets and the protection of innovations against misappropriation by foreign actors have become important tools in global competition, requiring close attention to industrial property policies to ensure competitiveness in strategic sectors of social interest—such as healthcare and food. Furthermore, the adoption of technical standards and high-level metrological certification is essential for avoiding trade barriers and expanding Brazil's presence in global value chains.

In addition to these strategic guidelines, funding for innovation must be expanded in a structured manner. Ensuring a continuous flow of resources to the National Fund for Scientific and Technological Development (FNDCT) is essential, but not sufficient. The need to move forward with the creation of new financing mechanisms—such as sovereign innovation funds, public-private partnerships, and tax incentives for research and development—has been demonstrated. Brazil invests less than 1.2% of its GDP in research and development (R&D), while leading nations in innovation invest more than 2.5%. Brazil needs to reach a 2% GDP-to-R&D ratio and ensure the constitutionally mandated minimum allocation of budgetary resources to critical and strategic areas, such as education and health. This gap, compared to countries with more robust innovation systems, undermines Brazil's competitiveness and must be addressed through long-term, ambitious, and effective strategies.

The new ENCTI 2024–2034 seeks to address this challenge. The ST&I agenda for the coming decade must integrate, in a coordinated and strategic manner, scientific advancement and technological innovation, sustainability, and the digitalization of the economy. Brazil has the potential to become one



of the leading players in the new knowledge economy, but to do so, it must establish a development model that transforms national knowledge into the foundation for economic growth and social inclusion. Implementing the Strategy's guidelines can secure a prominent role for the country on the global stage, strengthening its sovereignty and its ability to compete in strategic sectors.

## 1.2 Vision and Mission of the ENCTI 2024–2034

The ENCTI 2024–2034 was developed based on contributions from the 5th CNCTI, held in 2024. Launched by President Luiz Inácio Lula da Silva on July 12, 2023, through Decree No. 11,596 (Brazil, 2023), the Conference's theme was "Science, Technology, and Innovation for a Fair, Sustainable, and Developed Brazil." This Strategy is based on the conviction—grounded in successful international experiences—that science and technology are essential tools for the country's economic and social development.

The period of just over a year between the launch and the convening of the 5th CNCTI was marked by unprecedented mobilization and broad public participation. More than 100,000 people contributed to preparatory forums, state and regional conferences, thematic meetings, and free conferences, resulting in five summary documents and the "Lilac Book"—General Report of the 5th CNCTI – Toward a Fair, Sustainable, and Developed Brazil (Brazil, 2024a) and the Violet Book – Science, Technology, and Innovation for a Fair, Sustainable, and Developed Brazil – Contributions to a ST&I Strategy (Brazil, 2024b). These materials form a comprehensive collection of proposals from the scientific, business, and civil society communities that guide the ENCTI 2024–2034 and underpin the ST&I policy for the coming decade.

National ST&I strategies are, by their very nature, instruments of the state, reflecting more than two decades of institutional development, collective learning, and the refinement of public policies. Since the creation of the Sectoral Funds in the late 1990s and the first National Strategy for Science, Technology, and Innovation (ENCTI, 2002–2006), Brazil has been consolidating an increasingly coordinated National System for Science, Technology, and Innovation (SNCTI), with modern legal frameworks, solid funding mechanisms, and greater integration among science, production, and society.

The ENCTI 2024–2034 is part of this journey as an expression of continuity and renewal. It represents a new cycle of consolidation and progress, preserving fundamental principles, institutional stability, federal decentralization, social inclusion, and sustainability, while adapting them to meet the contemporary challenges of the digital, energy, and ecological transitions. In this context, the strategy recognizes the urgency of climate change and the need to strengthen multilateralism in global governance, guiding

Brazil's scientific and technological efforts toward cooperative international engagement and the development of sustainable, inclusive solutions aligned with global development commitments.

The MISSION of this ENCTI is: “To chart the course for transforming knowledge into technologies that serve society and innovation into a tool for social justice, promoting a fair, developed, and sovereign Brazil,” with the VISION of: “To support the National System for Science, Technology, and Innovation (SNCTI) in making Brazil a fair, developed, and sovereign country by integrating science, technology, and innovation with industrial transformation, the energy and ecological transition, and the promotion of social well-being.”

The words “fair,” “developed,” and “sovereign,” which appear in the mission and vision statements, express the fundamental values that guide ENCTI and reflect the broader objectives of the national ST&I policy:

“Fair” reflects ENCTI’s commitment to overcoming the deep inequalities that have marked the history of Brazilian social development and to promoting the empowerment and inclusion of historically excluded populations. Science and technology policy must ensure that the benefits of knowledge and innovation reach the entire population. Being “fair” means putting science and technology at the service of collective well-being, with a focus on generating and distributing wealth and strengthening citizenship.

“Developed” reflects the pursuit of a Brazil that is grounded in knowledge, innovation, and technology to promote economic growth, job creation, and increased productivity in an environmentally responsible and socially balanced manner. Here, development is understood in a broad sense—economic, human, and sustainable—and guides ENCTI’s strategies to consolidate a robust, coordinated SNCTI capable of driving the country’s progress.

“Sovereign” underscores the importance of national autonomy in the production and use of scientific and technological knowledge. A sovereign country is one that masters its own strategic technologies, reduces external dependencies, and independently charts its development course based on its interests and potential. Scientific and technological sovereignty is an essential prerequisite for ensuring security, competitiveness, and the ability to respond to global challenges.

Treating ENCTI as a state instrument means recognizing that ST&I policy transcends governments and terms of office and must be conducted with a long-term vision, intertemporal consistency, and federative coordination. It is a policy that integrates scientific knowledge, technological innovation, and industrial production into a national project for sustainable and sovereign development.

For Science, Technology, and Innovation (ST&I) to establish itself as a strategic axis of national development, it is essential to strengthen and preserve scientific and technological infrastructure, expand training and human resource development, ensure regional outreach, and promote cooperative and coordinated governance. In a global context in which sovereignty is directly linked to the capacity to produce and apply knowledge, the ENCTI 2024–2034, particularly through Structural Axis III, proposes strengthening Brazilian sovereignty by coordinating strategic projects aimed at consolidating national autonomy in critical areas and building an expanded concept of sovereignty as the foundation for sustainable development, national security, and national defense. This axis advances the definition of national missions with clear criteria, institutional leadership, and associated funding sources, guiding the SNCTI in strengthening the scientific and technological base, stimulating endogenous innovation, and transforming knowledge into economic and social values. For these objectives to be realized, it is essential that the strategy be aligned with economic, fiscal, and budgetary policies that recognize the central role of ST&I in the country's development and ensure the resources and incentives necessary to fulfill this strategic function.

In this regard, addressing the challenges of the 21st century—such as the climate crisis, technological inequalities, the energy transition, and the advancement of AI—requires sound governance, inter-institutional coordination, stable funding, and strategic international engagement. It is essential to bring science, education, industry, and society closer together, making industry the locus of applied innovation and innovation a driver of competitiveness and sovereignty.

Brazil should focus its ST&I agenda on areas where it has comparative advantages and the potential to play a leading global role. To this end, it is essential to increase investment in R&D and ensure predictable, sustained funding, including through the FNDCT, sovereign wealth funds, public-private partnerships, and the private sector. Investing in ST&I means investing in technological autonomy, the creation of skilled jobs, and the development of a green, digital, and inclusive economy.

Innovation, understood as a strategic axis of sustainable reindustrialization, must integrate science, technology, and production around national missions, in line with the Nova Indústria Brasil (NIB) plan. Endogenous innovation, based on the creation and mastery of national knowledge, and social innovation, focused on inclusion and sustainability, are complementary dimensions for promoting balanced development and collective well-being.

With its unique biodiversity, clean energy mix, and cultural diversity, Brazil is strategically positioned to lead the low-carbon energy, ecological, and digital transformation. The bioeconomy, renewable energy, environmental technologies, and social innovations are central axes of the national ST&I policy.

Consolidating this model requires a modern, financially stable, and well-governed National Science, Technology, and Innovation System (SNCTI), as well as the full implementation of the Legal Framework

for Science, Technology, and Innovation. Expanding public and private investments in R&D and creating collaborative innovation environments—such as technology parks and local productive arrangements—are essential for driving regional development and reducing territorial inequalities. The training and development of scientific and technological talent complete this cycle, enabling the transformation of science into wealth, knowledge into sovereignty, and innovation into social justice.

ENCTI's governance will be strengthened through the coordinated efforts of the SNCTI's national, state, and sectoral bodies, ensuring social participation, territorial focus, and continuity. This structure will ensure that the priorities defined in the participatory process of the 5th CNCTI are translated into enduring government guidelines that guide the Five-Year Action Plan and coordinate policies, programs, and investments.

Thus, the ENCTI 2024–2034 reaffirms the state's role as a catalyst, coordinator, and guarantor of ST&I policy, creating the structural conditions for innovation to flourish nationwide and for knowledge to translate into development, sovereignty, and social justice.

### 1.3 Challenges for Implementing ENCTI 2024–2034

Turning the ENCTI 2024–2034 vision and mission into reality through concrete action plans presents fundamental challenges.

One of the key strategic challenges for Brazil is ensuring the SNCTI's financial and institutional sustainability. The ongoing support of universities, public research institutes, and funding agencies is an indispensable condition for the country's scientific and technological autonomy. Without stable and predictable resources, the system loses its ability to plan, halts long-term projects, and weakens its critical infrastructure (laboratories, equipment, and research networks).

The predictability of the FNDCT (the country's main fund for supporting science, technology, and innovation), the strengthening of state funds, and the promotion of new sources of financing—such as sovereign wealth funds, public-private partnerships, and philanthropic investments in research—must form part of a framework for the system's long-term sustainability. Ensuring a larger share of federal budget investments for the Ministry of Science, Technology, and Innovation (MCTI) and its affiliated agencies is also essential to overcoming the challenge of financial sustainability.

Another challenge is ensuring consistency and continuity of incentives for business innovation, which is essential to integrating science, technology, and production into a single development project. In Brazil, many companies still prioritize investment in financial capital over investment in Research, Development, and Innovation.

Overcoming this imbalance requires a stable regulatory environment, predictable tax incentives, and long-term financial instruments that make innovation an economically rational and competitive choice. Public policies should encourage technological risk-taking, cooperation between companies and scientific institutions, and the formation of local innovation ecosystems.

The effectiveness of incentives for innovation is not limited to funding: it depends on business confidence in the ST&I policy, the reduction of bureaucracy, and coordination among federal, state, and sector-specific instruments. Only in this way will it be possible to make innovation a permanent axis of competitiveness and national productive sovereignty.

State reform is a structural prerequisite for consolidating and expanding a modern legal and regulatory framework that can support the full development of ST&I activities. This reform aims precisely to strengthen the state's role as a catalyst and coordinator of ST&I activities, in line with the practices of countries with more complex and robust innovation systems, with the goal of making government action more effective and better adapted to the uncertainty inherent in environments governed by the logic of discovery and creation. This entails improving the legal framework for ST&I, reducing bureaucratic barriers, and ensuring greater institutional agility and flexibility in managing resources, partnerships, and projects, as well as strengthening institutional capacities and valuing public service as essential axes for the proper implementation of scientific, technological, and social development policies.

More than just adjusting regulations, the goal is to strengthen the state's role as a catalyst and coordinator of innovation, creating a regulatory environment that fosters cooperation among the government, universities, and businesses and that recognizes the unique nature of scientific and technological dynamics. The consolidation of this framework must ensure legal certainty, predictability, and administrative efficiency—indispensable axes for transforming the ST&I policy into a state policy with continuity and long-term impact, overcoming the previous history of policy discontinuity in this area.

To consolidate an environment conducive to innovation and scientific sovereignty, it is essential to clearly distinguish between expenditure and investment within the context of public ST&I policies. Funds allocated to Research, Development, and Innovation should be treated as long-term strategic investments, not as current expenditures subject to fiscal constraints. This distinction is essential to ensure budgetary predictability, the continuity of structural programs, and institutional stability—conditions that enable the country to plan, innovate, and compete globally.

In this same vein, it is imperative to establish a differentiated regulatory framework for ST&I activities, recognizing their unique, experimental, and high-risk nature. The adoption of specific management and accountability mechanisms, tailored to the logic of research and innovation, enhances efficiency

and accountability without compromising process agility. Furthermore, exempting ST&I activities from the constraints imposed by the fiscal framework is a strategic prerequisite for the government to invest in science and technology in a stable, countercyclical manner, even during periods of budgetary constraints. Investment in ST&I should be treated as an asset for national development, not as a variable for fiscal adjustment.

## 1.4 Guiding Criteria for the Implementation of ENCTI 2024–2034

The ENCTI 2024–2034 adopts an innovative methodology for thematic structuring that aligns with the axes of the National Strategy. Axis I—Expansion, Consolidation, and Integration of the SNCTI, which will be discussed in Chapter 4—distinguishes among the scientific and technological fields in which Brazil is a global leader, has established excellence, or needs to strengthen its performance through strategic intervention. This approach brings clarity and strategic realism to the ENCTI 2024–2034, enabling alignment of major national challenges with the SNCTI’s maturity and responsiveness.

It is important to note that the references to priority areas are not listed in hierarchical order. The areas were grouped primarily for analytical classification purposes into the three categories mentioned—global leadership, excellence, and strategic intervention—which reflect different stages of maturity and distinct needs for government action, as described below. There is no ranking of importance among them.

Under Axis I, the strategy is organized into three levels:

1. **Major areas in which Brazil is a global leader**—these represent established comparative advantages and capabilities and should be treated as platforms for international leadership. These include, among others, tropical agricultural sciences (agriculture, agrarian sciences), health (dentistry, tropical medicine, epidemiology, parasitology), renewable energy, and the bioeconomy—areas in which the country already exercises global leadership and can further expand its role;
2. **Major areas of scientific and technological excellence**—these encompass fields in which Brazil has achieved high academic and institutional performance but still lacks mechanisms for knowledge transfer and scaling up production. Examples include primary health care, climate change, biotechnology, oceanography and polar research, advanced materials, and subfields of physics, chemistry, and space technologies. In these domains, the ENCTI 2024–2034 proposes strategies for integration among universities, Scientific, Technological, and Innovation Institutions (ICT), and the business sector, accelerating the transformation

of knowledge into innovation and competitiveness, while also consolidating a leading role in the scientific sphere; and

3. **Major areas where the country needs strategic intervention**—these correspond to structural gaps, including social and technological areas that undermine national autonomy and international integration. These are strategic fields such as agriculture (fertilizers, monitoring, sustainability), energy (offshore turbines, power grid control, etc.), and disruptive technologies (quantum technologies, AI, nanotechnology, biosensors, quantum dots, nanobiomaterials) in which Brazil must invest in a coordinated and intensive manner to reduce external dependencies and build technological sovereignty. The examples cited in the three cases are not exhaustive.

This approach to organizing priorities allows the ENCTI 2024–2034 to combine ambition with realism, promoting leadership in strategic areas, expanding excellence where a solid foundation already exists, and strengthening fields essential to scientific sovereignty.

In Axis II—Business Innovation and Reindustrialization on New Technological Foundations, which will be discussed in Chapter 5, the focus is on the contribution of the ST&I sector to overcoming the strategic challenges of the six missions that make up the NIB—Sustainable and Digital Agro-industrial Chains; Health Economic-Industrial Complex; Sustainable Infrastructure, Sanitation, Housing, and Mobility; Digital Transformation of Industry; Bioeconomy, Decarbonization, and Energy Transition and Security; and Technologies for National Sovereignty and Defense—ensuring the generation and transfer of the knowledge necessary to drive the intended reindustrialization.

In Axis III—Strategic Projects for National Sovereignty, which will be discussed in Chapter 6—a methodology was adopted to assess vulnerability in strategic areas and identify critical risks, technological bottlenecks, and capabilities essential to the country's development, defense, security, and autonomy. This approach ensures coherence among scientific, technological, and national sovereignty priorities.

Last but by no means least, Axis IV—Science, Technology, and Innovation for Social Development, which will be discussed in Chapter 7, focuses on the contribution of the ST&I sector to overcoming the social challenges that afflict the majority of the Brazilian population and ensuring basic social rights, with an emphasis on: food security and sovereignty; the guarantee of health and well-being; the right to safety and transportation; the valorization and professional development of work and workers; the nationwide dissemination of skills and competencies; the inclusion of historically excluded populations; and the popularization and defense of science itself.

The thematic classification described above lays the foundation for strategic choices across each axis of the ENCTI, providing guidelines that direct priorities, articulate long-term objectives, and inform the allocation of public resources. These foundations will be operationalized in the Action Plan for Science, Technology, and Innovation (PACTI), which translates the strategy into concrete initiatives, enabling the targeting of investments, guiding the strengthening of critical infrastructure, facilitating high-impact technology projects, and promoting greater coherence among government instruments, programs, and agendas, in line with national challenges and opportunities for scientific, technological, and innovative development.

The methodology adopted reaffirms ENCTI's commitment to a state policy based on evidence, long-term planning, and national priorities, integrating science, technology, production, and territory into a sovereign, sustainable, and innovative development project.

The core axes of ENCTI 2024–2034 are closely integrated and interconnected, aiming to structure science, technology, and innovation programs and initiatives focused on national strategic missions, with clear governance, institutional continuity, and a balance between basic research and mission-oriented applied research. It is recognized that complex and systemic challenges—such as the energy transition, digital transformation, food security, and adaptation to climate change—require long-term coordination, robust scientific and technological networks (such as the National Institute of Science and Technology – INCT), consolidated institutional capacities, adequate infrastructure, and advanced and continuous training of human resources.

Across all its core axes, the ENCTI recognizes the world of work as a strategic dimension of ST&I policy. The definition of scientific and technological priorities considers their capacity to contribute to skills development, professional retraining, the creation of higher-value-added jobs, and the reduction of regional disparities, in coordination with educational, industrial, and territorial policies.

ENCTI 2024–2034: (i) recognizes education and advanced training, aligned with the National Graduate Studies Plan (PNPG) 2025–2029 and the new National Education Plan (PNE) 2024–2034 (Brazil, 2024c) as the foundations of scientific and technological sovereignty, integrating knowledge, production, and territory into a model of sustainable and inclusive development; (ii) clearly distinguishes its structuring and guiding role from that of the Five-Year PACTI; and (iii) defines the major themes, guidelines, and priorities that should guide the ST&I system over the next decade, establishing general goals and medium- and long-term strategic choices resulting from the vision developed at the 5th CNCTI and the accumulation of previous policies.

The PACTI, in turn, will serve as the instrument responsible for detailing how these themes will be implemented, including timelines, interim targets, funding sources, institutional responsibilities, and monitoring and evaluation mechanisms.

Figure 1.1 summarizes the mission, vision, and methodological strategy for the ENCTI 2024–2034, as will be described throughout this document.



Figure 1.1 – Diagram of the ENCTI 2024–2034 Mission, Vision, and Methodological Strategy  
Source: Prepared by CGEE.

## 1.5 Conclusion

This chapter consolidates the strategic foundation of the ENCTI 2024–2034, presenting its vision, mission, and organizational methodology, as well as the main implementation challenges for the coming decade. It also establishes guiding criteria that identify areas of leadership, excellence, and

priority action, aligning national ambition with the SNCTI's capacity to respond and reaffirm the ENCTI as a state instrument that serves as a coordinating force among science, innovation, and productive development, aimed at social well-being, sustainability, and sovereignty. Furthermore, the Ten-Year Strategy—which is structural and guiding in nature—differs from the Five-Year PACTI, which will detail goals, responsibilities, and implementation mechanisms, ensuring coherence between the long-term vision and the effective implementation of public ST&I policies.

The document then delves into the progress and challenges of the national ST&I policy and the international landscape (global trends), which serve as the foundation for Part II, which presents the following structural axes: (i) expansion, consolidation, and integration of the SNCTI; (ii) business innovation and reindustrialization based on new technologies; (iii) strategic projects for national sovereignty; and (iv) ST&I for social development. Finally, Part III addresses the SNCTI and its mechanisms for governance, financing, and implementation, consolidating general guidelines and recommendations for the execution of the ENCTI 2024–2034.





## Progress and Challenges of the National Science, Technology, and Innovation Policy

*This chapter analyzes the main advances and challenges of the National ST&I Policy, highlighting the institutional milestones, structural achievements, and recent transformations that have shaped the National System for Science, Technology, and Innovation (SNCTI). This analysis seeks to understand how Brazil has, over the course of its history, built a solid scientific and technological foundation, and what steps must be taken to consolidate, expand, and integrate this system in a more balanced and sustainable manner.*

### 2.1 A Brief History of the Formation of the SNCTI

The year 2025 marked the 40th anniversary of the creation of the Ministry of Science, Technology, and Innovation (MCTI), consolidating Science, Technology, and Innovation (ST&I) as axes of national development. Although still in its early stages when compared to the well-established systems of major countries, Brazil has built a significant and unique National ST&I System (SNCTI), the result of a historical process of mobilizing talent, institutional consolidation, and public commitment to knowledge production.

Before this system was consolidated, however, the activities of the various stakeholders—the government, universities, the business sector, and civil society—were scattered and poorly coordinated, which limited the effectiveness of policies and the capacity for strategic coordination. The creation of the SNCTI thus represented a structural response to this fragmentation by promoting integration among institutions, instruments, and agendas, thereby establishing a common foundation for national science and technology policy.

The consolidation of this system resulted from four key movements:

- Institutionalization of Science, Technology, and Innovation (ST&I) as a policy anchored in legal frameworks and structural funding sources;
- Expansion of graduate education and scientific infrastructure, which has elevated the country to one of the leading producers of knowledge in the Southern Hemisphere;
- Gradual integration of innovation into productive development policies, strengthening the interface between research and the industrial sector; and
- Federative and participatory expansion, with the growing role of Research Support Foundations (FAP), State Secretariats for Science, Technology, and Innovation (Secti), and regional cooperation networks.

This journey represents a significant achievement. Brazil has built one of the most comprehensive scientific systems in the developing world, with institutional reach, a commitment to cooperation, and internationally recognized scientific output. However, this progress has also generated new tensions and imbalances: the system has become more complex and requires modern, integrated governance; the mature scientific base demands predictable, long-term funding; and the challenge of transforming knowledge into innovation and social value remains a frontier still consolidating.

Drawing on the contributions of the 5th CNCTI, compiled in the Lilac and Violet volumes, this chapter begins with the recognition that the country has reached a level of institutional maturity that allows it to view ST&I not only as a tool for development but as strategic infrastructure for national sovereignty. The challenge now is to ensure stability and coherence, and to strengthen strategically focused policies to transform the accumulated strength of its scientific system into technological capacity and productive autonomy.

### 2.1.1 The First Institutions

As early as the 19th century, institutions such as the National Museum (1818), the Rio de Janeiro Botanical Garden (1808), and the National Observatory (1827) symbolized the beginning of scientific institutionalization in the country, reflecting Brazil's desire for modernization and integration into the global scientific community (Figure 2.1).

The development of Brazilian science gained momentum in the second half of the 20th century with the creation of institutions that laid the foundations for the current National System for Science, Technology, and Innovation (SNCTI). Notable among these are the National Council for Scientific and Technological Development (CNPq) and the Coordination for the Improvement of Higher Education Personnel (Capes) (1951), focused on training and supporting researchers; the Agency for the Financing of Studies and Projects (Finep) (1967), as an agency supporting innovation; the National Institute for Space Research (INPE) (1961); the Oswaldo Cruz Foundation (Fiocruz) (1900), a pillar of public health; and the Brazilian Agricultural Research Corporation (Embrapa) (1973), which revolutionized tropical agriculture and established Brazil's international presence. Also worthy of mention are state institutions with significant historical and scientific impact, such as the Butantan Institute and the Campinas Agronomic Institute (IAC).

This trajectory consolidated science as a permanent feature of the Brazilian state, linking economic modernization to the development of human capital. However, the import-substitution industrialization process of the last century relied heavily on attracting investment from transnational corporations to promote the country's technological modernization. The result was the emergence of an industrial

system with a low propensity for endogenous innovation, heavily dependent on technology packages developed at the headquarters of foreign companies. Consequently, the SNCTI still faces structural limitations and contradictions that must be overcome:

- Low integration between research and the industrial production base, which limits economic and technological impact;
- Heavy technological dependence in sectors critical to the country's development;
- Low capacity to leverage government investments in R&D;
- Vulnerability and inconsistency of government funding in the face of political and fiscal instability;
- High regional concentration of scientific and technological capabilities, perpetuating territorial inequalities; and
- Weak institutional memory, which hinders policy evaluation and continuity.

Despite these limitations, Brazil possesses an invaluable asset: a consolidated, pluralistic, and internationally recognized national ST&I system capable of sustaining a new cycle of development. The challenge is to transform this foundation into a driver of innovation, reindustrialization, and sustainability, overcoming the logic of discontinuity and affirming ST&I as a state strategy and a pillar of national sovereignty.

Figure 2.1 illustrates the trajectory of the consolidation of Brazilian science over more than two centuries, highlighting key institutions and historical milestones that shaped the SNCTI. The timeline highlights both the pioneering role of 19th-century institutions and the institutional expansion and diversification that characterized the second half of the 20th century, underscoring the transition from a model centered on isolated initiatives to a coordinated, nationwide system as early as the first quarter of the 21st century.



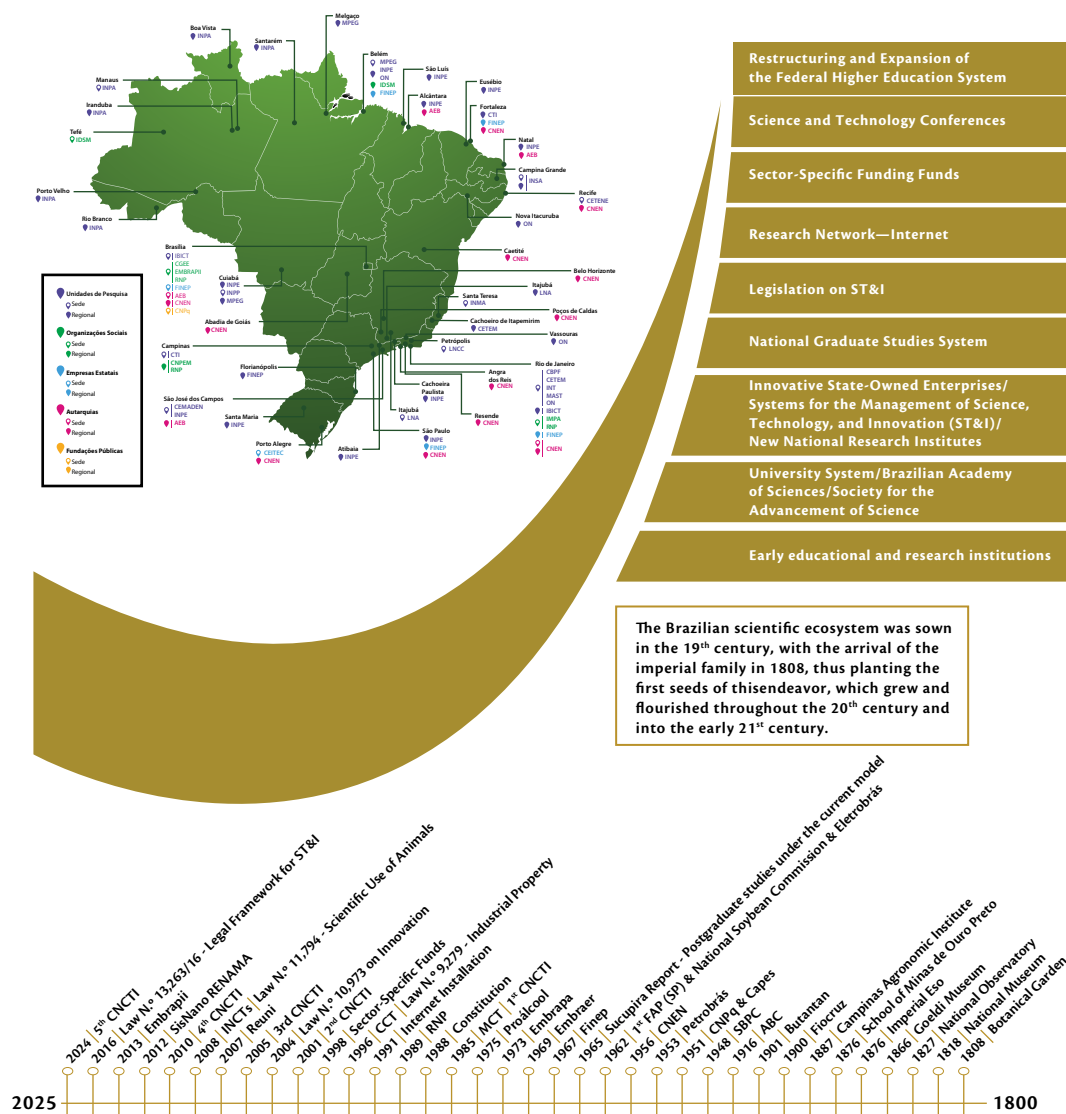


Figure 2.1 – Map of research units and social organizations affiliated with the MCTI, and the SNCTI timeline

Source: Prepared by CGEE, adapted from the 2024 MCTI report.

## 2.1.2 Current members of the SNCTI

Over the past few decades, the involvement of various institutions has led to more active participation by diverse sectors in the SNCTI. The result has been the establishment of a robust, complex, and heterogeneous national system.

Among the institutions operating in the field of science, technology, and innovation (ST&I), the Scientific, Technological, and Innovation Institutions (ICT) stand out for producing knowledge, training human resources, and promoting technology transfer. These institutions, which include universities, federal institutes, research centers and units, and social research organizations, fulfill three strategic functions:

- Support the generation of new knowledge and technologies;
- Facilitate the transfer of this knowledge and technology to the business sector and society; and
- Serve as spaces for open innovation, connecting social, business, and government needs.

In this context, universities play a pivotal role in basic and applied research, in training master's and doctoral students and researchers, and in consolidating cutting-edge networks, laboratories, incubators, and Technological Innovation Centers (NIT). Technical and technological education institutes and centers expand the reach of ENCTI by promoting training tailored to regional needs, Local Productive Arrangements (APL), and community-based innovation.

The SNCTI also involves regulatory and oversight bodies, such as the Office of the Comptroller General (CGU) and the Federal Court of Accounts (TCU), which ensure integrity and transparency in the use of public funds; the National Council for Science and Technology (CCT), which serves as a senior advisory body to the Office of the President; and representative entities from various sectors of the ST&I field, such as the Brazilian Academy of Sciences (ABC), the Brazilian Society for the Advancement of Science (SBPC), and the National Confederation of Industry (CNI), among others, which play a role in critical analysis, independent evaluation, and mediation between science, government, and society. More indirectly, regulatory agencies operate within the system to approve and monitor scientific and technological developments applied to services of public interest, particularly in the areas of health and technological equipment.

Funding and support agencies play a central role in sustaining the SNCTI, with Finep, CNPq, Capes, the State Research Funding Agencies (FAP), and the National Bank for Economic and Social Development (BNDES) serving as the main sources of funding for research, human resources development, and innovation. Table 2.1 outlines the distinct responsibilities of the various actors within the SNCTI.

Within the scope of ST&I promotion, there is a growing diversity of instruments and institutional arrangements that make up the national research support ecosystem, including philanthropic initiatives that, by complementing the government's efforts, contribute to scientific funding in the country.

Table 2.1 – Roles of SNCTI Stakeholders in the Implementation of the ENCTI

| Actors                                                                                        | Responsibilities (structural role)                                                                                                                              |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Federal Government (MCTI and other ministries)                                                | Set guidelines; establish legal, regulatory, and budgetary frameworks; coordinate the national ST&I policy.                                                     |
| States (Secti and FAP)                                                                        | Develop state policies aligned with the ENCTI; strengthen local innovation systems.                                                                             |
| Municipalities                                                                                | Promote local policies on science and innovation, digital inclusion, and support for APL.                                                                       |
| Teaching/research ICT                                                                         | Promote cutting-edge scientific research; train master's and doctorates degrees; coordinate and/or participate in national and international networks.          |
| Technical and technological institutes and centers                                            | Promote technical and technological training; respond to regional and APL demands.                                                                              |
| Research units and public R&D institutions (e.g., INPE, INPA, Fiocruz, Embrapa, CNPEM/Sirius) | Ensure a national scientific infrastructure; foster basic and applied research; promote strategic missions.                                                     |
| Embrapii                                                                                      | Facilitate cooperation projects between ICT and companies, enabling the transfer or joint development of knowledge to support innovation in domestic companies. |
| INCT (national R&D networks/arrangements)                                                     | Foster collaboration between government and academia to support cutting-edge research.                                                                          |
| Foundations supporting higher education institutions                                          | Ensure legal and administrative support for ICT.                                                                                                                |
| Technological Innovation Centers (NIT)                                                        | Take charge of managing innovation and intellectual property for ICT.                                                                                           |
| Research funding agencies (CNPq, Capes, Finep, FAP etc.)                                      | Fund research, training, and innovation.                                                                                                                        |
| Development finance institutions (e.g., BNDES; public banks)                                  | Provide credit and financial instruments for innovation/neo-industrialization.                                                                                  |
| Philanthropic institutions in ST&I                                                            | Invest in high-risk research, with a focus on basic research and innovation.                                                                                    |
| Business sector (large, medium, micro-enterprises, and startups)                              | Invest in R&D and innovation; transform knowledge into goods and services.                                                                                      |

| Actors                                                                                                  | Responsibilities (structural role)                                                                                          |
|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| S System (e.g., Senai, Sebrae, Sesi, Senac)                                                             | Provide vocational training, technology services, and support for entrepreneurship.                                         |
| Innovation ecosystems (parks, incubators, accelerators, hubs) and APL                                   | Connect academia, businesses, and society; foster entrepreneurship and regional innovation.                                 |
| Regulatory agencies and standard-setting bodies (e.g., Anvisa, Inmetro, CTNBio, Conceia, Cnen/ ANSN)    | Promote sector-specific regulation, safety, metrology, and ethics in research and the use of technologies.                  |
| INPI (Industrial Property)                                                                              | Oversee industrial property policy and management.                                                                          |
| Oversight bodies (TCU and CGU, AGU and State Attorney General's Offices)                                | Ensure legality, transparency, legal certainty, and accountability.                                                         |
| Collegial bodies (federal state/municipal councils)                                                     | Take on the strategic coordination and the shared and participatory definition of policies, programs, and investment plans. |
| Organized scientific community (ABC, SBPC, and representative entities from various fields and sectors) | Ensure scientific representation and independent critical evaluation.                                                       |
| Civil society (organizations, movements, councils, the public)                                          | Promote social participation and democratic oversight.                                                                      |

**Source:** Prepared by CGEE.

### 2.1.3 Previous ST&I Conferences and Strategies

Previous conferences and strategies played an important role in the evolution and consolidation of the SNCTI. Since the return to democracy, the country has consolidated an institutional foundation that integrates research, innovation, and social development, coordinating funding, regulation, and governance.

Each conference addressed the challenges of its time—from structuring the system in the 1980s and establishing innovation as state policy in the 2000s to current issues such as sustainability (social, environmental, energy, etc.), digital transformation, and technological sovereignty.

Tables 2.2 and 2.3 summarize this evolution, highlighting how ST&I instruments and strategies have shaped the SNCTI and paved the way for the ENCTI 2024–2034, which consolidates science and innovation as the foundations of sovereignty and the new knowledge economy.

Table 2.2 – Science, Technology, and Innovation Conferences held between 1985 and 2025

| Conferences/Year                                                                 | Context and Main Focus                                                                                                                            | Tools and Results Generated                                                                                                                                                                                                                                                                                                                             | Evolution toward ENCTI / PACTI                                                                               |
|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>1st CNCT (1985) – Redemocratization and creation of the MCT</b>               | Structuring of the SNCTI; focus on governance, training of human resources, and regional development.                                             | Creation of the Rhae Program, consolidation of agencies (CNPq, Capes, Finep, FNDCT), and strengthening of the national scientific base.                                                                                                                                                                                                                 | Conceptual Foundations for the ENCTI 2002–2006, focused on the structuring and integration of the system.    |
| <b>2nd CNCTI (2001) – New regional policy and innovation framework</b>           | Introduction of innovation and long-term planning; addressing regional inequalities and creation of Sectoral Funds.                               | Innovation Law (Brazil, 2004), Sectoral Funds, White Paper on ST&I (Brazil, 2006a), and creation of the CGEE.                                                                                                                                                                                                                                           | Foundation for ENCTI 2002–2006 and for the policy cycle that led to PACTI 2007–2010.                         |
| <b>3rd CNCTI (2005) – ST&amp;I for inclusion and development</b>                 | Emphasis on the interface between science, education, and industrial policy (PITCE); territorialization and internalization of research.          | Law for the Common Good (Brazil, 2005), expansion of Sectoral Funds, support for corporate innovation, closer ties between university and company, and preparation for the ST&I Action Plan (PACTI). The Yellow Book (Brazil, 2006b) was drafted based on the discussions at the 3rd National Conference on Science, Technology, and Innovation (2005). | Guides the PACTI 2007–2010 and the ENCTI 2012–2015 (systemic innovation and regulatory strengthening).       |
| <b>4th CNCTI (2010) – Sustainability and state policy</b>                        | ST&I as a state policy; integration of economic growth, social equity, and environmental preservation.                                            | The Blue Book (2010) was drafted, strengthening the FNDCT, along with policies for the popularization of science and social technology.                                                                                                                                                                                                                 | Guides the PACTI 2007–2010 and the ENCTI 2012–2015 (systemic innovation and regulatory strengthening).       |
| <b>5th CNCTI (2024) – ST&amp;I for a fair, sustainable, and developed Brazil</b> | Resumption of national conferences after 14 years; integration of ST&I, green and digital reindustrialization, and expanded social participation. | Launch of the Brazilian Artificial Intelligence Plan (PBIA) (Brazil, 2021); guidelines for the ENCTI 2024–2034; strengthening of governance and regional decentralization.                                                                                                                                                                              | Immediate foundation for the ENCTI 2024–2034, consolidating ST&I as infrastructure for national sovereignty. |

Source: Prepared by CGEE.

**Table 2.3 – Science, Technology, and Innovation Strategies implemented between 2002 and 2025, including the Science, Technology, and Innovation Action Plan (PACTI) for 2007 to 2010**

| Strategy or Plan/Period                       | Context and Main Focus                                                                                                                                                                                                                                                  | Tools and Results Achieved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Progress Toward ENCTI / PACTI                                                                                |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>ENCTI 2002–2006</b>                        | Structuring and integration: consolidation of a national agenda linking research, innovation, and industrial policy; establishment of inter-institutional governance.                                                                                                   | Creation and expansion of sectoral funds; strengthening of ICT; policies for human resources development and territorialization of ST&I; leads to the creation of PACTI 2007–2010 as an implementation plan for the strategy's guidelines.                                                                                                                                                                                                                                                                                                                                                                                                                         | Consolidates the SNCTI and integration among the state, universities, and businesses.                        |
| <b>PACTI 2007–2010*</b>                       |                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>– Increased investment in R&amp;D: from about 1.02% to 1.25% of GDP by 2010 (the 1.5% target was partially achieved);</li> <li>– Expansion of scholarship programs and research groups, especially in engineering and biotechnology;</li> <li>– Creating innovation ecosystems (technology parks, incubators, and research networks);</li> <li>– Progress in strategic areas such as biofuels, nanotechnology, and social technologies; and</li> <li>– Expanding digital inclusion and promoting science to the general public, with hundreds of telecenters and educational programs in science and technology.</li> </ul> |                                                                                                              |
| <b>ENCTI 2012–2015</b>                        | Systemic innovation and ICT-business cooperation: inspired by the Blue Book of the 4th CNCTI; institutional consolidation and expansion of innovation networks.                                                                                                         | Creation of Embrapii (Brazil, 2013), the Inova Program (Finep, 2013), Legal Framework for Science, Technology, and Innovation (Law No. 13,243/2016) (Brazil, 2016); diversification of funding and scientific internationalization.                                                                                                                                                                                                                                                                                                                                                                                                                                | Expands the focus on ICT- business cooperation, governance, and results.                                     |
| <b>ENCTI 2016–2022 and funding challenges</b> | Results-based management: a results-oriented approach, with performance indicators, impact goals, and federal integration.                                                                                                                                              | Introduction of metrics, administrative streamlining, inclusion of new economic and social actors, and incorporation of the bioeconomy, digital technologies, and the green economy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reinforces the need for financial predictability and institutional stability, preparing the 2024–2034 cycle. |
| <b>Thematic Action Plans (2017–2022)</b>      | Launched in 2017 and in effect through 2022; they include Oceans, Biotechnology, Sustainable Agriculture, Antarctica, Bioeconomy, Biomes, CHSS, Climate, Technology Outreach for Social Inclusion, Popularization of Science and Technology, Food Security, and Health. | The tools generated consist of a set of action plans (in PDF format, available on the MCTI website).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Not applicable.                                                                                              |

Source: Prepared by CGEE.

\* For the 2007–2010 period, the Action Plan replaced the ENCTI, including in the plan the strategies for the period following the 3rd CNCTI.

## 2.1.4 National plans related to science, technology, and innovation developed starting in 2023

The ENCTI 2024–2034 was developed in consultation with other national plans drafted starting in 2023—or currently being formulated—that establish strategic guidelines in complementary areas. These instruments reinforce the cross-cutting vision of ST&I as the foundation for sustainable development, social inclusion, reindustrialization, and national sovereignty.

A prime example is the Brazilian Artificial Intelligence Plan (PBIA) (Figure 2.2), launched in 2024 at the 5th CNCTI, developed under the coordination of the MCTI with technical support from the CGEE, based on a request submitted to the CCT by the President of the Republic, which consolidates AI as a driver of innovation and productive transformation.

Below, Table 2.4 summarizes the main national plans related to ST&I policy, indicating their current status, key contributions, and strategic challenges for the consolidation of an integrated national agenda.

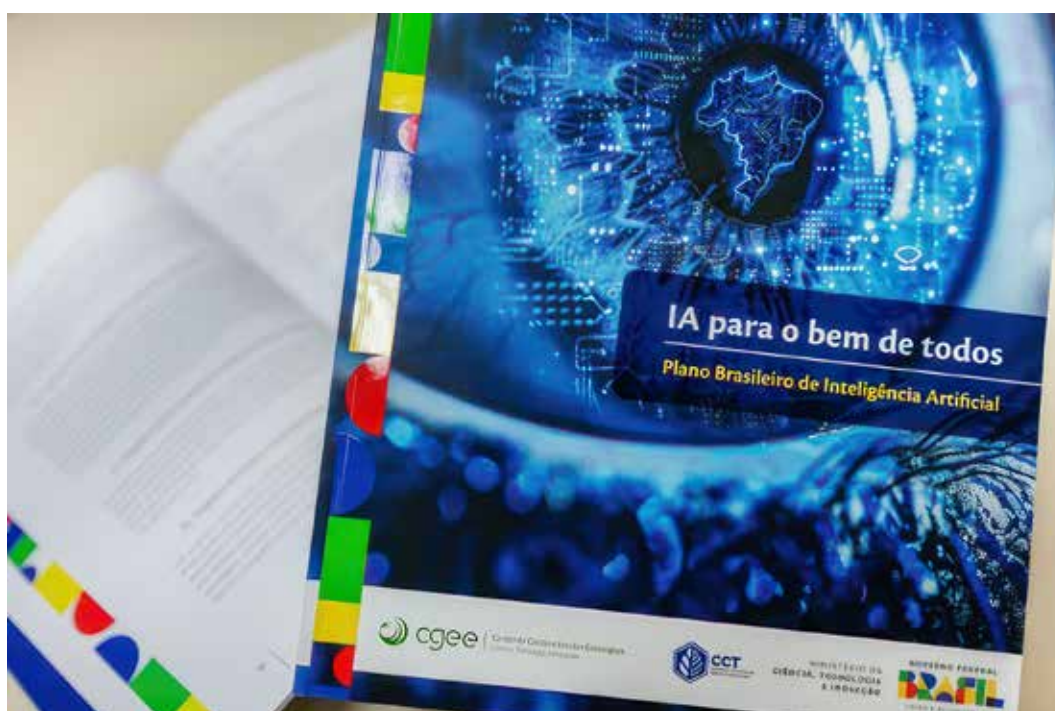


Figure 2.2 – Brazilian Artificial Intelligence Plan, 2025

Source: MCTI (Brazil, 2025a).

**Table 2.4 – National Plans related to Science, Technology, and Innovation and their main challenges (updated in September 2025, CGEE)**

| Plan / Strategy                                                      | Status / Current Version                                                                                                                                   | Description / Scope                                                                                                                                                                                                                                                                                             | Key Challenges                                                                                                                                                                                                     |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PBIA – Brazilian Plan for Artificial Intelligence (2025)</b>      | Final version published in June 2025; investments of up to R\$ 23 billion projected over four years.                                                       | Sets guidelines for research, ethics regulations, talent development, and infrastructure (e.g., supercomputers).                                                                                                                                                                                                | Ensure safety and ethical standards in the use of AI; expand national technical capacity; reduce technological dependence; foster innovation in less developed regions.                                            |
| <b>PNE – National Education Plan (2024–2034)</b>                     | Approved via Bill 2,614/2024.                                                                                                                              | Establishes goals for basic and higher education, teacher training, equity, and the use of educational technologies.                                                                                                                                                                                            | Integrate science and technology education from the ground up; improve digital infrastructure in schools; reduce regional and gender inequalities in science education.                                            |
| <b>PNPG – National Graduate Education Plan (2025–2029)</b>           | Version approved by the Superior Council of Capes in 2025, whose central premise is to update the roadmap for the National Graduate Studies System (SNPG). | Defines guidelines and objectives for master's and doctoral programs, to enhance the quality of graduate education and its contribution to scientific research, to promote the internationalization of programs, and to strengthen links with scientific and technological innovation and regional development. | Reduce regional inequalities in graduate education; expand the social impact of research; strengthen internationalization and interdisciplinarity; improve the evaluation of programs; ensure sustainable funding. |
| <b>Institutional Strategic Plan – Ministry of Health (2024–2027)</b> | Currently in effect.                                                                                                                                       | Defines priorities in health research and innovation, integrating ST&I into the Health Economic-Industrial Complex (CEIS).                                                                                                                                                                                      | Reduce dependence on imported supplies; expand health R&D infrastructure; strengthen integration among universities, the Unified Health System (SUS), and the business sector.                                     |
| <b>Axes of a National Project (CDESS)</b>                            | Current version approved by the Council for Sustainable Economic and Social Development, 2025.                                                             | Contains recommendations for priority actions for the next five years, serving as a practical reference to guide decisions, public policies, and strategic investments by the next administration.                                                                                                              | An integrated vision of the country we want to build, including sovereign and equitable science and technology.                                                                                                    |

**Source:** Prepared by CGEE.

## 2.2 Progress and Challenges

The progress observed in ST&I faced a turbulent period between 2016 and 2022, when Brazil experienced a considerable decline in various ST&I indicators. Virtually all indicators that had been improving suffered setbacks during that period, becoming immediate challenges to overcome and requiring the urgent recovery of the National Science, Technology, and Innovation System (SNCTI) to enable its subsequent expansion. We highlight areas where immediate progress and challenges are clear, as well as areas where the challenges are more structural in nature and will require a longer period to mitigate and resolve.

### 2.2.1 Funding for Science, Technology, and Innovation

The progress and challenges in funding for ST&I are shown in Figures 2.3 and 2.4, which illustrate recent efforts to restore the budget. Figure 2.3 shows the recovery of national expenditures on ST&I, highlighting the resumption of funding for basic and applied research after 2022. Figure 2.4 presents the evolution of the FNDCT budget (2003–2025), whose unprecedented recovery reaffirms its role as the primary source of support for structural science, technology, and innovation programs in the country. In line with the recommendations of the 5th CNCTI, the ENCTI 2024–2034 establishes as a strategic goal the progressive increase in national investment in R&D until it reaches 2% of GDP (to be discussed in Chapter 8), with stable funding, diversified sources, and budgetary predictability—conditions essential for consolidating Brazil's scientific and technological sovereignty.

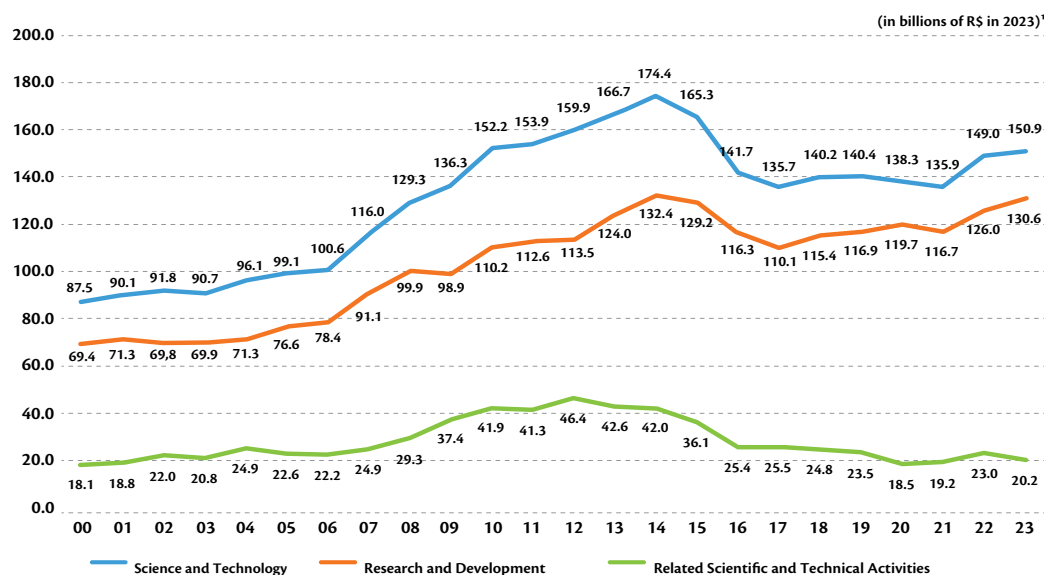
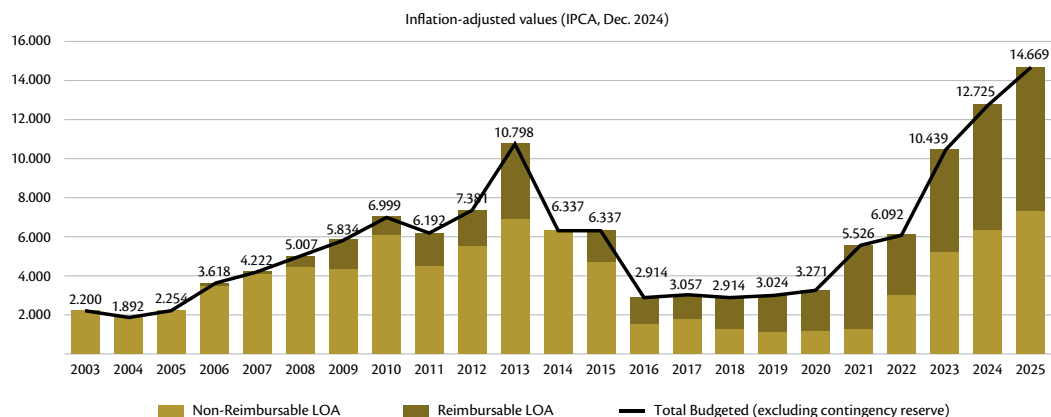


Figure 2.3 – National expenditure on science and technology, 2023, by activity (in billions of 2023 BRL)

Source: National Science, Technology, and Innovation Indicators 2025, MCTI.



**Figure 2.4 – Evolution of the FNDCT budget, 2003–2025 (in billions of BRL)**

**Source:** Finep (2025).

## 2.2.2 Human Resources

Advances in human resources development have only partially addressed the challenges facing ST&I. The integration of education and science has been one of the pillars of SNCTI's development. The expansion of higher education in the 1960s and 1970s, combined with the creation of graduate programs, established the National Graduate Education System (SNPG) and consolidated the foundation of scientific training that continues to support the country to this day. Currently, Brazil has more than 400,000 active researchers and awards approximately 90,000 master's and doctoral degrees per year, according to CAPES and CGEE. Most of these professionals work at institutions of higher education, particularly at universities and federal institutes, whose expansion has broadened access to scientific and technological training in all regions of the country.

This educational ecosystem has established a solid foundation for scientific output—ranking Brazil 13th in international scientific output—and for the internationalization of Brazilian research, although regional and integration inequalities persist and require new policies to integrate education, research, and innovation, as illustrated in Figures 2.5 and 2.6. Figure 2.5 highlights the essential role of graduate education, the primary driver of Brazilian scientific publications. The growth in the number of graduate degree recipients mirrors the growth in scientific output. The map in Figure 2.6 shows the distribution of the country's 69 federal universities, which are joined by 124 state universities—the main drivers, as mentioned, of Brazilian scientific output.

This major advance in human resources development presents an even greater challenge: preparing these professionals not only for academia, but also—and perhaps primarily—for industry.

Retaining postgraduate-level talent by providing adequate working conditions and salaries aligned with international market rates is also a challenge for the SNCTI.

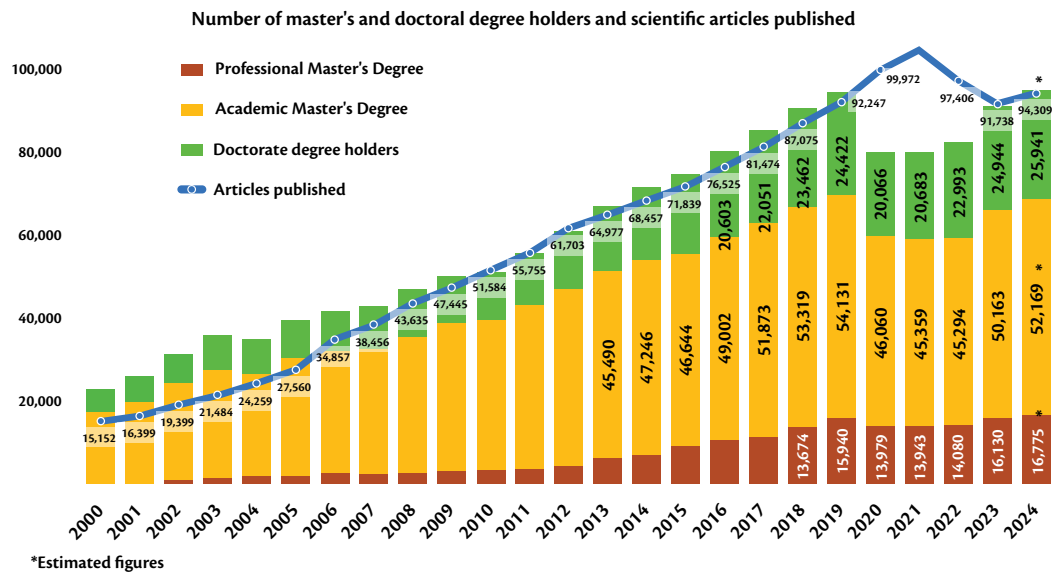


Figure 2.5 – Number of master's (academic and professional) and doctoral degree graduates per year, and scientific articles published, 2000–2024

Source: GeoCapes and Scival.

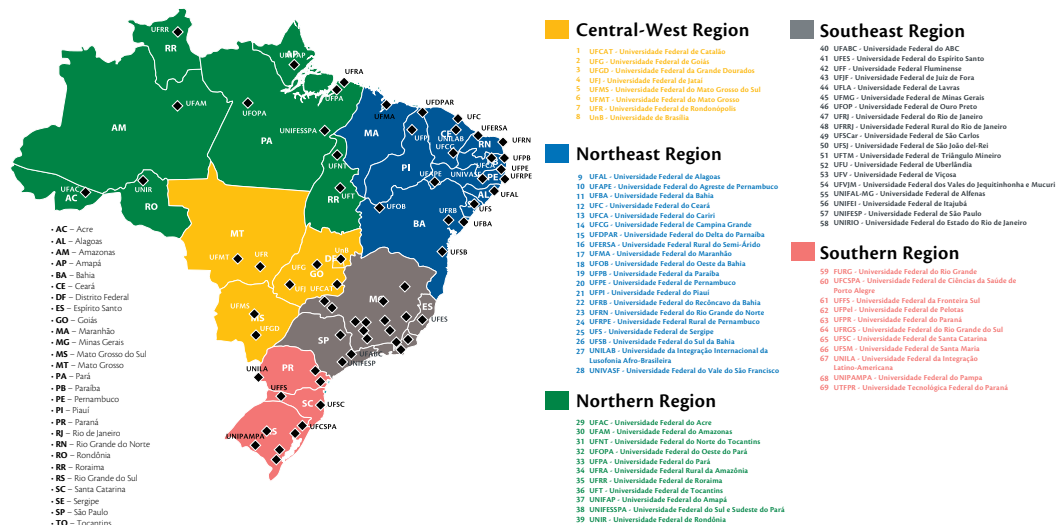


Figure 2.6 – Map of Federal Universities in Brazil, 2025

Source: (Brazil, 2025b).

It is also important to highlight the presence of state universities (124 institutions), the Federal Institutes of Education, Science, and Technology (IF), and the Federal Centers for Technological

Education (Cefet), the latter two being institutions of technical secondary and higher education with extensive geographic reach across the country, whose challenge is to play a more active role in technical and higher education training in areas of strategic importance to Brazil. Currently, 38 IF are spread across the country across 609 campuses, and 100 new IF have been authorized, as shown on the map in Figure 2.7. In addition to the IF, there are two Cefets, located in the states of Rio de Janeiro and Minas Gerais.

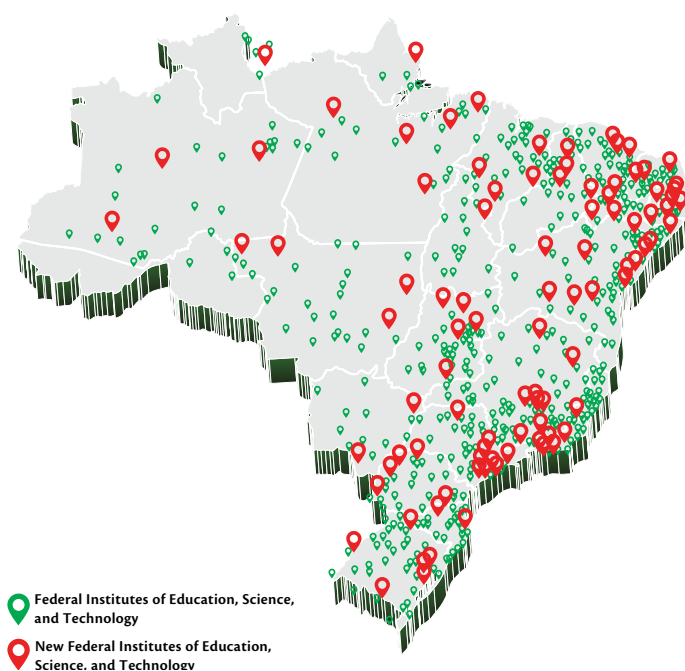


Figure 2.7 – Geographic distribution of the Federal Institutes (IF) of Education, Science, and Technology, indicating the expansion of a further 100 IF

Source: Prepared by Setec/MEC (Brazil, 2025c).

One of the fundamental challenges in human resources for ST&I—which will require more time and effort—is training and developing talent. Brazil faces a brain drain, discrepancies and inequality in scholarship stipends, and low integration between technical, higher, and graduate education. Strengthening scientific literacy and technological education is essential for building a solid social foundation for innovation, expanding access and diversity in knowledge production.

### 2.2.3 Coordination with Innovation

The integration of science, technology, and innovation remains one of the main challenges facing the SNCTI. Although the country has made progress in establishing legal frameworks and funding mechanisms, the transformation of knowledge into innovation remains constrained by structural

barriers, including excessive bureaucracy and low participation by small and medium-sized enterprises. Effective integration among universities, research centers, businesses, and the government remains indispensable to expanding the impact of science on the economy and society. Overcoming this challenge requires coordination among industrial, technological, and environmental policies, strengthening regional innovation ecosystems, and promoting Technological Innovation Centers (NITs), technology parks, and local productive arrangements. Experiences in regions such as the Amazon and the Semi-Arid region, where science and innovation are linked to sustainable territorial solutions, demonstrate the potential of a more integrated and inclusive national model of technological development.

From a structural and productive standpoint, the challenges involve reindustrialization based on new technologies, the consolidation of the bioeconomy, a just energy transition, and increased self-sufficiency in strategic supply chains, including semiconductors, healthcare, defense, and digital technologies. The low capacity of small and medium-sized enterprises to absorb technology, the scarcity of ongoing funding for startups and deep-tech companies, and the lack of long-term national innovation goals hinder the full realization of the country's scientific potential.

In the 2025 edition of the Global Innovation Index (GII), Brazil fell two positions compared to 2024, now ranking 52nd, and lost its leadership position in Latin America and the Caribbean (to Chile), as shown in the global map in Figure 2.8.



**Global leaders in innovation, 2025**  
**Top three innovation economies by region**

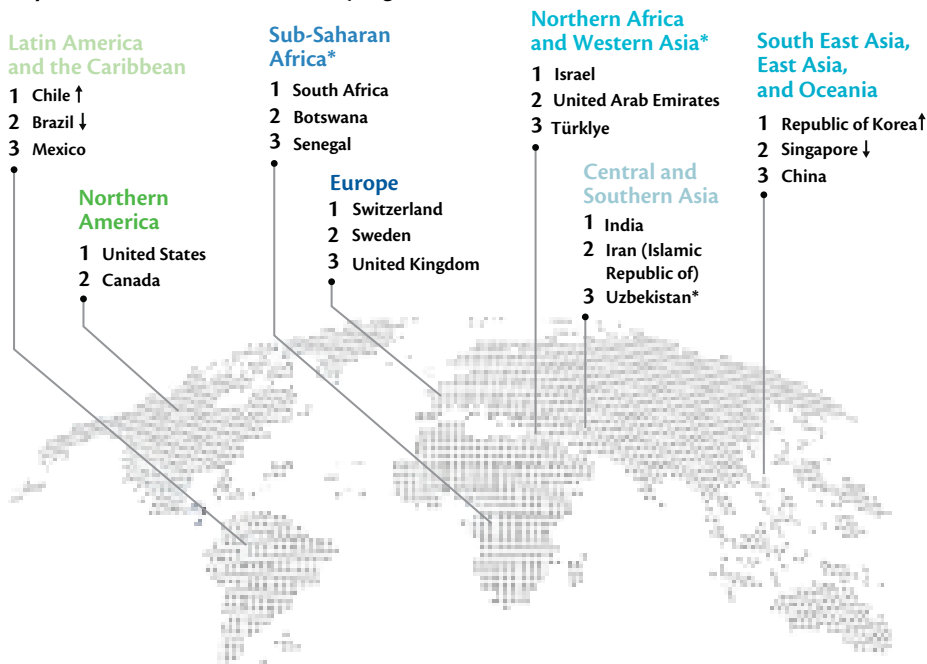


Figure 2.8 – Global Innovation Index 2025: highlighting the top three innovative economies by region  
 Source: WIPO, 2025.

In 2025, the GII assessed 139 countries using more than 80 indicators, including the political environment, education, and infrastructure.

The enormous challenge of advancing responsible innovation—not only in the technological sphere but also in the social sphere—is a key theme highlighted in this strategy for the next ten years.

In this context, the Brazilian Industrial Research and Innovation Agency (Embrapii) has established itself as one of the country's leading instruments for promoting collaborative innovation projects between companies and the ICT sector. Its model connects companies with centers of research excellence, enabling risk sharing, reducing barriers to R&D, and supporting startups and small businesses.

Since its creation in 2015, Embrapii has facilitated projects in strategic areas such as advanced manufacturing, healthcare, biotechnology, renewable energy, digital technologies, and sustainable mobility, and currently has 93 accredited units throughout the country (Figure 2.9).

## 91 Embrapii units - 2025

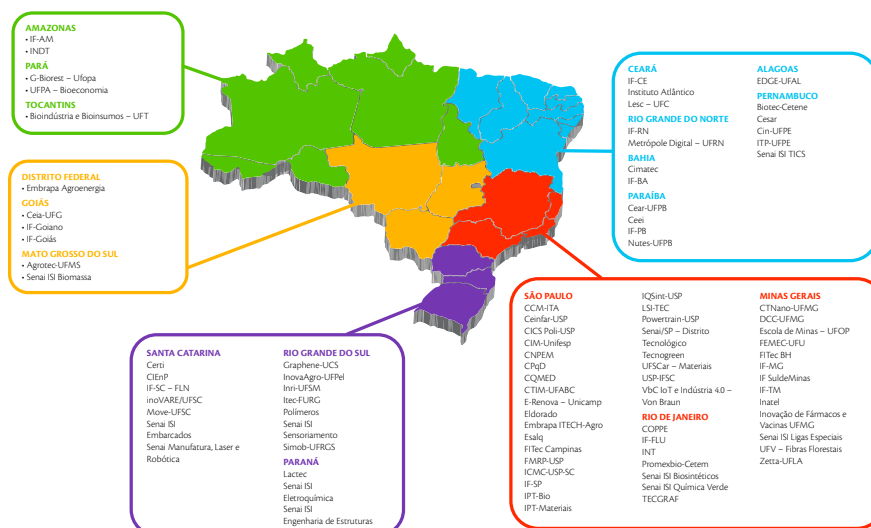


Figure 2.9 – Map of Embrapii Units in 2025, Brazil: ten years after its incorporation into the MCTI

Source: Embrapii (2025).

Its unique strength lies in leveraging private resources: for every Real of public funding, there is a significant private-sector contribution, alongside strong international cooperation that integrates Brazilian companies into global value chains.

### 2.2.4 Science, Technology, and Innovation Infrastructure

Advances in the infrastructure supporting science, technology, and innovation (ST&I) are integral to this ecosystem, spanning both small-scale multi-user laboratories (primarily available at universities and MCTI research facilities) and medium- and large-scale infrastructure. These multi-user laboratories are available not only to public institutions but also to private institutions, through institutional agreements. Brazil has invested in large-scale equipment, such as Sirius, a fourth-generation synchrotron light source and an integral part of the National Center for Research in Energy and Materials (CNPEM), and in expanding academic digital networks, such as the National Education and Research Network (RNP). In addition, the National Center for Natural Disaster Monitoring and Alerts (Cemaden) is constantly updating its equipment to meet the demands of this essential service. These assets generate cutting-edge data, attract international cooperation, and keep Brazilian science connected to the global forefront. Other examples of medium- and large-scale equipment under development include: the Brazilian Multipurpose Reactor (RMB, a research reactor with various applications, including the production of radioisotopes for use in medicine and industry); the Orion

Laboratory (a maximum-security BSL-4 laboratory); and BINGO (Baryon Acoustic Oscillations from Integrated Neutral Gas Observations, a radio telescope in the final stages of installation in the Northeast of the country).

Figure 2.10 illustrates Sirius, an integral part of CNPEM, a landmark of the national scientific infrastructure, and a symbol of Brazil's capacity to produce cutting-edge science.



Figure 2.10 – Sirius: the Brazilian synchrotron light source (external and internal views)

It is important to note that, from a systemic perspective, various research units also contribute to the ST&I infrastructure, including SENAI units and SENAI Institutes, as well as SESI, with innovation centers focused on quality of life and worker well-being.

However, structural challenges remain:

- Aging equipment and high maintenance costs;
- Regional asymmetries in access to major scientific facilities; and
- A shortage of specialized technical staff to operate and maintain this infrastructure.

Consolidating Brazil's scientific and technological sovereignty requires strengthening basic research and public and private infrastructure for science, technology, and innovation as a structural axis of the National ST&I System. Universities, institutes, research centers and units, multi-user laboratories, strategic state-owned enterprises, and public data and knowledge networks constitute the material, institutional, and human foundation that underpins long-term scientific output, talent development,

cutting-edge innovation, and the state's capacity to respond to strategic challenges, such as public health emergencies, climate change, the energy transition, and national security. This infrastructure is a necessary condition for technological autonomy, the reduction of external dependencies, and the reduction of regional inequalities, and it must be strengthened in a continuous, planned, and territorially distributed manner.

The ongoing promotion of basic science and the modernization of scientific infrastructure are indispensable to sustaining a robust innovation ecosystem in which fundamental discoveries translate into new products, services, and socio-environmental solutions.

## 2.3 Conclusion

The coming years will represent a period of integration and transformation for the SNCTI, marked by significant advances and new challenges. The system is expected to grow stronger through coordinated planning, integrated governance, and continuous innovation, with an emphasis on strengthening federative coordination, modernizing legal frameworks, diversifying funding sources, and investing in science education and talent development. The integration of science, territory, and society will be essential for translating knowledge into productive innovation, social inclusion, and environmental sustainability. These advances are expected to become irreversibly entrenched, guiding a national development model based on responsible ST&I, focused on sovereignty, sustainability, and improving social well-being. This chapter highlighted advances and challenges in ST&I funding, human resources, coordination with innovation, and ST&I infrastructure—all topics of great relevance to the ENCTI 2024–2034.



## 3 Trends in ST&I Strategies on the International Stage

*This chapter summarizes trends across nations in the development of their Science, Technology, and Innovation (ST&I) strategies. The international ST&I landscape in 2025 reveals converging strategic directions among developed and emerging countries, albeit with varying levels of investment and specific institutional arrangements. A comparative analysis of these policies reveals a common thread: ST&I is viewed as a central pillar of economic competitiveness, technological sovereignty, and national development. In all countries, the government plays a catalytic and coordinating role, seeking—with varying degrees of success—to adopt mission-oriented planning and strategic intelligence. Given the*

*success of its trajectory in recent decades, we highlight China's experience, with its bold strategy for economic development based on ST&I and education.*

### 3.1 Mission-oriented Planning and Strategic Intelligence

One of the most established trends is planning based on national missions, with a focus on long-term social, economic, and environmental challenges. This model, already in place in the European Union, Germany, Japan, and South Korea, is inspiring initiatives in Latin American countries such as Mexico, through the National Strategic Program (Pronaces) and the System of Public Research Centers in the Humanities, Sciences, Technologies, and Innovation (Secihti); Peru, with the National Policy on Science, Technology, and Innovation (Polcti) and the National System for Science, Technology, and Innovation (Sinacti); and Colombia, with National Council for Economic and Social Policy (Conpes) Resolution 4069. The use of foresight tools and technology scenarios has become increasingly established as a basis for setting priorities and aligning innovation goals with structural transitions, such as decarbonization and digitalization.

### 3.2 Sovereignty

The pursuit of autonomy in critical technologies—such as semiconductors, AI, biotechnology, quantum computing, and cybersecurity—has become a global strategic priority. Major powers, such as China, the United States, South Korea, and Germany, are consistently investing in technological self-sufficiency to reduce geopolitical risks and ensure production security. In Latin America, although R&D investments still account for a small percentage of GDP, the integration of the technological sovereignty agenda into national policies is on the rise. Notable initiatives include those focused on Amazonian sustainability in Peru; the socio-ecological transition and ethical artificial intelligence in Chile; electric mobility and space development in Mexico; and the deployment of 5G networks and blockchain applications in Uruguay—all expressions of a regional movement seeking autonomy and sovereign integration into the knowledge economy. In Brazil, national sovereignty is the main axis of the ENCTI 2024–2034, understood as the capacity to produce, protect, and apply scientific and technological knowledge in the public interest and for autonomous development. In recent years, the country has made progress in consolidating the institutions, legal frameworks, and scientific capabilities that underpin its strategic autonomy, but it still faces challenges related to external technological dependence, misinformation, and the lack of continuity in ST&I policies. The ENCTI reaffirms sovereignty in its multiple dimensions—knowledge, technology, health, energy, food, and cybersecurity—by aligning science, industry, and national defense around a vision for a sustainable and innovative nation. Strengthening the Health Economic-Industrial Complex (CEIS), mastering emerging technologies, and protecting strategic territories and environmental

assets are priorities for ensuring scientific autonomy, national security, and sovereign development. Thus, sovereignty ceases to be merely a political principle and becomes a concrete condition for strengthening science, innovation, and social justice in Brazil.

### 3.3 Green-Digital Convergence

Another key trend is the integration of ST&I, the ecological transition, and digital transformation, shaping a green-digital convergence agenda. The European Union articulates this vision through the European Green Deal and programs such as Horizon Europe, while Japan and South Korea link technological innovation to carbon neutrality goals and an aging population. In Latin America, this convergence is reflected in programs focused on sanitation projects, electric mobility, and ocean monitoring (e.g., in Mexico).

### 3.4 Network Governance and New Institutional Models

ST&I policies have been adopting hybrid governance models that combine government coordination with public-private networks, regional platforms, and innovation agencies with operational autonomy. Notable examples include SPRIND (Federal Agency for Disruptive Innovation) and DATI (German Agency for Transfer and Innovation) (Germany); the Moonshot program (Japan); and South Korea's innovation ecosystems. In Latin America, there is a trend toward increasing decentralization, with regional hubs in Argentina, innovation networks in Colombia, and a focus on the state as a coordinating entity—as in Brazil—thereby strengthening the National Innovation System through sector-specific funds and science diplomacy.

### 3.5 Science, Technology, and Innovation and the Reconfiguration of Global Power

The coming years will be marked by a period of consolidation and transformation of global ST&I strategies, against the backdrop of a transition toward a more diffuse and multipolar international order. The ENCTI 2024–2034 recognizes that scientific and technological capacity has become a central factor in sovereignty and competitiveness, repositioning countries such as China, India, and South Korea and redefining the geopolitics of knowledge. In this scenario, strengthening the National ST&I System will require not only internal planning and coordination but also a strategic vision regarding the reconfiguration of global power. Growing technological competition among major powers, the fragmentation of value chains, and the race for emerging technologies are redefining the spaces for

cooperation and autonomy. For Brazil, the challenge is to position itself as a relevant actor in this new ecosystem, expanding its capacity to produce critical knowledge, participate in international research networks, and engage in technological alliances that strengthen its scientific and productive sovereignty. Thus, the ENCTI 2024–2034 guides the country toward consolidating a development model based on responsible science, technology, and innovation (ST&I) that is committed to sustainability, strategic autonomy, and meaningful integration into the global innovation system.

### 3.6 Inclusion, Diversity, and the Democratization of Innovation

Several countries have sought to align their ST&I strategies with social justice, promoting territorial, ethnic, and gender inclusion. The European Union and Japan have incorporated these guidelines into their strategic plans, while in Latin America notable initiatives include citizen science and the promotion of indigenous knowledge in Mexico, the decentralization of innovation hubs in Chile, and Proinnovate in Peru, which encourages participation by companies and universities in peripheral regions.

### 3.7 Strengthening the State as a Catalyst and Coordinator

Despite the growing involvement of the private sector in some contexts, such as the United States and the United Kingdom, there remains a strong trend toward strengthening the state's role as a driver and coordinator of ST&I policies. In Germany, Japan, and South Korea, centralized coordination ensures policy continuity. In Latin America, Colombia and Mexico have been expanding their institutional capacity to coordinate long-term programs. This trend reflects the recognition that a cross-cutting feature of the international landscape is that innovation—beyond the market—depends on robust public structures, stable funding, and interministerial coordination.

### 3.8 Tensions between Strategic Autonomy and International Cooperation

The current dynamics of the geopolitics of science and innovation are marked by the tension between technological sovereignty and scientific interdependence. In this context, the European Union has adopted the concept of “open strategic autonomy,” while China, Russia, and the United States prioritize the internalization of value chains in critical sectors. At the same time, international cooperation on issues such as open science, ethical artificial intelligence, and the energy transition remains a space for multilateral coordination, particularly within regional economic blocs such as the Southern Common Market (Mercosur), the Community of Latin American and Caribbean States (CELAC), and the European Union itself. Table 3.1 summarizes the predominant trends in the ST&I strategies of the selected countries.

**Table 3.1 – Predominant Trends in Global Strategies**

| Country / Region | Major Trends                                                                                                                                                                                                                                                    |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Peru             | Mission-based planning; green-digital convergence; territorial inclusion; central governance; open science; fostering international cooperation networks.                                                                                                       |
| Mexico           | Mission-based planning; technological sovereignty; green-digital convergence; social inclusion; South-South cooperation; integration of emerging areas such as energy transition and cybersecurity.                                                             |
| Indonesia        | Mission-based planning; green-digital convergence; inclusion and valorization of local knowledge; network governance; societal impact metrics; South-South cooperation.                                                                                         |
| Colombia         | Mission-based planning; technological sovereignty; network governance; coordinating state; science diplomacy; promotion of application-driven research.                                                                                                         |
| Chile            | Technological sovereignty; green-digital convergence; inclusion and decentralization; coordinating state; open science; support for innovation in emerging sectors.                                                                                             |
| Uruguay          | Technological sovereignty; network governance; coordinating state; support for public and social innovation; open science.                                                                                                                                      |
| Argentina        | Network governance; territorial inclusion; moderate technological sovereignty; science diplomacy; open science; encouragement of academia-industry partnerships.                                                                                                |
| India            | Mission-based planning; technological sovereignty; green-digital convergence; inclusion and public digital infrastructure; multilevel governance; science diplomacy; South-South cooperation.                                                                   |
| France           | Mission-based planning; technological sovereignty; green-digital convergence; coordinating state; science diplomacy; promotion of technology transfer.                                                                                                          |
| European Union   | Mission-based planning; technological sovereignty; green-digital convergence; inclusion and social justice; multilevel governance; open science; periodic updates to strategic areas.                                                                           |
| China            | Mission-based planning; technological sovereignty; green-digital convergence; strong central government; defense and security; expansion of strategic international cooperation programs.                                                                       |
| United Kingdom   | Mission-based planning; technological sovereignty; green-digital convergence; a strong role for the private sector through public-private collaboration.                                                                                                        |
| Germany          | Mission-based planning; technological sovereignty; green-digital convergence; networked governance; a coordinating state; science diplomacy.                                                                                                                    |
| Japan            | Mission-based planning; technological sovereignty; green-digital convergence; centralized governance; moderate inclusion; defense and security; science diplomacy.                                                                                              |
| United States    | Mission-driven planning; technological sovereignty; green-digital convergence; decentralized model; defense and security; science diplomacy; robust investments in collaborative R&D.                                                                           |
| South Korea      | Mission-driven planning; technological sovereignty; green-digital convergence; networked governance; defense and security; constant updating of innovation priorities.                                                                                          |
| Israel           | Market-driven technology with an explicit national technology strategy (e.g., quantum engineering; artificial intelligence technologies applied to air domain autonomy). Coordinated planning among industry, academia, defense, infrastructure, and diplomacy. |

**Source:** Prepared by CGEE, 2025.

### 3.9 Lessons from China’s Science, Technology, and Innovation Strategy and Plans

Among the various countries analyzed, China is clearly an excellent example of how to develop and implement a long-term strategy with five-year plans that place ST&I (and education) at the center of the country’s transformation. China has had an economic development plan since 1949, and in 2006 it drew up one with a horizon extending to 2050. The five-year ST&I action plans are developed by the Chinese Academy of Sciences, an agency affiliated with the central government. The 15th Five-Year Plan (2025–2030) is currently being drafted (or has not yet been released), but its vision, strategy, and expected overall impact are already known (Figure 3.1).



Figure 3.1 – Vision, strategy, and impact of China’s 15th Five-Year ST&I Plan

Source: Internet.

Table 3.2 summarizes key elements of China’s ST&I plan and indicates how these approaches can address the challenges and guidelines of Brazil’s ST&I strategy. China’s experience in ST&I offers valuable insights for Brazil, without overlooking our specific federal and territorial characteristics and our democratic governance model.

Table 3.2 – An Analysis of China's ST&I Plan

| Scope                     | China (2006–2020 and 2021–2035 Plans)                                                                                                                                                | Notes for Brazil                                                                                                                                                       |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Planning                  | Medium- and long-term plans (15 years), linked to Five-Year Plans; clear quantitative targets (R&D/GDP, patents, scientific citations).                                              | Define clearer quantitative and qualitative targets (such as R&D/GDP, social impact) in a participatory manner and with shared responsibilities.                       |
| Innovation Model          | Strategy for technological self-sufficiency (zili ziqiang), reducing external dependence, focus on critical sectors (semiconductors, telecommunications, energy, healthcare, space). | Prioritize technological autonomy in strategic sectors (healthcare, biodiversity, renewable energy), learning from China's bottlenecks (chips and software).           |
| Investment in R&D         | 2.4% of GDP in 2020 (the target was 2.5%); with greater investment in experimental development ( $\approx 80\%$ ) and less emphasis on basic research ( $\approx 6\%$ ).             | Strive for a balance between basic and applied research; leverage private-sector R&D investments through government investments in ST&I.                               |
| Strategic Programs        | Megaprograms in science and technology (aircraft, satellites, genomics, quantum technology, AI, clean energy).                                                                       | Adopt a project-oriented approach, inspired by mega-programs but adapted to national priorities (sustainable agriculture, renewable energy, the Amazon, health).       |
| Governance                | Strong state centralization, but challenges in coordination among ministries; risk of distortions.                                                                                   | Maintain institutional pluralism as a distinctive feature; with participatory and shared planning.                                                                     |
| Human Resources           | "Thousand Talents Program" to attract scientists from abroad.                                                                                                                        | Promote programs to attract and repatriate researchers, expand local training, and diversify avenues for international cooperation.                                    |
| International Cooperation | Selective strategy: cooperation in areas of national interest (space exploration, quantum technology, health), but with a focus on reducing external dependence.                     | Combine open and strategic cooperation: seek critical technological alliances (such as in semiconductors and AI), while maintaining inclusive multilateral engagement. |

Source: Prepared by CGEE.

## 3.10 Conclusion

The international landscape of ST&I in 2025 reveals, despite differences in context and investment, a convergence around common strategic directions: mission-oriented planning, the pursuit of technological sovereignty, the integration of green and digital agendas, and the strengthening of the state as a catalyst for innovation. High-tech economies are consolidating this trend through

substantial investments in R&D and robust ecosystems focused on critical technologies, while Latin America, despite constraints, is advancing mission-oriented innovation policies that emphasize sustainability, diversity, and social inclusion.

In this scenario, South-South cooperation takes center stage as a pathway to strengthen endogenous capacities, reduce structural dependencies, and advance their own innovation agendas, bringing together Latin America, Africa, and Asia around issues such as inclusive AI, a just energy transition, and science diplomacy. Thus, the future of ST&I will depend not only on the rivalry among major powers but also on the ability of emerging regions to develop innovative alternatives based on biodiversity, sustainability, and social justice, thereby contributing to new knowledge geopolitics.



## Part II:

# The Structural Axes of the ENCTI 2024–2034





**Part II consists of 4 chapters  
that form the “heart” of this  
ENCTI and are composed of:**

**Structural Axis I – Expansion,  
Consolidation, and Integration of the  
National System for Science, Technology,  
and Innovation (Chapter 4)**

**Structural Axis II – Business Innovation  
and Reindustrialization on New  
Technological Bases (Chapter 5)**

**Structural Axis III – Strategic Projects  
for National Sovereignty (Chapter 6)**

**Structural Axis IV – Science,  
Technology, and Innovation for  
Social Development (Chapter 7)**





## 4 Structural Axis I: Expansion, Consolidation, and Integration of the National System for Science, Technology, and Innovation

*In this chapter, we address the expansion, consolidation, and integration of the National Science, Technology, and Innovation System (SNCTI), building on the recovery that began in 2023 and continuing it requires the expansion, consolidation, and—finally—integration of the SNCTI. Following a general introduction to the topics covered in the chapter, we propose strategies that include objectives, guidelines, what Brazil needs in place, and a 10-year timeframe.*

### 4.1 Introduction

Structural Axis I addresses the expansion, consolidation, and integration of the SNCTI, ensuring that science, technology, and innovation benefit society through tools that promote well-being, sovereignty, and sustainable development.

Initially formulated around the recovery, expansion, and consolidation of the System, as widely discussed in the preparatory meetings and during the 5th CNCTI, Structural Axis I evolved to incorporate stakeholder integration as a central dimension, recognizing that the recovery process began in 2023. This integration constitutes the foundation for a more inclusive, ethical, competitive, and sustainable national ST&I environment, in which knowledge is transformed into national sovereignty, public value, and social development.

The National Strategy for Science, Technology, and Innovation 2024–2034 (ENCTI 2024–2034) is realistic, but also ambitious. Given its continental size, large population, the scale, diversity, and quality of its scientific and technological community, and its growing contribution to global scientific output, Brazil cannot afford to downplay its role. Therefore, it is proposed that the country set as its medium- and long-term goal to assume global leadership in areas selected based on its strategic assets, such as its vast natural endowment, including biodiversity; its historical experience in public policies, such as the fight against hunger and extreme poverty; and its scientific and technological potential, such as sustainable energy.

The expansion and consolidation of the SNCTI require recognizing basic research as the foundation of national scientific capacity, with stable funding, disciplinary diversity, and coordination with human resource development, scientific infrastructure, and the country's strategic challenges.

The ENCTI 2024–2034 recognizes that Brazilian scientific excellence stems from well-established trajectories across multiple areas of knowledge and that the identification of priority areas does not imply a hierarchy among fields nor is it guided exclusively by immediate technological applications. Strengthening the SNCTI requires an integrated approach to science education that links different levels of education, values teaching careers, promotes pedagogical modernization, advances digital literacy, and ensures the ethical and responsible use of technologies, while recognizing the diversity of actors who make up the human foundation of the scientific system. This vision is underpinned by the stability and predictability of public funding and by coordination among funding instruments and initiatives, the details of which will be outlined in the Action Plan for Science, Technology, and Innovation (PACTI), reaffirming that investment in ST&I is strategic for the country's scientific sovereignty and sustainable development.

In this same context and considering the central role of research in supporting national strategic agendas, ENCTI recognizes that, in addition to the technological risk associated with innovation and productive development, scientific activity involves an epistemological risk inherent in exploring the frontiers of knowledge. Supporting high-risk, high-potential basic research constitutes a long-term strategic investment essential to the country's scientific and technological sovereignty, since areas now considered disruptive were, in previous decades, fields of basic research driven by scientific curiosity. Thus, the Strategy highlights the importance of mechanisms that sustain frontier research as the foundation for future technological and social transformations.

The ENCTI 2024–2034 encourages open science practices in the production and dissemination of scientific knowledge, understood as responsible openness, which balances transparency, reproducibility, collaboration, and social impact with the protection of sensitive and strategic data. From this perspective, open science simultaneously contributes to advancing knowledge, national development, and the preservation of the country's scientific, technological, and informational sovereignty, in a context marked by growing geopolitical disputes and technological asymmetries.

The debates, conclusions, and follow-up actions from the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP30), held in Brazil in 2025, confer additional strategic responsibility on ENCTI 2024–2034 in the context of global agendas on climate, sustainability, and sovereignty, by reinforcing the role of science, technology, and innovation as critical infrastructure for the implementation, monitoring, and international credibility of the climate commitments undertaken by the country under the Paris Agreement, the Nationally Determined Contributions (NDCs), and the National Adaptation Plans. The ENCTI is thus geared toward integrating basic research, innovation, data production and use, human resources development, and evidence-based public policies, with a focus on climate adaptation, emissions mitigation, the science-based bioeconomy,

a just energy transition, and the strengthening of territorial resilience, recognizing the central role of the Amazon, Brazil's biomes, and the most vulnerable territories. The Strategy thus reinforces Brazil's leading international role and its capacity to translate multilateral commitments into sustainable development, climate justice, and scientific and technological sovereignty.

In accordance with the methodology presented in the introduction to this Strategy, Structural Axis I is organized into priority areas, as shown in Table 4.1, which reflect national challenges and guide the consolidation and integration of the SNCTI. This chapter focuses on “scientific competencies,” which form the basis for technological development and innovation. These areas are then detailed in a coordinated manner, covering objectives, guidelines, time frames, and national needs. It is important to note that some of the major themes listed in Table 4.1 may appear under more than one criterion due to subtopics that have different classification levels, as is the case in the health sector. In the area of human resources, for example, several subfields of knowledge exhibit a high level of global integration—such as dentistry, physics, and chemistry, in which Brazil holds international leadership—while others require strategic intervention.

**Table 4.1 – Priority Areas According to the Guiding Criteria of the ENCTI 2024–2034**

| Priority Area                                | Classification According to the ENCTI Guiding Criteria | Strategic Rationale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Strategic Rationale                          | Global Leadership                                      | A strategic axis for a just energy transition and for strengthening Brazil's leadership in the production and dissemination of clean technologies.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Bioeconomy                                   | Global Leadership                                      | Sustainable use of the biodiversity of national biomes and marine resources as the scientific and economic foundation for sustainable development.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Agriculture Sustainability and Food Security | Global Leadership                                      | Food security has cemented Brazil's role as an international leader in the fight against hunger and the promotion of sustainable agri-food systems. Strengthening this area means integrating science, technology, and innovation into the production and consumption of healthy foods, thereby reinforcing the country's leadership in the global agendas for hunger eradication and sustainable development                                                                                                                                                                            |
| Health                                       | Global Leadership                                      | Health is a fundamental axis of social well-being, scientific sovereignty, and the nation's capacity to respond to public health emergencies. Brazil is a recognized global leader in various subfields, such as dentistry, parasitology, immunology, veterinary medicine, public health, and tropical medicine, which combine scientific excellence, social relevance, and strong potential for innovation. Strengthening these areas of expertise enhances the country's international leadership and consolidates the integration of science, technology, and public health policies. |

| Priority Area                                               | Classification According to the ENCTI Guiding Criteria | Strategic Rationale                                                                         |
|-------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Disruptive Areas (AI, Quantum Computing, and New Materials) | Strategic Intervention                                 | Overcoming technological dependencies and strengthening digital and industrial sovereignty. |

**Source:** Prepared by CGEE.

## 4.2 Detailed Priority Areas

### PRIORITY AREA: Renewable Energy

**Justification:** The acceleration of the energy transition and the need to reduce greenhouse gas (GHG) emissions position Brazil strategically on the global stage. With a predominantly renewable energy mix and one of the world's greatest potentials for solar, wind, biomass, and green hydrogen, the country is exceptionally well-positioned to lead the development and dissemination of sustainable technological solutions. However, challenges remain in expanding infrastructure, integrating variable energy sources, modernizing power grids, and creating a stable regulatory environment that fosters innovation. Overcoming these barriers requires integrated public policies, multisectoral governance, and robust investments in research, development, and skills training. Investing in renewable energy is therefore essential to consolidate Brazil's leadership in the energy transition, ensure energy and water security, create green jobs, and strengthen industrial competitiveness, thereby actively contributing to global decarbonization goals and sustainable development.

**Objective:** To strengthen the integration of science, technology, the environment, and energy, promoting a just and low-carbon transition and ensuring water and energy security.

#### Guidelines:

- Integration of energy, innovation, environmental, and industrial development policies under a national energy transition strategy;
- Support for the development and adoption of decarbonization and carbon capture technologies;

- Promotion of energy efficiency and the smart use of resources in production chains;
- Strengthening of inter-institutional and regulatory governance for long-term energy planning;
- Encouraging the expansion and modernization of electrical infrastructure, including smart grids and energy storage systems; and
- Fostering cooperation among the ICT sector, businesses, and governments to develop innovative clean energy solutions.

### **What Brazil needs:**

- Integrated energy planning, with long-term goals and sustainability indicators;
- Modern infrastructure for distributed generation, smart grids, and energy storage;
- A stable regulatory framework and tax incentives aimed at innovation and investment in clean energy;
- Technology parks and centers of excellence focused on research and development in renewable energy;
- Training and professional retraining programs focused on the green economy and the energy transition; and
- A national decarbonization strategy with mechanisms for monitoring, evaluation, and transparency.

### **Timeframe:**

**By 2030:** Consolidate regional leadership in renewable energy by expanding installed capacity and diversifying clean energy sources.

**By 2034:** Achieve a predominantly clean, competitive, and resilient energy mix, with low-carbon infrastructure and a well-defined path toward carbon neutrality by 2050.

### **PRIORITY AREA: Bioeconomy**

**Justification:** Brazil is home to one of the planet's greatest levels of biodiversity and holds a strategic position in the sustainable use of natural and marine resources. This natural wealth is a scientific, economic, and geopolitical asset that must be channeled into innovation, regional development, and environmental conservation. The promotion of essential ecosystem services—

such as climate regulation, water and food provision, carbon sequestration, and ecosystem protection—is a necessary condition for the sustainability of the bioeconomy and for the country's water, climate, energy, food, health, and territorial security. This field is classified as a global leadership field, as it combines scientific excellence with the potential for international leadership in the bioeconomy, ecological restoration, and ocean research, reinforcing the integration of knowledge, sustainability, and development.

**Objective:** To develop Brazil's bioeconomy based on the sustainable use of terrestrial and marine biodiversity, the creation of added value in sustainable production processes, and the development of innovative solutions to the country's climate, environmental, social, and production challenges.

**Guidelines:**

- Integration of the bioeconomy, conservation, ecological restoration, and promotion of ecosystem services agendas under a long-term national strategy;
- Valuing Brazilian biomes and coastal-marine ecosystems as natural heritage and drivers of sustainable regional development and social inclusion;
- Strengthening governance and environmental, coastal-oceanic, and polar monitoring systems, based on science, technology, data integration, and the assessment of ecosystem services;
- Promoting research and innovation in biotechnology, bio-inputs, genetics, and nature-based solutions;
- Expanding scientific observation networks for biodiversity, the ocean, and polar ecosystems, coordinated with the SNCTI;
- Integrating policies on ecological restoration, conservation areas, and the rational use of natural resources;
- International cooperation in ocean science, conservation, and sustainable bioeconomy, with an emphasis on biomes adjacent to neighboring countries; and
- Decentralization of resources and encouragement of research and innovation focused on social, regional, and territorial needs, especially in the areas of biodiversity and the bioeconomy.

**What Brazil needs:**

- An integrated national policy on bioeconomy, ecosystem services, and ocean science;

- A national network of laboratories and research centers focused on biodiversity, biotechnology, and marine resources;
- An advanced system for environmental and coastal monitoring and modeling;
- Legal and economic frameworks that recognize and value ecosystem services by biome;
- Expansion of the workforce with technical and scientific training in biotechnology, oceanography, and ecosystem management; and
- Coordinated governance among ministries, the ICT sector, the business sector, and local communities for the sustainable management of biomes.

### **Timeframe:**

**By 2030:** Consolidate integrated national programs on bioeconomy, ecosystem services, and ocean research; expand networks for monitoring and conserving biomes; and strengthen environmental governance.

**By 2034:** Achieve regional and international leadership in sustainable bioeconomy, with strengthened ecosystem services and the ongoing restoration and monitoring of terrestrial, marine, and coastal biomes.

### **PRIORITY AREA: Health**

**Justification:** Brazil has a distinguished scientific and technological tradition in health, supported by institutions such as Fiocruz, Butantan, public universities, and national research networks focused on infectious diseases, vaccines, and biotechnology. This foundation of excellence has ensured a leading role in responses to health crises, the development of immunobiologicals, and advances in dentistry and tropical medicine. However, challenges remain in integrating research with the healthcare system, in promoting national scientific output, and in transforming knowledge into innovation and technological sovereignty. This field is classified as a global leadership field, as the country possesses qualified human capital, a well-established scientific infrastructure, and the capacity for international cooperation, which position it as a strategic player in global health and biomedical innovation.

**Objective:** To consolidate Brazil's scientific and technological leadership in health by strengthening the integration of research, innovation, and public policy, with a focus on biotechnology, One Health, surveillance, prevention, advanced therapies, and medical instrumentation, thereby ensuring health sovereignty and promoting global health.

## **Guidelines:**

- Integration of basic science, biotechnology, and public health to expand national self-sufficiency in medical supplies, vaccines, pharmaceuticals, equipment, and diagnostics;
- Strengthening of scientific and productive infrastructure in health, with support for technology hubs and public-private partnerships;
- Promotion of innovation in precision medicine, advanced therapies, and digital health technologies (AI, big data, telemedicine);
- Expanding international cooperation in biomedical research, disease surveillance, and the development of vaccines and bioproducts;
- Strengthening coordination between the Ministry of Health, the Ministry of Science, Technology, and Innovation (MCTI), universities, and the ICT sector to define strategic research and innovation agendas;
- Strengthening the training and retention of researchers and health professionals in strategic areas and regions with lower scientific density;
- Promotion of oral health, tropical medicine, public health, and integrative practices incorporated into the SUS, as well as research on the social and environmental determinants of health; and
- Development of innovation policies focused on the public production of health supplies, vaccines, medicines, new methodological approaches (NAMs), equipment, and technologies, thereby strengthening national health sovereignty.

## **What Brazil needs:**

- A single, integrated health innovation system connecting research, regulation, production, and the market;
- A strengthened Health Economic-Industrial Complex (CEIS) with national leadership in immunobiologicals, pharmaceuticals, and medical technologies—including equipment, diagnostic devices, digital systems, and telemedicine solutions;
- A national biotechnology and biomanufacturing network with modern, regionally distributed laboratory infrastructure;
- Stable policies to promote translational research and the production of medicines, vaccines, and medical devices;

- Programs to train and attract talent in biotechnology, bioinformatics, epidemiology, and biomedical engineering;
- A modern and convergent regulatory framework for advanced therapies, genomic data, and digital health technologies; and
- Structured international cooperation in disease surveillance, tropical medicine, biotechnology, and global health.

### **Timeframe:**

**By 2030:** Consolidate the integration of research, innovation, and the healthcare system; expand self-sufficiency in vaccines and biopharmaceuticals; strengthen Brazil's presence in global biotechnology and global health networks.

**By 2034:** Achieve international leadership in biomedical innovation, advanced therapies, and precision medicine; consolidate health sovereignty with the capacity for rapid response to global emergencies; and ensure regional leadership in health science and technology.

### **PRIORITY AREA: Disruptive Fields (AI, quantum computing, and new materials)**

**Justification:** In fields such as AI, quantum computing, nanotechnology, and new materials, Brazil has pockets of excellence but still faces technological dependence and low production density. This area is classified as a strategic intervention area, as these technologies are critical to digital and industrial sovereignty and require immediate investment, modern regulation, and incentives for cutting-edge innovation. Rapid global technological evolution makes coordinated action essential to prevent the country from falling further behind.

**Objective:** To strengthen national capabilities in disruptive technologies—AI, quantum computing, and new materials—to reduce critical dependencies, ensure digital and technological sovereignty, and enhance the country's sustainable competitiveness in an ethical, secure, and inclusive manner.

### **Guidelines:**

- Integration of basic research, technological development, and industrial scaling, with a focus on strategic value chains and national missions;
- Promotion of initiatives related to data governance, standards, security, and reliability (responsible AI, cybersecurity, risk assessment, and security by design);

- Accelerating initiatives in the areas of open and shared R&D infrastructure (data, high-performance computing, testbeds, pilot lines, and prototyping labs);
- Accelerating the training and recruitment of talent in AI, data science, semiconductors, advanced materials, and quantum science/engineering, with cross-sectoral career paths;
- Creating experimental regulatory environments and intellectual property guidelines that stimulate innovation and the secure transfer of technology;
- Advancing strategic international cooperation on advanced platforms and networks, while safeguarding national interests and promoting technological interoperability; and
- Promoting the integration of disruptive technologies into agendas related to sustainability, health, industrial production, agriculture, defense, and digital public services.

### **What Brazil needs:**

- A national data and computing platform (HPC/GPUs/quantum computing under development), with access for academia and industry, and governance and ethics policies for AI;
- An emerging quantum ecosystem (laboratories, quantum communication networks, metrology, and instrumentation), with defined technology roadmaps;
- Capacity in semiconductors and new materials (pilot lines, encapsulation, characterization, centers for 2D/composite/bio-inspired materials);
- Talent training and retention programs, with scholarships, valued technical and scientific careers, and integration into the business sector;
- Frameworks and guidelines for responsible AI, cybersecurity, data protection, interoperability, and technical standards; and
- Funding mechanisms aligned with national missions and ICT-industry partnerships to accelerate Technology Readiness Levels (TRL) and scaling.

### **Timeframe:**

**By 2030:** Establish open infrastructure (data, HPC, and testbeds); train and retain critical talent; define national technology roadmaps in AI, quantum computing, and new materials; launch pilot projects and quantum test networks; and integrate disruptive technologies into missions in health, climate, agriculture, and industry.

**By 2034:** Consolidate R&D capabilities and industrial scaling in selected areas; operate quantum networks and responsible AI platforms at scale; and achieve self-sufficiency in high-impact key inputs and technologies.

## Strategic Axes of the SNCTI

The strategic axes of the SNCTI articulate three central dimensions for strengthening the country's scientific and technological capacity: education, as the foundation for training, retaining, and fostering the movement of talent in strategic areas; the Amazon, as a critical territory for knowledge, biodiversity, and sovereignty; and international cooperation, as a mechanism for meaningful integration into global networks and for expanding national capabilities. Together, these axes form an agenda focused on innovation and sustainable socio-environmental development, consolidating the foundations of a strong, integrated SNCTI capable of responding to the challenges of the 21st century.

### 1. Education

Education is one of the structural axes of the ENCTI, serving as a driving force for the training, qualification, and retention of human resources essential to the country's scientific, technological, innovative, and industrial development. The ENCTI 2024–2034 integrates basic education, technical training, higher education, and graduate studies into a continuous ecosystem that transforms knowledge into national capacity, technology, and sustainable regional development. In line with the PNE 2024–2034 and the PNPG 2025–2029, the educational strategy is guided by expanding scientific literacy, strengthening digital skills, and reducing regional inequalities, especially in the Amazon, the Semi-Arid region, and urban peripheries. In this ecosystem, extension work is an essential component of education, fostering a direct link among knowledge production, local needs, and social and productive innovation. Extension, understood as a practice that integrates academic and traditional knowledge, social technologies, and territory-oriented solutions, strengthens the dissemination of science into rural areas, drives regional innovation ecosystems, and contributes to the training of professionals committed to sustainable and inclusive development. The National Graduate Studies System (SNPG), which has been in place since the university expansions of the 1960s and 1970s and has been strengthened by the PNPG, forms the foundation on which Brazilian scientific output, innovation, and the capacity to respond to strategic challenges are built. However, despite producing approximately 90,000 master's and doctoral degree holders annually, the country still faces structural challenges: brain drain, insufficient integration of research into the business sector, a shortage of scholarships, regional

disparities, and the absence of robust policies to retain talent in strategic areas. The current context, marked by rapid transformations in the labor market and new global competitive dynamics, makes it urgent for Brazil to develop and retain expertise in cutting-edge fields such as AI, biotechnology, renewable energy, nanotechnology, quantum computing, digital transition, and the bioeconomy. The integration of education, research, extension, innovation, and productive development is strategic for creating higher-skilled jobs, promoting social inclusion, strengthening regional strengths, and enhancing the country's competitiveness in global value chains. Education, integrated with research, extension, and innovation, is establishing itself as a structural axis of the SNCTI and a fundamental axis for the country's scientific and technological sovereignty and sustainable development.

## 2. Amazon

The Amazon plays a pivotal role in Brazilian ST&I policy, both because of its ecological uniqueness and its strategic importance to the global climate, water security, and the 21st-century bioeconomy. Covering more than 6.7 million km<sup>2</sup> and home to approximately 10% of known biodiversity, the biome constitutes the largest tropical forest on the planet and a living laboratory where environmental, socioeconomic, and geopolitical challenges converge. Its global importance—in climate regulation, carbon sequestration, the maintenance of hydrological cycles, and atmospheric stability—makes the region a strategic asset not only for Brazil but for all of humanity.

The challenges facing the Amazon—such as deforestation, climate change, social vulnerabilities, and geopolitical pressures—require an integrated, sustainable, and locally focused scientific approach that brings together biodiversity, bioeconomy, social technologies, innovation, and governance. The preservation of the forest, the promotion of forest-based economies, and the reduction of local inequalities depend on the consolidation of a robust, decentralized, and data-driven scientific infrastructure that integrates traditional knowledge, scientific knowledge, and social participation. Under Axis I, the Amazon is treated as a strategic area for strengthening the SNCTI, requiring the expansion of regional research networks, the training and retention of local talent, the strengthening of science and technology institutes in the Legal Amazon, and the implementation of advanced and interoperable systems for environmental, climate, and territorial monitoring. At the same time, the region is establishing itself as a privileged platform for developing cutting-edge technologies in biotechnology, bioinformatics, renewable energy, environmental sensors, Earth observation systems, and digital solutions for territorial management. The Amazonian bioeconomy—based on biodiversity, ecosystem services, socio-biodiversity production chains, and locally based social technologies—is emerging as a priority driver of

innovation and productive inclusion, capable of expanding scientific sovereignty, generating added value, and strengthening regional ecosystems for sustainable development. The recommendations of the 5th CNCTI reinforce the region's role as a strategic axis of Brazilian scientific diplomacy, highlighting the importance of expanding international cooperation on climate, biodiversity, clean energy, and sustainable technologies, and of strengthening territorial and inter-institutional governance mechanisms that ensure environmental protection and national sovereignty over the biome. The ENCTI 2024–2034 recognizes the Amazon as an international hub for ST&I focused on sustainability, climate, and biodiversity, where traditional and scientific knowledge converge with local solutions to promote sustainable socio-environmental development.

### 3. International Cooperation

On the international stage, Brazil has expanded its presence in global ST&I projects, but it needs to strengthen its participation in global innovation networks and bolster South-South cooperation to advance its agenda, grounded in the right to development and in reciprocity and mutual respect.

Brazil's international cooperation in ST&I must be expanded and diversified, involving countries from multiple regions with diverse development models, reflecting the new geography of global knowledge discussed in Chapter 3. This is a strategic dimension for strengthening national sovereignty and for Brazil's active engagement in major global challenges.

The country seeks to expand and consolidate its scientific diplomacy activities based on collaboration, solidarity, and mutual interest, promoting partnerships with countries in the Global South and with advanced economies in cutting-edge fields of knowledge, such as energy transition, health, climate, biodiversity, sustainable agriculture, and digital transformation. This cooperation should be horizontal and structural, prioritizing joint research projects, researcher mobility, the sharing of scientific infrastructure, and business innovation partnerships, while also strengthening Brazil's leading role in regional networks and international organizations.

The ENCTI reaffirms Brazil's commitment to serving as a bridge for scientific integration between Latin America, Africa, and other developing regions, contributing to a more just, sustainable, and knowledge-based international order.



## 5 Structural Axis II: Business Innovation and Reindustrialization on New Technological Foundations

*Structural Axis II proposes the reindustrialization of Brazil on new productive, technological, and sustainable foundations, fully aligned with the missions of NIB and the priorities of the ENCTI 2024–2034, while recognizing that support for business innovation remains a cross-cutting component of this Strategy.*

### 5.1 Introduction: The Role of Science, Technology, and Innovation in the New Industry Brazil (Nova Indústria Brasil, NIB) Policy

This axis focuses on strengthening national capabilities in innovation, technology, and high-value-added production, thereby promoting the country's technological autonomy, productive security, and sustainable competitiveness. The central challenge of this axis concerns a major advancement in Brazilian industrial policy: the launch of NIB in 2023 (Brazil, 2024e). The structural axes of the ENCTI 2024–2034 are interconnected with the six missions of NIB (sustainable and digital agro-industrial chains; the Health Economic-Industrial Complex; sustainable infrastructure, sanitation, housing, and mobility; the digital transformation of industry; the bioeconomy, decarbonization, and energy transition and security; and technologies of interest to national sovereignty and defense) and are intended to enable the generation and transfer of knowledge to ensure the industrial transformation envisaged in the NIB. The NIB's missions reinforce ST&I's role as a driver of green and digital reindustrialization, linking scientific research, business innovation, and public policy to address major national and global challenges. Table 5.1 illustrates this linkage, highlighting the key challenges at the interface between ST&I and industrial policy that guide this axis of the Strategy.

In light of these principles, the effectiveness of the ENCTI 2024–2034 depends on the ability to consistently increase business investment in Research, Development, and Innovation, to improve the regulatory and governance environment in order to reduce barriers to cooperation between scientific and technological institutions and the business sector, and to train and qualify human resources to meet the strategic demands of productive transformation and the NIB. The Strategy recognizes that strengthening business innovation, fostering productive sovereignty in critical areas, and consolidating an environment conducive to calculated technological risk depend on the coordination of funding policies, public procurement instruments, technological and procurement, legal certainty, and inter-institutional coordination.

**Table 5.1 – Missions of New Industry Brazil (NIB) (Nova Indústria Brasil), its relationship with ST&I, and Key Challenges**

| Strategic Mission                                                                                                                 | Priority Production Chains                                                                                                                                                               | Relationship with ST&I                                                                                               | Key Challenges                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1. Sustainable and digital agro-industrial supply chains for food, nutritional, and energy security</b>                        | Precision agriculture (drones and sensors); agricultural machinery and its parts and components; fertilizers and biofertilizers; textiles.                                               | Agricultural research, plant and animal biotechnology, digitalization of the countryside, and precision agriculture. | Addressing climate vulnerabilities; expanding the regional bioeconomy; strengthening technical assistance; promoting inclusive innovation in rural areas.    |
| <b>2. A resilient Health Economic-Industrial Complex to reduce the vulnerabilities of the SUS and expand access to healthcare</b> | Medicines and biological active ingredients; vaccines, blood products, and advanced therapies; medical devices (medical equipment).                                                      | Support for ST&I in biotechnology, pharmacology, bioinformatics, and hospital innovation.                            | Reduce dependence on foreign sources; expand R&D infrastructure; integrate ICT and the business sector; ensure the sustainability of critical supply chains. |
| <b>3. Sustainable infrastructure, sanitation, housing, and mobility for productive integration and well-being in cities</b>       | Propulsion systems; electric batteries; metro and rail vehicles and their parts, pieces, and components.                                                                                 | ST&I applied to 5G, IoT, smart cities, and sustainable transportation technologies.                                  | Overcome logistical and regional connectivity gaps; stimulate innovation in urban mobility and sanitation.                                                   |
| <b>4. Digital Transformation of Industry to increase productivity</b>                                                             | Semiconductors; industrial robots; advanced digital products and services (digital platforms and cloud computing; audiovisual).                                                          | Integration with PBLA, E-Digital, and the development of advanced manufacturing.                                     | Reduce the technological gap among companies; expand connectivity and digital training; ensure data interoperability and industrial cybersecurity.           |
| <b>5. Bioeconomy, decarbonization, and energy transition and security to ensure resources for future generations</b>              | New energy sources (hydrogen, green diesel, and SAF); green energy equipment (solar panels and wind turbines); decarbonization of basic industries (green cement, steel, and chemicals). | R&D in clean energy, batteries, electric mobility, and low-carbon technologies.                                      | Scale up production of green technologies; reduce energy transition costs; expand R&D in energy storage; develop sustainable local supply chains.            |
| <b>6. Technologies of interest to national sovereignty and defense</b>                                                            | Launch vehicles; radars; satellites.                                                                                                                                                     | Innovation in critical technologies, semiconductors, satellites, monitoring systems, and cybersecurity.              | Reduce dependence on foreign technology; strengthen integration between defense and academia; protect critical infrastructure and strategic data.            |

**Source:** Prepared by CGEE.

In accordance with the methodology adopted in the formulation of the ENCTI 2024–2034, the priority areas for this axis are presented below, reflecting the NIB’s missions from the perspective of ST&I and articulating objectives, guidelines, time frames, and national needs, in order to guide Brazil’s productive, business, and technological transformation.

Table 5.2 – Priority Areas According to the Guiding Criteria of the ENCTI 2024–2034

| Priority Area                                                                                                            | Strategic Rationale                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Sustainable and digital agro-industrial supply chains for food, nutritional, and energy security                      | To establish Brazil as a leader in the bioeconomy and clean technologies, with a circular economy and reduced industrial emissions.                                                                  |
| 2. Resilient Health Economic-Industrial Complex to reduce the vulnerabilities of the SUS and expand access to healthcare | Restore productive and technological capacity in APIs, equipment, and digital solutions for the SUS, thereby strengthening health sovereignty and biomedical innovation.                             |
| 3. Sustainable infrastructure, sanitation, housing, and mobility for productive integration and well-being in cities     | Modernize infrastructure and cities with clean technologies, new materials, and digitalization, fostering green reindustrialization and territorial inclusion.                                       |
| 4. Digital transformation of industry to increase productivity                                                           | Accelerate digital transformation (AI, IoT, robotics, data, HPC) to boost productivity, integrate supply chains, and ensure information sovereignty.                                                 |
| 5. Bioeconomy, decarbonization, and energy transition and energy security to ensure resources for future generations     | Boost productivity and sustainability through biotechnology, precision agriculture, and digital traceability, reducing dependence on inputs and equipment and integrating producers into innovation. |
| 6. Technologies of interest to national sovereignty and defense                                                          | Build capacity in critical minerals, semiconductors, AI, cybersecurity, and the nuclear and space sectors, reducing vulnerabilities and integrating science, industry, and defense.                  |

Source: Prepared by CGEE.

## 5.2 Detailed Priority Areas

### PRIORITY AREA: Sustainable and Digital Agro-Industrial Chains (Linked to NIB Mission #1)

**Justification:** Brazil has one of the most competitive agro-industrial supply chains in the world, but it still relies on foreign inputs and technologies for mechanization, biotechnology, traceability, and process digitalization. This sector, recognized for its scientific and technological excellence, aims to integrate biotechnology, precision agriculture, and smart automation to promote more sustainable, traceable, and inclusive production chains. The digital transformation of the agro-industrial sector and the expansion of bioinnovation in agriculture strengthen food security, international competitiveness, and Brazil's leading role in technology.

**Objective:** To strengthen sustainable and digital agro-industrial chains, expanding the technological autonomy and competitiveness of Brazilian agribusiness on an inclusive and low-carbon basis.

### **Guidelines:**

- Integration of biotechnology, data science, and automation into agro-industrial production;
- Promotion of traceability, certification, and digital standardization of production chains;
- Expansion of applied research in agroecological systems, bio-inputs, and agro-environmental genomics;
- Promotion of technological inclusion for cooperatives and family farmers; and
- Promotion of regenerative and carbon-neutral practices.

### **What Brazil needs:**

- Regional hubs for bioinnovation and digital agriculture;
- Interoperable agro-environmental data infrastructure;
- A national policy on certification and digital traceability; and
- Low-carbon, high-efficiency agro-industrial production.

### **Timeframe:**

**By 2030:** Implement digital traceability in key export supply chains; establish an agricultural biotechnology R&D network.

**By 2034:** Consolidate Brazil's position as a regional leader in digital and sustainable agribusiness.

## **PRIORITY AREA: Health Economic-Industrial Complex (Linked to NIB Mission #2)**

**Justification:** The pandemic has revealed Brazil's vulnerability in the production of medical supplies, medications, equipment, and hospital infrastructure. Classified as requiring strategic intervention, this area proposes to rebuild the productive and technological foundations of the Health Economic-Industrial Complex (CEIS), thereby strengthening health sovereignty and emergency response capacity. The strategy integrates biotechnology, biomedical engineering, and digital transformation in healthcare to achieve production autonomy, foster biomedical innovation, and strengthen the SUS.

**Objective:** To restructure the national foundation of the healthcare industrial complex, with an emphasis on Active Pharmaceutical Ingredients (APIs), medical equipment, and digital solutions, to strengthen health sovereignty and biomedical innovation.

**Guidelines:**

- Establishing domestic production of APIs and strategic equipment as a matter of state policy;
- Integration of biomedical research, industry, and the public health system;
- Promotion of innovation in biotechnology, radiopharmaceuticals, and biomedical engineering;
- Strengthening of regulatory frameworks and clinical trial environments; and
- Encouragement of public-private partnerships focused on innovation.

**What Brazil needs:**

- A national complex to produce APIs, medical devices, and radiopharmaceuticals;
- Centers for biomedical engineering and the digitalization of the SUS;
- Hubs for pharmaceutical biotechnology and advanced chemical synthesis; and
- Metrological infrastructure integrated into the Health Economic-Industrial Complex.

**Timeframe:**

**By 2030:** Reduce dependence on imported APIs and equipment by 40%.

**By 2034:** Achieve self-sufficiency in strategic medicines and consolidate resilient healthcare industrial hubs.

**PRIORITY AREA: Sustainable Infrastructure, Sanitation, Housing, and Mobility**

**(Linked to NIB Mission #3)**

The modernization of the national infrastructure—including universal access to sanitation, decent housing, and sustainable mobility, as outlined in the NIB—in conjunction with public safety, is essential to reindustrialization and the reduction of regional inequalities. This area, classified as one of strategic importance, seeks to integrate technological innovation into urban and territorial planning, promoting sanitation, decent housing, sustainable mobility and safety, as well as energy efficiency

and social resilience. Smart, safe, and sustainable cities are drivers of social inclusion, productive competitiveness, and quality of life, enabling the use of integrated data, digital technologies, and nature-based solutions for efficient urban management, risk prevention, and the strengthening of public safety.

**Objective:** To promote sustainable urban and regional infrastructure by integrating science, technology, and innovation into land-use planning and public safety to build smart, inclusive, safe, and resilient cities.

**Guidelines:**

- Integration of urban, environmental, security, and industrial policies into a national strategy;
- Promotion of innovation in sanitation, construction, transportation, clean energy, and urban security;
- Encouragement of public-private partnerships and open innovation in sustainable infrastructure and security;
- Implementation of circular economy, the reuse of urban resources, and the safe management of waste and water; and
- Advancement of digital transformation, integrated data, and urban monitoring technologies for city planning and safety.

**What Brazil needs:**

- A national policy for sustainable, innovative, and safe cities;
- A network of R&D and innovation centers focused on urban engineering and public safety; and
- Regulatory frameworks that promote energy and water efficiency and integrated urban safety.

**Timeframe:**

**By 2030:** Promote pilot projects for smart and safe cities in all regions of the country.

**By 2034:** Consolidate a national network of sustainable, safe, and digital cities, with inclusive, resilient, and integrated infrastructure.

## PRIORITY AREA: Digital Transformation of Industry (Linked to NIB Mission #4)

**Justification:** Digital transformation cuts across the new reindustrialization effort. Classified as a strategic priority, this area aims to accelerate the integration of Brazilian industry with information, communication, and automation technologies, thereby strengthening digital and productive sovereignty. Artificial intelligence (AI), the Internet of Things (IoT), big data, and advanced manufacturing are becoming key drivers of industrial competitiveness and productivity.

**Objective:** To develop the country's digital and data infrastructure to promote intelligent automation, productive integration, and information sovereignty.

### Guidelines:

- Recognizing data and connectivity as strategic assets;
- Prioritizing HPC, AI, and digital security in industrial supply chains;
- Fostering interoperability and reliability in digital systems;
- Encouraging the adoption of advanced technologies in business sectors; and
- Promoting technical training in AI and data science.

### What Brazil needs:

- A national network of interoperable data centers and HPC facilities;
- An ecosystem of advanced manufacturing and industrial automation; and
- National standards for digital governance and AI ethics.

### Timeframe:

**By 2030:** Consolidate the national HPC infrastructure and data centers.

**By 2034:** Become a regional leader in AI and automation applied to industry.

## PRIORITY AREA: Bioeconomy, Decarbonization, and Energy Transition and Security (Linked to NIB Mission #5)

**Justification:** Brazil has unique potential to lead the global bioeconomy. This sector, classified as a global leader, aims to integrate renewable energy, biotechnology, and the circular economy, promoting the decarbonization of industry and the creation of new bio-based materials and products. It is a strategy for productive innovation with both environmental and economic benefits.

**Objective:** To consolidate the bioeconomy and the energy transition by integrating technological innovation, sustainability, and green reindustrialization.

### Guidelines:

- Prioritizing R&D in bioprocesses, biorefineries, and new materials;
- Integrating regulation and green certification into production chains; Promoting reuse, recycling, and energy efficiency;
- Leveraging carbon markets and climate innovation; and
- Training the workforce for green jobs.

### What Brazil needs:

- A national network of biorefineries and green certification laboratories;
- Stable regulatory frameworks and incentives for the low-carbon industry; and
- Professional retraining programs in the green economy.

### Timeframe:

**By 2030:** Have biorefineries in operation and low-carbon pilot supply chains.

**By 2034:** Assume regional leadership in the bioeconomy and decarbonized industry.

## PRIORITY AREA: Technologies Relevant to National Sovereignty and Defense (Linked to NIB Mission #6)

**Justification:** National sovereignty depends on the ability to develop critical and strategic technologies. Classified as a strategic priority, this area encompasses critical minerals, semiconductors, AI, cybersecurity, and the nuclear and space sectors as axes of scientific, technological, and industrial autonomy. The goal is to reduce vulnerabilities and strengthen integration among science, industry, and defense.

**Objective:** To develop and master critical technologies to ensure the country's sovereignty, defense, and technological security.

### **Guidelines:**

- Treating critical technologies as the core of productive sovereignty;
- Prioritizing semiconductors, AI, cybersecurity, and space technologies;
- Integration of ST&I, industry, and defense, with ethical and intellectual property safeguards;
- Encouraging the training and retention of talent in sensitive areas; and
- Defining national missions, with associated criteria, institutional leadership, and funding sources.

### **What Brazil needs:**

- A national ecosystem for semiconductors and responsible AI;
- Centers of excellence in cybersecurity and secure communications; and
- Integrated supply chains for critical minerals and nuclear energy.

### **Timeframe:**

**By 2030:** Establish domestic semiconductor production and operational AI/cybersecurity centers.

**By 2034:** Achieve consolidated technological autonomy in critical areas and effective digital sovereignty.

### 5.3 Systemic Support for Business Innovation

As mentioned at the beginning of this chapter, support for business innovation is a cross-cutting dimension of the ENCTI 2024–2034. Strengthening the national innovation ecosystem depends on effective coordination among universities, research institutes, companies, the government, and investors, as well as on the foundational role of institutions such as Embrapii, Sebrae, Senai, Anprotec, and Anpei, which promote integration, disseminate best practices, and strengthen businesses' capacity to innovate. Startups and technology-based companies play a central role in generating disruptive, science-based technologies with high added value, boosting production chains and contributing to the country's sustainable reindustrialization. Innovation environments—such as technology parks, incubators, accelerators, living labs, and sector-specific hubs—are privileged spaces for collaborative innovation, connecting research, entrepreneurship, investment, and the market. However, there remains a strong geographic concentration of these environments, along with limitations in scientific and technological infrastructure across various regions, underscoring the importance of decentralization, the creation of national networks, and the strengthening of local productive arrangements and emerging ecosystems.

In this context, it is strategically important to adopt mechanisms that can scale up investment in innovation and foster high-quality partnerships among scientific and technological institutions, companies, and startups, especially in less dynamic regions and sectors. The adoption of hybrid financing mechanisms and co-investment arrangements, combined with impact metrics, can help attract private capital, share technological risks, and steer productive innovation toward socio-environmental and regional development outcomes aligned with the objectives of the ENCTI.

Sustainable reindustrialization requires the strategic use of the state's purchasing power, guiding government procurement policies and investments to drive innovation, stimulate domestic production, and promote technology localization. International experience shows that public purchasing power, combined with consistent regulatory and fiscal incentives, is crucial for fostering innovation markets and accelerating the technological maturation of both startups and established companies. To this end, a stable and predictable framework of fiscal, financial, and regulatory incentives is essential to reduce bureaucracy, increase legal certainty, and stimulate long-term business investment in Research, Development, and Innovation. The Legal Framework for Innovation, the Law of Good, the Informatics Law, the financial support instruments of Finep and the BNDES, technology procurement contracts, and innovation ecosystems constitute a significant framework, but one still marked by relative fragmentation, risks of funding discontinuity, and low integration among sectoral policies. NIB's strategic missions aim precisely to overcome these limitations.

It is necessary to reduce regulatory complexity, increase the predictability of support instruments, strengthen the governance of innovation policies, and improve dialogue between the government and the business sector to ensure efficiency, stability, and alignment of strategic interests. The development of technology-based companies, the strengthening of a culture of innovation, and increased business investment in R&D are central elements for consolidating a dynamic and competitive National Science, Technology, Innovation, and Communication System (SNCTI). It is equally essential to recognize that innovation involves both technological breakthroughs and incremental improvements, both of which are fundamental to raising the productivity and competitiveness of Brazilian industry. The combination of effective incentives, consistent government policies, and systemic integration among the ecosystem's stakeholders will enable Brazil to move toward a model of scientific, productive, and technological development aligned with the demands of the 21st century—one capable of generating highly skilled jobs, expanding technological sovereignty, and strengthening the country's presence in global value chains.





## 6 Structural Axis III: Strategic Projects for National Sovereignty

*The title, originally formulated as “Axis III – Science, Technology, and Innovation for National Strategic Programs and Projects,” was expanded to include the dimension of “National Sovereignty,” in line with the current geopolitical context and the need to strengthen Brazil’s scientific, technological, and productive autonomy in the face of contemporary challenges both in the country and around the world.*

### 6.1 Introduction

Structural Axis III proposes strengthening Brazil’s sovereignty by coordinating strategic projects to consolidate national autonomy in critical areas and by structuring a broader concept of sovereignty as the foundation for sustainable development, security, and national defense.

In accordance with the guiding criteria for the scientific and technological priorities of the ENCTI 2024–2034, presented in the introduction to this Strategy, Structural Axis III is organized into priority areas that reflect national challenges and guide the strengthening of scientific and technological capabilities essential to national sovereignty and security. The guiding criteria for this Axis have been modified based on the degree of vulnerability to national sovereignty in each area (high, medium, or low). These areas are then detailed in a coordinated manner through objectives, guidelines, time frames, and national needs.

Table 6.1 – Priority Areas According to the Guiding Criteria of the ENCTI 2024–2034

| Priority Area                                                                                                                                     | Degree of Vulnerability | Strategic Rationale                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Information and Communication Technologies: Digital Technologies, Semiconductors, Cybersecurity, and Communication Technologies, Big Data Storage | High                    | Build the national data and computing infrastructure to support the digital transformation of the economy; strengthen national capabilities in critical and emerging technologies, including AI, while ensuring digital sovereignty, cybersecurity, and integration among communications infrastructure, data, and smart automation. |
| Strategic and Critical Minerals                                                                                                                   | High                    | Develop technologies for the exploration, processing, and recycling of strategic minerals, reducing vulnerabilities in essential supply chains and promoting mineral sustainability.                                                                                                                                                 |

| Priority Area                                             | Degree of Vulnerability | Strategic Rationale                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Drugs and Active Pharmaceutical Ingredients (APIs)        | High                    | Reconstitute the national capacity to produce pharmaceutical inputs, strengthening health sovereignty and the integration among biomedical research, biotechnology, and the health industry.                                                                                                                                                                  |
| Critical Inputs and Fertilizers (NPK and bioalternatives) | High                    | Reduce external dependencies and increase productive autonomy through innovation in mineral and biotechnological fertilizers, which are essential to food security and agricultural sustainability.                                                                                                                                                           |
| Radioisotopes                                             | High                    | Ensure national self-sufficiency in the production of radioisotopes with safety, innovation, and state-of-the-art technological infrastructure, to guarantee the continuity and expansion of their use in healthcare, energy, agriculture, and industry.                                                                                                      |
| Nuclear Program                                           | High                    | Reinforce the autonomy of the Brazilian Nuclear Program through the development of sensitive instruments, materials, and technologies subject to restrictions and/or embargoes on international transfers, aim of strengthen the domestic nuclear reactor manufacturing industry—particularly small modular reactors, microreactors, and propulsion reactors. |
| Space Sector (Components)                                 | High                    | Reinforce Brazil's space autonomy through the development of critical components, domestically developed low-Earth orbit satellites, positioning, navigation, and time systems, observation systems, and launch technologies, integrating science, defense, and industrial innovation.                                                                        |

Source: Prepared by CGEE.

## 6.2 Detailed Priority Areas

### PRIORITY AREA: Information and Communication Technologies

(semiconductors, cybersecurity, advanced communications, cloud computing)

**Justification:** Digital transformation is a cornerstone of Brazil's technological sovereignty, industrial competitiveness, and capacity for innovation. The country faces challenges in computing, connectivity, and communications infrastructure, as well as limited production capacity for semiconductor components and devices, cloud systems, and digital security, which leaves it vulnerable to external dependencies and subject to technological, industrial, and market access constraints. Establishing an integrated national strategy for digital and critical technologies is essential to ensuring digital sovereignty, cybersecurity,

data protection, production efficiency, innovation, and industrial competitiveness. It is important to harness the full potential of digital technologies to boost productivity, competitiveness, and income and employment levels throughout the country, with the aim of building a free, just, and prosperous society for all. This agenda is also crucial for scientific and technological advancement in sectors such as health, energy, agriculture, industry, defense, education, and public administration, and is essential for ecological transformation and the modernization of the Brazilian state. The convergence of big data and cloud computing, AI, advanced components based on organic, inorganic, and quantum semiconductor devices, and bioinformatics and advanced communication technologies will position Brazil to lead technological development in the Global South through responsible, ethical, and sustainable innovation.

It should be noted that the world continues to be—and will continue to be—transformed by the internet and related digital technologies, such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, cloud computing, mobile systems, social and collaborative networks, cyber-physical systems, deep learning, information security, cybersecurity, high-performance computing, and quantum computing. Information and knowledge are becoming increasingly intertwined with daily activities through portable devices that are progressively more reliably and rapidly connected. This relationship fosters new forms of interaction between the physical and virtual worlds, the reorganization of life in urban and rural areas, and more efficient access to public and private services.

**Objective:** To develop and consolidate the national digital and technological infrastructure, ensuring informational sovereignty, mastery of advanced and critical technologies, and productive integration based on digital technologies such as big data, cloud computing, AI, semiconductor and quantum devices, advanced communication networks, and cybersecurity.

**Guidelines:**

- Recognition of data, digital infrastructure, and critical technologies as strategic assets of national sovereignty;
- Prioritization of technological development in high-performance computing, semiconductors, and advanced devices—including organic devices and those based on optical and quantum technologies—to drive development and innovation in AI and cybersecurity;
- Promotion of interoperability, security, reliability, and ethics in public and private digital systems;
- National data regulation and governance, with an emphasis on protection, transparency, and the responsible use of AI;

- Encouragement of the adoption of digital technologies and automation in productive sectors, strategic value chains, and public services;
- Fostering of public-private partnerships and international scientific cooperation in AI, chips, secure networks, and advanced communications;
- Promotion of integration among science, industry, defense, and government to strengthen digital sovereignty;
- Encouragement of training, retraining, and retention of talent in data science, information security, quantum technologies, bioinformatics, advanced AI, and digital engineering;
- Stimulation of research, development, and innovation in ICT; and
- Strengthening Brazil's participation in global forums on digital issues, fostering Brazilian competitiveness and presence abroad, and promoting regional integration in the digital economy and bilateral cooperation.

#### **What Brazil needs:**

- A national distributed data and computing infrastructure, with public cloud services and an advanced, high-speed, interoperable, and secure communications network;
- An advanced and sovereign technology ecosystem, with centers of excellence in AI, semiconductors and advanced devices, quantum technologies, and cybersecurity;
- A stable regulatory framework and national technical standards for interoperability and digital protection;
- Training and certification programs in data science, cybersecurity, and industrial automation;
- A national strategy for digital sovereignty and technological innovation, coordinating the government, the ICT sector, and the business sector;
- Incentives to promote domestic production of semiconductors and advanced devices, secure hardware, and strategic software;
- Capacity-building and training programs to prepare society for the digital world, equipping it with new knowledge and advanced technologies, and preparing it for the jobs of the future; and
- Development of new technologies, with an expansion of scientific and technological output, and solutions to national challenges.

### **Timeframe:**

**By 2030:** Deploy the national network of data centers and HPC; expand domestic production of semiconductors and advanced devices; consolidate AI and cybersecurity centers and international partnerships.

**By 2034:** Achieve informational autonomy and digital sovereignty, positioning Brazil as a regional leader in critical technologies, big data, and artificial intelligence applied to industry and sustainable innovation.

### **PRIORITY AREA: Strategic and Critical Minerals**

**Justification:** The energy and digital transitions depend on minerals such as lithium, niobium, and rare earth elements, in which Brazil is rich but still lacks integrated technological and industrial capacity. This sector is highly vulnerable given its high-value-added applications and requires clean technologies, sustainable processing, and value-added production chains to reduce external vulnerabilities and strengthen national mineral sovereignty.

For rare earth elements, it is urgent to complement the production chain by filling existing gaps. This is a sensitive area associated with high-value-added applications that require clean technologies, sustainable processing, and strengthening national production chains, thereby reducing external vulnerabilities and expanding the country's mineral sovereignty.

**Objective:** To develop sustainable technologies for the extraction, processing, and reuse of strategic and critical minerals that are essential to the energy and digital transitions.

### **Guidelines:**

- Treating strategic minerals as the foundation for national productive and technological sovereignty;
- Prioritizing sustainable, high-value-added practices in mineral exploration;
- Integrating mining, energy, and innovation policies within a green economy framework;
- Strengthening governance and environmental regulation in the mining sector; and
- Promoting research, innovation, and technical training focused on clean mining and the circular economy for these materials.

### **What Brazil needs:**

- A national policy on strategic minerals focused on innovation and sustainability;
- Technological infrastructure for processing and recycling;
- Industrial supply chains integrated into the green economy;
- Mastery of rare-earth separation technology; and
- A thorough understanding of its reserves of critical minerals.

### **Timeframe:**

**By 2030:** Expand the mapping of reserves and launch production chains for critical minerals; develop a plan for the rare earth processing chain (post-mining).

**By 2034:** Consolidate self-sufficiency in strategic mineral inputs and export clean mining technologies.

## **PRIORITY AREA: Drugs and Active Pharmaceutical Ingredients (APIs)**

**Justification:** External dependence on active pharmaceutical ingredients (APIs) poses a strategic vulnerability for the Brazilian healthcare system, a vulnerability that was critically exposed during the pandemic. Classified as a high-vulnerability area, this sector seeks to leverage the national pharmaceutical production base to strengthen health sovereignty and integration among research, biotechnology, and industry, with a focus on biomedical innovation and sustainable production.

**Objective:** To restructure the national production base for pharmaceuticals and APIs, strengthen health sovereignty and biomedical innovation, and integrate research, industry, and the healthcare system.

### **Guidelines:**

- Establishing the production of active pharmaceutical ingredients (APIs) as a strategic axis of national health sovereignty;
- Promoting integration among research institutions, the pharmaceutical industry, and the public health system;

- Fostering technological innovation in biotechnology and advanced chemical synthesis;
- Promoting regulatory stability and economic predictability for the sector; and
- Fostering technical and scientific training in pharmaceutical biotechnology.

#### **What Brazil needs:**

- A national production complex for active pharmaceutical ingredients (APIs) and essential medicines;
- Technology hubs in pharmaceutical biotechnology and advanced chemical synthesis;
- Regulatory and technological capacity integrated with the SUS; and
- Production autonomy for strategic medicines.

#### **Timeframe:**

**By 2030:** Reduce dependence on imported APIs by 40% and establish pharmaceutical biotechnology hubs.

**By 2034:** Achieve self-sufficiency in priority APIs for the SUS and consolidate regional leadership in pharmaceutical innovation.

### **PRIORITY AREA: Critical Inputs and Fertilizers (NPK and Bio-alternatives)**

**Justification:** Brazil relies heavily on imports of mineral fertilizers, especially NPK compounds—nitrogen, phosphorus, and potassium—which represents a strategic vulnerability for food security and productive sovereignty. This is one of the areas of high vulnerability, which requires the development of national technological pathways and sustainable biotechnological alternatives, integrating soil science, the bioeconomy, and industrial innovation. The discovery by scientist Johanna Döbereiner, a pioneer in the study of biological nitrogen fixation, demonstrated Brazil's scientific potential to reduce dependence on foreign sources and generate significant economic benefits for the country and the world. Inspired by this legacy, the ENCTI 2024–2034 proposes to strengthen this production chain by promoting innovation, sustainability, and greater competitiveness in Brazilian agribusiness.

**Objective:** Strengthen national self-sufficiency in agricultural inputs, with an emphasis on mineral fertilizers (NPK), bio-inputs, and biotechnology solutions, thereby reducing external vulnerabilities and promoting sustainable production.

**Guidelines:**

- Advancing technological and productive self-sufficiency in strategic inputs for agribusiness;
- Transitioning to sustainable models for the production of fertilizers and bio-inputs;
- Integrating scientific innovation, industrial development, and food security;
- Aligning production practices with the circular economy and carbon neutrality; and
- Coordinating institutional efforts among agricultural, environmental, and industrial policies.

**What Brazil needs:**

- A bio-inputs supply chain;
- Regional R&D hubs for fertilizers and bio-inputs.

**Timeframe:**

**By 2030:** Establish regional R&D hubs for fertilizers and bio-inputs; expand domestic NPK production.

**By 2034:** Consolidate relative self-sufficiency and regional leadership in sustainable bio-fertilizers.

**PRIORITY AREA: Radioisotopes**

Justification: Radioisotopes are isotopes that emit ionizing radiation. Those with very long half-lives occur naturally (the U and Th series), but most radioisotopes are artificial, produced through nuclear reactions in nuclear reactors or particle accelerators. Brazil has recognized capabilities in the production of radioisotopes and the development of nuclear technologies for medical and industrial use. However, it imports significant quantities of radioisotopes because its existing facilities lack sufficient production capacity to meet its needs. This area is classified as highly vulnerable due to the negative impact a shortage could have on social applications and technological development. Although Brazil still possesses the expertise to maintain regional leadership and expand strategic applications in health, energy, and the environment—while adhering to high standards of safety and innovation—there is a need to strengthen national nuclear technology institutes and establish facilities of a scale commensurate with the country's needs.

**Objective:** To consolidate Brazil's scientific and technological leadership in the production and application of radioisotopes and nuclear technologies for healthcare, energy, and industry.

**Guidelines:**

- Treating nuclear technology as a strategic driver of scientific, industrial, and social development;
- Providing the country with the technology and facilities necessary for the production of radioisotopes through the implementation of the Brazilian Multipurpose Reactor (RMB) Project;
- Promoting synergy among research, innovation, and safety in nuclear applications;
- Governing the sector through integrated efforts among scientific, regulatory, and industrial institutions;
- Valuing applied research on medical, energy, and environmental uses of radiation; and
- Strengthening international cooperation on peaceful nuclear technologies.

**What Brazil needs:**

- Implementation of the Brazilian Multipurpose Reactor (RMB) Project;
- An integrated network of research and radioisotope production centers;
- Secure and modern technological infrastructure;
- Robust nuclear regulation and governance; and
- Autonomous production capacity for medical and industrial purposes.

**Timeframe:**

**By 2030:** Build the RMB nuclear reactor and associated laboratories to ensure self-sufficiency in medical radioisotopes—for both the production of radiopharmaceuticals and diagnostic and therapeutic applications in nuclear medicine—and to utilize neutron beams for materials research and industrial applications.

**By 2034:** Commission and expand the RMB facilities and consolidate regional leadership in applied nuclear technology and radiation safety.

## PRIORITY AREA: Nuclear Program

**Justification:** The Brazilian Nuclear Program, which includes the Navy's Nuclear Program, combines a solid scientific foundation with growing potential for innovation but faces technological vulnerabilities stemming from international access restrictions, export control regimes, and dependence on foreign sources for advanced instrumentation. This high level of vulnerability requires structural measures to modernize the technological infrastructure, expand national autonomy, and address the requirements of safeguards agreements and mechanisms that restrict technological advancement. Strengthening the program requires consolidating the instrumentation chain, ensuring nuclear and radiological safety, acquiring state-of-the-art monitoring systems, and expanding training for highly specialized personnel, while integrating civil, industrial, medical, and defense applications within a highly complex regulatory environment. Developments in the mining and processing of uranium and other fissile materials, isotopic enrichment, and the fabrication of advanced fuel elements will also be essential to maintaining competitiveness in a sector that has experienced a strong resurgence driven by the strengthening of the global energy transition. All these actions will be carried out in strict compliance with the provisions of the Federal Constitution, which limits nuclear activities in the country to peaceful purposes and prohibits the development or construction of nuclear weapons.

**Objective:** To modernize and diversify the civilian (electricity and cogeneration, medicine, agriculture, and food), industrial, and defense applications of nuclear technology, thereby strengthening national security and technological autonomy.

### Guidelines:

- Positioning the nuclear program as a driver of scientific, technological, and industrial innovation, with applications in health, energy, agriculture, industry, and defense;
- Ensuring high standards of safety, transparency, traceability, and sustainability in nuclear applications;
- Reducing technological vulnerabilities associated with international controls by expanding national instrumentation and monitoring capabilities;
- Promoting national scientific development and international cooperation in the peaceful uses of nuclear energy;
- Integrating efforts among research centers, industry, regulatory agencies, and the Brazilian Navy to develop cutting-edge technologies; and

- Encouraging specialized technical and scientific training, with a focus on nuclear physics, engineering, instrumentation, radiation protection, and sensitive technologies.

### **What Brazil needs:**

- A national nuclear instrumentation complex, including sensors, detectors, monitoring systems, and advanced analytical technologies;
- A robust, agile, and transparent regulatory framework, aligned with international standards, while preserving national technological autonomy;
- Research, innovation, and testing centers dedicated to civil, industrial, medical, defense, and environmental nuclear applications;
- A national capacity for the development of microreactors and SMRs, focused on the cogeneration of electricity and other strategic resources, such as desalinated water, hydrogen, and heat for industrial use, thereby strengthening Brazil's position in the international energy transition landscape;
- Advanced training and professional certification programs in critical areas of nuclear technology; and
- Mechanisms for international cooperation that expand access to knowledge while preserving sovereignty and autonomous development.

### **Timeframe:**

**By 2030:** Expand the use of nuclear technology in energy, defense, medicine, agriculture, and food, seeking to convince society of its safety and practicality; strengthen national capabilities, reduce external technological vulnerabilities, and complete pilot industrial facilities for Brazil's first power reactors (micro and/or small-scale).

**By 2034:** Consolidate Brazil's position as a regional leader in nuclear infrastructure, peaceful innovation, and high-value-added, sensitive nuclear technologies, with full integration of research and development with applications in energy, defense, medicine, agriculture, and food. The launch of the first nuclear-powered submarine is expected to solidify this regional leadership, reflecting Brazil's mastery of the nuclear fuel cycle and its capacity to build research and power reactors. Labgene, the Navy's land-based prototype of a nuclear propulsion reactor, will be the first power reactor effectively designed and built in the country.

## PRIORITY AREA: Space Program

**Justification:** Brazil has a long scientific tradition and a growing space sector infrastructure, with a focus on remote sensing and satellite engineering. The sector needs to consolidate national autonomy in components and launch vehicles, strengthen the domestic space industry, and expand the use of space technologies for civilian, environmental, and defense purposes.

**Objective:** To strengthen Brazil's space autonomy by focusing on the development of components, observation systems, and launch technologies.

### Guidelines:

- Treating space as a strategic domain for science, innovation, and national sovereignty;
- Expanding synergies among the defense sector, academia, and the space industry;
- Promoting the peaceful and sustainable use of space, with a focus on socioeconomic and environmental applications;
- Promoting technological leadership in propulsion, satellites, and remote sensing; and
- Ensuring integrated governance between space programs and industrial policies.

### What Brazil needs:

- An integrated space research and production complex;
- An industrial supply chain for space components;
- An autonomous capability for orbital launches; and
- Technological expertise in the development of low-Earth orbit satellites and positioning, navigation, and timing systems.

### Timeframe:

**By 2030:** Expand domestic production of space components and systems.

**By 2034:** Conduct orbital launches using domestic technology and consolidate the space industry into an integrated entity.

## 6.3 National Defense as a Strategic Area for Brazil's Technological Sovereignty

Defense is a strategic component of Axis III of the ENCTI 2024–2034, integrating science, technology, and innovation with the needs of national sovereignty, the protection of strategic resources, and the strengthening of state capabilities. The sector operates in cutting-edge fields such as AI, quantum technologies, cyber technologies, space technologies, nuclear technologies, advanced sensors, and semiconductors— which are subject to strict international controls, access restrictions, and technological constraints. This heightens Brazil's vulnerability and underscores the need to expand scientific and technological autonomy.

The defense-related ST&I agenda is guided by strategic programs, such as the Brazilian Nuclear Program, the Brazilian Space Program, the Blue Amazon Management System (SisGAAz), and the Integrated Border Monitoring System (Sisfron), which are aimed at technological autonomy, the protection of critical infrastructure, and the preservation of the country's geopolitical assets.

Against a backdrop of shifting security paradigms and intensifying international tensions and conflicts, national mastery of critical and disruptive technologies has become essential to national defense and geopolitical competitiveness, as well as a major challenge for engagement with ST&I. Strengthening military institutions of excellence, such as the Technological Institute of Aeronautics (ITA) and the Military Institute of Engineering (IME), is equally fundamental for training highly qualified personnel and for scientific advancement in sensitive areas. Within this ecosystem, the Defense Industrial Base (BID) emerges as a driver of technological innovation and reindustrialization, integrating public and private companies as well as startups into knowledge-intensive production chains.

The coordination between strategic defense projects and ST&I policies is essential to reduce vulnerabilities, expand national capabilities, and address geopolitical risks associated with technological dependence and regional fragmentation. Strengthening technological sovereignty requires the continuity of foundational programs, budgetary predictability, international cooperation on a sovereign basis, and integrated governance between defense and other ST&I sectors. As part of Axis III, defense is established not only as an instrument of deterrence but also as a central element of a national project for sustainable, innovative, and geopolitically assertive development.

The ENCTI 2024–2034 reaffirms that the integration of defense and ST&I is a prerequisite for Brazil's strategic autonomy, national resilience, and international projection in a global landscape marked by growing technological and geopolitical competition. The consolidation of technological sovereignty in the defense sector requires national mastery of strategic technological capabilities, to be detailed

in the PACTI. These capabilities are essential for operational autonomy, the protection of critical infrastructure, and the strengthening of the Defense Industrial Base, in line with the strategic objectives of ENCTI 2024–2034.





## Structural Axis IV: Science, Technology, and Innovation for Social Development

*Inspired by strategic social missions, Axis IV of the ENCTI 2024–2034 focuses on the ST&I sector's contribution to overcoming social challenges that afflict most of the Brazilian population and to ensuring basic social rights, in line with the fundamental objectives defined in the Federal Constitution. The ENCTI's recommendations under this axis reaffirm the fundamental role of the ST&I sector in promoting social justice, socio-environmental sustainability, and shared prosperity in Brazil.*

### 7.1 Introduction

Structural Axis IV reaffirms the role of Science, Technology, and Innovation (ST&I) as a fundamental axis of socioeconomic development, the promotion of social rights, the reduction of inequalities, and the consolidation of citizenship in Brazil. By integrating scientific knowledge, social innovation, and public policies to improve the population's living conditions, this axis highlights the central role of ST&I in building a more just, resilient, and sustainable country.

Axis IV—ST&I for Social Development, detailed in this chapter, highlights the decisive role of the ST&I sector in overcoming historical inequalities, expanding access to fundamental rights, and valuing knowledge as a public good—essential to promoting inclusive, sustainable development oriented toward collective well-being. This is a cross-cutting axis that recognizes the role of scientific knowledge as a driver of social transformation, contributing to efforts to address the structural, regional, and global challenges facing the country.

The priority areas for this axis were defined based on criteria of scope and effectiveness in promoting social development. These areas are presented below, articulating objectives, guidelines, time frames, and national needs, and guiding the necessary integration among science, society, and sustainable development.

Axis IV of the ENCTI 2024–2034 emphasizes the territorial, social, and democratic dimensions of science, technology, and innovation, recognizing that it is at the local level that the results of policies on research, innovation, reindustrialization, and technological sovereignty are realized. By territorializing ST&I policy, with special attention to historically underrepresented regions and populations, the ENCTI helps reduce regional inequalities, strengthen territorial innovation ecosystems, combat misinformation, and bolster public trust in science, reaffirming ST&I as an instrument of inclusion, sustainable development, and social resilience in the face of contemporary challenges.

Table 7.1 – Priority Areas According to the Guiding Criteria of the ENCTI 2024–2034

| Priority Area                                  | Strategic Rationale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Food and Nutritional Security</b>           | Enhance the resilience and competitiveness of agri-food chains through R&D in bio-inputs, biotechnology, and digital traceability, ensuring healthy, safe, and accessible food and positioning Brazil as a global leader in agri-food innovation and the fight against food insecurity. Integrate ST&I, social innovation, bioinnovation, agroecology, and food governance to ensure the human right to adequate food, structurally address hunger, and strengthen national productive sovereignty. Promote sustainable, inclusive, and low-carbon food systems by bringing together local knowledge, modern science, and digital technologies. |
| <b>Health and Wellness</b>                     | Strengthen the SUS as a cornerstone of innovation, expanding primary care, digital health, health surveillance, biotechnologies, and assistive technologies, while ensuring regional equity, quality of life, and the overall well-being of the population.                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Public Safety</b>                           | Promote ST&I technologies and solutions aimed at protecting citizens, combating crime, preventing risks, reducing violence, and strengthening community resilience, based on data science, smart technologies, monitoring and alert systems, community participation, and effective public management.                                                                                                                                                                                                                                                                                                                                          |
| <b>Housing</b>                                 | Integrate ST&I, urban planning, social technologies, materials science and engineering, and innovation in sustainable construction to expand access to decent housing, reduce costs and environmental impacts, strengthen social infrastructure, and promote safe, healthy, and resilient cities. New materials and sustainable construction solutions contribute directly to addressing territorial vulnerabilities, improving housing quality, and supporting public policies for inclusive urban development.                                                                                                                                |
| <b>Transportation</b>                          | Use ST&I to promote inclusive urban mobility and sustainable, accessible, and efficient public transportation by integrating digital technologies, AI, smart mobility systems, spatial planning, and reducing inequalities among regions and social groups.                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Valuing Work</b>                            | Integrate ST&I into vocational training, certification, and retraining policies to expand technical, digital, green, and scientific skills, strengthening workers' integration into knowledge-intensive and higher-value-added sectors to increase national productivity and reduce social, regional, and productive inequalities.                                                                                                                                                                                                                                                                                                              |
| <b>Reducing Inequalities</b>                   | Apply ST&I to address social, economic, educational, territorial, and gender disparities, and to guide evidence-based redistributive and social inclusion policies that expand opportunities and access to essential services throughout the country, especially for historically vulnerable populations and regions.                                                                                                                                                                                                                                                                                                                           |
| <b>Inclusion and Diversity</b>                 | Institutionalize affirmative action policies in ST&I to promote safe, equitable, and inclusive environments and expand access for historically excluded populations to education, scientific research, digital technologies, and innovation opportunities.                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Popularization and Advocacy for Science</b> | Establish the popularization of science as a foundational policy by strengthening scientific communication, expanding public access to knowledge, combating misinformation, and consolidating science as a public good essential to democracy and social development. This also involves recognizing the cultural and symbolic value of science, expanding its presence in the social imagination, and strengthening it as an integral part of national culture.                                                                                                                                                                                |

Source: Prepared by CGEE.

## 7.2 Breakdown of Priority Areas

### PRIORITY AREA: Food And Nutritional Security

**Justification:** Food and nutritional security is a strategic dimension for national development and for the country's health and economic sovereignty. Although Brazil has a solid scientific foundation and recognized expertise in agri-food production and agro-environmental research, it faces challenges related to the availability, access, nutritional quality, and stability of food systems. The transition to sustainable, resilient, and traceable models requires coordination among technological innovation, biotechnology, agroecology, risk management, public health surveillance, the digitalization of production chains, and social policies. Food security also involves cultural and social dimensions, as dietary patterns directly affect public health and the population's living conditions. Thus, science, technology, and innovation play a central role in strengthening sustainable production chains, ensuring safe and healthy food, and reducing regional and nutritional vulnerabilities amid climate change, urbanization, and pressures on natural resources.

**Objective:** Ensure the sustainability and resilience of agri-food chains by integrating biotechnological innovation, digital traceability, and regional productive inclusion. Promote the sustainable production of healthy foods with low environmental impact to help eliminate hunger, reduce excessive consumption of fat and sugar, and improve the quality of the Brazilian diet.

#### Guidelines:

- Treating food security as a strategic dimension of national sovereignty, public health, and economic sustainability;
- Integrating science, technology, and agri-food production chains to strengthen regional and community-based food production and distribution systems;
- Promoting the transition to sustainable, resilient food systems with low environmental impact;
- Valuing traditional knowledge, family farming, and community networks as drivers of social innovation and productive inclusion;
- Strengthening public food security policies based on scientific evidence and territorial data;
- Promoting healthy foods while simultaneously preventing malnutrition and diet-related diseases;
- Establishing digital platforms for food monitoring, traceability, and certification;

- Encouraging international cooperation in sustainable agriculture, food technologies, and climate and health risk management; and
- Promoting training and interdisciplinary research networks focused on food security.

### **What Brazil needs:**

- A sustainable, safe, traceable, and digitized agri-food system;
- Regional food bioinnovation hubs and integrated agroecological networks;
- National and regional food security observatories, with georeferenced data;
- Cross-sectoral governance among agriculture, health, science, the environment, and social development;
- Low-carbon agricultural production, with digital traceability and public certification;
- R&D infrastructure for bioprocesses, healthy foods, bio-inputs, and social technologies applied to food production and distribution; and
- Promotion of the development, regulatory validation, and adoption of advanced technologies for food preservation, conservation, and safety—including physical and nuclear processes—with a focus on reducing post-harvest losses, extending shelf life, ensuring food safety, and enhancing the competitiveness of agro-industrial supply chains.

### **Timeframe:**

**By 2030:** Implement an integrated national network for sustainable food security, comprising digital traceability systems, regional observatories, monitoring and certification platforms, regional food bioinnovation hubs, and expanded R&D infrastructure in biotechnology, agroecology, healthy foods, bio-inputs, and social technologies, thereby strengthening low-carbon production chains and local production of safe food.

**By 2034:** Consolidate Brazil's position as a regional leader in sustainable food systems and food sovereignty, with resilient, digitized, and traceable supply chains that are fully integrated with the bioeconomy, traditional knowledge, regional productive inclusion, and intersectoral governance, ensuring food security as a foundational principle of the national ST&I policy.

## PRIORITY AREA: Health and Well-being

**Justification:** Strengthening the Unified Health System (SUS) is essential to reduce inequalities, ensure rights, and promote well-being nationwide. The expansion of digital health, combined with biotechnology, assistive technology, and surveillance technologies, enhances the SUS's capacity to innovate in diagnostics, therapies, prevention, comprehensive care, and emergency response. ST&I must integrate scientific evidence, technological innovation, and efficient public management, with a particular focus on strengthening primary care, territorial equity, and the integration of health, social protection, and the environment. In this way, ST&I becomes a driver of inclusion, sustainability, and quality in health services.

**Objective:** To strengthen the SUS as a hub for innovation, inclusion, and knowledge production, expanding digital health, assistive technologies, and the country's biomedical capacity, with territorial equity and integration among surveillance, care, prevention, and science.

### Guidelines:

- Investing in telemedicine, telehealth, and remote care (primary care, surveillance, aging);
- Supporting R&D in biotechnology and translational medicine (diagnostics, vaccines, personalized therapies);
- Creating regional centers for innovation in digital health (universities, hospitals, ICT companies);
- Establishing partnerships between the SUS, research institutions, and startups for low-cost digital and assistive solutions;
- Integrating data and information systems (SUS, Social Security, CadÚnico) with governance and data protection;
- Promoting AI and data analytics in healthcare based on ethical principles;
- Supporting home care and community networks; recognizing caregivers;
- Training and specializing professionals in digital health, biotechnology, and innovation management; and
- Promoting healthy cities with inclusive infrastructure and environmental/epidemiological surveillance.

### **What Brazil needs:**

- An interoperable national telemedicine/telehealth infrastructure;
- Regional centers for innovation in digital health;
- Secure health data platforms with cross-system integration;
- Installed capacity for biomedical and translational R&D; and
- Continuing education programs in digital health and biotechnology.

### **Timeframe:**

**By 2030:** Promote digital health and expanded assistive technologies; implement telemedicine nationwide; ensure regional innovation centers are operational; foster consolidated partnerships among the SUS, academia, and the private sector.

**By 2034:** Promote the full integration of health and social protection information systems; strengthen biotechnology and translational medicine; implement a sustainable, inclusive, and advanced healthcare model.

## **PRIORITY AREA: Public Safety**

**Justification:** Public safety is one of the nation's greatest challenges and requires integrated solutions that combine prevention, intelligence, technology, social development, and institutional strengthening. ST&I plays a strategic role in enhancing public safety by combining data, sensors, AI, environmental monitoring, digital technologies, and territorial analysis to combat crime, prevent violence, reduce vulnerabilities, and promote safe and inclusive cities. In addition to monitoring, tracking, and smart surveillance technologies, ST&I must strengthen preventive approaches, such as urban planning, the protection of vulnerable populations, and the promotion of rights. The integration of data science, social innovation, community participation, and effective public management is essential for developing security policies that are effective, transparent, and focused on the collective well-being.

**Objective:** To integrate ST&I into public safety through smart technologies, territorial analysis, social innovation, violence prevention, and the strengthening of public governance, thereby promoting safe, inclusive, and resilient cities, with respect for human rights and data protection.

## **Guidelines:**

- Developing and applying smart surveillance systems (AI, sensors, cameras, drones, neural networks) aimed at prevention, rapid response, and the protection of vulnerable populations;
- Expanding the use of data science, big data, and predictive modeling to analyze patterns of violence, urban emergencies, extreme weather events, and socio-environmental risks;
- Establishing regional innovation centers for public safety, bringing together universities, research institutes, law enforcement agencies, civil defense agencies, and local governments;
- Integrating digital technologies into smart public lighting systems, safe mobility, environmental monitoring, and resilient urban infrastructure;
- Developing digital security and cybersecurity solutions to protect critical infrastructure, public services, and sensitive population data;
- Promoting social prevention technologies through community participation, local dialogue, youth engagement, schools, and local organizations;
- Ensuring that security technologies comply with principles of ethics, transparency, data protection, and human rights;
- Training security professionals, public managers, and technical teams in digital technologies, data science, risk management, and innovation; and
- Supporting interdisciplinary research that integrates urban planning, sociology, geography, digital technologies, and public policy, with a focus on citizen safety.

## **What Brazil needs:**

- Integrated infrastructure for smart surveillance, territorial monitoring, and emergency response;
- Regional public safety innovation centers, connected to universities and government agencies;
- Secure national data platforms for public safety, mobility, climate, and infrastructure, with transparent governance;
- Established capabilities in cybersecurity, risk management, predictive analytics, and digital security;
- Community and territorial networks for violence prevention, coordinating policies on youth, education, urban planning, and social assistance; and
- National protocols on ethics and data protection for security technologies.

### **Timeframe:**

**By 2030:** Ensure that regional security innovation centers are operational; expand smart surveillance and environmental monitoring; implement interoperable data platforms; provide training in AI, cybersecurity, and integrated risk management.

**By 2034:** Ensure the full integration of security and surveillance systems; strengthen cybersecurity and predictive analytics; consolidate a public safety model grounded in innovation, rights, and territorial intelligence.

### **PRIORITY AREA: Housing**

**Justification:** Adequate housing is a fundamental right and an indispensable condition for social development, health, productive inclusion, and well-being. The housing shortage, precarious urban conditions, territorial inequalities, and the impacts of climate change make it urgent to develop sustainable, accessible, and technology-driven housing solutions in Brazil. ST&I play a decisive role in transforming the sector by developing new materials, industrialized construction, green building, energy efficiency, digitalization, smart urban planning, climate resilience, and social technologies for inclusive urbanization. Coordination among research, public policy, and the business sector is essential to reduce costs, improve building quality, promote sustainable infrastructure, and expand access to decent housing across all regions of the country.

**Objective:** To strengthen ST&I to reduce the housing deficit and promote sustainable, resilient, and low-cost housing, expanding access to innovative construction technologies, smart urban planning, and socio-environmental solutions that ensure territorial equity.

### **Guidelines:**

- Developing new sustainable building materials and technologies, including advanced composites, bio-concrete, recycled materials, engineered wood, and low-carbon solutions;
- Promoting modular, industrialized, and precision construction, reducing costs, construction time, and environmental impacts;
- Promoting social housing technologies, including ecological sanitation solutions, water harvesting systems, energy efficiency, and natural ventilation;
- Territorial mapping and urban modeling using AI, sensors, geoprocessing, and public data to guide housing and urbanization policies;

- Supporting housing innovation labs, in partnership with universities, research institutes, local governments, and the construction sector;
- Encouraging the adoption of technical standards and sustainable certifications for social housing, with environmental and accessibility criteria;
- Incorporating technologies for climate resilience (heat mitigation, sustainable drainage, prevention of extreme events, adaptation of high-risk areas);
- Expanding technical training in sustainable construction, bioclimatic design, building maintenance, and low-cost technologies; and
- Integrating policies on housing, mobility, sanitation, the environment, and productive inclusion, supported by scientific evidence and territorial data.

#### **What Brazil needs:**

- A national program for sustainable, low-carbon housing, featuring accessible technologies;
- Research infrastructure and innovation centers focused on sustainable construction and smart cities;
- Interoperable platforms for housing, urban, and socio-environmental data to inform public policy;
- Networks of living labs and demonstration projects for innovative social housing;
- Permanent funding programs for new materials, modular construction, energy efficiency, and ecological sanitation; and
- National training and certification in green and digital skills for the construction sector.

#### **Timeframe:**

**By 2030:** Expand sustainable, low-cost technologies; promote modular and industrialized construction; ensure that regional housing innovation centers are operational; consolidate territorial data to inform housing and urbanization policies.

**By 2034:** Promote the full integration of sustainable solutions into housing policy; consolidate new materials and low-carbon construction methods; establish a model for resilient, inclusive, and smart housing throughout the country.

## PRIORITY AREA: Transportation

**Justification:** The transportation sector is fundamental to economic development, territorial integration, and social well-being. However, it faces structural challenges related to urban mobility, carbon emissions, high logistics costs, low energy efficiency, inequalities in access, and vulnerability to extreme weather events. In Brazil, the historical predominance of private transportation creates mobility inequities: those without cars end up paying more for less efficient public transportation, with fewer options and longer travel distances, thereby widening territorial and socioeconomic inequalities. In contrast to countries where public, rail, and air transportation is widely accessible and subsidized, the Brazilian model perpetuates exclusion, places an undue burden on vulnerable families, and increases emissions. ST&I play a strategic role in transforming this landscape by offering solutions based on digital technologies, AI, sensors, sustainable vehicles, smart infrastructure, predictive maintenance, energy efficiency, and integrated urban planning. Innovation can reduce inequalities, expand access to quality public transportation, strengthen supply chains, and promote an inclusive, sustainable, and resilient mobility model.

**Objective:** To integrate ST&I into the national transportation system to promote sustainable, safe, smart, and accessible mobility, while enhancing energy efficiency, decarbonization, territorial equity, and mobility justice.

### Guidelines:

- Developing smart mobility solutions using AI, big data, sensors, geolocation, and integrated traffic management systems;
- Investing in sustainable public transportation, including fleet electrification, advanced biofuels, green hydrogen, and low-emission technologies;
- Promoting predictive maintenance for roads, railways, bridges, and fleets, using advanced sensing, digital twins, and real-time monitoring;
- Supporting smart infrastructure (stations, terminals, highways, railways, waterways) integrated with environmental information and surveillance systems;
- Modernizing logistics chains through digital tracking, data interoperability, route optimization, and multimodal platforms;
- Promoting regional research and innovation centers focused on sustainable mobility, smart cities, and Logistics 4.0;
- Ensuring accessibility and inclusion through safe, universal, and adapted transportation for older adults, people with disabilities, and vulnerable populations;

- Integrating policies on transportation, urban mobility, land-use planning, climate, and sustainable development, using scientific evidence and spatial data; and
- Promoting training and professional development in technologies for mobility, sustainable logistics, clean energy, and transportation engineering.

#### **What Brazil needs:**

- Smart mobility networks and sustainable public transportation, with open and interoperable data;
- Modernized, climate-resilient, and digitally monitored logistics and transportation infrastructure;
- Urban and logistics fleets with a high proportion of electric, hybrid, and low-emission vehicles;
- National platforms for multimodal planning and optimization (road, rail, air, and waterway);
- Innovation centers for mobility, smart cities, and sustainable logistics connected to ICT and local governments; and
- Ongoing technical and scientific training programs focused on clean mobility, smart logistics, and reducing inequalities in access.

#### **Timeframe:**

**By 2030:** Ensure expanded smart mobility; expand sustainable fleets; ensure that predictive maintenance is in place in major urban centers; consolidate integrated multimodal platforms; ensure that regional mobility innovation centers are operational.

**By 2034:** Implement digitized, interconnected national transportation systems; consolidate sustainable logistics; adopt urban fleets that are predominantly low-emission; and fully establish an inclusive, resilient, and data-driven mobility model.

### **PRIORITY AREA: Valuing Work**

**Justification:** The rapid technological transformation—marked by digitalization, automation, AI, the bioeconomy, and the energy transition—is redefining the global production structure and presenting Brazil with the strategic challenge of upskilling its workforce to add value, boost productivity, and reduce historical inequalities. The country's territorial and socioeconomic inequalities are directly reflected in opportunities for access to education, science, connectivity, and skilled employment, making the

valorization of work fundamental to an inclusive and innovative development trajectory. In this context, ST&I play a decisive role in guiding policies on education, retraining, and professional development that prepare workers for knowledge-intensive occupations, medium- and high-tech sectors, and more complex productive activities. At the same time, it is essential to ensure that the productivity gains generated by innovation benefit workers, thereby reducing regional and social disparities and strengthening territorial cohesion. Valuing work requires expanding technical, digital, and scientific skills by integrating vocational education, higher education, graduate studies, applied research, innovation, and productive development. Social technologies, the solidarity economy, and collaborative initiatives remain relevant as complementary tools for productive inclusion in vulnerable regions; however, the overarching focus is on large-scale training and skill development, which can position Brazil at higher levels of productivity, technological sophistication, and global competitiveness.

In this context, the technological transformations associated with digitalization, automation, and AI are having a profound impact on the world of work, requiring that ST&I policy be coordinated with education, employment, and social development policies. The ENCTI 2024–2034 recognizes work as a cross-cutting strategic dimension, guiding the definition of scientific and technological priorities to generate higher-value-added jobs, promote professional retraining, and reduce social and regional inequalities. The promotion of innovation must be linked to strategies to prevent job insecurity, technological unemployment, large-scale workforce retraining, technical and scientific training, productive restructuring, and inclusion, to ensure that technological gains translate into social well-being, productive inclusion, and balanced regional development.

**Objective:** To strengthen the training, skills, and recognition of the Brazilian workforce by expanding technical, digital, and technological competencies to promote greater productivity, competitive integration, and value creation in strategic sectors, thereby ensuring productive inclusion and reducing inequalities.

#### **Guidelines:**

- Supporting and promoting large-scale professional training programs, prioritizing digital, green, industrial, and scientific skills aligned with new technological foundations, in coordination with the Ministry of Education (MEC), the Ministry of Labor and Employment (MTE), and other relevant agencies;
- Coordinating technical training, higher education, graduate studies, and applied research, strengthening educational pathways integrated with the SNCTI and the productive demands of strategic sectors;
- Supporting professional retraining and transition policies, especially in sectors impacted by automation, digitalization, and technological changes, through evidence-based approaches, technology, and innovation;

- Promoting the role of creative and non-repetitive work by training workers and improving their compensation so that they benefit from the productivity gains generated by innovation;
- Promoting advanced technology training programs in strategic areas such as AI, advanced computing, biotechnology, semiconductors, renewable energy, cybersecurity, and advanced manufacturing;
- Strengthening the integration between vocational and technological education networks and the SNCTI, promoting synergies among federal institutes, universities, research centers, and productive sectors;
- Promoting policies to attract, retain, and develop talent, coordinating incentives for innovation, technological entrepreneurship, and skilled integration into high-value-added production chains;
- Coordinating social technologies and the solidarity economy as complementary tools, with a focus on productive inclusion, especially in vulnerable areas; and
- Supporting the creation of observatories and laboratories for labor and skills trends, producing strategic data on employability, innovation, and the impact of technology on occupations.

### **What Brazil needs:**

- A coordinated national system for training and technological retraining, with strong integration among the Ministry of Science, Communications, and Information Technology (MCTI), the Ministry of Education (MEC), the Ministry of Labor and Employment (MTE), the Ministry of Development, Industry, and Commerce (MDIC), and the states;
- Ongoing programs to support professional training in digital, green, industrial, and emerging technological skills;
- Integrated networks linking technical education, universities, research institutes, technology centers, and productive sectors;
- Advanced technological training centers and experimental laboratories in strategic sectors;
- National platforms for monitoring the labor market, emerging skills, and technological impacts; and
- Mechanisms for productive inclusion based on social technologies and collaborative models, as complementary tools.

## Timeframe:

**By 2030:** Establish an integrated national system to support training and technological reskilling, linking vocational education networks, advanced training centers, and capacity-building programs in digital and green skills, aligned with the strategic agendas of the SNCTI.

**By 2034:** Consolidate a highly qualified, productive workforce engaged in high-value-added sectors, reducing regional inequalities and strengthening national competitiveness, with continuing education serving as the cornerstone of the national ST&I policy.

## PRIORITY AREA: Reducing Inequalities

**Justification:** Social, territorial, economic, and knowledge-access inequalities remain among the main obstacles to Brazil's development. These disparities manifest across the country through historical differences in scientific infrastructure, digital connectivity, employment opportunities, skills training, public services, and living conditions. ST&I play a decisive role in overcoming this situation by expanding local capacities, democratizing access to knowledge production, and supporting evidence-based redistributive public policies. The transition to a technology-intensive economy—characterized by digitalization, AI, biotechnology, automation, and new green and digital value chains—can exacerbate inequalities if not accompanied by structural policies. However, when linked to the reduction of regional disparities, the expansion of science into the interior, and quality training, it becomes a powerful driver of social inclusion, the valorization of labor, and territorial development. In this context, the ENCTI aims to strengthen scientific and technological capacities in less-favored regions by expanding access to infrastructure, data, connectivity, training, and knowledge-production networks. ST&I thus becomes an instrument of territorial justice and the promotion of equity, increasing social cohesion and contributing to a more just and inclusive country.

**Objective:** To guide nationwide structural policies, based on ST&I, to reduce social, regional, and productive inequalities. Strengthen scientific and technological capacities in vulnerable regions, expand access to infrastructure, knowledge, and quality training, and ensure that technological advances contribute to social inclusion, the valorization of labor, and greater territorial equity, thereby promoting sustainable development and social cohesion.

## Guidelines:

- Encouraging research and innovation initiatives that are sensitive to local realities, incorporating socioeconomic, environmental, and cultural data to guide evidence-based public actions;

- Supporting structural ST&I policies that expand scientific and technological capacities in vulnerable regions, promoting greater territorial balance in infrastructure and investments;
- Promoting the expansion of science into the interior, by expanding research networks, open laboratories, regional centers, and digital platforms that democratize access to knowledge and technology;
- Providing quality training and strengthening scientific, technical, and digital skills, in coordination with educational and productive systems, to ensure entry into higher-value-added markets;
- Promoting initiatives in social innovation, social technology, and citizen science as processes of sociotechnical reconfiguration to foster productive inclusion and reduce inequalities; and
- Fostering data systems, indicators, and geointelligence that enable the monitoring of regional inequalities, the impacts of ST&I policies, and progress in social inclusion.

### **What Brazil needs:**

- Regional centers and networks for research, innovation, and technological training, aligned with regional strengths and challenges;
- Interoperable platforms for territorial, socioeconomic, and technological data, guiding evidence-based public policies;
- Decentralized scientific infrastructure, including multi-user laboratories, computing centers, and regional observatories;
- A national policy for the expansion of ST&I into the interior and for regional balance, integrated into medium- and long-term planning;
- Systems for monitoring and evaluating inequalities in ST&I, with a focus on regional, gender, racial, and labor dimensions;
- Collaborative networks for social innovation, social technology, and citizen science, as complementary tools for productive inclusion; and
- Permanent structures for attracting, retaining, and facilitating the movement of talent, thereby strengthening scientific capacities in vulnerable regions.

### **Timeframe:**

**By 2030:** Establish a solid foundation for reducing territorial inequalities in ST&I, through the expansion of decentralized scientific infrastructure, the operation of observatories and interoperable territorial

data platforms, and the systematic use of AI and geointelligence in diagnosing inequalities; consolidate cooperation mechanisms among universities, the private sector, governments, and communities, as well as national instruments for attracting and retaining talent, thereby expanding access to knowledge and quality training in vulnerable regions.

**By 2034:** Consolidate territorial ST&I systems linked to sustainable regional development, with stable decentralization of investments, greater knowledge-based productive inclusion, and a significant reduction in regional inequalities in access to scientific infrastructure and training opportunities; integrate territorial equity as a principle of national ST&I policies, positioning science, technology, and innovation as permanent drivers of social inclusion, the valorization of work, and territorial cohesion.

## PRIORITY AREA: Inclusion and Diversity

**Justification:** Brazilian scientific and technological output still reflects inequalities based on gender, race/ethnicity, region, class, and disability, which limit the country's potential for innovation and perpetuate historical exclusions. For ST&I to serve as an instrument of social justice, it is essential to expand access, retention, and quality training for women, Black people, Indigenous peoples, Quilombolas, people with disabilities, traditional communities, and LGBTQIA+ populations at all levels of the scientific and technological chain. The inclusion of these populations—historically excluded from formal opportunities for training, funding, scientific careers, and technological development—strengthens the diversity of perspectives, broadens problem-solving approaches, and drives innovation. The development of technical, digital, and scientific skills, combined with safe and non-discriminatory environments, is a prerequisite for a truly democratic and geographically balanced SNCTI.

**Objective:** To institutionalize an inclusive and geographically balanced model of ST&I that ensures access, capacity building, retention, and advancement for populations historically excluded from science, technology, and innovation. To promote equity across gender, race/ethnicity, geographic region, and disability throughout the entire knowledge production chain, thereby strengthening innovation, social justice, and epistemic plurality.

### Guidelines:

- Establishing the National Policy on Inclusion and Diversity in ST&I, with public targets, funding instruments, and monitoring mechanisms;
- Expanding scientific, digital, and technological training programs aimed at women, Black people, Indigenous peoples, Quilombola communities, traditional communities, people with disabilities, and LGBTQIA+ groups, from elementary school through graduate school;

- Implementing care and parenting policies (leave, daycare, support for dependents), coordinated with initiatives to combat harassment, racism, ableism, misogyny, and LGBTphobia, through ombudsman offices, support channels, and prevention policies;
- Expanding incentives for the participation of girls and women in science, engineering, computing, and STEAM fields—Science, Technology, Engineering, Arts, and Mathematics—through mentoring programs, scholarships, training, and leadership opportunities;
- Encouraging international cooperation to promote diversity, equity, and inclusion in ST&I;
- Creating mechanisms to ensure the retention and advancement of historically excluded groups in scientific and technological careers; and
- Promoting the production of data, indicators, and studies on diversity, inclusion, harassment, discrimination, and regional inequalities in ST&I.

### **What Brazil needs:**

- A national framework for inclusion and diversity in ST&I, with targets, indicators, and public oversight;
- Comprehensive programs for training, retention, and academic and professional advancement for historically excluded populations;
- Institutional mechanisms to prevent and address violence and discrimination in research and innovation environments;
- Integrated databases on diversity in ST&I, disaggregated by gender, race/ethnicity, region, and disability; and
- A network for training, mentoring, and support that ensures access to and advancement in scientific and technological careers.

### **Timeframe:**

**By 2030:** Implement a national policy; incorporate diversity goals into calls for proposals and advisory boards; expand scholarships, retention initiatives, and training programs; institutionalize prevention and support mechanisms.

**By 2034:** Increase the presence of historically excluded groups in all areas of ST&I; promote parity and representation in decision-making bodies; recognize and consolidate diversity as a foundational principle of the SNCTI.

## PRIORITY AREA: Popularization and Advocacy of Science

**Justification:** The popularization of science is a strategic prerequisite for strengthening the democracy of knowledge, fostering critical thinking, and combating misinformation that affects public decision-making, public health, and social trust in institutions. As a central dimension of informational sovereignty, high-quality scientific communication bridges the gap between science and society, broadens access to evidence, values scientific work, and ensures the country's cognitive and cultural autonomy. It is also a territorial agenda: the democratization of knowledge must reach urban peripheries, public schools, rural regions, Indigenous territories, quilombola communities, and traditional communities, while respecting local knowledge, linguistic diversity, and regional realities. Popularizing science, therefore, means defending democracy, strengthening evidence-based public policies, and promoting equitable access to knowledge, thereby overcoming structural and cultural inequalities.

**Objective:** To make the popularization and advocacy of science a foundational policy of the SNCTI, ensuring professional public communication, democratic access to knowledge, the promotion of critical thinking, and integration among scientific production, culture, education, and society. To consolidate the democratization of scientific knowledge as a political, cultural, and civilizational value—not merely a technical one—by guiding ongoing efforts toward inclusion, social participation, and informational sovereignty.

### Guidelines:

- Establishing programs to promote and provide continuing education for science communicators;
- Supporting museums, science centers, science fairs, and science competitions, with a special focus on outlying and rural regions;
- Promoting partnerships with public and community media and the strategic use of digital media and influencers;
- Developing science and media literacy programs that bring together schools, universities, and local media;
- Establishing regional science communication networks involving state departments, ICT, and public institutions;
- Expanding research on public perceptions of science to guide evidence-based policies; and
- Guaranteeing access to scientific data and public repositories, ensuring transparency and usability.

### **What Brazil needs:**

- An integrated national plan for the popularization of science and a national observatory for scientific information and communication in ST&I;
- An integrated network for science communication, connecting scientific, cultural, educational, and community institutions;
- Regional centers for science communication, with infrastructure for the production of digital, audiovisual, and accessible content;
- Ongoing training programs in science communication, media literacy, and combating misinformation;
- National repositories and platforms to democratize access to ST&I data, publications, and content; and
- Indicators and monitoring systems regarding access to knowledge, public participation, and the social impact of science popularization.

### **Timeframe:**

**By 2030:** Implement and consolidate the Integrated National Plan for the Popularization of ST&I; establish a national observatory for scientific information and communication; create structured regional networks; expand the presence of science in public and community media.

**By 2034:** Consolidate professionalization in science communication (permanent careers and funding); promote the full integration of science popularization as a cross-cutting ST&I policy, ensuring democratic access, territorial diversity, and the strengthening of scientific culture.



## Part III:

# Governance and Guidelines for the Implementation of ENCTI





**Part III of this document consists of**

**Chapter 8 — The Challenges Facing  
the National System for Science,  
Technology, and Innovation (SNCTI);**

**Chapter 9 — Conclusion and  
General Recommendations; and  
the references consulted in the  
preparation of this document.**





## Challenges Facing the National System for Science, Technology, and Innovation (SNCTI)

*This chapter addresses the challenges faced by the SNCTI as it seeks to become a pillar of a new, sustained cycle of development based on the restoration and affirmation of national sovereignty. It outlines pathways for the consolidation, strengthening, and integration of the System, with an emphasis on governance, sustainable financing, monitoring and evaluation mechanisms, and reducing territorial inequalities.*

### 8.1 The Importance of the SNCTI for the Implementation of the ENCTI

The ENCTI will be effective only if it is supported by coordinated action among the institutions that make up the SNCTI. More than just an institutional or regulatory framework, the SNCTI is a living organism composed of actors, relationships, flows of knowledge, and resources that gives concrete form to the national ST&I policy. Within the SNCTI, the ENCTI's strategic guidelines are translated into public policies, programs, and outcomes that directly impact the country's development.

The SNCTI cooperatively coordinates the federal government (with its various ministries, led by the MCTI), states and municipalities, ICT—including universities and federal institutes—the business sector, Research Support Foundations (FAP), funding agencies, regulatory bodies, and civil society.

The ST&I sector is an essential foundation for national sovereignty. Ensuring its stability, continuity, and strengthening is essential for Brazil to expand its capacity for innovation, reduce external vulnerabilities, and strengthen its strategic role on the global stage.

The legal basis for the National Science, Technology, and Innovation System (SNCTI) lies in the 1988 Federal Constitution (Brazil, 1988), which establishes the promotion of science and innovation as a duty of the State (Art. 218). This was reinforced by Constitutional Amendment No. 85/2015, which recognized innovation as a driver of economic and social development. It is therefore necessary to adapt this legal basis to promote its full consolidation by integrating the actors of the SNCTI, while ensuring its flexibility and respecting the operational limits inherent in a federal system.

In addition to the foundation of science and technology, innovation ecosystems are fundamental to translating research results into business and government initiatives, generating knowledge, value, and development.

**Strengthening this ecosystem requires:**

- Appropriate and consistent incentives to increase business investment in R&D and foster partnerships between ICT and domestic companies to develop innovation projects;
- Establishing and maintaining adequate laboratory infrastructure at ICT to support innovation projects in companies;
- Support for incubators, accelerators, technology parks, and innovation hubs;
- Structural measures to reduce regional inequalities;
- Encouragement of interdisciplinary collaboration and innovation geared toward national missions; and
- Promotion of data and results sharing, while safeguarding the protection of personal data and copyrights, as well as the sovereignty of strategic data.

With coordinated governance and modern infrastructure, the country can consolidate inclusive and sustainable innovation ecosystems, expanding its integration into global value chains. A key challenge for the SNCTI is securing funding sources to enable increased investment in science, technology, and innovation in the country. The continuity and sustainability of these sources ensure the System's expansion, including not only public-sector investments but also mechanisms and incentives that leverage broader business-sector investments in innovation.

## 8.2 Monitoring, Evaluation, and Temporality

The ENCTI 2024–2034 establishes monitoring, evaluation, and periodic review as structural components of its governance and overall effectiveness over the ten-year horizon. The Strategy guides the adoption of a systematic and transparent monitoring model—based on indicators aligned with its strategic objectives, including territorial impact indicators aimed at reducing regional inequalities—and the conduct of periodic reviews that enable adjustments, course corrections, and institutional learning throughout its implementation. The details of the ENCTI monitoring and evaluation process will be presented in the PACTI and should distinguish among capacity, performance, and impact indicators using well-defined criteria, establish a mechanism for continuous evaluation, and provide for a comprehensive review of the Strategy's implementation in 2029.

## 8.3 Challenges for the Integration and Governance of the SNCTI

Strengthening the SNCTI requires overcoming its main structural challenges: governance, funding, and regional inequalities, which will lead to the system's full integration. This section outlines some essential conditions for strengthening the system and for the sustainable implementation of the ENCTI.

### 8.3.1 Conditions for Strengthening and Operating the SNCTI

Based on the above, for the SNCTI to act effectively and continuously in implementing the ENCTI 2024–2034, it is essential to ensure a set of conditions that guarantee governance, integration, and systemic sustainability:

1. **Continuous and participatory governance** – institutionalizing permanent channels for dialogue and coordination among the government, the scientific community, the business sector, and civil society;
2. **Legal certainty and reduction of bureaucracy** – the proper implementation and improvement of the Legal Framework for Science, Technology, and Innovation, with support from the CGU and the TCU to harmonize interpretations and simplify procedures;
3. **Ongoing monitoring and evaluation** – the creation of systems of social, economic, and environmental impact indicators, monitored by independent bodies, ensuring transparency and continuous improvement of policies;
4. **Sustainable and diversified financing** – the guarantee of budgetary stability and long-term predictability, with diversification of funding sources and the creation of new mechanisms—such as endowment funds, co-investments, and tax incentives—that expand public and private investment in ST&I;
5. **Federative outreach** – strengthening the leading role of states and municipalities, with research support foundations serving as hubs for promotion and federative and territorial coordination;
6. **Technical and technological education** – the integration of vocational training, applied research, and regional innovation, ensuring complementarity with universities and research centers; and

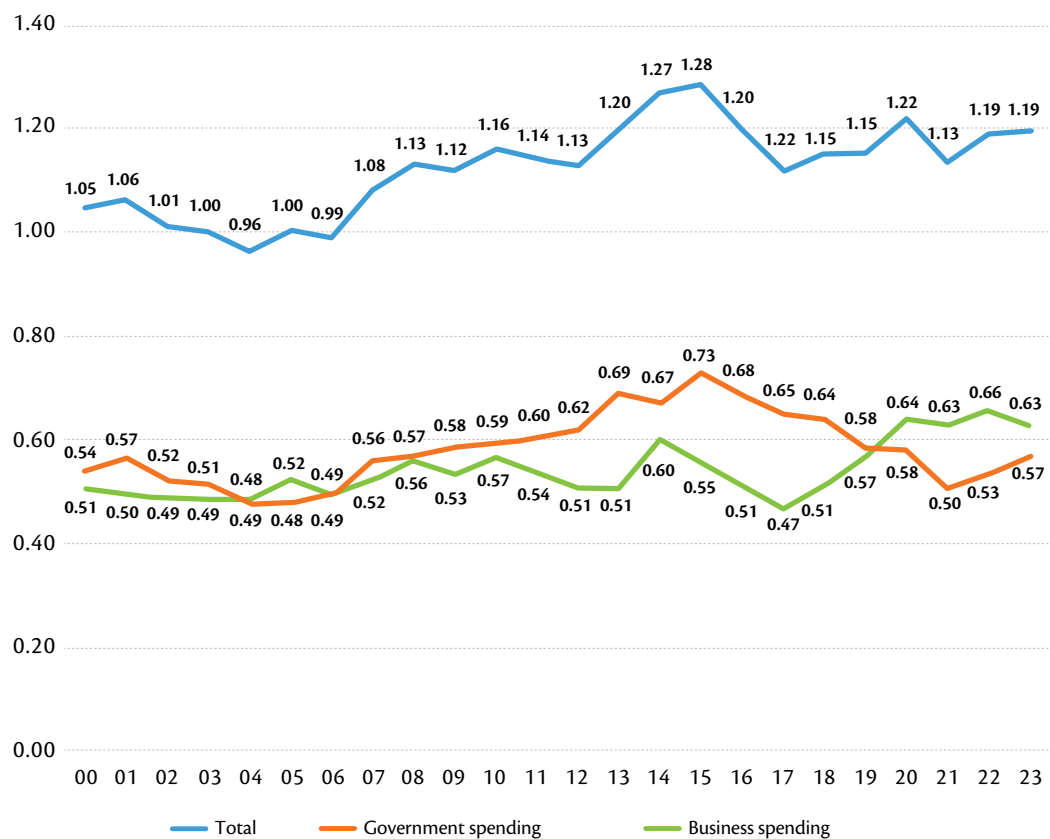
4. **Interministerial integration** – the cross-cutting implementation of ST&I policies in strategic areas (education, health, the environment, energy, defense, industry, and social development), ensured through governance committees and joint plans.

### 8.3.2 Reducing Social and Regional Inequalities in the SNCTI

Reducing social and regional inequalities is essential for national sovereignty and for consolidating a sustainable and inclusive development model. In recent decades, Brazil has made progress in creating regional scientific institutions, expanding federal universities and institutes into the country's interior, and fostering the emergence of technology-based local productive arrangements, which have broadened access to knowledge and innovation beyond major urban centers. These advances have consolidated a more diverse research network and contributed to the development of regional scientific and technological capacities that are promoting—albeit still tentatively—a reduction in the inequalities generated over decades. However, structural challenges persist, undermining the territorial equity of ST&I policy. Regions such as the Amazon, the Semi-Arid region, and the coastal areas still face low scientific density, limited infrastructure, restricted digital connectivity, and socioeconomic and environmental vulnerabilities. In these areas, the concentration of natural resources and traditional knowledge coexists with historical inequalities in access to education, innovation, and public investment. The ENCTI 2024–2034 reaffirms the commitment to use ST&I as a tool for cohesion and inclusion. The Strategy should aim to create Regional Development Centers and Territorial Innovation Hubs, urban living labs focused on sustainable and inclusive solutions, programs for specific actions in strategic territories, and support for social technologies and local productive arrangements. The challenge at hand is to transform these initiatives into ongoing government policies, with effective social participation. Progress will depend on Brazil's ability to reduce historical disparities, consolidate ST&I infrastructure nationwide, and transform innovation into a vector for social justice and sovereignty.

### 8.3.3 Boosting Investment in Research, Development, and Innovation

Given its importance to the entire system, we highlight research and innovation funding in this section. Funding for science, technology, and innovation (ST&I) in Brazil comes from various sources and has grown over the past three decades, but it remains far from sufficient to sustain a new cycle of sustainable and sovereign development based on national knowledge. Figure 8.1 shows the evolution of R&D investments relative to Brazil's GDP from 2000 to 2023.



**Figure 8.1 – National Research and Development expenditure as a percentage of GDP, by sector, 2000–2023 (in %)**

**Source:** National Science, Technology, and Innovation Indicators 2025, MCTI.

The graph in Figure 8.1 shows modest growth, with investments rising from 1% of GDP to nearly 1.2% over two decades. This trend contrasts with the performance of countries that have built more robust and advanced ST&I systems, such as the United States, Germany, China, and South Korea.

Figure 8.2 Evolution of the percentage of R&D expenditures relative to GDP in selected countries, compared with Brazil.

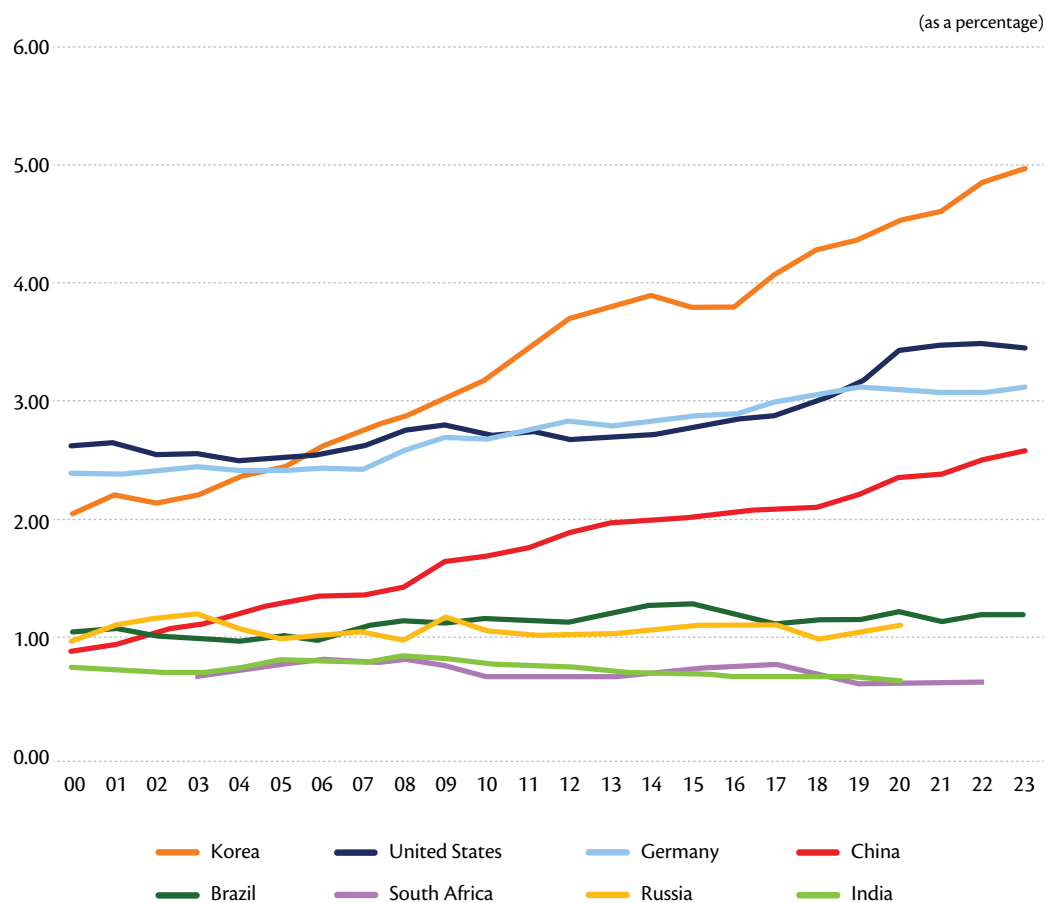
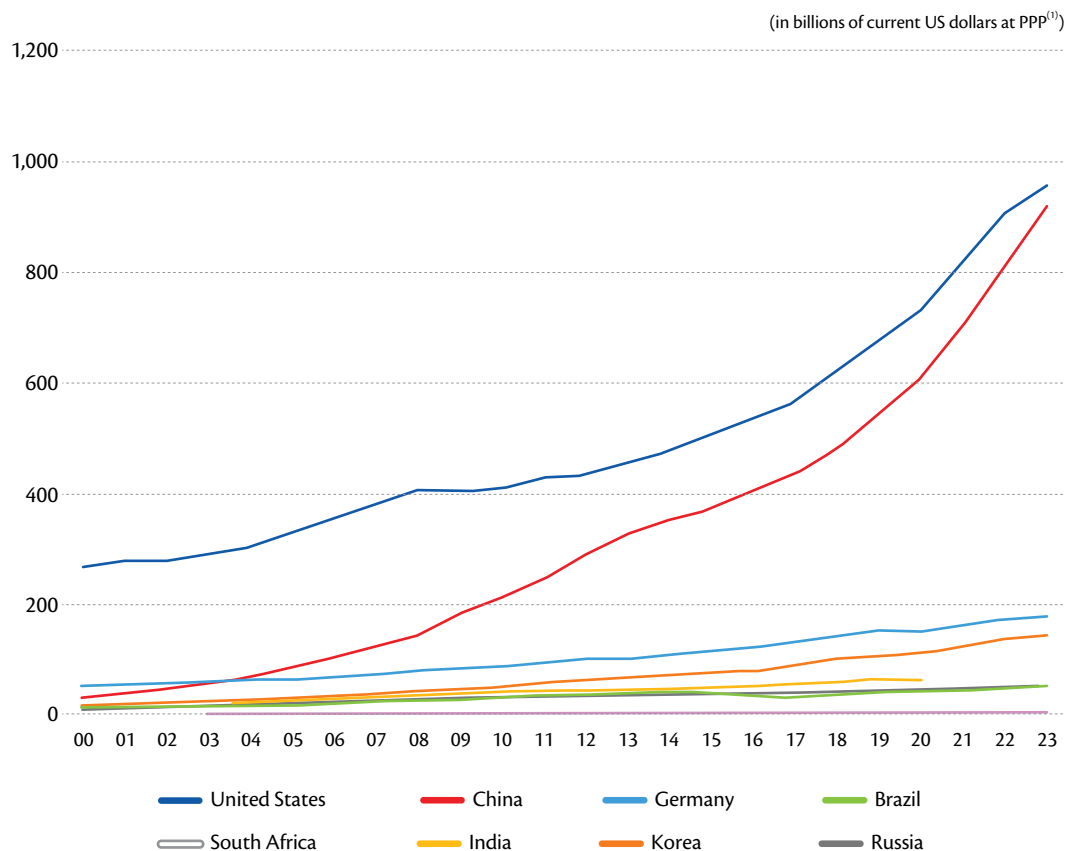


Figure 8.2 – National Research and Development expenditure as a percentage of GDP, by selected country, 2000–2023 (in %)

Source: National ST&I Indicators 2025, MCTI.

When international data are analyzed based on purchasing power parity (PPP), the disparity becomes even more striking (Figure 8.3).



**Figure 8.3 – National Research and Development expenditure based on Purchasing Power Parity (PPP) (in billions of current PPP dollars)**

**Source:** National ST&I Indicators 2025, MCTI.

As a final example, the graph in Figure 8.4 compares government and private-sector expenditures across various countries, including Brazil. While Brazil maintained a level that can be considered constant, with little variation in the trend of spending in both cases (government and business), the United States, Japan, China, and South Korea substantially increased business investments, with China and South Korea recording the most significant increases.

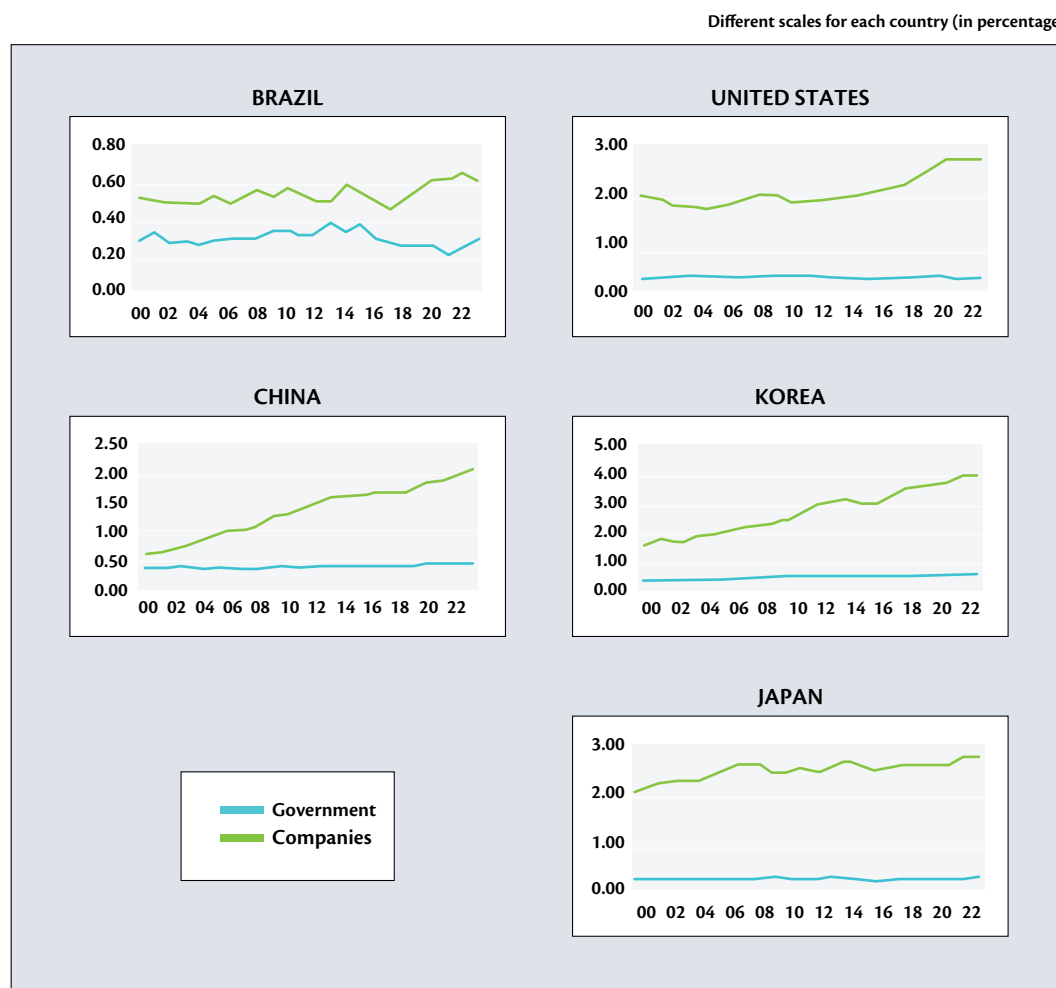


Figure 8.4 – Government and business Research and Development expenditure as a percentage of GDP for Brazil, the United States, China, South Korea, and Japan, 2000–2023

Source: National Science, Technology, and Innovation Indicators 2025, MCTI.

It is worth noting that private sector R&D investments in Brazil in 2023 (0.6% of GDP) were twice as large as government investments (0.27% of GDP). In the United States, the same level of government investment (0.27% of GDP) was accompanied by private-sector R&D investments of 2.7% (a factor of ten). In South Korea, this multiplier effect was eightfold, and in China and Germany, it was fivefold in the same year. These data reveal that the sustained expansion of R&D investments in Brazil requires adopting more robust, consistent, and effective mechanisms and incentives to promote domestic corporate investment in Research, Development, and Innovation.

### 8.3.4 Public Investment in Science, Technology, and Innovation

Public investment plays a central role in supporting scientific and technological research in the country. However, the budgets of CNPq and Capes remain below the levels needed to fulfill their missions, and many states do not comply with the legal and regulatory requirements for allocating resources to their respective state research funding agencies (FAP). This directly impacts the training of new scientists and the operation of research institutions. Universities and research institutes continue to operate under severe budgetary constraints at the federal, state, and municipal levels. The lack of funding poses a risk of losing research teams, operational shutdowns, and the interruption of historical data series—elements that are fundamental to national scientific sovereignty. Brazil should adopt public funding rules and mechanisms that treat ST&I investments differently, ensuring their release, continuity, expansion, and multi-year predictability, as well as intergovernmental co-financing and the territorial alignment of funding initiatives. Germany, South Korea, and Chile have already established sovereign funds and differentiated R&D regimes, recognizing the productive nature of these investments. Brazil should follow this path, treating funding for the ST&I sector as a strategic capital investment, rather than as a current expenditure, subject to budget cuts and discontinuities.

### 8.3.5 Business Investment and Innovation

Business investment in ST&I is an indispensable prerequisite for a modern, productive, and competitive economy. However, as we saw previously, the Brazilian business sector still invests relatively little in R&D, concentrating its investments in a few large companies and traditional sectors. To change this situation, the framework of incentives for innovation should be strengthened, with instruments that offer credit on competitive terms, legal certainty, stability, and effective counterparts, making business investments in Research, Development, and Innovation more attractive than financial investments disconnected from productive activities. In addition to public funding for business innovation, the Good Law, the Informatics Law, and other tax incentive mechanisms must be improved and expanded, so as to stimulate continuous business investment in Research, Development, and Innovation, thereby contributing to technological advancement, the creation of skilled jobs, and the strengthening of the national productive base. The success of the effort to promote Brazil's development and reindustrialization on new technological foundations depends largely on a strategic alliance among the public, business, and ICT sectors, supported by a consistent, integrated national strategy.

## 8.4 Conclusion

The SNCTI serves as the vector that integrates and drives the various dimensions of the national ST&I policy, translating the ENCTI into concrete action.

Through coordination among the government, scientific institutions, the business sector, and society, the system converts strategy into results, ensuring that the country remains on course toward a sustainable, inclusive, and sovereign development model.

In addition to greater integration among SNCTI stakeholders—a prerequisite for its success—the ENCTI 2024–2034 proposes a simultaneously optimistic and realistic approach to increasing R&D investments as a share of Brazil's GDP: a reassessment of public and private financing mechanisms, with the adequacy, expansion, or introduction of new instruments that offer legal certainty, continuity, and effective counterparts. Such changes are essential for the ST&I sector to become a fundamental pillar of building a fair, developed, and sovereign Brazil in the 21st century.





## Conclusion and General Recommendations

The National Strategy for Science, Technology, and Innovation (ENCTI) 2024–2034 is established as a state instrument to build a national initiative that integrates knowledge, productive development, social inclusion, and technological autonomy. Chapters 1 through 3 provided a general introduction to the Strategy (Chapter 1), national progress and challenges (Chapter 2), and the international landscape (Chapter 3).

The mission and vision of ENCTI—already described in the introduction in Chapter 1—make it clear that science and innovation are not ends in themselves, but rather tools for promoting social justice, economic prosperity, and strategic autonomy. The document emphasizes that a just Brazil is one that democratizes access to knowledge and overcomes historical inequalities; a developed Brazil is one that bases its progress on science and innovation, with environmental responsibility and social balance; and a sovereign Brazil is one capable of mastering critical technologies, protecting its interests, and autonomously defining its development path.

By synthesizing the contributions of the 5th CNCTI and the body of work spanning four decades of public policies ST&I, the Strategy reaffirms that science, technology, and innovation constitute an essential pillar of national sovereignty and an indispensable path for Brazil to take a leading role in the knowledge economy.

Based on this understanding, the ENCTI addresses key challenges for the future of ST&I policy in the country, such as the need to significantly increase national investment in research and development and to reach the target of 2% of GDP for R&D—a goal that depends crucially on increased private-sector investment, in line with the practices of the world’s most innovative economies. The Strategy also reaffirms the importance of strengthening the SNCTI, improving the legal framework, and consolidating national technological sovereignty, and is structured as a robust state policy guided by broad social participation, capable of addressing historical vulnerabilities and promoting scientific and technological development aligned with the country’s interests.

In this context, it should be recognized that funding for ST&I cannot be viewed exclusively from a short-term perspective. The framework that seeks to reduce funding instruments—such as the FNDCT’s repayable loans administered by Finep—to the notion of an “implicit subsidy” disregards their nature as strategic investments and their foundational role in generating productive capacity, skilled jobs, and industrial innovation. National and international evidence demonstrates that every Brazilian Real (R\$) invested in science and technology generates multiplier effects on the economy, boosting productivity, stimulating industrial chains, and strengthening the country’s competitiveness. The ENCTI is based on the understanding that public investment in ST&I constitutes an essential asset

for development, with medium- and long-term economic, social, and technological returns, and that subjecting it strictly to conventional fiscal adjustment logic compromises the State's ability to foster innovation, reduce structural vulnerabilities, and sustain a sovereign reindustrialization project. Thus, the Strategy affirms the need for governance, evaluation, and transparency models that recognize the systemic returns on investment in ST&I, preventing restrictive approaches from undermining the achievement of its strategic objectives and the full fulfillment of national development missions.

In this regard, the Strategy's four structural axes, detailed in Chapters 4 through 7, outline a clear path for the coming decade. Axis I (Chapter 4) organizes and classifies the scientific and technological areas in which Brazil already exercises leadership, has established excellence, or requires strategic intervention, thereby enabling investments to be directed according to the maturity and potential of the SNCTI. Axis II (Chapter 5) integrates ST&I policy with the missions of NIB (Brazil, 2024e), linking innovation, reindustrialization, and productive competitiveness on sustainable technological foundations. Axis III (Chapter 6) directly addresses vulnerabilities to Brazil's sovereignty in critical sectors, strengthening national autonomy and reducing structural dependencies in this area, and Axis IV (Chapter 7) emphasizes that science must serve society, guiding actions to overcome inequalities, guarantee rights, expand capabilities, and promote population well-being, thereby reaffirming the social character of ST&I policy.

Chapter 8 of the document shows that only a robust, integrated, and financially stable National ST&I System is capable of transforming strategic guidelines into concrete results—results that expand scientific capacity, stimulate endogenous innovation, strengthen reindustrialization on new technological foundations, and address the challenges of the energy, digital, and ecological transitions. This effort requires institutional stability, cooperative governance, diversification of funding sources, and a commitment to federalism, as highlighted in the analyses of the SNCTI's structural role.

Thus, ENCTI 2024–2034 envisions a future in which science, technology, and innovation underpin an inclusive, sustainable, and competitive development model that strengthens Brazil's presence on the global stage and tangibly improves the lives of its people. With a long-term strategic vision and a commitment to social transformation, ENCTI reaffirms its *raison d'être*: to guide the country in building a truly fair, developed, and sovereign Brazil.

In this context, it becomes evident that the consolidation of a State Strategy for ST&I depends not only on well-formulated guidelines but, above all, on the SNCTI's capacity to operate in an integrated, stable, and results-oriented manner. Recognizing this condition is essential to understanding that the effective implementation of the ENCTI rests on the vitality of the SNCTI, whose consolidation is a prerequisite for transforming strategic ambition into operational capacity.

The implementation of the ENCTI 2024–2034 therefore requires a governance, funding, monitoring, and execution framework that is consistent with its 10-year timeframe and the complexity of the challenges it addresses. In line with the deliberations of the 5th CNCTI, the operationalization of governance mechanisms, interministerial and federative coordination, the framework of funding instruments, monitoring and evaluation models, and the funding arrangements necessary for the execution of the ENCTI will be detailed and implemented within the framework of the Action Plan for Science, Technology, and Innovation (PACTI). This arrangement ensures coherence between strategy and implementation, preserves the nature of the ENCTI as a state instrument, and allows its execution to incorporate, in a dynamic and consensual manner, the recommendations of the scientific community, the country's international commitments, and institutional lessons learned over time.

## 9.1 The Fundamental Challenge of ENCTI: Reaching 2% of GDP in R&D Investment by 2034

The ENCTI identifies the challenge of ensuring that R&D investments reach 2% of national GDP by 2034. As international experience shows, this goal will not be achieved solely or predominantly through an expansion of government investments in R&D and related scientific and technical activities. As noted, such investments must be expanded and their continuity ensured, but they must also be capable of leveraging more robust private-sector investments in research and innovation. Only in this way can the Brazilian government fulfill its role as a catalyst and coordinator of a new cycle of sustainable and sovereign national development, based on endogenous knowledge and innovation.

To address this challenge realistically, the Strategy proposes the following as priority and foundational actions:

1. Amend the legal and regulatory framework for public funding in the field of ST&I so that it is treated as a strategic capital investment, free from freezes, cutbacks, or discontinuities;
2. Ensure the expansion and continuous maintenance of the resources necessary for the proper functioning of public ST&I institutions (universities, institutes, research units, public organizations, and companies);
3. Ensure constitutional minimum thresholds in the distribution of budgetary resources to critical and strategic areas that are part of the SNCTI, such as education and health, and the promotion of ST&I projects within its scope;

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4. Ensure the continuity and enforcement of legislation mandating the full annual release of revenues from the sources that make up the FNDCT and the identification of new revenue sources for the Fund, especially in areas marked by significant technological dependence;
  5. Increase the budgets of federal funding agencies, particularly CNPq and Capes;
  6. Expand support programs for startups and technology-based companies, as well as programs to share the higher risks of business innovation through economic subsidies;
  7. Expand the capacity of public agencies and banks—particularly FINEP and BNDES—to competitively provide credit for innovation projects by domestic companies;
  8. Ensure compliance with legal and regulatory provisions that allocate portions of state and municipal tax revenues to State Innovation Funds (FAP) and/or ST&I activities;
  9. Ensure that public investments are strategically focused on mission-driven, structural, and mobilizing programs and projects, as outlined in the four axes of the ENCTI 2024–2034, and expand partnerships and intergovernmental and intersectoral integration in their implementation;
  10. Significantly expand the use of public procurement, including technology procurement, to complete the cycle of business innovation by addressing national needs in strategic areas;
  11. Expand the scope, quality, and effectiveness of tax incentive mechanisms for business innovation, such as the Law of Good and the Informatics Law, ensuring that domestic companies fulfill their obligations and increase their investments in Research, Development, and Innovation; and
  12. Improve and consolidate the Legal Framework for ST&I, reduce bureaucratic barriers, and ensure greater institutional agility and flexibility in the management of public and private resources, to make operations in this area more open, effective, and adapted to the uncertainty inherent in environments governed by the logic of discovery and creation.

These structural measures are part of a broader set of recommendations for the implementation of the ENCTI, which we present below:

## 9.1.1 Recommendations for the Implementation of ENCTI 2024–2034

### 1. Governance, Planning, and National Coordination

1. Establish integrated and permanent governance for the Strategy, with central coordination by the MCTI and coordinated participation by ministries, states, the business sector, the ICT sector, and civil society;
2. Establish the Five-Year ST&I Action Plan as a key instrument for implementation, monitoring, evaluation, and revision of the ENCTI's objectives;
3. Strengthen the management structures of the SNCTI by expanding technical capacities, long-term planning, and strategic intelligence;
4. Ensure policy continuity by shielding structural initiatives from political cycles and fiscal instabilities;
5. Expand participatory governance mechanisms by incorporating conferences, councils, and thematic forums into the ENCTI review process;
6. Enhance the national integration of ST&I policies through inter-federative partnerships and by strengthening the FAP and Sectis;
7. Consolidate national ST&I metrics, using internationally comparable indicators and unified data systems;

### 2. Structural, Stable, and Strategic Financing

8. Ensure the predictability, stability, and expansion of the FNDCT's financial capacity, while preserving its role as the primary national instrument for structural investment;
9. Increase national investment in R&D to 2% of GDP, with a significant expansion of business investment, in line with standards in innovative economies;
10. Expand public-private partnerships and blended finance mechanisms for high-tech-risk projects;
11. Promote tax incentives to stimulate innovation, with regulatory stability and tax simplification;
12. Expand access to specific instruments supporting innovation in startups and technology-based companies, through economic grant programs, seed capital, and venture tech funding;
13. Treat R&D as an investment, not an expense, with specific tax rules for scientific and technological activities;
14. Ensure that ST&I activities are governed by a differentiated regulatory framework, recognizing their experimental and risky nature;
15. Encourage scientific philanthropy and endowment funds for universities and research centers;

### 3. Talent Development, Valorization, and Retention

16. Increase the value of research grants and create attractive career paths, thereby encouraging national talent to remain in the country;
17. Coordinate with the PNPG to align master's and doctoral training with national ST&I priorities, strengthening the integration of graduate studies with innovation ecosystems, industry, the public sector, and regional strengths, ensuring a policy for high-level training that is consistent with the country's strategic needs;
18. Create and/or expand national training programs in the priority areas of the four axes of the ENCTI;
19. Coordinate with the MEC and CAPES to align the PNE and the PNPG with the ENCTI, with the aim of expanding science education starting in basic education;
20. Create and/or expand large-scale professional retraining programs for the digital transition, with a focus on vulnerable workers;
21. Promote the training and inclusion of historically excluded populations in the SNCTI, addressing structural inequalities in the system;

### 4. Science-Technology-Innovation-Industry Collaboration

22. Bring the ICT sector and the business sector closer together through risk-sharing mechanisms and incentives for corporate R&D;
23. Expand support for cooperative innovation projects between the ICT sector and businesses;
24. Establish national innovation targets aligned with the NIB, with clear indicators and continuous monitoring;
25. Establish regulatory sandboxes for the priority areas of the four axes of the ENCTI;
26. Strengthen NIT and intellectual property centers, with legal and technical support for technology transfer;
27. Create an Integrated National Network of Innovation Ecosystems, connecting technology parks, incubators, and local productive arrangements;
28. Expand innovative government procurement policies, including technology commissions, encouraging domestic companies to develop solutions for the public sector and completing the cycle of public support for business innovation in the country;

### 5. Technological Sovereignty and Strategic Autonomy

29. Identify critical technologies and create national programs for each one, ensuring productive and technological mastery;

30. Expand policies on semiconductors, advanced manufacturing, and AI, with a long-term industrial plan;
31. Strengthen cybersecurity and digital integrity, including hardware, software, and local production of components;
32. Expand the Health Economic-Industrial Complex, reducing external dependencies and strengthening the production of biopharmaceuticals, vaccines, and medical equipment;
33. Protect environmental, genetic, and cultural assets as the foundation of bioeconomic and territorial sovereignty;

## 6. Social, Territorial, and Inclusive Development

34. Promote science to overcome inequalities, with programs focused on food security, health, mobility, employment, and digital inclusion, and strengthen local capacities to respond to climate, health, and social risks;
35. Create ST&I programs for vulnerable territories, national biomes, urban peripheries, and traditional communities;
36. Expand citizen science policies, with social participation in the production, interpretation, and use of knowledge, in order to integrate local knowledge, community practices, and social technologies;
37. Ensure digital accessibility and universal connectivity, reducing technological inequalities through public connectivity networks, productive digital inclusion, and widespread technological literacy;
38. Foster social innovation, especially in public policies, essential services, and territorial management, to promote scalable solutions in areas such as education, health, mobility, public safety, and the environment;
39. Promote, within the framework of Science, Technology, and Innovation (ST&I), training and professional qualification strategies that develop strategic skills for the digital, energy, and productive transitions, contributing to higher-skilled jobs, productivity gains, and productive inclusion;
40. Coordinate with other national education and labor policies (such as the National Plan for Professional Qualifications [PNPG] and vocational training policies) to align advanced training programs with long-term technological and social demands, while respecting ministerial competencies and reinforcing the role of Science, Technology, and Innovation (ST&I) as a driver of strategic qualifications;
41. Guide the production of knowledge and technologies that contribute to expanding opportunities, reducing inequalities, and supporting redistributive policies led by other ministries, reinforcing the role of ST&I as a driver of social justice;
42. Promote research, development, and innovation in sustainable technologies applied to civil construction and urban planning, encompassing efficient, low-cost solutions aligned with the principles of smart urbanism, in order to support housing and urban policies implemented by the relevant agencies;

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- 43. Promote studies and technologies related to urban mobility, intelligent transportation systems, sustainability, and land-use planning, contributing to evidence-based solutions and innovation in public policies coordinated by other sectors;
  - 44. Support scientific research and technological development that contribute to violence prevention, data analysis, information systems, and technologies to support public safety management, while preserving fundamental rights and guarantees and working in partnership with the agencies responsible for this area;
  - 45. Encourage ST&I projects that integrate scientific knowledge, local economic strengths, and innovative solutions to urban and rural challenges, thereby strengthening territorial capacities and promoting inclusive regional development;

## **7. Scientific infrastructure, laboratories, and major equipment**

- 46. Support the maintenance, modernization, and expansion of research infrastructure at universities, research institutes, and other science, technology, and innovation (ST&I) entities;
- 47. Ensure the maintenance, upgrading, and expansion of major facilities, such as Sirius and other strategic infrastructure in the country;
- 48. Create national programs for multi-user laboratories, expanding access for ST&I entities and companies in underserved regions;
- 49. Expand data and supercomputing infrastructure, ensuring high-capacity connectivity and integration with international networks;
- 50. Support regional technology centers focused on local strengths (bioeconomy, national biomes, decarbonization, digital agriculture);
- 51. Establish interregional consortia for science, technology, and innovation (ST&I) infrastructure, modernizing and sharing strategic laboratories;

## **8. International Cooperation in Science, Technology, and Innovation**

- 52. Expand Brazil's presence in international research networks, major experiments, and global platforms;
- 53. Expand cooperation in science, technology, and innovation (ST&I) in Latin America and the Caribbean, with integrated initiatives on biodiversity, climate, energy, and industrialization;
- 54. Create programs to attract international talent by providing funding to centers of excellence in Brazil;
- 55. Improve intellectual property agreements, prioritizing technological protection and global market integration;
- 56. Incorporate multilateral guidelines on ethical AI, energy transition, and open science into national policies;

- 57. Expand research networks, dual degree programs, South-South cooperation, and the mobility of talent within the context of the internationalization of science;

## 9. Popularization and advocacy of science

- 58. Create an Integrated National Network for the Popularization and Promotion of Science, covering all levels of the Federation;
- 59. Leverage digital technologies for the dissemination of science, using open platforms and accessible content;
- 60. Promote widespread scientific literacy by integrating school curricula, the media, and regional policies;
- 61. Encourage museums, science fairs, and science competitions, expanding participation by young people and minorities;

## 10. Monitoring, evaluation, and continuous learning

- 62. Establish a permanent evaluation system for ENCTI, with indicators, targets, and biennial reviews;
- 63. Map the economic, social, and environmental impacts of science and innovation;
- 64. Create an integrated system of ST&I data to support the production of strategic intelligence, international comparisons, and technology foresight;
- 65. Adopt open government practices, with transparency, public dashboards, and periodic reports.

In light of this comprehensive set of principles, challenges, and strategic guidelines, the ENCTI 2024–2034 reaffirms that the future of ST&I in Brazil depends on the country's ability to translate guidelines into coordinated action, sustained investments, and long-term policies. The effective implementation of the Strategy requires robust mechanisms for planning, monitoring, and continuous evaluation that can guide priorities, ensure coherence among actions, and guarantee institutional stability throughout the decade. Achieving the established goals requires ongoing government effort, federal commitment, expanded social participation, and integration with the business sector in order to progressively consolidate a robust, dynamic, and effective National ST&I System. Thus, the structural actions and recommendations already presented constitute the necessary foundation for the Strategy to move beyond being a mere vision of the future and establish itself as the driving force behind a national project based on knowledge, innovation, and social justice. They outline, in concrete terms, the path capable of leading Brazil toward fair, sustainable, and sovereign development.



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# Glossary





## Glossary

**Accelerating Innovation** – A strategy to reduce the time between scientific research and technological application, fostering the development of domestic solutions.

**Agenda 2030** – A global UN plan that establishes the 17 Sustainable Development Goals (SDGs), serving as a reference for Brazilian public policies.

**Agroecology** – A production model that integrates sustainable agricultural practices, biodiversity, and traditional knowledge.

**Amazon Bioeconomy** – A strategy that combines biodiversity, local knowledge, and scientific innovation in the Amazon.

**Applied Research** – Research aimed at solving concrete problems.

**Basic Research** – The production of fundamental knowledge without immediate application.

**Biodiversity** – The variety of organisms and ecosystems, which forms the basis for environmental balance and scientific knowledge.

**Bioeconomy** – An economic model that uses biological resources sustainably to generate innovation, income, and jobs.

**Blue Bioeconomy** – Sustainable use of marine and coastal resources to generate value and innovation.

**Circular Economy** – A production system that prioritizes reuse, recycling, and waste reduction.

**Citizen Science** – A partnership between amateurs and scientists in collecting data for scientific research, using participatory methodologies developed by citizens or in collaboration with professional researchers.

**Clean Energy** – Energy sources with low environmental impact, such as solar, wind, and biomass.

**Climate Governance** – A set of policies and actions aimed at mitigating and adapting to climate change.

**Climate Justice** – A principle that seeks equity in the responsibilities and impacts of climate change.

**Convergent Technologies** – The integration of nanotechnology, biotechnology, information and communication technologies, and cognitive sciences.

**Creative Economy** – A sector based on culture, art, innovation, and knowledge.

**Data Economy** – The generation of value from data and digital information.

**Decarbonization** – Reduction of carbon emissions in production and energy processes.

**Digital Government** – Modernization of public administration based on data and digital services.

**Digital Inclusion** – Democratization of access to technologies and digital skills.

**Digital Sovereignty** – National control over data, platforms, and digital infrastructure.

**Digital Transformation** – Adoption of digital technologies across all sectors of the economy and government.

**Diversity in Science** – Inclusion of different social groups in the production and management of knowledge.

**Endowment Funds** – A long-term financing mechanism for ST&I.

**Energy Transition** – The replacement of fossil fuels with renewable energy sources.

**Environmental Sovereignty** – Protection of natural heritage and autonomy over ecological resources.

**Ethical Use of Technology** – Technological development guided by human rights and social responsibility.

**Family Farming** – A family-based production system that ensures food security, income generation, and rural sustainability.

**Federative Coordination** – Cooperation among the federal government, states, and municipalities for the decentralized implementation of public policies.

**Food Sovereignty** – The right to define one's own agricultural policies, with an emphasis on family farming and sustainability.

**Foresight** – A tool for forecasting the future to inform strategic planning in ST&I.

**Gender Equity** – The principle and practice of promoting justice among people of different genders by recognizing the historical, social, and cultural inequalities that particularly affect women and girls.

**Gender Mainstreaming** – The incorporation of a gender perspective into all stages of policy formulation.

**Green Economy** – Economic growth combined with environmental sustainability.

**Green Reindustrialization** – A process of productive modernization based on clean technologies and sustainable practices, aligned with the energy transition and the NIB.

**Health Economic-Industrial Complex (CEIS)** – A production system that integrates research, innovation, production, and health services.

**Impact Economy** – A model that seeks economic returns combined with positive social and environmental impact.

**Industry 4.0** – Intelligent automation based on the Internet of Things (IoT), AI, and robotics.

**Innovation Ecosystem** – An interconnected network of actors and institutions that promote innovation.

**Innovation Ecosystems** – Ecosystems that connect universities, businesses, government, and civil society around innovation.

**Innovation Governance** – A management framework that regulates and encourages interaction among the government, businesses, and society.

**Integrated Information Management** – Coordination of data and systems to support public policies and strategic decisions.

**Just Transition** – A process of sustainable change that ensures social protection for workers.

**Legal Amazon** – A strategic region for policies on sustainability, the bioeconomy, and environmental sovereignty.

**National Strategy for Science, Technology, and Innovation (ENCTI – 2024–2034)** – Toward a fair, developed, and sovereign Brazil. **Smart Cities** – Urban environments that use digital technologies for sustainability, governance, and inclusion.

**Open Data Infrastructure** – Platforms and standards that ensure public and interoperable access to government information.

**Open Innovation** – Collaboration among businesses, universities, and government to share knowledge.

**Open Science** – A movement that promotes open access to scientific data, publications, and methodologies.

**Popularization of Science** – Participatory initiatives for social engagement in ST&I.

**Public Contract for Innovative Solutions (CPSI)** – A public procurement instrument provided for in the Legal Framework for Science, Technology, and Innovation.

**Regional Economic Block** – An alliance among countries for commercial, technological, and scientific integration.

**Regional Integration** – Scientific and technological cooperation among neighboring countries.

**Research Infrastructure** – Facilities and equipment that support the ST&I system.

**Science Diplomacy** – International cooperation in science and technology as a foreign policy tool.

**Science Education** – Education that fosters critical thinking and public understanding of science.

**Scientific Culture** – The social capacity to understand, use, and value scientific knowledge.

**Social Innovation** – Innovative solutions to social and environmental challenges.

**Social Participation** – Society's involvement in the development and monitoring of public policies.

**Social Technologies** – Solutions created in partnership with communities to generate positive social and environmental impact.

**Sociobiodiversity** – Biological and cultural diversity associated with traditional ways of life.

**Spin-off** – A company created based on research results, technological assets, knowledge, or skills developed within universities, science and technology institutes, or research organizations, with the goal of transferring, developing, and commercially exploiting innovations generated in these environments.

**Startup** – A nascent or early-stage organization characterized by an innovative, scalable, and repeatable business model that uses scientific and technological knowledge or new organizational arrangements to develop products, processes, or services, operating in environments of high uncertainty.

**Sustainability** – A principle that guides balanced practices in the economic, social, and environmental spheres.

**Sustainable Development** – A model that seeks a balance between economic growth, social justice, and environmental preservation.

**Sustainable Future** – A vision that integrates innovation, social equity, and environmental responsibility.

**Sustainable Regional Development** – Policies that link innovation with local strengths to reduce territorial inequalities.

**Technological Autonomy** – The capacity to develop and master strategic technologies without external dependence.

**Technological Sovereignty** – National autonomy in critical and digital technologies.

**Technology Foresight** – Identification of future trends and opportunities in innovation.

**Territorialization of Innovation** – A development strategy based on local strengths.

**Value Chains** – A set of integrated production stages that connect research, innovation, and sustainability to strengthen industrial competitiveness.

## Acronyms and abbreviations in this publication

|                     |                                                                                         |
|---------------------|-----------------------------------------------------------------------------------------|
| <b>ABC</b>          | Brazilian Academy of Sciences                                                           |
| <b>ANSN</b>         | National Nuclear Safety Authority                                                       |
| <b>Anvisa</b>       | National Health Surveillance Agency                                                     |
| <b>APL</b>          | Local Productive Arrangement                                                            |
| <b>BNDES</b>        | National Bank for Economic and Social Development                                       |
| <b>Capes</b>        | Coordination for the Improvement of Higher Education Personnel                          |
| <b>CCT</b>          | National Council for Science and Technology                                             |
| <b>CDESS</b>        | Council for Sustainable Economic and Social Development                                 |
| <b>CEIS</b>         | Health Economic-Industrial Complex                                                      |
| <b>CGEE</b>         | Center for Management and Strategic Studies                                             |
| <b>CGU</b>          | Office of the Comptroller General                                                       |
| <b>CNCTI</b>        | National Conference on Science, Technology, and Innovation                              |
| <b>CNEN</b>         | National Nuclear Energy Commission                                                      |
| <b>CNI</b>          | National Confederation of Industry                                                      |
| <b>Cepem/Sirius</b> | National Center for Research in Energy and Materials                                    |
| <b>CNPq</b>         | National Council for Scientific and Technological Development                           |
| <b>Concea</b>       | National Council for the Control of Animal Experimentation                              |
| <b>Conpes</b>       | National Council for Economic and Social Policy (Colombia)                              |
| <b>COP</b>          | Conferences of the Parties to the United Nations Framework Convention on Climate Change |
| <b>ST&amp;I</b>     | Science, Technology, and Innovation                                                     |
| <b>CTNBio</b>       | National Technical Commission on Biosafety                                              |
| <b>E-Digital</b>    | Brazilian Strategy for Digital Transformation                                           |
| <b>Embrapa</b>      | Brazilian Agricultural Research Corporation                                             |
| <b>Embrapii</b>     | Brazilian Industrial Research and Innovation Corporation                                |
| <b>FAP</b>          | Research Support Foundations                                                            |
| <b>Finep</b>        | Agency for the Financing of Studies and Projects                                        |
| <b>Fiocruz</b>      | Oswaldo Cruz Foundation                                                                 |
| <b>FNDCT</b>        | National Fund for Scientific and Technological Development                              |
| <b>HPC</b>          | High-Performance Computing                                                              |
| <b>AI</b>           | Artificial Intelligence                                                                 |

**ICT** | Scientific, Technological, and Innovation Institution  
**IF** | Federal Institutes of Education, Science, and Technology  
**INCT** | National Institute of Science and Technology  
**Inmetro** | National Institute of Metrology, Quality, and Technology  
**Inpa** | National Institute for Amazonian Research  
**Inpe** | National Institute for Space Research  
**INPI** | National Institute of Industrial Property  
**MCTI** | Ministry of Science, Technology, and Innovation  
**NIB** | Nova Indústria Brasil  
**NIT** | Technological Innovation Center  
**OECD** | Organization for Economic Cooperation and Development  
**PACTI** | Action Plan for Science, Technology, and Innovation  
**PBIA** | Brazilian Artificial Intelligence Plan  
**PITCE** | Industrial, Technological, and Foreign Trade Policy  
**PNE** | National Education Plan  
**Rhae** | Human Resources Program in Strategic Areas  
**RNP** | National Education and Research Network  
**SBPC** | Brazilian Society for the Advancement of Science  
**Sebrae** | Brazilian Micro and Small Business Support Service  
**Secti** | State Secretariat for Science, Technology, and Innovation  
**Senac** | National Commercial Apprenticeship Service  
**Senai** | National Industrial Apprenticeship Service  
**Sesi** | Social Service for Industry  
**SNCTI** | National System for Science, Technology, and Innovation  
**SUS** | Unified Health System  
**TCU** | Federal Court of Accounts  
**SUS** | Sistema Único de Saúde  
**TCU** | Tribunal de Contas da União.

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