FIRST BIENNIAL TRANSPARENCY REPORT OF BRAZIL

TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

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BRAZIL 2024

FEDERATIVE REPUBLIC OF BRAZIL

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MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION
ESPLANADA DOS MINISTÉRIOS, BLOCO E
https://www.gov.br/mcti/pt-br
CEP: 70.067-900 – Brasília – DF

F527 First biennial transparency report of Brazil to the United Nations Framework Convention on Climate Change. -- Brasília: Ministry of Science, Technology and Innovation, 2024.

216 p.: il.

ISBN: 978-65-5471-014-5

1. Climate change – Impact – Brazil. 2. Climate change – Mitigation – Brazil. 3. Paris Agreement. 4. Climate – Brazil I. Interministerial Committee on Climate Change.

CDU 551.583(81)

Ficha catalográfica elaborada por: Lorena Nelza Ferreira Silva – CRB-1/2474

INTRODUCTION

The Ministry of Science, Technology and Innovation (MCTI, Ministério da Ciência, Tecnologia e Inovação) - whose institutional view is "to play a leading role in the country's sustainable development through Science, Technology and Innovation" - coordinates the Brazilian Government's activities with a view to fulfilling its commitment to periodically report to the United Nations Framework Convention on Climate Change (UNFCCC), and more recently within the framework of the Enhanced Transparency Framework of the Paris Agreement, through updated information on various initiatives within the scope of the national climate agenda. To this end, the MCTI implements a technical cooperation project that raises international funds from the Global Environment Facility (GEF) and has the support of the United Nations Development Programme (UNDP) for its implementation.

In fulfilling this obligation of reporting to the UNFCCC, the country has submitted four previous editions of the National Communication document in 2004, 2010, 2016 and 2020, in addition to submitting four Biennial Update Reports in 2014, 2017, 2019 and 2020.

The preparation of this First Biennial Transparency Report, under the Paris Agreement, is a fundamental milestone in Brazil's commitment to tackling climate change. This is of the utmost importance to demonstrate, in a transparent and systematic way, the country's progress in implementing public policies aimed at mitigating and adapting to climate change, as well as accounting for greenhouse gas emissions and removals. Compliance with established international standards reinforces Brazil's credibility on the global stage, and provides essential inputs for the continuous improvement of national environmental policies, with a view to a sustainable development that is in line with international climate goals.

The chapters of this Report have been prepared in accordance with the Annex to Decision 18/CMA.1, Modalities, Procedures and Guidelines (MPGs) for the transparency framework for action and support and with Annex V to Decision 5/CMA.3, Guidance for operationalizing the modalities, procedures and guidelines for the enhanced transparency framework, both referred to in Article 13 of the Paris Agreement.

This is another important step in the coordination of Brazilian participation in the processes related to the transparency arrangements under the UNFCCC and the enhanced transparency framework for action and support under the Paris Agreement.

Luciana Barbosa de Oliveira Santos
Minister of Science, Technology and Innovation

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Communication from the National Focal Point to the UNFCCC

Ministry of Foreign Affairs

In line with its unbreakable commitment to transparency, one of the structural pillars of the UNFCCC, Brazil submits its first Biennial Transparency Report (BTR) in a timely manner. In the context of the country's renewed commitment to fighting climate change and to the multilateral regime, the process of drafting the BTR1 represents the mobilization of efforts by its entire public sector involved in environmental and climate policies. These efforts represent the reactivation of forces whose potential has only remained latent in recent years. The country is now strengthening itself once again, so that it can continue to play the global role that we are so proud of.

Brazil is and wishes to remain a climate and sustainable development powerhouse. Political setbacks in Brazilian history have not been able to obliterate the country's strength to play its global role in a new era of climate action. We reiterate our support to transparency arrangements under the UNFCCC, including the Enhanced Transparency Framework (ETF) under the Paris Agreement, through the submission of the BTR1, which updates our commitments to transparency since the submission of the last Brazilian Biennial Update Report (BUR), in 2020.

Brazil is back. We need urgent climate action, now. For this reason, the country has repositioned climate change as a priority, along with efforts to fight hunger, poverty and inequalities. Since 2023, the country has been building a unified vision for correcting and consolidating the course of its climate policies, with national, regional and global effects.

In 2023, the Brazilian Government relaunched the Interministerial Committee on Climate Change (CIM) and announced the nationwide "Ecological Transformation Plan", which consolidates the country's vision for a future of economic growth with social inclusion and environmental preservation. The National Climate Change Fund (Fundo Nacional sobre Mudança do Clima) received additional resources from Brazil's first issuance of sustainable sovereign bonds, amounting to USD 2 billion, while the "Eco Invest Brazil" initiative, launched in April 2024, aims to promote structural conditions to attract foreign private investment for ecological transformation.

Regionally, Brazil hosted the "Amazon Summit" in August 2023, bringing together the leaders of the eight signatory countries of the Amazon Cooperation Treaty. The Summit resulted in the adoption of the Belém Declaration, establishing a new common agenda for regional cooperation in favor of the sustainable development of the Amazon, combining protection of the biome and of the river basin, social inclusion, the promotion of science, technology and innovation, stimulating the local economy and valuing indigenous peoples and local and traditional communities and their ancestral knowledge.

At the international level, Brazil held the presidency of the G20 throughout 2024, with the slogan "Building a just world and a sustainable planet", incorporating climate change solutions into both the Sherpa and finance Tracks. In addition to the Working Groups on Environment and Climate Sustainability and Energy Transition, Brazil established the Bioeconomy Initiative and the Task Force for Global Mobilization Against Climate Change (TF-CLIMA). In an unprecedented initiative, TF-CLIMA brought together the Ministries of Foreign Affairs, Finance, Environment/Climate and central banks around structural solutions for national actions and international financial flows to combat climate change.

Brazil's commitment to strengthening multilateralism and global climate governance is also reflected in the designated presidency of COP30, in which Brazil has been working with the presidencies of COP28 and COP29 to advance the "Roadmap to Mission 1.5". Brazil's engagement in the Mission 1.5 presidencies troika, aimed at strengthening international cooperation for ambition for the next round of Nationally Determined Contribution (NDC), was accompanied by Brazil's ambition at the national level. In November 2024, Brazil presented its new NDC[1], with the ambition to reduce emissions by between 59% and 67% by 2035, compared to 2005. The ambition expressed in Brazil's NDC demonstrates Brazil's determination to inspire collective leadership, despite being a developing country with a historical contribution to global warming that is relatively smaller than the responsibility of developed countries. Since the start of President Lula's new Government, Brazil has launched a number of policies and measures, described in Chapter 3, to optimize the implementation and achievement of its NDC.

To support the implementation of the NDC and Brazil's National Adaptation Plan (NAP), the CIM is working on the National Climate Change Plan (Plano Clima) to consolidate the national strategy in this area, involving seven sectoral climate mitigation plans and 16 climate adaptation plans. The National Climate Change Plan (Plano Clima) will be divided into two branches: Adaptation and Mitigation. This will allow the development of the National Mitigation and Adaptation Strategies and of the Sectoral Mitigation and Adaptation Plans, according to the breakdown of emissions and removals in Brazil's National Greenhouse Gas (GHG) Inventory.

As it is committed to "zero deforestation", Brazil has made significant progress towards reducing deforestation, also during 2023. By relaunching the Amazon Fund, the Brazilian Government has resumed programs that had been discontinued by the previous government, such as the Action Plan for the Prevention and Control of Deforestation in the Cerrado (PPCerrado, Plano de Ação para Prevenção e Controle do Desmatamento e das Queimadas no Cerrado) and in the Legal Amazon (PPCDAm, Plano de Ação para Prevenção e Controle do Desmatamento na Amazônia). The PPCDAm was responsible for an 83% decrease in deforestation in the Amazon between 2004 and 2012 and allowed, together with other measures, for a 22% reduction in deforestation in the Amazon from January to December 2023, and an additional 40.5% reduction from January to May 2024. Recent data also indicate a 15% reduction in deforestation in the Cerrado in the first half of 2024. Also in 2023, Brazil began updating its National Plan for the Recovery of Native Vegetation (PLANAVEG, Plano Nacional de Recuperação da Vegetação Nativa), to recover at least 12 million hectares of native vegetation by

1 Due to the submission deadline, the analyses and conclusions contained in this Biennial Transparency Report refer to the third update of the first Brazilian NDC, from November 2023.

2030. At COP28 in Dubai, in December 2023, Brazil's National Bank for Economic and Social Development (BNDES, Banco Nacional de Desenvolvimento Econômico e Social) launched the "Restoration Arc" initiative to finance the recovery of 24 million hectares of the Amazon Rainforest by 2050, which should involve around 200 billion reais, with 1 billion reais already invested by the country. Thus, relying on international cooperation, Brazil invites partners to join in this epic effort, which symbolizes the regeneration that our planet, our societies and our economies need towards a new paradigm of low-carbon and climate-resilient development.

In the energy sector, Brazil has made remarkable progress, with renewable sources now accounting for around 50% of the country's total energy supply and 90% of its electricity supply. Installed electricity generation capacity expanded by 9.4% between 2022 and 2023, with significant decreases in thermal generation from natural gas (-7.9%) and oil products (-19.3%). This change was driven by substantial increases in solar (+68.1%) and wind (+17.4%) generation, resulting in a 6% reduction in GHG emissions from electricity generation in one year. These ambitious actions underline Brazil's commitment to tackling climate change and advancing sustainable development on a global scale.

In addition, the National Energy Transition Plan and the National Hydrogen Program (PNH2) are key milestones in Brazil's strategy for the energy transition. The program's three-year work plan from 2023-2025 establishes three priorities for the period: defining the national legal-regulatory framework, intensifying investments in Research, Development and Innovation activities, and expanding access to financing.

The Brazil of the future is a country that is preparing, starting in the present, to establish itself as a climate powerhouse through low-carbon ecological transformation and resilience to global climate change. The National Policy on Climate Change, under review, will incorporate the concepts of just transition and climate justice into its legal framework in an unprecedented way. Without prejudice to other definitions enshrined in the Brazilian legal system, Brazil considers the transition to a socio-economic development model with low greenhouse gas emissions and resilient to climate change to be just, in the context of sustainable development and efforts to eradicate poverty. In conducting just transitions, the country will take into account the difference between socio-economic sectors; equity and the principle of common but differentiated responsibilities and their respective capacities in light of national circumstances; the reduction of potential impacts on vulnerable groups, including in the process of transitioning the workforce, food, energy and other socio-economic systems; the fight against hunger, poverty and inequalities, between and within countries, as well as climate justice. Brazil will promote "climate justice", understood as an approach to combating social inequalities and promoting human rights in the face of climate change, with special attention to vulnerable groups. Brazil aims to go through the global climate transition considering not only national development priorities, but also social protection measures to reduce the associated impacts, through extensive dialogue and social participation.

Brazil, which is preparing for the future, has adopted the 2030 Agenda as a reference for its public policies in three dimensions: economic, social and environmental. This has revitalized adherence to commitments

to the United Nations Sustainable Development Goals (SDGs). Since the beginning of 2023, Brazil has recreated the National Commission for the SDGs and has been promoting actions related to the promotion of the SDGs. An example of this is the choice of priority themes for the Brazilian presidency of the G20 in 2024, such as the fight against hunger, poverty and inequality, sustainable development and the reform of the global governance system. In 2024, the country submitted its Voluntary National Review (VNR) to the United Nations, reporting on compliance with SDGs 1, 2, 13, 16 and 17. The renewal of the Brazilian climate agenda is reflected in SDG 13 through structural transformations, promoted, for example, by the Ecological Transformation Plan, launched in 2023 and presented at COP 28. This Plan sets out pathways towards a sustainable economy, redirecting investments towards the energy transition, the bioeconomy and sustainable land use.

The adoption of the 2030 Agenda and the Paris Agreement in 2015 laid a solid foundation for the coherent implementation of climate action and of the sustainable development goals at all levels. Almost ten years later, maximizing synergies between climate action and sustainable development has never been more critical. That's why Brazil hosted the Fifth Global Synergy Conference in September 2024, whose program was developed based on the three priorities of Brazil's G20 presidency - fighting hunger, poverty and inequality; sustainable development; and reforming global governance - with the aim of transposing these priorities to the intersection between fighting global climate change and implementing the SDGs. We must ensure full alignment and coordinated efforts to close the implementation and ambition gaps of both the SDGs and the Paris Agreement, based on science, evidence and practical experience.

Technology is a key element in the climate transition that Brazil proposes to lead by example. The "New Industry Brazil" (NIB, Nova Indústria Brasil) program, Brazil's new industrial policy, launched in January 2024, has six missions related to the ecological transition, increased autonomy and modernization of the Brazilian industrial park, including the agro-industry, health, urban infrastructure, information technology, bioeconomy and defense sectors. NIB's "Mission 5", focused on "bioeconomy, decarbonization and energy transition and security to guarantee resources for future generations", includes, among its objectives, supporting ecological transformation, with a 30% cut in emissions per added value of the industry's Gross Domestic Product (GDP); increasing the share of biofuels in the transport energy matrix by 50%; and increasing the technological and sustainable use of biodiversity by the industry by 1% per year.

Brazil, recognizing that past technologies, widely used by developed countries since the Industrial Revolution, have contributed to the rise in global temperatures, seeks to incorporate new technologies to drive climate action and build a more just and sustainable future. Brazil's vast territory offers opportunities, but also challenges for monitoring and combating criminal activity. With the help of national technologies, such as the Real-Time Deforestation Detection System (DETER, Sistema de Detecção do Desmatamento na Amazônia Legal em Tempo Real) from the National Institute for Space Research (INPE, Instituto Nacional de Pesquisas Espaciais), Brazil seeks to monitor and support the surveillance and control of deforestation

and forest degradation. In the same way, Brazil's Ministry of Science, Technology and Innovation stands out in the development of tools for recording emissions and projections based on implemented sectoral policies, such as the National Emissions Registry System (SIRENE, Sistema de Registro Nacional de Emissões) and the National Simulator of Sectoral Policies and Emissions (SINAPSE, Simulador Nacional de Políticas Setoriais e Emissões), which promote internal transparency and contribute to both correcting the course and increasing the climate ambition of Brazilian public policies. The Ministry of Management and Innovation in Public Services, for its part, has been working hard to modernize the National Rural Environmental Registry System, with the aim of integrating it with other systems in Brazil's public digital infrastructure and, thus, guaranteeing effective compliance with the Forest Code. Fully operationalized, the CAR – Rural Environmental Registry (Cadastro Ambiental Rural) has the potential to consolidate itself as the largest land-use governance system in the world, therefore, covering all rural properties in the country.

Brazil's ecological transformation will be all the more successful the better we foster the development of climate technologies and innovative entrepreneurship. Federal funding agencies, such as FINEP - Financing Agency for Studies and Projects (Financiadora de Estudos e Projetos) and EMBRAPII - Brazilian Company for Industrial Research and Innovation (Empresa Brasileira de Pesquisa e Inovação Industrial) have increasingly dedicated themselves to promoting innovation in sustainable segments, such as renewable energies, bioeconomy and circular economy, among others. By supporting start-up sustainable technology-based businesses, (the startups), especially in the North and Northeast regions, the Brazilian Government has sought to link environmental entrepreneurship to the imperatives of economic and social growth, in line with the goals of the 2030 Agenda.

Looking to the future, Brazil has incorporated the sustainability dimension into its Brazilian Artificial Intelligence Plan for the period from 2024 to 2028. The Plan recognizes that AI is a tool capable of leveraging Brazil's social and economic development, and the country seeks to overcome technological gaps, understanding that the climate emergency cannot be tackled without advances in specific technologies that will prepare us for the future. To this end, the country is calling for international collaboration and a commitment to inclusive financing for capacity building in developing countries.

With the political shift in Brazil in 2023, structural changes will reposition the country on the development path towards a low-carbon, climate-resilient economy. Through the policies and measures adopted domestically to combat climate change, Brazil demonstrates renewed commitment to the ultimate goal of the UNFCCC, determined to mobilize itself nationally to contribute to the transition to net-zero emissions in a more just world, free from poverty and adapted to the new climate reality.

SUMMARY

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chapter 1

NATIONAL CONTEXT

1.1 Characterization of Brazil's territory

The Federative Republic of Brazil is located in South America and occupies nearly half of the continent's territory, between the parallels 5°16'20" north latitude and 33°45'03" south latitude, and the meridians 34°47'30" and 73°59'32" west (BRASIL, 2016). It is the world's fifth largest country, exceeded in territorial extent only by Russia, Canada, China and the United States. It is bounded by the Atlantic Ocean along nearly 8,500 km of its eastern coastline, and shares over 15,700 km of inland borders with all South American countries, except Chile and Ecuador. Specifically, Brazil borders Uruguay to the south; Argentina, Paraguay and Bolivia to the southeast; Peru to the west; Colombia to the northwest; and Venezuela, Guyana, Suriname and French Guyana to the north (IBGE – Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística), 2024a; BRASIL, 2016). It encompasses a wide range of tropical and subtropical landscapes, including wetlands, savannahs and plateaus, besides containing most of the Amazon River basin, which has the world's largest river system and the world's most extensive rainforest (IBGE, 2024a).

DATAFRAME 1.1 | RELEVANT INFORMATION ABOUT BRAZIL[2]

Parameter	Characteristics
Territory	Total area of 8,510,417.771 km²; divided in five political-administrative regions – North, Northeast, Central West, South and Southeast; composed of 26 states and the Federal District.
Population	203,080,756 people (in 2022).
Climate	Five climatic regions: Equatorial (North), Tropical (most of the territory - 81.4%), Semi-arid (Northeast), Tropical of Altitude (Southeast), and Subtropical (South).
Biodiversity	Six biomes[3]: Amazon (49.5%), Cerrado (23.3%), Atlantic Forest (13%), Caatinga (10.1%), Pantanal (1.8%) and Pampa (2.3%).
Protected areas	Terrestrial conservation units make up 18.5% of the Brazilian continental area (1,579,417.53 km²), while marine conservation units cover an area of 961,248.01 km², protecting 26.3% of this biome, in a total of 2,945 Conservation Units at the three administrative levels. With regard to Indigenous Lands, they make up 13.8% of the national territory, with a total of 631 territories.
Water resources	The country has approximately 12% of the planet's surface fresh water. And 12 river basins provide abundant water resources; however, they are unevenly distributed throughout the territory. Currently, the main use of water in the country, in terms of quantity used, is irrigation, with more than 900 m3/s (ANA – National Water Agency (Agência Nacional de Águas), 2019).
Energy matrix	The percentage of renewable sources in the Brazilian Energy Matrix in 2023 was 49.1%, which is significantly higher than the world average (~15%). In the electricity matrix, renewable sources accounted for 89.2% of domestic electricity supply in 2023.

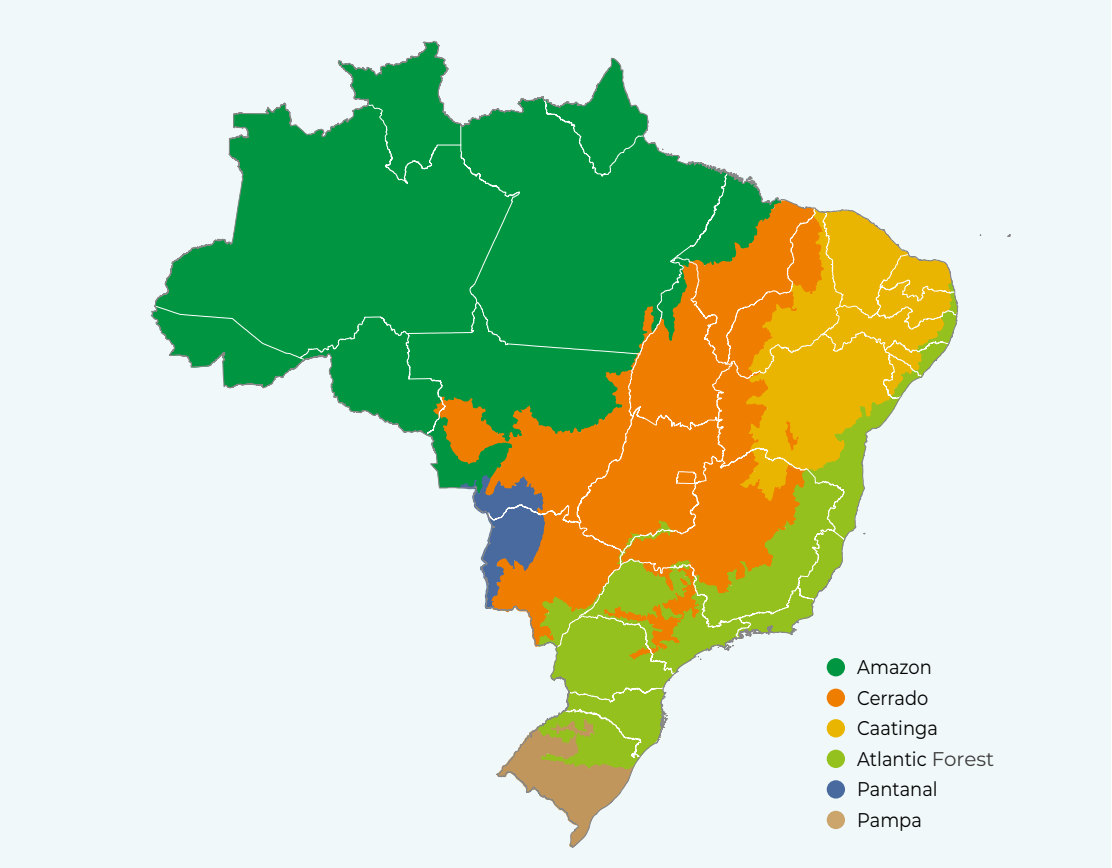
2 Data from the Brazilian Institute of Geography and Statistics (available at: www.ibge.gov.br) and EPE – Energy Research Office (Empresa de Pesquisa Energética) (2024); National Register of Conservation Units: (available at: https://cnuc.mma.gov.br/powerbi; Official data from FUNAI – National Indian Foundation (Fundação Nacional do Índio): (available at: https://www.gov.br/funai/pt-br/atuacao/terras-indigenas/geoprocessamento-e-mapas.

3 A Biome is defined as a collection of life (plant and animal life) constituted by the grouping of contiguous vegetation types identifiable on a regional scale, with similar geoclimatic conditions and a shared history of changes, which results in a unique biological diversity. (IBGE, 2004). Biome distribution data available at: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101676.pdf.

Brazil is continental in terms of its size, with a great diversity of climatic regimes, a variety of natural features (soil, relief, vegetation and fauna) and one of the largest coastal zones in the world, with 10,900 km. These factors form a unique environmental composition responsible for the formation of six major biomes, which together comprise some of the greatest biodiversity on the planet (Figure 1.1).

Much of Brazil's territory is occupied by forests and grasslands. Tropical moist and seasonal forests are mostly common in the Amazon and in the Atlantic Rainforest (IBGE, 2004). In the Cerrado, savannah formations are predominant, but they also occur in other regions of the country, including the Amazon. Steppic savannah formations occur mainly in the northeastern Caatinga. Steppe formations occur mainly in plateau and prairies in the far south area of Brazil, in the Pampa biome, due to the subtropical climate. Campinaranas, on the other hand, can be found mainly in the Amazon, in the Rio Negro watershed (IBGE, 2010). Finally, the Pantanal biome stretches across the states of Mato Grosso and Mato Grosso do Sul.

FIGURE 1.1 | DISTRIBUTION OF BRAZILIAN BIOMES IN THE NATIONAL TERRITORY



Source: Adapted from IBGE (2004).

Brazilian biodiversity accounts for 10% to 20% of global species diversity (MOTTA, 2015) and comprises around 30% of the world's tropical forests (MYERS *et al.,* 2000). Currently, more than 50,000 species of plants and 12,000 species of animals are recognized in Brazil. In 2022, of the 13,939 species of fauna assessed, 1,253 are endangered and of the 7,517 species of flora assessed, 3,207 are endangered, i.e., classified as "critically endangered", "endangered" and "vulnerable", according to the methodological criteria recommended by the International Union for Conservation of Nature (IBGE, 2023).

The country has one of the largest coastal zones in the world, which is a privileged part of the Brazilian territory in terms of natural, economic and human resources.

The main sources of water in Brazil are rainfall and river flows from other countries, which are concentrated in the Amazon biome. The country has approximately 12% of the planet's surface fresh water, which is unevenly distributed throughout the territory in 12 river basins (ANA, 2019). Vegetation cover plays an extremely important role in retaining water in various ecosystems. The basins are used for different purposes, such as irrigation, human and animal supply, industry, energy generation, mining, aquaculture, navigation, tourism and leisure.

Although Brazil is widely recognized for its water availability, there are significant differences between regions. Firstly, there is water abundance in the North, where 65% of Brazil's water resources are concentrated, but only 5% of the population lives there. In contrast, the semi-arid Northeast, where the Caatinga biome is located, faces water scarcity and is home to 30% of the population, but has only 4% of water resources available. In this region, the intermittency of the rivers, which dry up during the dry season, makes the use of reservoirs essential to guarantee a continuous supply of water. Some of these areas are classified as being at high water risk, with annual rainfall of less than 500 mm, water deficits and prolonged droughts, a predominance of crystalline rocks and intermittent rivers, and extensive use of weirs to ensure water supply. Finally, the Southeast region, where the Atlantic Forest and Cerrado biomes are located, has 60% of the national GDP and 40% of the population, has only 6% of the water available. Large reservoirs are used to meet growing water demands, mainly for hydroelectric power generation and urban and industrial supply. In addition to these characteristics, anthropogenic pressures have a significant impact on water quality in the region (SOUZA FILHO *et al.*, 2018). The Cerrado, which stretches across several central states of the country and covers 22% of the country's territory, is one of the world's 34 biodiversity hotspots and represents important agricultural production. The springs of three major watersheds of South America are located in the Cerrado biome (Amazon/Tocantins, São Francisco and La Plata). It also encompasses the Guarani, Bambuí and Urucaia aquifers, and plays a strategic role in water reserves and biodiversity protection (BRASIL, 2021).

1.2 Population and socioeconomic characterization

The Brazilian population is predominantly female, mixed race, young and concentrated in large urban centers. However, this profile varies considerably across the country. Among the observed and future trends of the 2022 Census[4], there is the prospect of a rapidly ageing population, a reduction in the general growth rate and changes in the concentration profile, with greater growth in the interior and more accentuated growth in medium-sized cities (between 100,000 and 500,000 inhabitants) than in large ones (over 500,000) (IBGE, 2023).

The data also indicates that, in 2022, the resident population in Brazil was of 203,080,756 people, representing an increase of 6.5% in relation to the population recorded in 2010 and an average annual growth of 0.52% (IBGE, 2023). The population has grown almost 20 times in the last 150 years, since the first census carried out in Brazil in 1872, with a significant increase between 1950 and 2010.

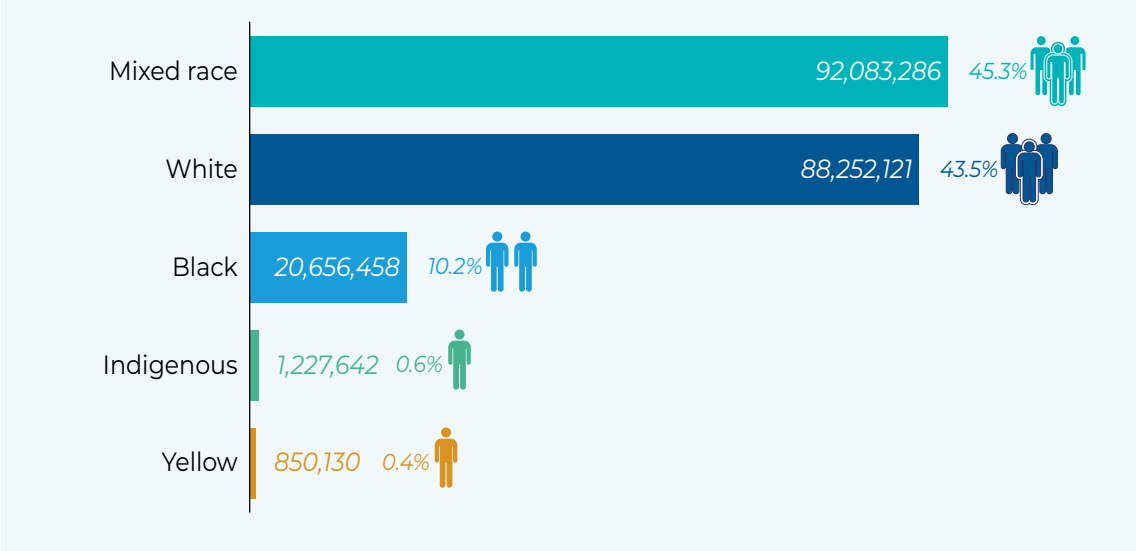
The distribution of the population is heterogeneous across the territory, with the Southeast region being the most populous region (41.8% of the population), followed by the Northeast region (26.9%), South (14.7%), North (8.5%) and Center-West (8.0%) (IBGE, 2023). The country's average population density is 23.86 inhabitants per square kilometer, with the highest concentration in the Southeast (91.8 inhabitants per square kilometer) and the lowest in the North (4.5 inhabitants per square kilometer), which highlights the aforementioned regional disparities.

Women make up the majority of the population, with 94.25 men for every 100 women, which accentuates the historical trend of female predominance. From the 25 to 29 age group, the female population becomes the majority in all regions of the country, intensifying at older ages, due to the lower mortality of women at these ages (IBGE, 2023).

Women tend to live longer than men from the age of 10 due to factors such as greater health care and access to medical services, especially reproductive health. In contrast, men, especially black men, face more risks at work and in urban life, as well as lethal violence, influenced by racism and masculinity pressures. These conditions, combined with limited educational and income opportunities for black men, result in more women reaching older ages. Gender and race inequalities are key factors in this scenario. In 2022, 61.2% of men were aged up to 40, while the comparable proportion for women was 57.4%. After that age, the situation is reversed: only 38.8% of men were over 40 years old, while 42.6% of women were older than that. The black population is the majority, with 55.5% of mixed-race and black people (Figure 1.2). The North has the highest percentage of mixed-race people (67.2%), the South has the highest proportion of white people (72.6%) and the Northeast has the highest percentage of black people in its population (13.0%) (IBGE, 2024b).

4 The Demographic Census is the most complex statistical operation carried out in the country, through which the characteristics of the entire population and households of the National Territory are surveyed.

FIGURE 1.2 | PROPORTION OF COLOR OR RACE, BASED ON THE ETHNIC-RACIAL IDENTIFICATION OF THE BRAZILIAN POPULATION



Source: IBGE (2024b).

In addition to regional inequalities and specificities, a point worth highlighting is the country's socio-cultural diversity. Different ways of life, cultural values and traditions coexist in the country, represented by peoples and communities with their own characteristics. Of these, indigenous peoples and *quilombolas* stand out because of their population profile and recent data collected in the national territory.

The indigenous population living in Brazil has practically doubled in 12 years, with a positive variation of 88.96%. The 2010 Census counted 896,917 indigenous people (0.47% of the population), while the 2022 Census recorded 1,694,836 people (0.83% of the population). The North and Northeast regions are home to 75.70% of the country's indigenous population. Quilombola people[5] represent 0.65% of the total Brazilian population, and the majority live in the Northeast region (68.1%), followed by the Southeast (13.7%) and North (12.5%) (IBGE, 2022).

With regard to socio-economic aspects, despite the fact that the Human Development Index (HDI) does not guarantee the necessary elements for analyzing the country's complex socio-economic structure, given the high level of income concentration, as well as accentuated regional, gender

5 "According to Article 2 of Decree No. 4,887, of November 20, 2003, ethnic-racial groups are considered to be remnants of *quilombo* communities, according to self-assignment criteria, with their own historical trajectory, endowed with specific territorial relations, with a presumption of black ancestry related to resistance to the historical oppression suffered by them." (p. 4, Incra – National Institute for Rural Settlement and Agrarian Reform (Instituto Nacional de Colonização e Reforma Agrária), n.d.)

It should be noted that, in Brazil, there is a very close relationship between native and traditional Brazilian peoples and communities and environmentally protected areas. The Legal Amazon is particularly important for indigenous peoples and traditional communities, as almost a third (32%) of the country's *quilombolas* and just over half (51%) of indigenous peoples are found in this region (IBGE, 2022). In the Amazon biome, approximately 561 Indigenous Territories (IT), spread over 116.8 million hectares, represent around 20% of the area of this biome (BRASIL, 2021). The Northeast region also stands out with a high percentage of indigenous peoples and *quilombola* communities (IBGE, 2022).

Brazil's indigenous and traditional peoples and communities contribute to the conservation of the protected areas in which they live, which increases the resilience of biomes and also favors mitigation. Studies indicate that Indigenous Lands help protect against deforestation and have rates that are 20 times lower than unprotected areas (QIN *et al*., 2023). Between 1985 and 2022, these areas lost less than 1% of their native vegetation, while in private areas this loss was of 17% (MAPBIOMAS, 2023).

For indigenous peoples, the ecosystem services provided by "nature" are perceived as intrinsically interconnected (VIVEIROS DE CASTRO, 1996). In this context, the protection of indigenous territories and traditional peoples, in addition to ensuring the provision of numerous ecosystem services, is important for maintaining their cultural values and ways of life. Indigenous and traditional peoples' practices are sustainable, but they coexist with pressure factors in their areas, such as predatory and commercial fishing, logging activities, mining and others (NOGUEIRA *et al*., 2018; PINHO; ORLOVE; LUBELL, 2012).

and racial disparities, among others, Brazil's HDI for 2022 is 0.760, which is slightly above the world's average. Brazil ranks 89th out of 193 countries, down two places in relation to last year's ranking, but remaining in the high human development classification. Between 1990 and 2022, Brazil's HDI grew by 22.6% (UNDP, 2023).

Between 2012 and 2022, Brazil went through a period of major economic and social challenges and transformations, which are reflected in the main indicators. Table 1.1 shows some economic indicators, updated based on national references.

TABLE 1.1 | BRAZIL'S SOCIO-ECONOMIC INDICATORS

Socio-economic indicators[6]	2012	2014	2016	2018	2020	2022
GDP (trillion BRL, current values)	4.8	5.8	6.3	7	7.6	9.9
GDP Agriculture at current prices (%GDP)	4.9	5.03	5.66	5.15	6.59	6.65
GDP Industry at current prices (%GDP)	26.03	23.79	21.23	21.85	22.51	26.33
GDP Services at current prices (%GDP)	69.07	71.18	73.11	73	70.9	67.02
GDP *per capita* (thousand BRL)	24.7	29.1	31.1	34.4	37.3	49.6
GDP *per capita* (thousand USD)	12.6	12.3	8.9	9.4	7.2	9.6
HDI[7]	0.732	0.753	0.753	0.762	0.758	0.760
Gini Index[8]	0.54	0.526	0.537	0.545	0.524	0.518
Life expectancy at birth (years) [SDG 3]	74.48	75.11	75.68	76.22	76.21	75.5
Infant mortality rate (per 1,000 births) [SDG3.2]	17.3	16.3	16.4	15.2	14	15.5
National poverty rate[9]	34.7	30.8	33.7	33.3	31	31.6
International poverty rate[10]	6.6	5.2	6.7	7.4	6	5.9

Source: References are indicated in the footnote.

In Brazil, poverty is analyzed from a monetary perspective, i.e., based on a value that serves as a cut-off point for defining the poor and the non-poor. In 2022, Brazil recorded that 31.6% of its population was living in poverty, while 5.9% lived in extreme poverty, totaling 67.8 million people living in poverty and 12.7 million in living extreme poverty in the country[11]. Poverty and extreme poverty showed an unequal distribution between different groups and regions, with reductions in all regions, especially in the North and Northeast, where poverty and extreme poverty fell more sharply (IBGE, 2023).

Education in Brazil has made significant progress over the years, according to the most recent data. In 2022, the country had a population of 163 million people aged 15 and over, of whom 151.5 million were literate, representing a literacy rate of 93.0%. This is a remarkable progress compared to 1940, when only 44.0% of this age group could read and write. The reduction in illiteracy is evident over the decades, with the rate falling from 9.6% in 2010 to 7.0% in 2022. However, significant inequalities persist, especially between different racial groups and regions. The data shows that illiteracy rates among black people (10.1%) and mixed-race people (8.8%) are considerably higher than among white people (4.3%), and even higher among indigenous people (16.1%) (IBGE, 2023).

6 Ipea – Institute of Applied Economic Research (Instituto de Pesquisa Econômica Aplicada), 2024. Available at: http://www.ipeadata.gov.br/Default.aspx

7 UNDP, 2024. **Human development summary**. Available at: https://hdr.undp.org/data-center/specific-country-data#/countries/BRA

8 Measures the degree of inequality in the distribution of individuals according to per capita household income. Its value is 0 when there is no inequality (the *per capita* household income of all individuals is the same) and tends to 1 as inequality increases.

9 Proportion of the population below the national poverty line. National poverty line (for monitoring the Sustainable Development Goals - ODS/IBGE) of USD 5.50 a day, converted at purchasing power parity (PPP-2011) of BRL 1.66 per dollar.

10 Proportion of the population below the international poverty line. Line of USD 1.90 per day, converted at purchasing power parity (PPP-2011) of BRL 1.66 per dollar.

11 Poverty: up to USD 6.85 per day; Extreme poverty: USD 2.15 per day - per capita household income according to World Bank criteria.

The importance of social programs in mitigating poverty and extreme poverty has become clear in Brazil. Government social programs contributed with 67% of the household income of people living in extreme poverty in 2022. Among poor households, social benefits made up 20.5% of their income. The absence of these social programs would have significantly exacerbated the situation, increasing the proportion of people living in poverty and increasing extreme poverty. In addition, inequality in income distribution, as measured by the Gini index, would have been higher, reinforcing the importance of these social policies in reducing poverty and promoting a more equitable society (IBGE, 2023). Aspects of the population's vulnerabilities will be discussed in more detail in Chapter 4, "Information related to climate change impacts and adaptation", of this Report.

1.3 Economy and infrastructure

Brazil is a developing country with a complex and dynamic economy. It is characterized as an urban-industrial country, with the agricultural sector playing a key role in the national and world economy. In addition, it has a clean electricity matrix and an energy matrix that is in transition towards a predominance based on renewable sources.

In 2023, Brazil's GDP was BRL 10.9 trillion, with a growth of 2.9% compared to 2022, placing the country among the 10 largest economies in the world according to estimates by the International Monetary Fund (IMF). Brazil's *per capita* GDP was BRL 50,193.72 in 2023, a real increase of 2.2% compared to the previous year. The unemployment rate at the end of 2023 was 7.8% (IBGE, 2024c).

Since 2000, Brazilian agribusiness has played a crucial role in both supplying the domestic market and expanding into the international market, with coffee, sugar cane, soybeans, corn, cotton and meat production standing out. This progress has been driven by the adoption of modern technologies, efficient production systems and innovations, which have transformed the country's agricultural and livestock systems (CONTINI *et al.*, 2022).

In 2023, the GDP of Brazilian agribusiness was BRL 2.58 trillion, representing approximately 23.8% of the country's total GDP (CEPEA - Center for Advanced Studies in Applied Economics (Centro de Estudos Avançados em Economia Aplicada)/CNA, 2024a). In addition to its importance for the GDP, the sector is fundamental to the trade balance, accounting for more than 40% of total exports. Agribusiness, which involves the production of inputs for agriculture, the agro-industries that process these raw materials and the distribution and other services necessary for agricultural and agro-industrial products to reach the end consumer, employs 27% of the total employed population in Brazil, equivalent to 28 million people, 38% of whom are female and 15% have higher education. The sector has been showing a trend of growth in the average education level of workers and an increase in the formalization of employment (CEPEA/CNA, 2024b).

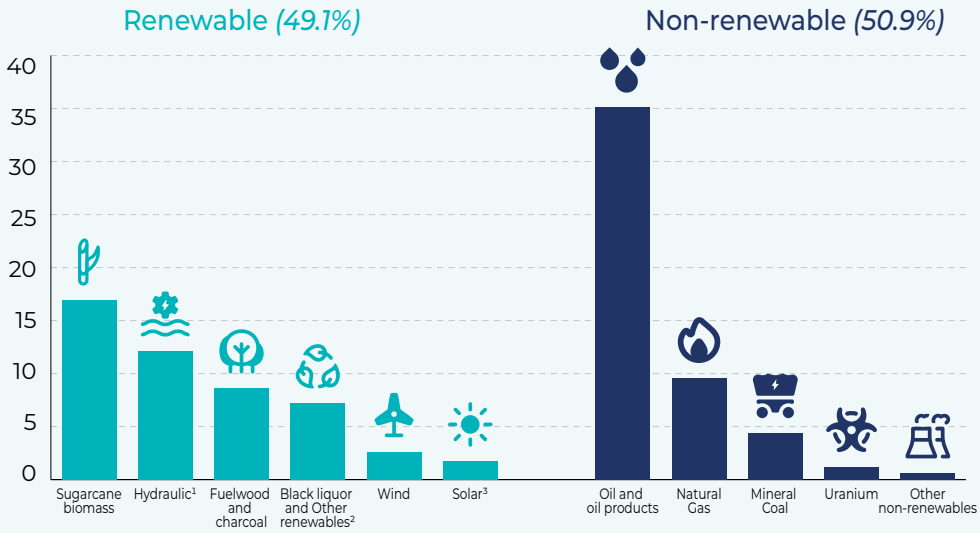
The country's strategies, by encouraging research and technological development

for sustainable tropical agriculture, have made it possible to increase productivity per hectare, in line with economic and population growth. The adoption of these technologies by farmers has allowed for a more constant supply of food throughout the year, thus guaranteeing more stable prices for consumers, as well as higher quality food.

Brazilian industry is a fundamental pillar of the national economy and contributed with 25.5% of the country's Gross Domestic Product (GDP) in 2023. Covering a wide range of segments, from manufacturing to advanced technology, its share of the trade balance is the most significant among all economic sectors, reaching 66.6% through the export of goods and services. From a global point of view, Brazil is responsible for 1.5% of the world's industrial production. In 2022, industry's share of formal employment was 21.2% (CNI – National Industry Confederation (Confederação Nacional da Indústria), 2024).

With regard to the Brazilian energy matrix, the high use of renewable sources stands out, well above the global average. Over the last 20 years, the share of renewables in Brazil's Domestic Energy Supply (DES) has remained at a high level, reaching 49.1% in 2023 (Figure 1.3). This shows that the country has for years been taking steps to strengthen its energy matrix by investing in renewable sources. The diversification of the matrix, based on the development of wind and solar sources, has made it possible to ensure high levels of renewability in Domestic Energy Supply, even with fluctuations in the supply of hydroelectric and other renewable sources.

FIGURE 1.3 | DOMESTIC ENERGY SUPPLY (DES) IN BRAZIL IN 2023, BROKEN DOWN BY SOURCE



[1] Includes electricity imports
[2] Includes black liquor, biodiesel, other biomass, biogas and charcoal industrial gas
[3] Includes solar photovoltaic and solar thermal sources

Source: Based on EPE (2024a).

Currently, 99.8% of the Brazilian population has access to electricity (IBGE, 2023). The largest electricity consumption is in the Southeast (48%) and the largest consumer is the industrial sector (36%), followed by the residential sector (31%) (EPE, 2024b).

Brazil's installed electricity generation capacity increased by 9.4% between 2022 and 2023, reaching 226 GW. The largest proportional increase occurred in solar generation, which at the end of 2023 had an increase of 13.4 GW, representing an increase in installed power of 54.8% compared to the previous year (EPE, 2024a). In terms of electricity generation, there was a 4.6% increase in 2023 compared to 2022. In that period, there were reductions in thermal generation from natural gas (-7.9%) and oil derivatives (-19.4%). Over the last 20 years, the share of renewable sources in the electricity matrix has remained above 70% (EPE, 2024a).

The share of renewable sources in the total supply of electricity in the Brazilian matrix reached 89.2% in 2023. Hydroelectric generation, including imported electricity, accounted for 61%; And, wind generation grew by 17.4% compared to 2022, consolidating its leadership among wind, biomass, nuclear and solar photovoltaic sources, with 13.2%. Regarding electricity generation, in 2023, the biggest increase was in the solar photovoltaic source, with 68.1% growth compared to 2022 (with a 7% share), coming close to biomass generation (8% in 2023) (EPE, 2024a).

In addition to the high rate of renewability, the Brazilian electricity matrix has also proved to be highly efficient in the last 20 years, maintaining the efficiency of power plants above 65% in the period, due to the large share of sources such as hydro, wind and solar, reaching 78.7% in 2023 (EPE, 2024a).

Brazil's electricity generation and transmission system has a robust network that connects generation to load, the so-called Brazilian Interconnected System (SIN, Sistema Interligado Nacional), made up of four subsystems: South, Southeast/ Central-West, Northeast and most of the North region.

According to ONS – National Electric System Operator (Operador Nacional do Sistema Elétrico) (2024), in 2023 the transmission network was 170,000 km long, connecting all Brazilian regions and integrating the different sources of electricity. This configuration optimizes the use of the country's resources and contributes to access to electricity.

The country is the second largest producer of ethanol and biodiesel in the world, with large-scale production as a vehicle fuel and the generation of bioelectricity for the SIN from surplus sugarcane bagasse at distilleries. In recent years, products derived from sugar cane have stood out, accounting for 16.9% of the share of sources in Brazil's domestic energy supply in 2023. In the transport sector, ethanol and biodiesel have increased their share. In 2023, ethanol production stood at 32.1 million m^3, an increase of 5.4% compared to 2022. Biodiesel production in 2023 increased 19.9% compared to 2022. The mandatory percentage of biodiesel blended into diesel was increased to 12% (in volume) from April 2023 (EPE, 2024a).

Brazil's transportation infrastructure comprises five modes of transport: road, rail, air, water and pipelines. The country has more than 73,000 kilometers of federal highways[12], which integrate the national territory and are a strategic instrument for economic and regional development. Its logistics matrix is highly structured around road transportation, which, in addition to playing a considerable role in the transportation of large volumes (65.7% of useful ton-kilometer), is also largely responsible for transporting high added-value goods, with a share of 84.7% of the matrix in useful ton-kilometer (BRASIL, 2020). This mode of transport also plays a leading role in the transportation of people, accounting for 89.2% of passengers transported (BRASIL, 2020).

The Civil Aviation system accounts for 1.4% of Brazil's GDP and generates 1.5 million jobs. In 2023, the sector recorded the transportation of 112.6 million passengers, 91.4 million in Brazil and 21.2 million international passengers. This activity accounts for 6% of Brazil's passenger modal split (115 billion passengers-kilometer). With regard to cargo transportation, the subsector accounted for 0.1% of the modal split (1.1 billion tons-kilometer) (ANAC – National Civil Aviation Agency (Agência Nacional de Aviação Civil), 2024)).

Most of the cargo related to international trade is transported through ports. In 2021, 1.2 billion tons of cargo were handled in Brazilian ports. Of this total, most is associated with long haul/foreign trade. In terms of ton-kilometers, the share of long-haul maritime transport reached 98% (17.5 trillion ton-kilometers) in 2021 (ANTAQ – National Agency for Waterway Transportation (Agência Nacional de Transportes Aquaviários), 2023). Additionally, with 8,500 km of coastline and 19,500 km of active waterways, Brazil has a high potential for navigation (CNT - National Transport Confederation (Confederação Nacional do Transporte), 2022). This category (cabotage and inland waterways) accounted for 17% of Brazil's cargo modal split in 2022 (260 billion ton-kilometers) (ANTAQ, 2023).

Railways have been increasing their share of Brazil's freight transportation matrix. With approximately 31,000 kilometers of network, freight railways accounted for 24% of the modal split (371 billion ton-kilometers) in 2022 (ANTF - National Association of Railway Carriers (Associação Nacional dos Transportadores Ferroviários), 2022).

The concessionaires have made significant investments in expanding capacity, promoting the elimination of urban conflicts and operational improvements, making it possible to increase transport volume and speed. At the same time, the expansion of the rail network, through concessions and the construction of new lines, continues to be a priority for the Brazilian government.

12 Road network of the National Department of Transportation Infrastructure and federal road concessions. Available at: https://www.gov.br/dnit/pt-br/assuntos/atlas-e-mapas/pnv-e-snv

1.4 Institutional arrangements and political dimensions

Brazil plays an important role in the global governance of climate change. At the international level, the United Nations Conference on Environment and Development (Rio-92) was a milestone. Brazil was the first country to sign the Convention, which was ratified by Congress on February 28, 1994. In 2012, the country consolidated the relevance of the issue by organizing Rio+20. In addition, Brazil, as a Party to the UNFCCC, complies with its obligation to prepare and disclose its National Communications (NCs), Biennial Update Reports (BURs), and now the Biennial Transparency Reports (BTRs) under the Paris Agreement.

The Brazilian Government has a set of regulatory frameworks and management instruments aimed at implementing the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement in the country. The main one is the **National Policy on Climate Change** (PNMC, Política Nacional sobre Mudança do Clima)[13], which established the legal framework for action to tackle climate change in Brazil until 2020. The process of reviewing the PNMC was initiated in 2023 by the Interministerial Committee on Climate Change (CIM, Comitê Interministerial sobre Mudança do Clima), with the aim of addressing its objectives, principles, guidelines and institutional instruments, as well as promoting a low greenhouse gas emission economy.

The PNMC aims to: promote sustainable development with the protection of the climate system; reduce greenhouse gas emissions from different sources, as well as strengthen the removal of these gases by sinks; implement measures to adapt to climate change; preserve, conserve and recover natural resources; consolidate and expand legally protected areas; and stimulate the development of a Brazilian Emissions Reduction Market. The objectives of the National Policy on Climate Change should be in line with sustainable development in order to pursue economic growth, the eradication of poverty and the reduction of social inequalities.

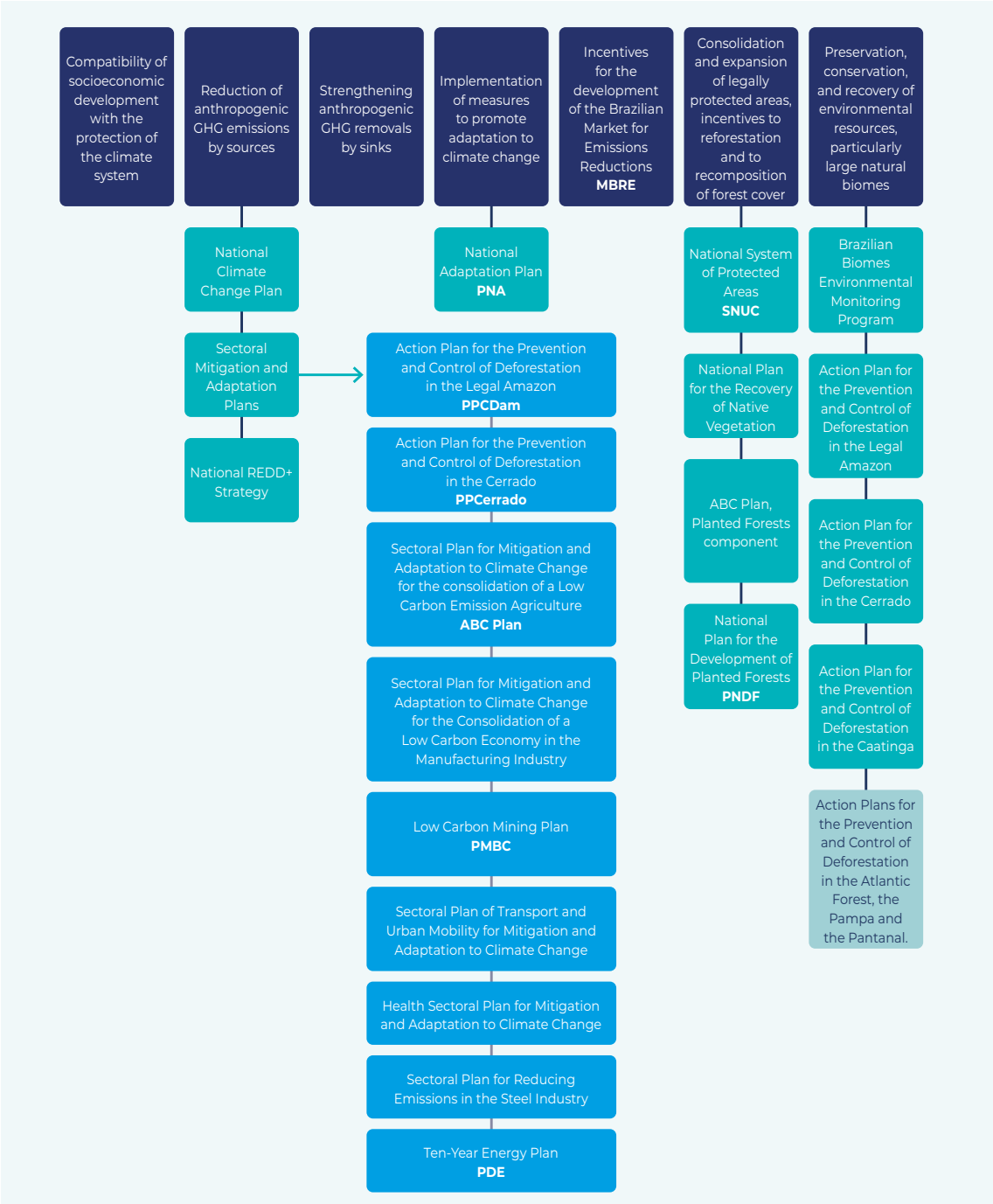
The instruments provided for in the PNMC include the National Climate Change Plan; the National Fund for Climate Change; the Action Plans for the Prevention and Control of Deforestation in the biomes; as well as Brazil's National Communication to the UNFCCC. In addition, policy instruments include the use of fiscal and tax measures, credit and funding lines, research lines by funding agencies, and financial and economic measures relating to climate change mitigation and adaptation, among others.

Institutional instruments at government level include the Interministerial Committee on Climate Change (CIM) and the Commission for the Coordination of Meteorological, Climatological and Hydrological Activities (CMCH, Comissão de Coordenação das Atividades de Meteorologia, Climatologia e Hidrologia). At the level of civil society, the Brazilian Forum on Climate Change (FBMC, Fórum Brasileiro

13 Established by Law No. 12,187, of December 29, 2009

de Mudança do Clima) and the Brazilian Research Network on Global Climate Change (Rede Brasileira de Pesquisas sobre Mudanças Climáticas Globais) (Rede CLIMA) are also institutional instruments that help implement the Convention. The full list of PNMC instruments can be found in Figure 1.4.

FIGURE 1.4 | INSTRUMENTS OF THE NATIONAL POLICY ON CLIMATE CHANGE (PNMC)



Source: Based on Law No. 12,187, of December 29, 2009.
Decree No. 11,075, of 2022, revoked the Ten-Year Energy Plan as a sectoral mitigation plan.

The **National Climate Change Plan** (known as the Climate Plan) is the instrument that consolidates the strategies, plans and targets of the federal executive branch to achieve the goals of the PNMC and to reach the targets of the Nationally Determined Contribution (NDC).

The preparation of the Climate Plan is coordinated by the Ministry of the Environment and Climate Change (MMA, Ministério do Meio Ambiente), with the technical and scientific coordination of the Ministry of Science, Technology and Innovation (MCTI, Ministério da Ciência, Tecnologia e Inovação) and the involvement of more than 20 ministries. The Climate Plan will have a timeline of up to 2035, with actions and targets planned for the following periods: 2024-2027; 2028-2031; 2032-2035. The process of drawing up the Climate Plan is underway and will be completed by 2025.

FIGURE 1.5 | STRUCTURE OF THE NATIONAL CLIMATE CHANGE PLAN (CLIMATE PLAN)

Source: DPMA, SMC and MMA, 2024.

According to Figure 1.5, the Climate Plan is divided into two strategies, one for mitigation and one for adaptation. For the mitigation strategy, the Plan aims to identify the most suitable alternatives in terms of cost and effectiveness to reduce the country's emissions. The proposals consider initiatives such as combating deforestation, conserving and restoring native vegetation, encouraging the adoption of low-carbon

agricultural practices, increasing energy efficiency, promoting green hydrogen and the use of other low-emission fuels, as well as selective waste collection and the energy use of solid waste.

The national commitment to reduce emissions will be assigned to the different economic sectors, both for 2030 and 2035. The National Mitigation Strategy will be followed by seven sectoral plans establishing actions, targets, implementation costs, means of funding, monitoring and evaluation.

The purpose of the Climate Plan in the area of adaptation is to reduce vulnerability to climate impacts and promote adaptive capacity in the national territory, with the promotion of climate justice as its guiding principle. The National Adaptation Strategy will include 16 sectoral plans, which will have targets, indicators and means of implementation. The process of drawing up the Climate Adaptation Plan is detailed in Chapter 4 of this Report.

The Climate Plan also includes a section on the cross-cutting strategy for Climate Action, which should consolidate complementary approaches and instruments needed to achieve the goals set out in the Mitigation and Adaptation Strategies and their respective Sectoral Plans. They will cover at least the following topics: socio-economic implications of the transition to climate neutrality; education, research, development and innovation; means of implementation; monitoring, management, evaluation and transparency mechanisms. It should be noted that the Climate Plan will include gender mainstreaming in all its programs and projects.

In order to promote a broad participative process in the Climate Plan, the Participative Climate Plan was drawn up, a partnership between the General Secretariat of the Presidency, the Ministry of the Environment and Climate Change (MMA) and the Ministry of Science, Technology and Innovation (MCTI). On-site and on-line spaces for discussion are planned, such as meetings with public policy councils, regional plenary sessions, seminars, workshops and discussions. In this context, we highlight the Participative Brazil Platform (Plataforma Brasil Participativo) and the 5th National Environment Conference, the theme of which will be "Climate Emergency: the challenge of ecological transformation".

Brasil Participativo is a digital platform developed by the Federal Government so that the population can contribute to the creation and improvement of public policies. In the case of the Climate Plan, people can contribute in two ways, at different times in the process of drawing up the plan. The first one involves sending in proposals during the process of drawing up the plan, where any Brazilian citizen can register up to three (3) proposals on the platform and vote on up to ten (10) proposals. The ten most voted proposals will be analyzed and may or may not be incorporated. The second moment of participation is the public consultation regarding the plan, when the Climate Plan documents will be made available, allowing the population to evaluate the proposals included in them.

Also in the context of the Participative Climate Plan is the 5th National Environment Conference, a space dedicated to debates on tackling climate change. With the aim of democratizing and promoting more direct participation, the Brasil Participativo platform will be used to collect society's opinions on the themes and proposals that the Climate Plan should address. This approach makes it possible to create a synergy between the discussions held

at the conference and the discussions on the Climate Plan, which are taking place simultaneously, promoting the face-to-face mobilization of organizations to expand contributions on the Brasil Participativo platform. The municipal stages and free conferences will take place between June 2024 and January 2025; the state and district stages will take place between January and March 2025; and the national stage will be held in May 2025.

Chapters 3 and 4 of this Report provide details of the Climate Plan's mitigation and adaptation strategies, respectively.

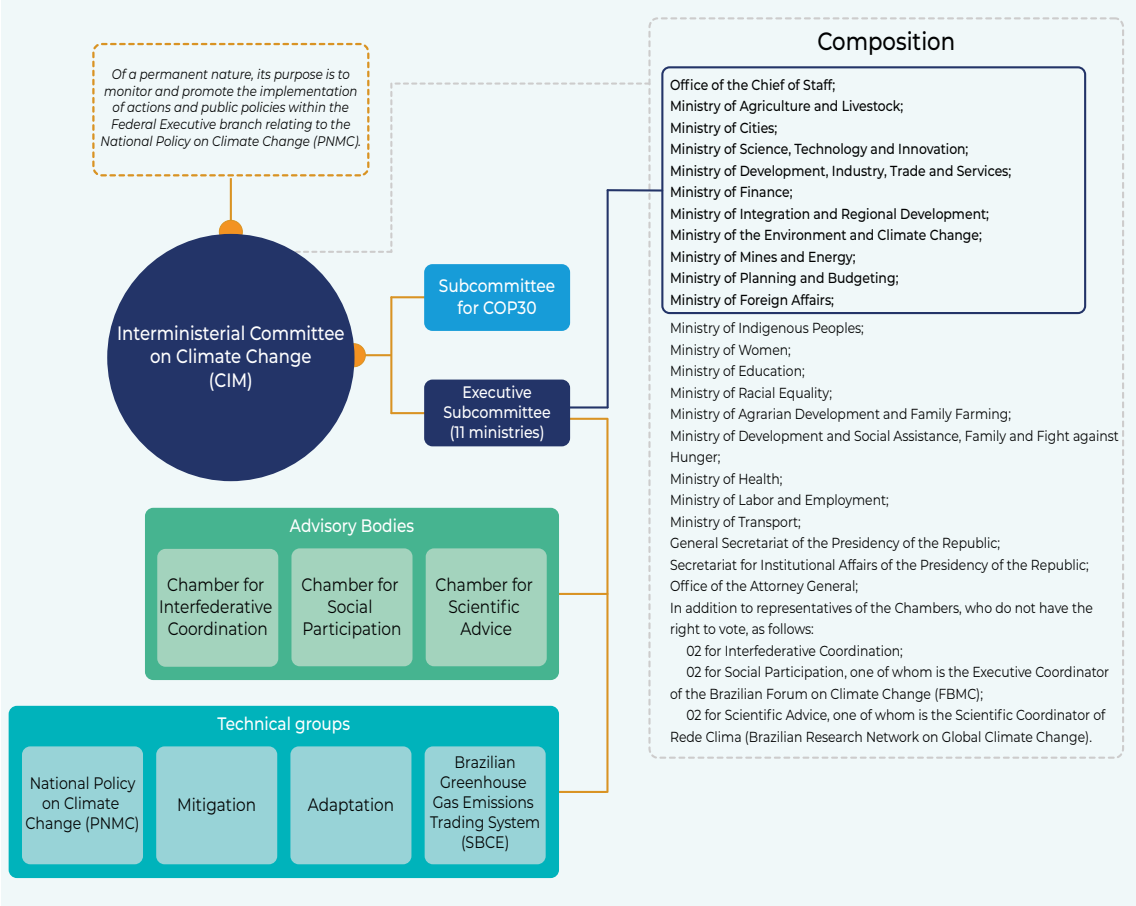
In addition to the PNMC and its instruments, it should be noted that in 2023 there was a restructuring of the Federal Government, with Ministries increasing or incorporating structures related to the climate change agenda, which indicates the growing relevance and capillarity of the issue in the country, reflecting efforts to align sectoral policies with the related national and international commitments.

The issue of climate change has also been incorporated directly into recently approved sectoral policies, such as the National Integrated Fire Management Policy and the review of the National Environmental Education Policy. The first one includes, in its principles, the promotion of actions to tackle climate change and, as a guideline, the assessment of climate change scenarios and the potential increase in the risk of wildfires and their severity. The second one provides for the encouragement of individual and collective participation, including schools at all levels of education, in prevention, mitigation and adaptation actions related to climate change, as well as the development of instruments, methodologies and the raising of society's awareness of these issues.

Other important measures were the re-establishment of the Plans for the Prevention and Control of Deforestation in the Brazilian biomes and the National Policy on Air Quality. In August 2023, the Brazilian Government introduced the economy-wide "Ecological Transformation Plan", which outlines a vision of economic growth, social inclusion and environmental preservation. There is also the initiative called Pact for Ecological Transformation, of August 2024, aligned with the Ecological Transformation Plan, which represents a commitment between the Executive, Legislative and Judicial branches to act in a harmonious and integrated manner to promote ecological transformation, through legislative, administrative and judicial measures. More details can be found in Chapters 3 and 4 of this Report.

With regard to institutional arrangements, the **Interministerial Committee on Climate Change (CIM)**[14], the country's main permanent climate governance body, has, among its duties, the purpose of promoting, integrating and monitoring the implementation of actions and public policies related to climate change, as well as deciding on strategies for the development, implementation, funding, monitoring, evaluation and updating of policies, plans and actions related to this issue in the country. The CIM is currently working on the review of the National Policy on Climate Change (PNMC), as well as on the preparation of its strategic mitigation and adaptation plans. It also considers the regulation of the Brazilian Emissions Trading System. Figure 1.6 shows the structure of the CIM.

FIGURE 1.6 | STRUCTURE OF THE INTERMINISTERIAL COMMITTEE ON CLIMATE CHANGE (CIM)



Source: Based on Decree No. 12,040, of June 5, 2024, and Resolution No. 6 of the CIM, which approves its Internal Regulations.

14 Decree No.12,040, of June 5, 2024.

The inclusion of the Ministry of Women as a member of the CIM, with a view to mainstreaming women's policies in the Climate Plan, is noteworthy. In addition to the 23 ministries, representatives appointed by the Social Participation Chamber, one of whom is the Executive Coordinator of the Brazilian Forum on Climate Change - FBMC (Fórum Brasileiro de Mudança do Clima), and representatives appointed by the Interfederative Coordination Chamber and by the Scientific Advisory Chamber are members of the CIM without voting rights. The Scientific Advisory Chamber aims to support climate policy with the best available science, and is responsible for proposing to the CIM data, information and scientific evidence to support the formulation, implementation, monitoring and evaluation of public climate policies, and contributing to public awareness and scientific dissemination related to climate change, its causes, consequences and mitigation and adaptation options. One of the representatives of the Scientific Advisory Chamber is the Scientific Coordinator of the Brazilian Research Network on Global Climate Change (Rede Clima).

Rede Clima plays a key role in supporting the Research and Development activities of the National Climate Change Plan and on the subject of transparency. Established in 2007 by the MCTI, Rede Clima aims to meet national needs for knowledge on climate change and provide information for the formulation of public policies. Scientific research helps to fill identified information gaps, while contributing significantly to the development of climate knowledge and its repercussions at national and regional level.

The institutional dialogue between the Brazilian government and civil society takes place through the CIM Social Participation Chamber. Additionally, there is the Brazilian Forum on Climate Change (FBMC), which aims to "raise awareness and mobilize society and contribute to the discussion of the actions needed to deal with global climate change, in accordance with the National Policy on Climate Change, the United Nations Framework Convention on Climate Change and the international agreements arising from it, including the Paris Agreement and Brazil's Nationally Determined Contributions, and in accordance with the legislation in force".

The Interfederative Coordination Chamber is a consultative body with the aim of promoting the participation of subnational governments, which, in the case of Brazil, are the states, Federal District and municipalities, in the development, improvement and implementation of climate change mitigation and adaptation measures. It also aims to contribute to the alignment between national, sectoral and cross-cutting policies and regional and local policies and circumstances, as well as encouraging the development of subnational plans and monitoring the implementation of climate policy at subnational level.

The Ministry of Science, Technology and Innovation (MCTI), through the General Coordination of Climate Science (CGCL, Coordenação-Geral de Ciência do Clima), of the Department of Strategic Policies and Programs (SEPPE, Secretaria de Políticas e Programas Estratégicos), performs the duties of Designated National Entity for the technology mechanism of the United Nations Framework Convention on Climate Change (UNFCCC) and for the Clean Development Mechanism (CDM). The MCTI coordinates the preparation, in consultation with other Ministries and competent bodies, of the National Communications of the Federative Republic of Brazil, the

Biennial Update Reports and the Biennial Transparency Reports of Brazil, including the national inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases[15]. The CGCL is also responsible for the National Emissions Registry System (SIRENE, Sistema de Registro Nacional de Emissões), which is the Government's official tool in the process of Measurement, Reporting and Verification (MRV) of anthropogenic greenhouse gas (GHG) emissions.

The Ministry of Foreign Affairs (MRE, Ministério das Relações Exteriores) is responsible for acting as Brazil's focal point for the UNFCCC and the Intergovernmental Panel on Climate Change (IPCC). The Ministry of Finance (MF, Ministério da Fazenda) acts as the Designated National Authority for the Green Climate Fund, the Operational Focal Point for the Global Environment Facility (GEF) and the Designated Member for the Committees of the Climate Investment Funds (CIF). The Office of the President´s Chief of Staff is responsible for coordinating the Interministerial Committee on Climate Change (CIM). The Ministry of Environment and Climate Change (MMA, Ministério do Meio Ambiente e Mudança do Clima) performs the duties of the Executive Secretariat of the CIM. Additionally, the MMA performs the duties of Designated National Authority and other duties relating to the instruments established in Article 6 of the Paris Agreement under the United Nations Framework Convention on Climate Change, in coordination with the Ministry of Foreign Affairs.

15 Decree No. 11,550, of June 5, 2023.

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FIRST
BIENNIAL TRANSPARENCY REPORT
OF BRAZIL

TO THE UNITED NATIONS
FRAMEWORK CONVENTION
ON CLIMATE CHANGE

chapter 2

NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

As part of the submission of the First Biennial Transparency Report (BTR1), Brazil prepared, in a separate document, the National Inventory Report (NIR 2024).

The Paris Agreement represents a crucial global commitment to tackling climate change and limiting global warming. The active participation of countries in this agreement is fundamental for the reduction of greenhouse gas emissions and the promotion of joint actions for a more sustainable future, reconciling economic and social development with environmental protection.

Joining the Paris Agreement can bring significant economic and environmental benefits to Brazil, with access to green funds, increased international competitiveness and job creation for a low-carbon economy. With regard to the environment, it can help preserve ecosystems, reduce vulnerability to extreme weather events and promote the use of clean technologies. In this scenario, National GHG Inventories are essential to ensure transparency, monitor progress towards climate targets and support decision-making.

Brazil reaffirms its commitment and global responsibility in the face of climate change by preparing and submitting, in accordance with its national capabilities, the National Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases (GHG) not controlled by the Montreal Protocol. This effort is part of the First Biennial Transparency Report (BTR1), covering the time series from 1990 to 2022, in accordance with the requirements of the Enhanced Transparency Framework (ETF).

The National Inventory of GHG Emissions and Removals, presented in this document, has been prepared in accordance with the Annex to Decision 18/CMA.1, Modalities, Procedures and Guidelines (MPGs) for the transparency framework for action and support and with Annex V to Decision 5/CMA.3, Guidance for operationalizing the modalities, procedures and guidelines for the enhanced transparency framework, both referred to in Article 13 of the Paris Agreement.

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) were used as a methodology.

The estimated GHGs were carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Other indirect GHGs, such as carbon monoxide (CO), nitrogen oxides (NO_x) and other non-methane volatile organic compounds (NMVOC) have been included whenever possible.

Due to the various sources of anthropogenic GHG emissions, the Inventory is organized according to the activities covered by the sectors: Energy (CRT 1); Industrial Processes and Product Use (IPPU) (CRT 2); Agriculture (CRT 3); Land Use, Land-Use Change and Forestry (LULUCF) (CRT 4); and Waste (CRT 5). On the other hand, GHG removals are only accounted for in the LULUCF sector, as a result of the increase in carbon stocks, for example through vegetation growth.

The estimates used the same methodological approach as the one used in the inventory submitted in Brazil's Fourth National Communication (1990-2016) (BRASIL, 2021), and updated the country's Inventory with results from 1990 to 2020, published in a national document, the 6th edition of Brazil's Annual Estimates (BRASIL, 2022).

In order to update the activity data, mainly public and official references were consulted. Data that was not published in publications or other media was requested from the institutions responsible for such data, or experts were consulted. The collection of data and the preparation of the inventory of GHG emissions and removals pose a number of challenges, such as the need for detailed, up-to-date data and the lack of specific data for some categories of emissions. The integration of data from multiple sources and the need for the extrapolation and interpolation of historical data also introduces uncertainties into the estimates. All the technical details, such as activity data, methodologies, equations, parameters and emission factors used can be found in the **National Inventory Report (NIR 2024),** which is part of this submission and is available at the National Emissions Registry System (SIRENE).[16]

The key categories were identified using Tier 1 level and trend assessments, as recommended in the 2006 IPCC Guidelines (Volume 1, Chapter 4)[17] and adopted by the MPGs. This approach identified the sources, which, when combined, contribute to 95% of total emissions, or 95% of the inventory trend in absolute terms.

In order to calculate the uncertainties of the activity data and emission factors, the error propagation method (Approach 1) was used at national level for all sectors, with the exception of the Waste sector, which used the Monte Carlo method (Approach 2), given the possibility of detailing the various parameters involved in this estimate.

It should be noted that, in accordance with Decision 18/CMA.1, all the Inventory's analyses and results are presented in kt CO_2 eq, using the Global Warming Potential (GWP) metric for a 100-year time horizon contained in the IPCC's Fifth Assessment Report (GWP AR5) (IPCC, 2013). In addition, in accordance with Decision 18/CMA.1, Brazil also presents the emissions of gases aggregated in terms of global temperature potential over a 100-year time horizon (GTP 100) in the National Inventory of Emissions and Removals of Greenhouse Gases not controlled by the Montreal Protocol (NIR 2024, section 2.8 Information on the metrics used).

16 Available at: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/publicacoes/relatorios-bienais-de-transparencia-btrs

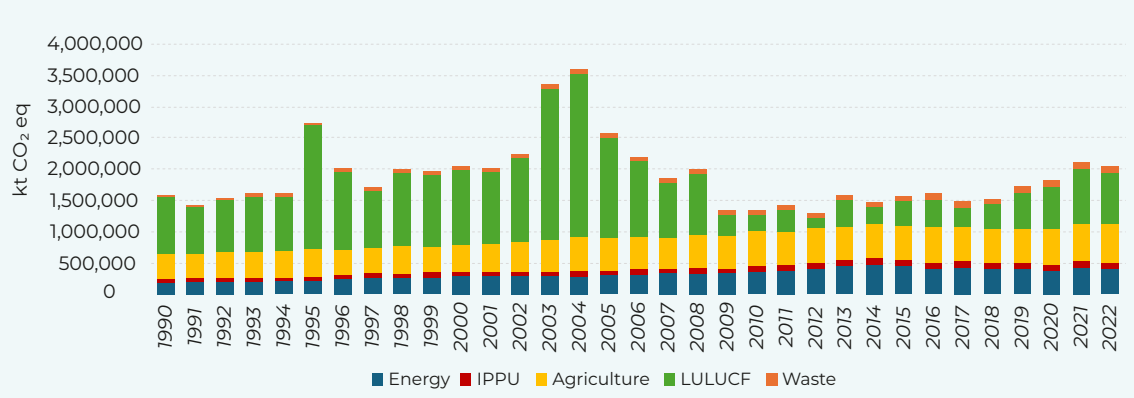
17 Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme. Vol. 1, General Guidance and Reporting, **Chapter 4., Methodological Choice and Identification of Key Categories.** IPCC, 2006.

2.1 Brazil's GHG emissions and removals results

Brazil's total net emissions were 2,039,236 kt CO_2 eq in 2022. Although this represents an increase in emissions compared to 2020 (1,824,760 kt CO_2 eq), as shown in Table 2.1, these emissions are lower than those estimated for 2021 (2,116,314 kt CO_2 eq).

Total emissions in 2022 fell by 20.4% (or -522,009 kt CO_2 eq) compared to the 2005 ceiling (Figure 2.1), the reference year for Brazil's NDC. In relation to the levels seen in that year, there was a significant reduction in emissions from the LULUCF sector, mainly related to the reduction in deforestation, during the implementation period of the Action Plans for the Prevention and Control of Deforestation, implemented by the LULUCF sector between 2005 and 2019, and resumed in 2023 (more details are provided in Chapter 3).

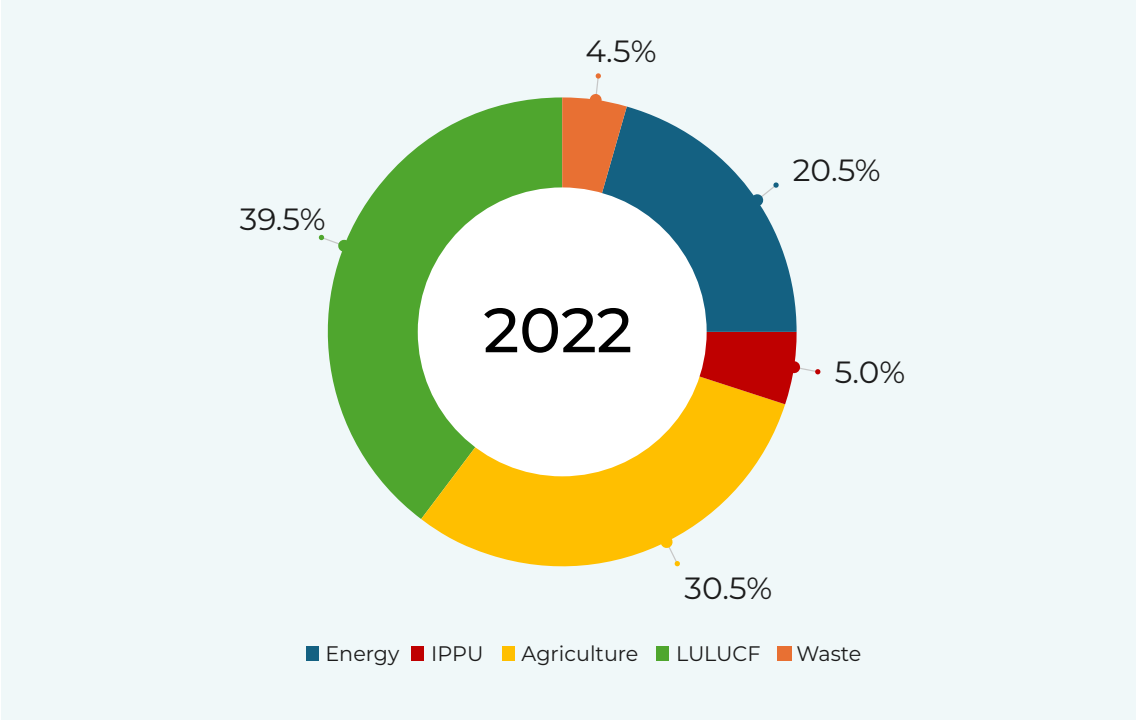
FIGURE 2.1 | NET EMISSIONS BY SECTOR WITH LULUCF, IN KT CO_2 EQ



Source: Brazil's National Inventory Report, 2024.

When analyzing the time series of national emissions, a different pattern can be seen when compared to developed countries, with 70% of the estimated value in 2022 occurring in the LULUCF and Agriculture sectors; 25% in Energy and IPPU sector; and 5% in the Waste sector (Figure 2.2).

FIGURE 2.2 | SECTORAL SHARE OF NET GHG EMISSIONS IN 2022



Source: Brazil's National Inventory Report, 2024.

Emissions in the Energy sector reached 418,451 kt CO_2 eq in 2022. The Fuel Combustion subsector (1.A) was responsible for 94.5% of these emissions, while the Fugitive Emissions subsector (1.B) accounted for the remaining 5.5%. The Transport category was the most representative, accounting for 52% of the Energy sector's total emissions, followed by Manufacturing Industries and Construction and Energy Industries, with 17% and 14%, respectively.

Estimates of emissions from the IPPU sector totaled 102,317 kt CO_2 eq in 2022. The Metal Industry contributed with the largest share of emissions, accounting for 51% of the sector's emissions in kt CO_2 eq in 2022. On the other hand, the Mineral Industry subsector was the second most representative, with 32%.

Emissions from Agriculture totaled 622,014 kt CO_2 eq in 2022. Analyzing the contribution by subsector, it is possible to identify that the Enteric Fermentation subsector was the most representative of the Agriculture sector, with 65% of total emissions in 2022, followed, in order of magnitude, by the Agricultural Soils subsector, with 23%. However, the Manure Management and Liming subsectors together contributed with approximately 9% of emissions, while the Rice Cultivation, Urea Application and Field Burning of Agricultural Residues subsectors together accounted for less than 3% of the sector's total emissions for that year.

Between 1990 and 2022, there was an 11% reduction in the emission of enteric methane per head of cattle. In this key category in particular, progress has been made in

terms of the efficiency and sustainability of its production systems, which has been reflected in gains in production efficiency, such as the expansion of high-yielding dairy cattle systems and cattle confinement.

Net emissions from the LULUCF sector totaled 805,694 kt CO_2 eq in 2022. The sector's most representative net emissions came from the Grassland subsector (959,862 kt CO_2 eq), mainly reflecting conversions from Forest to Grassland (949,958 kt CO_2 eq). The largest net removals came from the Forest Land subsector, which contributed with -312,125 kt CO_2 eq, mainly as a result of vegetation protected within Conservation Units (CUs) and Indigenous Lands (ILs).

Given the effective adoption of the Action Plans for the Prevention and Control of Deforestation, the sector's emissions in 2022 were 69% lower than the peak seen in 2004, with a decrease from 56.5 to 22.3 thousand km^2 in the area deforested in the Amazon and Cerrado biomes.

Emissions from the Waste sector totaled 90,761 kt CO_2 eq in 2022. The Solid Waste Disposal subsector contributed the most to the sector's emissions in 2022, with 53,421 kt CO_2 eq, or around 59% of the total. Wastewater Treatment and Discharge emitted 36,056 kt CO_2 eq in that year and accounted for, approximately, 40% of the sector's total. The other subsectors contributed with a smaller share of emissions.

In general, the increase in the collection and proper disposal of waste has contributed to an increase in emissions from the sector. Emissions from Uncategorized Waste Disposal Sites showed a reduction of 24% compared to 2020, which is due to the increase in landfill disposal, which, consequently, reduced the rate of waste disposed of in unmanaged waste disposal sites or garbage dumps.

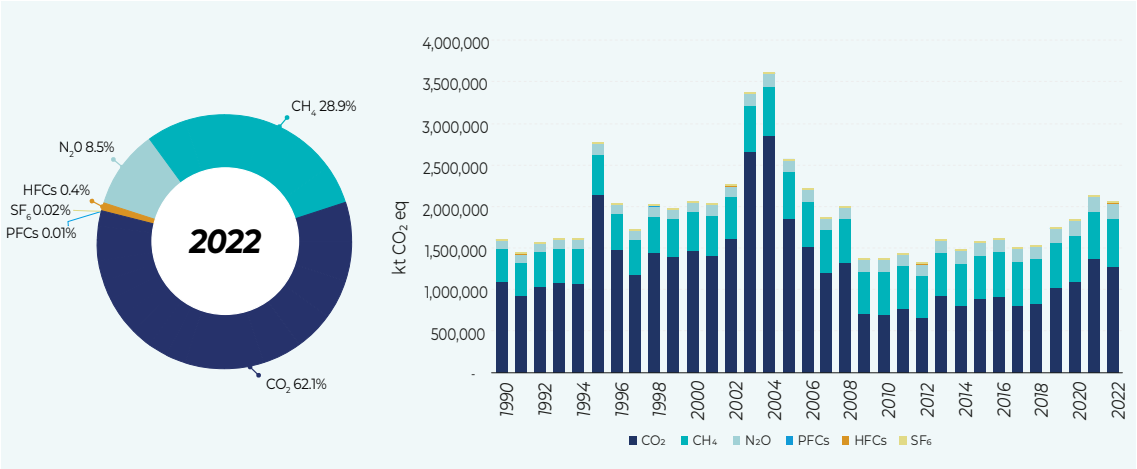
TABLE 2.1 | NET EMISSIONS BY SECTOR WITH LULUCF, IN KT CO_2 EQ, SELECTED YEARS

SECTOR/CATEGORIES	1990	2005	2016	2020	2022
	NET EMISSIONS (kt CO_2eq)				
TOTAL	**1,588,395**	**2,561,246**	**1,603,968**	**1,824,760**	**2,039,236**
1. ENERGY	**196,119**	**318,363**	**424,610**	**390,210**	**418,451**
1.A. Fuel combustion	187,161	299,732	403,235	369,462	395,626
1.A.1. Energy Industries	25,308	48,620	78,925	68,134	56,565
1.A.2. Manufacturing industries and construction	37,633	65,396	71,952	62,697	69,116
1.A.3. Transport	85,195	139,226	204,239	187,220	217,378
1.A.4. Other sectors and Other (Not specified elsewhere)	39,025	46,489	48,119	51,411	52,567
1.B. Fugitive Emissions	8,959	18,630	21,375	20,748	22,824
2. IPPU	**56,870**	**83,335**	**93,931**	**96,992**	**102,317**
2.A. Mineral industry	15,170	20,444	29,715	32,070	32,993
2.B. Chemical industry	8,379	13,195	8,470	7,155	7,021
2.C. Metal Industry	32,673	47,614	48,925	48,739	52,226
2.D. Non-Energy Products from Fuels and Solvent Use	520	661	763	820	843
2.E. Electronics Industry	0	0	0	3	1
2.F. Product Uses as Substitutes for Ozone Depleting Substances (ODS)1	0	1,234	5,768	7,879	8,891
2. G. Other Product Manufacture and Use	128	187	290	325	343
3. AGRICULTURE	**394,743**	**520,260**	**567,146**	**583,740**	**622,014**
3.A. Enteric Fermentation	284,981	370,824	376,932	376,720	404,062
3.B. Manure Management	17,801	21,951	27,716	27,713	29,012
3.C. Rice cultivation	9,271	10,796	11,159	11,779	11,901
3.D. Agricultural soils	71,071	104,417	131,056	141,045	145,078
3.F. Field Burning of Agricultural Residues	1,848	2,296	551	473	477
3.G. Liming	9,141	8,097	15,844	21,593	27,087
3.H. Urea Application	631	1,878	3,888	4,417	4,397
4. LULUCF	**908,066**	**1,573,714**	**436,546**	**665,084**	**805,694**
4.A. Forest Land	-43,666	-269,055	-345,479	-326,825	-312,125
4.B. Cropland	79,305	196,422	138,607	157,403	184,499
4.C. Grassland	876,829	1,673,983	658,720	855,213	959,862
4.D. Wetlands	6,412	12,326	8,745	10,601	11,675
4.E. Settlements	6,896	7,067	5,154	5,008	5,670
4. F. Other Land	1,275	5,021	8,998	11,740	12,620
4.G. Harvested Wood Products	-18,984	-52,050	-38,198	-48,056	-56,507
5. WASTE	**32,596**	**65,574**	**81,735**	**88,735**	**90,761**
5.A. Solid Waste Disposal	13,186	35,658	45,798	49,824	53,421
5.B. Biological Treatment of Solid Waste	18	49	56	63	61
5.C. Incineration and Open Burning of Waste	1,151	2,014	1,272	1,326	1,224
5.D Wastewater Treatment and Discharge	18,241	27,854	34,608	37,522	36,056

Notes: ODS - Ozone Depleting Substances.
Source: Brazil's National Inventory Report, 2024.

CO_2 was the predominant gas in Brazil's emissions, with a 62% share in 2022. Also in 2022, CH_4 and N_2O gases accounted for 29% and 8.5%, respectively, while SF_6, HFCs and PFCs combined accounted for 0.47% of the total (Figure 2.3).

FIGURE 2.3 | BRAZIL'S NET EMISSIONS BY GHG, IN KT CO_2 EQ



Source: Brazil's National Inventory Report, 2024.

CO_2 emissions resulted from activities mainly related to the use of fossil fuels for energy and to the changes in land use and land cover. Other sources that make up CO_2 emissions are the industrial processes for the production of pig iron and steel, cement, lime, soda ash, ammonia and aluminum, as well as the use of fertilizers in agriculture and the incineration or burning of solid waste.

National emissions of CH_4 come from agricultural activities, changes in land use and land cover, waste treatment, some industrial processes and from the extraction and refining of oil and natural gas.

National emissions of N_2O resulted from the application of Inorganic N Fertilizers and Organic N Fertilizers to the soil, as well as from the treatment of domestic wastewater, the burning of fossil fuels and biomass, industrial processes and changes in land use and land cover.

With regard to fluorinated gases, the main emission in Brazil refers to HFCs, mainly from the use of HFC-134a in the air conditioning and refrigeration subsector.

2.2 Other relevant information

The Ministry of Science, Technology and Innovation (MCTI) is responsible for coordinating the preparation of Brazil's National Communications, Biennial Update Reports and Biennial Transparency Reports, which includes coordinating the preparation of the Inventory, and plays an important role in coordinating the different working groups that contribute to the collection of sectoral data.

Since a large part of the methodological approach of the NIR 2024 is the result of the Inventory submitted in Brazil's Fourth National Communication, it is important to highlight the collective and multidisciplinary effort made in its preparation, which involved more than 150 institutions and over 300 experts from all regions of the country. Due to its scope and specificity, it had the participation of an important part of the Brazilian scientific and business community, as well as various governmental institutions, trade associations, third sector organizations, universities and research centers, largely represented by the Technical-Scientific Coordination of the Brazilian Research Network on Global Climate Change (Rede Clima).

Several public and private entities contribute by making activity data available, or by developing national parameters and emission factors that are up-to-date and relevant to the methodology to be applied in the preparation of estimates of GHG emissions and removals for the country.

In summary, the process of drawing up the Inventory reflects a robust and collaborative effort, involving a wide range of actors and institutions from different sectors in Brazil. The continuous progress in updating GHG estimates, based on the best scientific evidence available, demonstrates the country's commitment to transparency and methodological improvement. This engagement not only strengthens the national monitoring capacity, but also places Brazil as an important player on the global stage by providing reliable climate data, which is essential for formulating public policies and promoting international cooperation in the fight against climate change.

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chapter 3

INFORMATION NECESSARY TO TRACK PROGRESS MADE IN IMPLEMENTING AND ACHIEVING NATIONALLY DETERMINED CONTRIBUTIONS UNDER ARTICLE 4 OF THE PARIS AGREEMENT

3.1 National circumstances and institutional arrangements

Reducing greenhouse gas (GHG) emissions is the main path indicated by science to contain the advance of global warming and prevent even more serious impacts. Mitigation includes the adoption of technological changes and replacements aimed at reducing the use of resources and emissions per unit of production, as well as the implementation of measures and policies aimed at reducing emissions and increasing carbon removals.

Population and urban growth have brought with them the challenge of reconciling economic development with environmental conservation and social inclusion. To this end, Brazil has stepped up its efforts towards sustainable development and, due to investments in research and innovation, has succeeded in increasing its industrial and agricultural production in line with environmental responsibility and with the fight against poverty. Investment in agricultural production has enabled Brazil to transform itself from a food-importing country with serious food insecurity in the 1970s to the world's second largest food exporter, an important guarantor of the planet's food security.

Brazil is a world reference in sustainable agriculture, using an integrated approach to the landscape as a premise, adopting sustainable practices in areas suitable for agriculture and encouraging the environmental regularization of rural properties. The Brazilian Forest Code[18] is one of the most advanced environmental laws in the world. As a Federal law, it establishes fundamental guidelines for the preservation of native vegetation on private rural properties in Brazil. It is essential for maintaining environmental balance, guaranteeing soil fertility, air quality, abundant water and climate stability, which are essential factors for sustainable agricultural production. The legislation not only regulates the protection of vegetation, but also defines rules for Permanent Preservation Areas (APPs, Áreas de Preservação Permanente) and Legal Reserves (RLs), as well as providing for forest exploration, the supply of raw materials, control of the origin of wood products and fire prevention.

Additionally, it creates the Rural Environmental Registry - CAR (Cadastro Ambiental Rural), a nationwide electronic public registry, which is mandatory for all rural properties, with the purpose of integrating environmental information on rural properties and possessions, creating a database for control, monitoring, environmental and economic planning and combating deforestation.

Brazil stands out both due to its natural characteristics and its political and economic actions. Characteristics such as extensive forests, enormous potential for renewable energies, low-carbon agriculture, technology and innovation, legislation and the implementation of public policies, as

18 Law No. 12,651, of May 25, 2012. The first version of the Forest Code dates back to 1934. In 1965 it underwent a reform and in the following decades, other laws and provisional measures updated the Forest Code.

well as active participation in negotiations and commitment to international agreements are factors that combine to give Brazil a strategic role in tackling climate change, allowing it to make a significant contribution to mitigating impacts and promoting sustainable development.

Unlike most developed countries, Brazil's emissions are not predominantly from the burning of fossil fuels, but occur in the Land Use, Land-Use Change and Forestry (LULUCF) and Agriculture sectors. For more details on Brazil's emissions profile, please see Chapter 2, "National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases", of this Report, as well as the details presented in **Brazil's National Inventory Report (NIR 2024).**

In order to understand how national circumstances affect GHG emissions and removals over time, it is important to highlight the country's continental dimensions and its complex and dynamic economy. The relevant information for tracking the progress made in implementing and achieving the NDC regarding the country's political, social, economic, climatic and environmental aspects is detailed in Chapter 1., "National context", of this Report.

Historically, land-use conversions in the Amazon and Cerrado biomes have been related to the observed trends in GHG emissions. However, the Action Plans for the Prevention and Control of Deforestation and Fires have contributed to reducing emissions from this sector since 2005. Details are given in section 3.4 of this Chapter 3.

The agriculture sector is a major player in the world economy. The country currently has the third largest cattle production in the world, behind India and China, and is responsible for around 16.2% of the entire global herd (USDA – United States Department of Agriculture, 2024). The sector is important for the country's economy, in terms of its share of the national GDP and its contribution to the development of a low-carbon economy. For around five decades, the country has been investing in research and technological development in tropical agriculture which, together with public policies and technical assistance for the optimization of areas already in use and the recovery of pasture areas, has increased productivity by approximately four times.

Another important consideration is the fact that Brazil has a predominantly renewable electricity matrix, especially from hydroelectric source. In 2023, renewable sources accounted for 89.2% of electricity generation (EPE, 2024). In addition, the country has a robust biofuels program. It is the second largest producer of ethanol and biodiesel in the world, with large-scale production as a vehicle fuel and with the generation of bioelectricity for the Brazilian Interconnected System (SIN, Sistema Interligado Nacional) - a unified system that connects almost all places in the country to the same electricity system, made from the surplus sugarcane bagasse in the distilleries. The high percentage of renewable sources gives the sector a low carbon footprint.

3.1.1 Institutional arrangements currently in force to track the progress made in implementing and achieving the NDC

In order to meet a wide range of demands for mitigating and adapting to climate change, the Government has set up an institutional arrangement that addresses the issue cross-sectionally, through coordinated activities at different levels (national and subnational), as presented in Chapter 1. "National context", of this Report. Therefore, the topic of mitigation follows the frameworks and guidelines contained in the National Policy on Climate Change (PNMC)[19] and includes the institutions and duties contained in the CIM. In 2023, one of the decisions made by the Interministerial Committee on Climate Change (CIM) was to start drawing up the Climate Plan, which has a mitigation component and will be detailed in section 3.1.1.2 of this Report.

3.1.1.1 National Policy on Climate Change (PNMC) and results of the plans implemented to achieve the voluntary targets for reducing GHG emissions

In order to support Brazil in achieving its commitment to tackling climate change, the National Policy on Climate Change (PNMC) stands out as an instrument for implementing and complying with mitigation actions.

The PNMC established the voluntary commitment to adopting mitigation actions with a view to reducing its GHG emissions by between 36.1% and 38.9% in relation to the emissions projected for 2020. In absolute values, this target consisted of GHG emissions of between 1,977 and 2,068 Mt CO_2 eq (GWP SAR) in 2020, with the projected value in the reference scenario for 2020 being of 3,236 Mt CO_2 eq (GWP-SAR). The PNMC is currently being reviewed by the Interministerial Committee on Climate Change (CIM).

Following the legal definition of the first national mitigation commitment, two regulatory decrees were issued (Decrees No. 7,390/2010 and No. 9,578/2018), defining the action plans for the prevention and control of deforestation in the biomes and sectoral plans for mitigation and adaptation to climate change, which are listed below:

- Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm, Plano de Ação para Prevenção e Controle do Desmatamento na Amazônia);
- Action Plan for the Prevention and Control of Deforestation and Fires in the Cerrado (PPCerrado, Plano de Ação para Prevenção e Controle do Desmatamento e das Queimadas no Cerrado);
- Ten-Year Energy Expansion Plan (PDE, Plano Decenal de Energia) (revoked by Decree No. 11.075 of 2022);
- Sectoral Climate Change Mitigation and Adaptation Plan for the Consolidation of a Low Carbon Emission Economy in Agriculture (ABC Plan); and
- Steel Sector Emissions Reduction Plan.

19 Law No. 12,187, dated December 29, 2009.

Decree No. 7.390/2010 (revoked by Decree No. 9,578/2018) also established a set of actions that served as the basis for drawing up the Nationally Appropriate Mitigation Actions (NAMAs) under the Convention.

Historically, progress in implementing the NAMAs has been reported through the four Biennial Update Reports (BURs). As a record of progress in implementing these actions, Appendix 3.I presents the consolidation of the results of the plans implemented to achieve the PNMC's targets, considering a time horizon of up to 2020.

As an **overall result of the progress in implementing the PNMC**, the emission reduction achieved in 2020 was of 47%, exceeding the target that was set at 36.1% to 38.9%, compared to the projected value for the year. In other words, 1,715 Mt CO_2 eq (GWP-SAR) were emitted in 2020, while the value projected in the reference scenario was 3,236 Mt CO_2 eq (GWP-SAR). The plans that have been implemented are detailed below.

The **Action Plans for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm) and of Fires in the Cerrado (PPCerrado)** are coordinated by the Ministry of the Environment and Climate Change (MMA) and have the general objective of reducing deforestation and degradation of native vegetation while promoting the maintenance of ecosystem services, through a sustainable model for the use of forest resources and agricultural practices. The PPCDAm began in 2004 and the PPCerrado began in 2010. However, in 2019, they were revoked by Decree No. 10,142/2019.

With the publication of Decree No. 11,367/2023, the PPCDAm and PPCerrado were resumed along with plans for the other biomes. For the purposes of this biennial report, the new plans established by the aforementioned decree are reported in item 3.4.2.

The PPCDAm and the PPCerrado are considered instruments for implementing the PNMC, with a focus on mitigating GHG emissions related to land use, land-use change and forestry (LULUCF). They also contribute to the implementation of the National Strategy for the Reduction of Greenhouse Gas Emissions Resulting from Deforestation and Forest Degradation; Sustainable Management of Forests; and Conservation and Enhancement of Forest Carbon Stocks (ENREDD+ – National Strategy for REDD+). The main national instrument for funding REDD+ mitigation actions is the Amazon Fund (Fundo Amazônia), a pioneering Brazilian payment-by-results initiative, led by an inter-institutional committee chaired by the Ministry of the Environment and Climate Change (MMA), in partnership with the Brazilian Bank for Economic and Social Development (BNDES), among others.

The National Plans for the Control of Deforestation and Fires are also instruments of the National Policy to Combat Desertification and Mitigate the Effects of Drought, in line with the National Plan for the Recovery of Native Vegetation (PLANAVEG, Plano Nacional de Recuperação da Vegetação Nativa) and the National Biodiversity Policy (PNB, Política Nacional de Biodiversidade). In this way, they act transversally, contributing to different national and international environmental commitments.

The actions of the Action Plans for the Prevention and Control of Deforestation and Fires included (i) regularizing the ownership of public lands in the states of the Legal Amazon, (ii) land-use planning,

strengthening protected areas, (iii) ensuring liability for environmental crimes and offenses, (iv) implementing shared forest management, (v) preventing and combating wildfires, (vi) improving and strengthening the monitoring of vegetation cover, (vii) promoting sustainable forest management and (viii) implementing economic instruments to control illegal deforestation.

As a result of these actions, in 2020 the deforestation rate in the Legal Amazon fell by 45% compared to the average for the period between 1996 and 2005, and the deforested area in the Cerrado fell by 63% compared to the average for the period between 2001 and 2008.

The **Sectoral Climate Change Mitigation and Adaptation Plan for the Consolidation of a Low Carbon Emission Economy in Agriculture (ABC Plan)** is one of the main instruments of Brazilian agricultural policy for promoting sustainability, including the reduction of GHG emissions. The ABC Plan was the result of work initially coordinated by the Office of the President's Chief of Staff, the Ministry of Agriculture, Livestock and Supply (MAPA, Ministério da Agricultura, Pecuária e Abastecimento) and the Ministry of Agrarian Development (MDA, Ministério do Desenvolvimento Agrário).

The ABC Plan was structured in such a way as to include the promotion of a set of sustainable production systems, practices, products and processes, called "ABC technologies" (Appendix 3.II), with a solid technical and scientific basis, including: No-till farming system (NTFS); Recovery of Degraded Pastures (RDP); Integrated Crop-Livestock-Forestry (ICLF); Biological Nitrogen Fixation (BNF); Planted Forests (PF); and; Manure Treatment (MT). As a whole, the "ABC technologies" aimed to expand the total areas destined for their implementation by 35.5 million hectares, with the purpose of, in addition to the mitigation and adaptation related to climate change, raising farmers' income and increasing environmental, economic and social sustainability in the agriculture sector.

One of the crucial operational instruments for implementing the ABC Plan was the credit line created specifically to support farmers to adopt ABC technologies, the Program for Reducing Greenhouse Gas Emissions in Agriculture (ABC Program), approved by Central Bank Resolution No. 3,896, of August 17, 2010. During the first decade of the ABC Plan, the ABC Program provided R$32.27 billion to fund ABC technologies, implemented through 38,300 contracts. Nevertheless, many farmers have adopted ABC technologies with their own resources, or with other sources of funding, other than the ABC Program.

In the period from 2010 to 2020, the area of application of these technologies (excluding manure treatment, which is addressed in volume) was increased to 54.03 million hectares, exceeding the overall target set at 52%. On the other hand, emission mitigation, estimated at 193.67 Mt CO_2 eq, exceeded the upper limit of the target by 19%, i.e., 163 Mt CO_2 eq) (Table ***3.1***).

TABLE 3.1 | ABC PLAN RESULTS BY TECHNOLOGY

ABC Technology	Physical target 2010-2016	GHG reduction target 2010-2016	Physical target level 2010-2016	GHG reduction target level (2010-2020)
Recovery of Degraded Pastures	15 million ha	104 Mt CO2eq	26.8 million ha (179%)	36.1 Mt CO2 eq (35%)
Integrated Crop-Livestock-Forestry and Agroforestry Systems	4 million ha	18 to 22 Mt CO2 eq	10.76 million ha (269%)	40.78 Mt CO2 eq (185%)
No-till Farming System	8 million ha	16 to 20 Mt CO2 eq	14.59 million ha (182%)	26.7 Mt CO2 eq (133%)
Biological Nitrogen Fixation	5.5 million ha	10 Mt CO2 eq	11.78 million ha (214%)	21.56 Mt CO2 eq (216%)
Planted Forests	3 million ha	-	1.88 million ha (63%)	8.82 Mt CO2 eq
Manure Treatment	4.4 million m3	6.9 Mt CO2 eq	38.34 million m3 (871%)	59.81 Mt CO2 eq (867%)

Source: Brasil, 2023b.

The mitigation outcomes resulting from the adoption of ABC Plan technologies were estimated based on a literature review, databases and repositories from official government institutions (Brazilian Institute of Geography and Statistics (IBGE, Instituto Brasileiro de Geografia e Estatística) MAPA – Ministry of Agriculture, Livestock and Supply (Ministério da Agricultura, Pecuária e Abastecimento) and MCTI), sectoral estimates (Brazilian Tree Industry) and emission factors from the National GHG Inventory of Brazil's Third National Communication to the United Nations Framework Convention on Climate Change (MANZATTO *et al*., 2020).

The ABC Plan was renamed as "Sectoral Plan for Adaptation to Climate Change and Low Carbon Emission in Agriculture, with a view to Sustainable Development (ABC+)", or in its short form "Plan for Adaptation and Low Carbon Emission in Agriculture (ABC+)".

The ABC+ Plan implementation period covers the years from 2021 to 2030, with the aim of consolidating national agriculture based on sustainable, resilient and productive systems, as science-based adaptation and mitigation solutions. In order to support the agricultural sector by offering lines of credit, incentives and agricultural policies, the Harvest Plan (Plano Safra) stands out. It is a public policy of the Brazilian Government that has been part of the ABC+ Plan since 2023.

The ABC+ Plan provides relevant support for the implementation of the NDC, and, for this reason, it is reported in section 3.4.3, along with other policies and mitigation measures related to the implementation and achievement of the NDC.

The **Steel Sector Emissions Reduction Plan** was implemented with the aim of promoting the sustainable production of charcoal used as an input in the production of pig iron, steel and ferroalloys, in order to reduce GHG emissions and increase the sector's competitiveness. Launched in 2010 and completed in 2021, it was structured around forest preservation and

forest plantation components, as well as industrial and technological components related to increasing efficiency in the carbonization process.

The Plan provided for encouraging the development of solutions for the adequate supply of sustainable feedstocks, encouraging the use of wood obtained by planting forests; and the development and dissemination of more efficient charcoal production technologies that increase the efficiency of converting wood into charcoal with improved environmental quality and reduced emissions by (i) replacing the use of native forest with planted forest, (ii) wood carbonization processes and (iii) increasing the use of sustainable charcoal in the pig iron, steel and ferroalloys production sectors, in the context of a low-carbon circular economy.

The pilot project BRA/14/G31 - Sustainable Steelmaking, coordinated by the Ministry of the Environment and Climate Change (MMA), implemented by the United Nations Development Programme (UNDP) and funded by the Global Environment Facility (GEF), began to be implemented in 2016. The following institutions were members of the Project Monitoring Committee (PMC): Ministry of Development, Industry, Trade and Services (MDIC, Ministério do Desenvolvimento, Indústria, Comércio e Serviços), Ministry of Science, Technology and Innovation (MCTI), Ministry of Agriculture and Livestock (MAPA) and the Government of Minas Gerais. The main objectives of the project were to contribute to the dissemination of more efficient technologies in current carbonization processes, with the financial incentive mechanism of payment-by-results as a key element, as well as to contribute to the establishment of public policies to encourage forest sustainability in the sector.

Six projects were contracted under the payment-by-results mechanism. The development of an MRV Platform to track the progress of these activities was completed to support the production of greenhouse gas emission reduction estimates. For the small charcoal producer, 4 Demonstration Units were set up (Zona da Mata, Northeast Minas Gerais, Montes Claros and Sete Lagoas), which served as the basis for the capacity-building program.

Consultancy studies were completed which served as the basis for public policies to encourage forest sustainability in the sector, as well as the starting point for the ongoing development of the sustainability strategy for the Brazilian pig iron, steel and ferroalloys sector.

The added value of the project consists of the sustainable production of charcoal, with a reduction in gas emissions and the production of better quality, denser, less thin and more resistant products, which may attract new markets. Technological development activities have been initiated by industries in the sector, consultancies and research institutes, on topics such as improving kilns, capturing by-products, using heat to dry wood, logistics, scale benefits, operating costs, capturing exhaust gases for burning and cogeneration.

Effective results have been achieved in reducing GHG emissions through innovative technological solutions. The innovation also stands out in terms of support mechanism - a pioneering approach for the Federal Government, GEF and UNDP. These include:

- Six support contracts for industrial-scale charcoal producers have been signed and are in progress, under the payment-by-results mechanism for charcoal

production, with the adoption of more efficient and sustainable production technologies. An independent audit carried out in 2019 found a reduction of 102,156 t CO_2 eq as a result of these contracts. The first payments were, then, made for greenhouse gas emission reduction results achieved in 2019 and 2020;

- In 2020, 11.2% of national crude steel production was obtained through the charcoal route. Of this total, 84% of the wood used to produce charcoal came from self-owned forests, 13% from forests planted by third parties and 2% from legalized forest waste.

- The "kiln-furnace" ("*forno-fornalha*") technology, developed by the Federal University of Viçosa (UFV, Universidade Federal de Viçosa), has been validated as being technically and economically viable for charcoal production. The gravimetric yield obtained was very positive, as it went from a baseline of 26% to an average of 33% (target of 32%), and the associated reduction in GHG emissions was estimated at 46.2%;

By December 2019, more than 300 people had been trained in the construction and operation of the kiln-furnace systems and carbon balance methodologies.

In addition to the sectoral plans described above, the country has also invested in other initiatives with regard to expanding the supply of hydroelectricity, alternative renewable sources, notably wind power plants, small hydroelectric plants and bioelectricity, biofuels and increasing energy efficiency. These initiatives are reported in sections 3.4.4 to 3.4.7, as they are permanent policies with significant impacts on Brazil's progress and achievement of the NDC.

3.1.1.2 National Climate Change Plan (Climate Plan)

As presented in Chapter 1, "National context", of this Report, The **National Climate Change Plan** (known as the Climate Plan) is the instrument that consolidates the strategies, plans and targets of the federal executive branch to achieve the goals of the PNMC, the national implementation and achievement of the targets of the Nationally Determined Contributions (NDC).

The Climate Plan will cover the period from 2024 to 2035, will be updated no more than every four years and will comprise a National Strategy and Sectoral Mitigation Plans; a National Strategy and Sectoral Adaptation Plans; and a Cross-Cutting Strategy for Climate Action.

Chapter 4, "Information related to the impacts of climate change and adaptation" provides details of the adaptation strategy.

The plan, which will serve as a guide for Brazil's climate policy and for the National Mitigation Strategy, will mainly aim to reduce GHG emissions. The objective is to reach an agreement on a national commitment to reduce emissions, allocated among the different economic sectors, both for the 2030 time horizon and for 2035, in an integrated manner, taking into account the impacts between the sectors, with a view to minimizing the cost to society.

The National Mitigation Strategy will be followed by seven sectoral plans establishing actions, targets, implementation costs, means of funding, monitoring and evaluation, namely:

- Land-use change and forestry;
- Agriculture and livestock;
- Cities, including urban mobility;
- Energy, including electricity and fuels; and Mining;
- Industry;
- Waste; and
- Transport.

Together with the mitigation and adaptation strategy, the Climate Plan includes a section on the cross-cutting strategy for Climate Action, which should consolidate complementary approaches and instruments necessary to achieve the objectives defined in the Mitigation and Adaptation Strategies and their respective Sectoral Plans, covering at least the following topics: socio-economic implications of the transition to climate neutrality; just transition; education, research, development and innovation; means of implementation; monitoring, management, evaluation and transparency mechanisms.

The process of drawing up the Climate Plan is underway and will be launched in its full version in 2025. It is worth highlighting the importance of maintaining and restoring the integrity of national biomes in achieving the objectives of the Climate Plan, as well as the targets of the NDC. It is, therefore, of fundamental importance to promote an increase in the areas of Conservation Units (CUs) and Indigenous Lands (ILs), guaranteeing the protection and sustainable management of natural ecosystems and traditional territories. As well as strengthening the recognition and demarcation of indigenous lands, respecting the rights, autonomy and participation of local communities and indigenous peoples over their territories and natural resources, valuing traditional knowledge and sustainable management practices.

3.1.1.3 Other relevant information

In addition to the institutional examples mentioned above, other arrangements relate to the climate agenda, including the National Committee for Reducing Emissions from Deforestation and Forest Degradation, Conservation of Forest Carbon Stocks, Sustainable Forest Management and Enhancement of Forest Carbon Stocks - REDD+ (CONAREDD+) and the Executive Committee for the Control of Illegal Deforestation and Recovery of Native Vegetation (CONAVEG). CONAREDD+ aims to coordinate, enforce and monitor the implementation of the National REDD+ Strategy, and coordinate the development of eligibility conditions for REDD+ payments and results-based actions in Brazil. CONAVEG is responsible for coordinating the implementation, monitoring and evaluation of the National Policy for the Recovery of Native Vegetation (PROVEG) and the National Plan for the Recovery of Native Vegetation (PLANAVEG).

Specifically for climate transparency, the Ministry of Science, Technology and

Innovation is responsible for managing climate data and data systems and producing reports to the UNFCCC, through the General Coordination of Climate Science (CGCL). It also coordinates the implementation of GEF climate mitigation projects and is the Designated National Authority (DNA) for the UNFCCC Technology Mechanism and the Clean Development Mechanism.

Within the scope of the Interministerial Committee on Climate Change (CIM)[20], the Ministry of Foreign Affairs (MRE) acts as Brazil's focal point to the United Nations Framework Convention on Climate Change Panel on Climate Change (IPCC); the (UNFCCC) and the Intergovernmental Ministry of Finance acts as the Designated National Authority for the Green Climate Fund, as the Operational Focal Point for the Global Environment Facility (GEF) and as a Designated Member of the Climate Investment Fund (CIF) Committees; and the Ministry of the Environment and Climate Change (MMA) performs the duties of Designated National Authority and other duties relating to the instruments established in Article 6 of the Paris Agreement under the United Nations Framework Convention on Climate Change, in coordination with the Ministry of Foreign Affairs.

3.1.2 Arrangements and data systems for monitoring, reporting and archiving information related to the NDC implementation and achievement

3.1.2.1 Measurement and reporting of greenhouse gas emissions

In October 2017, Brazil established the National Emissions Registry System (SIRENE, Sistema de Registro Nacional de Emissões)[21] through Decree No. 9,172/2017. SIRENE is a computerized system developed by the MCTI, whose main objective is to make available the results of the national inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol. SIRENE aims to provide security and transparency to the process of drawing up inventories of greenhouse gas emissions.

SIRENE provides charts and tables of national emissions, which can be exported in an editable format based on filters selected by the user. In addition, all official publications and transparency reports are made available to society on the platform. SIRENE also provides emissions and energy scenarios for 2012-2050, which are generated based on information from the "Options for Mitigating Greenhouse Gas Emissions in Key Sectors in Brazil" project, a GEF project previously implemented by the MCTI with the support of the United Nations Environment Programme (UNEP). It also provides a breakdown of GHG emissions and removals by federative unit/state, based on data from the Fourth National Communication.

This system also includes a free public platform, developed with the purpose of

20 Decree No. 12,040, of June 5, 2024

21 Available at: https://www.gov.br/mcti/pt-br/sirene

providing visibility and transparency to the voluntary submission of greenhouse gas (GHG) emission and removal inventory results by organizations in general, called Organizational SIRENE (SIRENE Organizacionais).

The Organizational SIRENE module was developed in a collaborative process with various public and private institutions. The initiative establishes some standardized requirements for the accounting of greenhouse gas (GHG) emissions throughout the country, guaranteeing the security and robustness of the data; it stimulates the management and awareness of organizations regarding data collection, preparing them for carbon trading markets and scenarios; it supports the production sector, decision-makers and Brazilian public managers in the development and prioritization of policies and actions to achieve the NDCs targets.

3.1.2.2 Reporting of sectoral greenhouse gas emission reduction in agriculture

The ABC+ Integrated Information System (SINABC, Sistema Integrado de Informações do ABC+) is an automated platform within the scope of the ABC+ Plan (see item 3.4.3), set up via a technical cooperation agreement between the Department of Innovation, Sustainable Development, Irrigation and Cooperativism of the Ministry of Agriculture and Livestock (MAPA) and the Federal Data Processing Service (SERPRO, Serviço Federal de Processamento de Dados).

The SINABC Platform has three pillars:

- The Governance System of the ABC Plan (SIGABC, Sistema de Governança do Plano ABC) with public access to be fed by the State Management Groups (GGEs, Grupos Gestores Estaduais) of the ABC+ Plan. These groups are responsible for coordinating and guiding the Plan's actions within the scope of each Brazilian federative unit/state. Currently, State Management Groups (GCEs) have been formally established in 23 federative units/states, and are structured in 20 of them, through the establishment of partnerships with federal, state and municipal government institutions, as well as non-governmental institutions and the private sector;

- The Rural Credit and Proagro – Agricultural Activity Guarantee Program (Programa de Garantia da Atividade Agropecuária) Operations System (SICOR, Sistema de Operações do Crédito Rural e do Proagro), including the development of a business intelligence panel based on cross-referencing the rural credit operations databases of the Central Bank of Brazil (SICOR), the Ministry of the Environment and Climate Change (MMA), rural properties (SICAR) and the Brazilian Institute of Geography and Statistics (IBGE); and

- The Multi-institutional Platform for Monitoring Greenhouse Gas Emissions Reductions in Agriculture - ABC Platform, which consists of the development of a technological solution for the sustainable practices of ABC+, starting with "Degraded Pasture Recovery Practices (DPRP)" and, in the next stages, the Management of Livestock Production Waste (MLPW) and Intensive Finishing (IF).

3.1.2.3 Long-term, low-emission and climate-resilient development

In 2021, the MCTI launched the National Simulator of Sectoral Policies and Emissions (SINAPSE, Simulador Nacional de Políticas Setoriais e Emissões), a Federal government tool for projecting scenarios for the implementation of sectoral public policies with the potential to reduce GHG emissions. SINAPSE is the result of a partnership with the research institutes WRI Brasil and Energy Innovation. It is based on the Emissions Policy Simulator (EPS), a free and open-source computer model created by Energy Innovation LLC and adapted to the Brazilian circumstances. SINAPSE has great potential to support Brazilian decision-makers and public managers in developing and prioritizing the introduction of policies to achieve the NDCs targets.

The SINAPSE tool allows users to simulate future climate mitigation scenarios through 48 policy measures in six sectors, ranging from deforestation, road transportation, number of lives preserved (deaths avoided) by reducing emissions, among others. The user can download the scenarios generated, with all the parameters selected, which include policy implementation progression rates for future years (intermediate policy compliance targets). The tool makes it possible to identify pathways that differ from the reference scenario (business as usual) and determine the feasibility of different pathways to achieve the NDCs targets.

The system is currently being improved to include 30 additional policies that are highly relevant to the national circumstances.

3.1.2.4 Brazil's national transparency system under the Paris Agreement (DataClima+)

The project called "Enhancement of the national transparency framework in Brazil under the Paris Agreement (DataClima+)" will be developed under the Capacity-Building Initiative for Transparency (CBIT), with financial support from the Global Environment Facility (GEF) and implemented in partnership with the United Nations Environment Program (UNEP). The project will run for 48 months and is currently undergoing a selection process to recruit consultants, with support from the Brazilian Biodiversity Fund (Funbio, Fundo Brasileiro para a Biodiversidade) and UNEP.

DataClima+ aims to enhance the national transparency framework in Brazil to support the formulation of national policies and meet the requirements of the Enhanced Transparency Framework (ETF) under the Paris Agreement. Brazil will formalize and streamline the governance of climate data needed to meet ETF requirements and inform decision-making, thus addressing the Measurement, Reporting and Verification (MRV) challenges reported in previous National Communications.

Thus, the project will develop and implement policies, rules, processes, organizational structures and technologies following the best practices of governance and business process management, with standardized and well-documented procedures that serve as the basis for the organizational knowledge management approach, increasing the efficiency of the system and, above all, the productivity of the MCTI in the preparation of transparency reports.

In addition, the project will support the implementation of institutional arrangements required for the timely receipt of raw data and the necessary capacity-building to ensure that key stakeholders benefit from the information system to be developed. The project is organized into three components:

- Component 1 focuses on designing and building an integrated climate data system for Brazil, DataClima+, connecting existing databases with new ones. It will also formalize the institutional arrangements needed to support data collection, governance and management through an integrated climate transparency framework so that national efforts are coordinated and efficient. In the case of tracking and progress in the implementation of the NDC and information on means of implementation (support needed and received by the country), new integrated IT modules will be created. Component 1 also includes stakeholder engagement actions and capacity-building needed to ensure the adoption of the system.
- Component 2 will enhance the individual modules of the integrated climate data platform in compliance with the ETF and its Modalities, Procedures and Guidelines (MPGs): GHG emissions, adaptation, NDC tracking and means of implementation. This will be achieved mainly by standardizing processes following a Business Process Management approach and through project actions that enhance databases, tools, models and system capacity for each module.
- Component 3 will support national policy and decision makers to effectively incorporate climate data and projections into their regulatory and planning processes. This will be achieved by enhancing databases, tools and models to assess the effectiveness of different sectoral policy scenarios in achieving national climate targets (SINAPSE module). It will also establish institutional arrangements to integrate SINAPSE not only into sectoral and subnational planning and budgeting bodies, but also into efforts to prepare a long-term national strategy in accordance with the Paris Agreement, Article 4, paragraph 19.

3.2 Description of Brazil's nationally determined contribution under Article 4 of the Paris Agreement, including updates

Since the original submission in 2016, Brazil has submitted updates of its NDC in 2020, 2022 and 2023[22]. Brazil's Intended Nationally Determined Contribution (iNDC) was submitted in 2015, before the adoption of the Paris Agreement, and became an NDC in 2016, with its domestic ratification and international entry into force. The NDC was developed based on the principles of common but differentiated equity and responsibility, and respective capacities, as well as national circumstances. Initiatives were considered for the three sectors with the largest share in Brazil's emissions profile (Land Use, Land-Use Change and Forestry, Energy and Agriculture). The initiatives are listed below, but are not exhaustive:

i) increasing the consumption of sustainable biofuels in the Brazilian energy matrix to approximately 18% by 2030, increasing the supply of ethanol, including by increasing the percentage of advanced biofuels (second generation), and increasing the percentage of biodiesel in diesel blend;

ii) in the forestry sector and land-use change:

- strengthening compliance with the Forest Code at federal, state and municipal level;
- strengthening policies and measures aimed at achieving zero illegal deforestation in the Brazilian Amazon by 2030 and offsetting greenhouse gas emissions from legal suppression of vegetation by 2030;
- restoring and reforesting 12 million hectares of forests by 2030, for multiple uses; and
- expanding the scale of sustainable management systems of native forests, through georeferencing and traceability systems applicable to the management of native forests, with a view to discouraging illegal and unsustainable practices;

iii) in the energy sector, achieving an estimated 45% share of renewable energies in the composition of the energy matrix by 2030, including:

- expanding the use of renewable sources, in addition to hydroelectric power, in the total energy matrix to a share of 28% to 33% by 2030;
- expanding the domestic use of non-fossil energy sources, increasing the share of renewable energies (in addition to hydroelectric power) in the electricity supply to at least 23% by 2030, including by increasing the share of wind, biomass and solar power;
- achieving 10% efficiency gains in the electricity sector by 2030.

iv) in the agriculture sector, strengthening the Low-Carbon Emission Agriculture Plan (ABC Plan) as the main strategy for sustainable development in agriculture, including through the

22 Available at: https://unfccc.int/NDCREG

additional restoration of 15 million hectares of degraded pastures by 2030 and the increase of 5 million hectares of Integrated Crop-Livestock-Forestry (ICLF) systems by 2030;

v) in the industry sector, promoting new clean technology standards and expanding energy efficiency and low-carbon infrastructure measures; and

vi) in the transport sector, promoting efficiency measures, improvements in transport infrastructure and in public transport in urban areas.

The first update complied with the Paris Agreement's decision that countries should communicate new targets for 2030 by 2020, demonstrating progress in relation to the previous NDC and reflecting the country's maximum possible ambition. At the time, Brazil added the long-term goal of achieving climate neutrality by 2060, while maintaining the initial reduction percentages (37% in 2025 and 43% in 2030, compared to 2005). GHG climate neutrality means net zero emissions, considered in CO_2 eq, i.e., anthropogenic GHG emissions are balanced by anthropogenic removals of these gases, weighted by metrics, during a specific period.

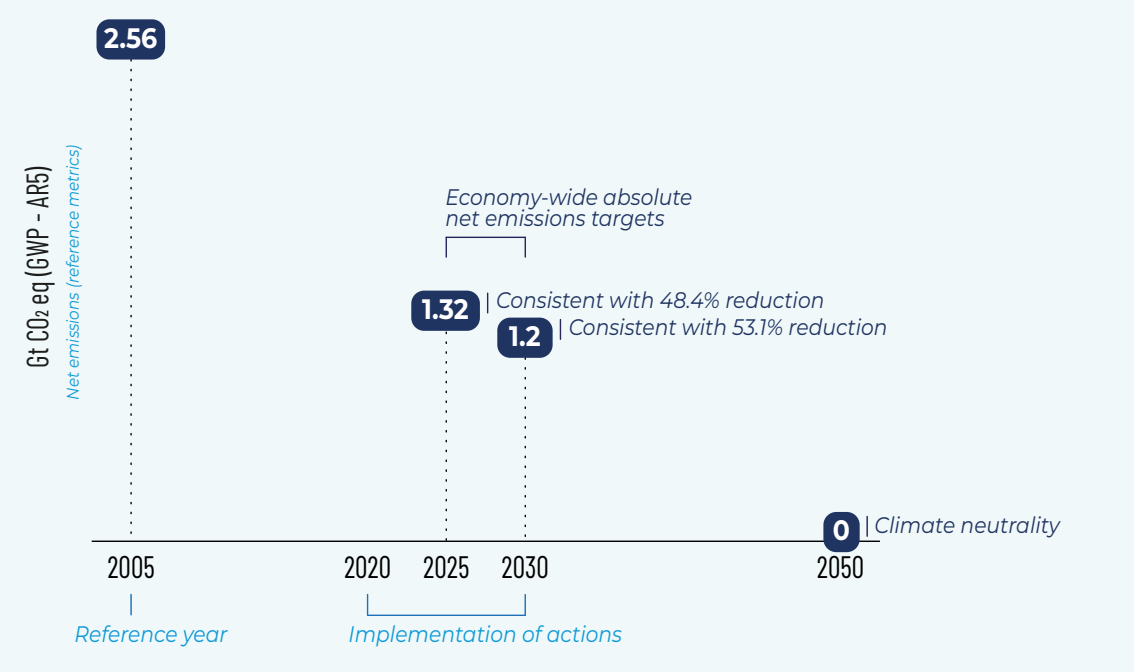
This update also presented the new national emissions result for the base year of 2005, reported in Brazil's Third National Communication to the UNFCCC (submitted in 2016). The information was the result of improvements to the National Inventory which, based on the best available knowledge, took into account the availability of more detailed natural vegetation maps, in addition to new carbon emission and removal factors.

The second update, submitted in March 2022, updated the national mitigation commitment, increasing the 2030 target to 50% and anticipated the GHG climate neutrality target to 2050. The data from the Inventory published in Brazil's Fourth National Communication to the UNFCCC (submitted in 2020) was used as a reference.

The purpose of the third update, presented on November 3, 2023, was to re-establish the level of ambition of the original commitment, maintaining the absolute emission values of the original commitment, and to preserve the commitment to climate neutrality in 2050.

In the current version of the NDC, the country is committed to an emissions limit of 1.32 Gt CO_2 eq and 1.20 GtCO_2 eq (GWP-AR5) in 2025 and 2030, respectively, considering all sectors of the economy. This corresponds to a reduction of 48.4% and 53.1%, respectively, compared to national GHG emissions in 2005, according to data from Brazil's most recent national GHG inventory (published in this BTR1), as per Figure 3.1 below.

FIGURE 3.1 | BRAZIL'S NATIONALLY DETERMINED CONTRIBUTION



Source: Brazil's First Biennial Transparency Report, 2024.

By adjusting the NDC, Brazil has demonstrated its full commitment to the Paris Agreement. The level of ambition of Brazil's NDC reflects Brazil's determination to lead by example. As a developing country, its historical contribution to climate change has been small compared to the historical responsibility of developed countries as a result of anthropogenic GHG emissions. This NDC, therefore, far exceeds the level of ambition expected of a developing country, in terms of equity and the principle of common but differentiated responsibilities and respective capabilities, under Article 3, paragraph 1, of the UNFCCC, and Article 2, paragraph 2, of the Paris Agreement.

In order to improve the clarity, transparency and comprehension aspects of the Brazilian NDC, Table 3.2 presents the description of the information, according to the Appendix of Annex II of Decision 5/CMA.3.

TABLE 3.2 | DESCRIPTION OF BRAZIL'S NATIONALLY DETERMINED CONTRIBUTION UNDER ARTICLE 4 OF THE PARIS AGREEMENT

Description	
Target(s) and description, including target type(s), as applicable (b, c).	Net emissions limit of 1.32 Gt CO_2 eq in 2025 and 1.2 Gt CO_2 eq in 2030.
Target year(s) or period(s), and whether they are single-year or multi-year target(s), as applicable.	2025 and 2030.
Reference point(s), level(s), baseline(s), base year(s) or starting point(s), and their respective value(s), as applicable.	2.56 Gt CO_2 eq (GWP-AR5) in 2005.
Time frame(s) and/or periods for implementation, as applicable.	2020-2030.
Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable.	Economy-wide absolute net emissions targets consistent with all the sectors of Brazil's National Greenhouse Gas Emissions Inventory and all the gases reported: CO_2, CH_4, N_2O, SF_6, perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs).
Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards the NDC under Article 4 of the Paris Agreement, as applicable.	Brazil strives to achieve the NDCs targets through domestic measures coordinated and implemented by the Federal Government. The Brazilian Government does not rule out the use of internationally transferred mitigation outcomes (ITMOs), as defined in Article 6 of the Paris Agreement, to complement the national efforts to achieve Brazil's NDC. Brazil may also consider the possibility of transferring international mitigation outcomes generated within its national territory. Any international transfers of mitigation outcomes obtained within Brazilian territory will be subject to the prior and formal consent of the Federal Government, in accordance with the terms and conditions, including the legislation, to be developed nationally for this purpose.
Any updates or clarifications of previously reported information, as applicable.	Information on emissions in 2005 and reference values may be updated and recalculated due to methodological improvements applicable to the Brazil's National Inventory of Greenhouse Gas Emissions.

Source: Brazil's First Biennial Transparency Report, 2024.

3.3 Information necessary to track progress made in implementing and achieving the nationally determined contribution of Brazil

In accordance with the targets mentioned in the previous item, the country will use the indicators described in Table 3.3 to track the progress and achievement of the Brazilian NDCs targets.

TABLE 3.3 | INDICATORS TO TRACK THE PROGRESS AND ACHIEVEMENT OF BRAZIL'S NDCS TARGETS

Indicators	Details
Total net GHG emissions	Indicator that measures the achievement of the NDC, given that the Brazilian NDC indicates GHG emission limits for 2025 and 2030.
Reduction of GHG emissions	Indicator that measures NDC progress by establishing the ratio of the total net GHG emissions of the last year inventoried in the National Inventory time series to the total net GHG emissions reported in the base year of 2005.

Source: Brazil's First Biennial Transparency Report, 2024.

Information on emissions in 2005 and reference values may be updated and recalculated as a result of improvements to the methodologies applicable to the inventories.

The calculation of the achievement of the NDCs targets is carried out by drawing up the National Inventory of Emissions and Removals of Greenhouse Gases not controlled by the Montreal Protocol. The emissions of the gases covered are aggregated in terms of global warming potential over a 100-year time horizon (GWP 100), based on the values stipulated in the IPCC's Fifth Assessment Report (AR5), as agreed by the CMA.

In accordance with Decision 18/CMA.1, Brazil also presents the emissions of gases aggregated in terms of global temperature potential over a 100-year time horizon (GTP 100) in the National Inventory of Emissions and Removals of Greenhouse Gases not controlled by the Montreal Protocol (NIR, section 2.8 Information on the metrics used, pages 43-45).

Brazil will update its national inventories for the time series based on the 2006 IPCC Guidelines.

Table 3.4 below provides a summary of methodologies and accounting approaches relevant to the calculation of the progress and achievement of the NDCs targets. The details are presented in the structured summaries through the common tabular format (CTFs).

TABLE 3.4 | METHODOLOGIES AND ACCOUNTING APPROACHES CONSISTENCY WITH ARTICLE 4, PARAGRAPHS 13 AND 14, OF THE PARIS AGREEMENT AND WITH DECISION 4/CMA.1

Reporting requirement	Description or reference to the relevant section of the BTR
Accounting of anthropogenic emissions and removals in accordance with common methodologies and metrics assessed by the IPCC and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement	
Methodology/accounting approach used to assess the implementation and achievement of the targets	Emissions of the gases covered will be calculated based on the 2006 IPCC Guidelines. The methodological level ("Tier") used will depend on the availability of data in the various sectors. An effort will be made to apply at least Tier 2 for the key categories identified. The emissions of the gases covered will be aggregated in terms of global warming potential over a 100-year time horizon (GWP 100), based on the values stipulated in the IPCC's Fifth Assessment Report (AR5), or GWP 100 values from a subsequent IPCC assessment report, as agreed by the CMA. The Brazilian Government will use the latest national greenhouse gas inventory available to measure achievement with the NDC.
IPCC approach used to estimate emissions and removals from harvested wood products.	Brazil used the atmospheric flow approach, in accordance with the 2006 IPCC Guidelines, to estimate emissions and removals from harvested wood products (HWP). The "production approach" was initially indicated in the annex to Brazil's NDC, as it is a generic approach; however, it was identified that this approach considers HWP trade in a limited way between countries. Thus, considering the national circumstances of significant HWP exports, Brazil applied the "atmospheric flow approach" in its National Inventory because it is more representative of the national circumstances. Nevertheless, in order to meet the transparency criteria of the Paris Agreement (paragraph 56 of Decision 18, CMA1), Brazil also presents the results from the production approach as supplementary information, according to Table A.VII.28 of the NIR 2024.
Methodological consistency between the communication and implementation of NDCs:	
Consistency in scope and coverage, definitions, data sources, metrics, assumptions and methodological approaches between the communication and implementation of the NDC.	In order to ensure methodological consistency between the communication and implementation of the NDC, the gases and sectors provided for in the iNDC submitted in 2015 and in the NDC (ratified in 2016), as well as in their respective updates in 2020, 2022 and 2023, were maintained. All categories of anthropogenic emissions and removals corresponding to the NDC were accounted for and no emission or removal categories were excluded.
Technical changes to update reference points and reference levels	
Updating of reference points or levels, improvements in accuracy and technical and methodological changes during the implementation of the NDC.	NIR 2024, section 2.3.2 Consistency and recalculations of the time series.
Efforts to include all categories of anthropogenic emissions or removals in the NDC:	
Accounting, inclusion and maintenance of categories of anthropogenic emissions and removals corresponding to the NDC	NIR 2024, section 2.7 General assessment of completeness.

Table 3.5 shows the progress made in achieving Brazil's NDCs targets, based on the results of the most recent National Inventory, published in this BTR1. For the last year of the time series (2022), Brazil emitted 2.04 Gt CO_2 eq, which corresponds to a reduction of 0.52 Gt CO_2 eq or 20.3% compared to 2005 (2.56 Gt CO_2 eq).

TABLE 3.5 | TRACKING PROGRESS IN IMPLEMENTING AND ACHIEVING THE NDC

Indicators	Unit	Reference year	Reference level	Target year	Target level	Level in 2020	Level in 2021	Level in 2022
Total net GHG emissions	Gt CO_2 eq	N.A	N.A	2025	1.32	1.82	2.12	2.04
				2030	1.20			
GHG emissions reduction	%	2005	2.56 Gt CO_2 eq	2025	48.4%	28.8%	17.4%	20.4%
				2030	53.1%			

N.A = Not applicable
Source: Brazil's First Biennial Transparency Report, 2024.

Although total emissions in 2022 are higher than in the start year of implementation of the NDC (2020), this figure is lower than the total in 2021.

The reduction in emissions compared to 2021 suggests a possible downward trend that may extend to 2023, given the reduction in the deforested area of the Amazon from 11.6 to 9 thousand km² between 2022 and 2023, the reduction in warnings of deforestation in the same biome, carried out by the DETER – Real-Time Deforestation Detection System in the Legal Amazon Region (Sistema de Detecção do Desmatamento na Amazônia Legal em Tempo Real)[23]alert system, from 7.9 to 4.3 thousand km² (in the period from August/2023 to July/2024 compared to August/2022 to July/2023). This result comes at the same time as recent initiatives, such as the increase in the mandates of biodiesel and anhydrous ethanol blending with mineral diesel and gasoline (EPE, 2024), as well as the expansion of installed wind and solar generation capacity in the national electricity matrix; among other vectors, as shown in item 3.4 below.

In addition, five new Conservation Units (CUs) were created in 2023 and 2024, four of them in the Amazon biome and one in the Caatinga biome; the new protected areas total 260,577.90 hectares[24]. Since 2023, 10 new areas have been demarcated as Indigenous Lands (ILs) in Brazil[25]. CUs and ILs are considered as protected areas for estimating CO_2 removals (NIR 2024, Land Use, Land-Use Change and Forestry section - CRT 4).

23 Available at: https://terrabrasilis.dpi.inpe.br/.

24 Source: https://www.gov.br/icmbio/pt-br/assuntos/dados_geoespaciais.
Accessed in: June 2024.

25 Available at: https://www.gov.br/funai/pt-br/assuntos/noticias/2024/governo-federal-anuncia-demarcacao-de-mais-duas-terras-e-reafirma-compromisso-com-os-povos-indigenas.

3.4 Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement

As mentioned above in item 3.1.1 of this chapter, Brazil is in the process of drawing up the Climate Plan - Plano Clima, which will be the instrument for achieving the targets of the Brazilian NDCs.

The actions, plans and policies presented below, considering the period from 2020 to 2023, are a selection of actions with an impact on the key GHG emission/removal categories of the National GHG Inventory. **However, they do not represent the totality of the country's efforts to achieve the targets of its NDC**. As of the next biennial reports, it is expected that mitigation policies and measures will be reported in accordance with the Sectoral Mitigation Plans of the National Climate Change Plan.

The following are some of the policies, measures and mitigation plans considered by the Brazilian Government to be highly relevant for the implementation and achievement of Brazil's NDC.

3.4.1 Action Plans for the Prevention and Control of Deforestation (PPCDs, Planos de Ação para Prevenção e Controle do Desmatamento) in the Brazilian Biomes

Description:

Decree No. 11,367/2023 instituted the Action Plans for the Prevention and Control of Deforestation (PPCDs) in the Amazon, Cerrado, Atlantic Forest, Caatinga, Pampa and Pantanal biomes.

The coordination of inter-ministerial actions to reduce deforestation rates in the national territory is carried out by the Permanent Inter-ministerial Commission for the Prevention and Control of Deforestation, a collegiate body linked to the Office of the Chief of Staff of the Presidency of the Republic, with the Ministry of the Environment acting as the commission's executive secretariat.

The PPCDs coordinate a broad set of public policies that contribute to reducing deforestation and forest degradation, as well as actions for the conservation, sustainable management and recovery of native vegetation. These policies, in turn, fall under the responsibility of different Federal Government bodies. The plans are based on four pillars: i) Sustainable Productive Activities; ii) Environmental Monitoring and Control; iii) Land-use and Territorial Planning; iv) Regulatory and Economic Instruments, aimed at reducing deforestation and implementing the actions covered by the other pillars of the plans.

The adoption of specific plans aims to offer appropriate responses to the circumstances and specificities of each biome. The plans for the Amazon and Cerrado biomes have already been drawn up, while the plans for the Caatinga, Atlantic Forest, Pampa and Pantanal biomes are in the process of being drafted and should be completed by the end of 2024.

Objective: To reduce deforestation and forest degradation and promote the conservation, sustainable management and recovery of native vegetation in the Brazilian biomes.

Type of Instrument: Regulatory, economic and technical-scientific.

Status: Implemented.

Sectors affected: LULUCF.

Gases affected: CO_2, CH_4, N_2O .

Implementing Entity or Entities: Ministry of the Environment and Climate Change (MMA) and related entities, as well as a wide range of Ministries and Federal Government agencies.

Start year of implementation: 2023

3.4.1 (continued)

Results:

- Reduction of vegetation suppression in the Amazon from 11.6 thousand to 9.0 thousand km², between 2022 and 2023), which is equivalent to a decrease of 22.3 %.
- Reduction in warnings of deforestation in the Amazon, carried out by the DETER alert system[26] (from 7.9 to 4.3 thousand km2 in the period from August/2023 to July/2024 compared to August/2022 to July/2023), which is equivalent to a decrease of 45.7%.

The above-mentioned results stem from the following actions:

Creation of the Monitoring System of the Action Plans for the Prevention and Control of Deforestation and Fires in the Biomes (SISPPCD, Sistema de Monitoramento dos Planos de Ação para a Prevenção e Controle do Desmatamento e Queimadas dos Biomas)[27], which aims to monitor and track the implementation of action plans and collect information on the implementation of lines of action, targets and indicators, which will support the preparation of the monitoring and evaluation reports.

Pillar - Sustainable Production Activities:

- Resumption of the Payment for Environmental Services (PSA, Pagamento por Serviços Ambientais) and Technical Assistance and Rural Extension (ATER, Assistência Técnica e Extensão Rural) Programs of the Forest+ program (Floresta+) (BRL 500 million), Green Grant (Bolsa Verde) (BRL 200 million) (MMA);
- Expansion of Forest Concessions by 878,000 ha (Brazilian Forest Service/MMA);
- Actions to support communities affected by drought in the Amazon region (BRL 628 million in Amazonas state alone) (coordinated by Vila Produtiva Rural and the Ministry of Integration and Regional Development - MIDR (Ministério da Integração e Desenvolvimento Regional);
- Amazon+Sustainable Plan (Plano Amazônia+Sustentável), support to 6,000 producers, BRL 80 million (MAPA);
- Açaí Route Strategy (Estratégia Rota do Açaí) and Bioeconomy Initiatives in Amapá (MIDR);
- Call for tenders for the procurement of machinery to support extractive production in socio-biodiversity chains (MDIC);
- Light for All Program (Programa Luz para Todos) MME – Ministry of Mines and Energy (Ministério de Minas e Energia);
- Support of BRL 60 million for research on biodiversity, forest regeneration and satellite laboratories (MCTI);

Pillar - Environmental Monitoring and Control:

- Increase in fines and embargoes with the adoption of remote actions;
- Seizure of production and destruction of goods seized in areas embargoed due to illegal deforestation;
- Cancellation, suspension and abeyance of the Rural Environmental Registry (CAR) in Indigenous Lands, Conservation Units and Unallocated Public Forests and private areas;
- Coordination with states for integrated actions to control deforestation;
- Actions for disintrusion and control of air space in Indigenous Lands (illegal mining);
- Reinforcement of the control of environmental crimes in the Amazon and of illegal activities on the border

Pillar - Land-use and Territorial Planning:

- Reinstatement of the Technical Chamber for the Allocation of Federal Rural Public Lands - Federal Decree No. 11,688 of September 5, 2013 (MDA – Ministry of Agrarian Development (Ministério do Desenvolvimento Agrário);
- Declaration of interest in the allocation of 3.75 million hectares to studies for new CUs and areas for forest concessions;
- Indication of more than 3.8 million hectares for studies aimed at recognizing indigenous lands;
- Blocking new occupations in areas declared to be of interest is currently under consideration (MMA, SPU – Federal Properties Management Office (Secretaria de Patrimônio da União) / MGI - Ministry of Management and Innovation in Public Services (Ministério da Gestão e Inovação em Serviços Públicos)

Pillar - Regulatory and Economic Instruments, aimed at reducing deforestation and implementing the actions covered by the other pillars of the plans:

- Creation of green markers in the public budget in the Annual Budget Bill (PLOA, Projeto de Lei Orçamentária Anual) (BRL 20 billion) and the Multi-Year Plan (PPA, Plano Plurianual) (50 programs in 24 bodies) (Ministry of Planning and Budgeting);
- Reinstatement of the Amazon Fund (Fundo Amazônia), with declarations of interest in new donations of BRL 3.5 billion (USA, UK, Germany, EU, Denmark, Japan and Switzerland) (MMA, MRE and BNDES);
- Launch of the Union with Municipalities Program (Programa União com Municípios) to reduce deforestation and wildfires in 70 municipalities (BRL 600 million from the Amazon Fund) (MMA and MDA);
- Harvest Plan (Plano Safra) as an inducer of low-carbon agriculture (MMA, Ministry of Finance - MF, MAPA, MDA):
  - Bonus of 1% in the interest rate for validated CAR – Rural Environmental Registry (Cadastro Ambiental Rural) and adoption of sustainable technologies;
  - Restriction of rural credit to suspended CAR, federal and state embargoes, properties partially overlapping with ILs, CUs and unallocated public forests (Resolution 5081/23 of the National Monetary Council);
- Measures to regularize the gold trade in order to combat illegal mining, involving: Registration of clients by the holder of the mining rights (MME) and adoption of the electronic invoice for Gold as a financial asset (MF and MME)

26 Available at: https://terrabrasilis.dpi.inpe.br/.

27 Available at: https://sisppcdam.mma.gov.br/index.html.

3.4.1 (continued)

Estimates of GHG emission reductions (CO_2 eq):

For this reporting item, the country needed flexibility, in light of its capabilities, as described below:

- Description of flexibility used:

Flexibility was applied in the reporting of estimates of expected and achieved emission reductions during the NDC implementation period.

- Clarification of the capacity constraint that makes it impossible to provide the information:

Quantified targets for emission reductions resulting from the implementation of PPCDs have not yet been established due to the need to develop technology and research.

- Ongoing or planned measures to overcome capacity constraints:

The ongoing discussions to define the Climate Plan and, in particular, the sectoral plan for the Land Use, Land-Use Change and Forestry (LULUCF) sector should include guidelines for defining the measurement methodology.

- Timeframe for implementing the necessary improvements and progress made regarding the improvements:

The methodology for measuring the quantified targets for reducing emissions resulting from the decrease in deforestation, to be applied within the scope of the PPCDs and the Climate Plan, is being developed and is expected to be completed by the end of the first half of 2025.

3.4.2 National Plan for the Recovery of Native Vegetation (PLANAVEG)

Description:

PLANAVEG aims to expand and strengthen public policies, financial incentives, markets, technologies, good agricultural practices and other measures necessary for the recovery of native vegetation, mainly in permanent preservation areas - APP – Permanent Preservation Areas (Área de Preservação Permanente) and legal reserves - RL (Reserva Legal), but also in degraded public areas (Conservation Units and Indigenous Lands).
Originally organized based on 8 strategic initiatives, PLANAVEG ambitions are:

- Awareness-raising: launching a communication movement focused on farmers, agribusiness, urban citizens, opinion-makers and decision-makers, in order to raise awareness on what the recovery of native vegetation is, what benefits it brings, and how to get involved and support this process;
- Seeds & seedlings: promoting the production chain for the recovery of native vegetation by increasing the capacity of nurseries and other structures for the production of native species, and rationalizing policies to improve the quantity, quality and accessibility of seeds and seedlings of native species;
- Markets: fostering markets from which landowners can generate income through the sale of wood, non-wood products, protection of springs and aquifer recharge areas, among other services and products generated by the recovery of native vegetation;
- Institutions: defining the roles and responsibilities of Government bodies, companies and civil society, and aligning and integrating existing and new public policies in favor of recovering native vegetation;
- Financial mechanisms: developing innovative financial mechanisms to encourage the recovery of native vegetation, including preferential bank loans, donations, environmental offsets, specific tax exemptions and forest bonds;
- Rural extension: expanding rural extension services (public and private) with the aim of contributing to landowners capacity-building, with an emphasis on low-cost recovery methods;
- Spatial planning & monitoring: implementing a national spatial planning and monitoring system to support the decision-making process for the recovery of native vegetation;
- Research & development: increasing the scale and focus of investment in research and development and innovation to reduce the cost, improve the quality and increase the efficiency of native vegetation recovery, taking into account environmental, social and economic factors.

Objective: To consolidate the political pact between public and private actors to meet the target of recovering 12 million hectares of native vegetation by 2030 (as provided for in Decree No. 8,972/2017, which established the National Policy for the Recovery of Native Vegetation - Proveg), in a way that is connected to current challenges and opportunities, whether in the economic field, within the scope of the Ecological Transformation Plan; in the social field, through the direct engagement of Traditional Peoples and Communities; or in the environmental field, with zero-deforestation policies, effective incorporation of the Payment for Environmental Services agenda, recovery of degraded areas and climate change mitigation and adaptation measures.

Type of Instrument: Regulatory, Economic and Technical-Scientific

Status: Implemented

Sectors affected: LULUCF

Gases affected: CO_2, CH_4, N_2O

Implementing Entities: Ministry of the Environment and Climate Change (MMA) and the National Committee for the Recovery of Native Vegetation (CONAVEG, Comissão Nacional para Recuperação da Vegetação Nativa).

Start year of implementation: 2017

Results:

In 2022, the MMA and the partner institutions in the National Committee for the Recovery of Native Vegetation (CONAVEG) took stock of the level of implementation of the Plan's eight strategic initiatives. Although the Plan is the main reference quoted by the most relevant native vegetation recovery actions/initiatives since its launch in 2017, many challenges have been identified that need to be overcome, such as: moving forward with a spatial recovery monitoring system; improving and implementing mechanisms to fund recovery production chain activities; advancing awareness and capacity-building on recovery.

In 2023, CONAVEG was resumed and three Thematic Advisory Chambers worked on reviewing PLANAVEG, the text of which was sent out for public consultation in September 2024:

1. The economics of recovering native vegetation;
2. Spatial intelligence and monitoring, and;
3. Implementation arrangements.

As it is a Strategic plan, PLANAVEG has generated indirect results (as it is a legal framework) by substantiating fundraising for recovery projects/initiatives in all biomes.

3.4.2 (continued)

Estimates of GHG emission reductions (CO_2 eq):

For this reporting item, the country needed flexibility, in light of its capabilities, as described below:

- Description of flexibility used:

Flexibility was applied in the reporting of estimates of expected and achieved emission reductions during the NDC implementation period.

- Clarification of the capacity constraint that makes it impossible to provide the information:

PLANAVEG's current target is to recover 12 million hectares of native vegetation by 2030, but it has no defined methodology and, therefore, no specific targets for reducing emissions resulting from this recovery. The challenge is due to limited staff and budget to prioritize this methodological development.
Estimating the reduction in emissions is complex, because, although there are some metrics already established for some types of vegetation, especially for forests, there are some gaps for other native vegetation formations. The challenge is to develop a formula that weights the different values per type of vegetation, creating parameters that really reflect the national effort to recover the different native vegetation formations. Brazil relies on international cooperation to fill the gaps in the means of implementation and welcomes financial, technological and capacity-building resources to do so.

- Ongoing or planned measures to overcome capacity constraints:

Currently, PLANAVEG has no ongoing measure to overcome the constraint in terms of calculating emission reductions. The effort to integrate PLANAVEG into the Climate Plan provides the opportunity to move forward with finding and establishing the methodology for these calculations. The plan is to incorporate the monitoring strategy, the activity of defining the methodology and the parameters for calculating emission reductions into the review of PLANAVEG, which is taking place in 2024.

- Timeframe for implementing the necessary improvements and progress made regarding the improvements:

The development of appropriate methodologies for defining and monitoring quantified emission reduction targets is planned for 2025. Furthermore, the implementation of PLANAVEG depends on the completion of the Climate Plan and of the Sectoral Plan for Mitigation of Land-Use Change and Forestry. It is expected to be completed by the end of the first half of 2025.

3.4.3 ABC+ Plan "Plan for Adaptation and Low-Carbon Emission in Agriculture (2021-2030)"

Description:

In April 2021, the ABC+ Plan was created, covering the period from 2021 to 2030. Encouraging the adoption of sustainable production systems, practices, products and processes, known as SPSABC, remains the central element of the ABC+ plan. After extensive consultation with experts in the different technologies, carried out through technical-scientific discussions, the scope and nomenclatures of the SPSABC already covered in the previous stage were revised.

The ABC+ Plan expanded the scope of the Recovery of Degraded Pastures (RDP) technology, which began to consider, in addition to recovery, the renewal of pastures with some degree of degradation, and was renamed as "Practices for the Recovery of Degraded Pastures (PRDP)". The "Manure Treatment (MT)" technology was renamed as "Management of Livestock Production Waste" (MLPW)" and began to include other substrates in addition to animal manure. Biological Nitrogen Fixation (BNF), henceforth called "Bioinputs (BI)", started to include Plant Growth-Promoting Microorganisms (PGPM) and multifunctional microorganisms. Integrated Crop-Livestock-Forestry (ICLF) was renamed as "Integration Systems (IS)", with greater emphasis on agroforestry systems, addressing them separately from ICLF. Finally, three new technologies were included: the Vegetables No-till Farming System (VNTFS), within the No-till Farming System, as well as the Irrigated Systems (IS) and Intensive Finishing (IF).

ABC+ Plan (2021-2030) - SPSABC/targets: Expansion of the area that adopts the ABC+ technologies by more than 72 million hectares (double the target set in the previous decade), seeking a mitigation outcome equivalent to 1.076 Gt CO_2 eq, a volume that is five times higher than the one recorded in the ABC Plan, implemented from 2010 to 2020.

Objective: To continue promoting actions to establish a more sustainable and resilient national agriculture sector, capable of controlling its GHG emissions, and which guarantees the supply of food, grains, fibers and bioenergy, in quantity and quality, with the conservation of natural resources, even in the face of growing climate uncertainty.

Type of Instrument: Regulatory, economic and technical-scientific.

Status: Implemented.

Sectors affected: Agriculture.

Gases affected: CO_2, CH_4, N_2O.

Implementing Entity or Entities: Ministry of Agriculture and Livestock (MAPA).

Start year of implementation: 2021.

Results:
It is currently under development, with SPS ABC+ as the pilot: "Practices for the Recovery of Degraded Pastures (PRDP)". The targets and preliminary results can be accessed on a management dashboard (proof of concept) at: https://www.gov.br/agricultura/pt-br/assuntos/sustentabilidade/planoabc-abcmais/abc/sinabc
SPS ABC+ "Intensive Finishing" is at an advanced stage of development.

Estimates of GHG emission reductions (CO_2 eq):

Expected estimates:

- Practices for the Recovery of Degraded Pastures (PRDP) - Recovery of 30 million hectares of degraded pastures, with estimated mitigation of 113.7 Mt CO_2 eq by 2030;
- Integration Systems (IS): expansion of 10 million hectares, with estimated mitigation of 34.1 Mt CO_2 eq by 2030. Agroforestry Systems (AFS): Expansion of 0.1 million hectares, with estimated mitigation of 37.9 Mt CO_2 eq by 2030;
- No-Till Farming System (NTFS): Expansion of the area of no-till farming of grains (NTFG) by 12.5 million hectares, with estimated mitigation of 12.1 Mt CO_2 eq by 2030. Expansion of the area of no-till farming of vegetables (NTFV) by 0.08 million hectares, with estimated mitigation of 0.88 Mt CO_2 eq by 2030;
- Planted Forests (PF): Expansion of the planted forest area by 4 million hectares, with mitigation of 510 Mt CO_2 eq by 2030;
- Bioinputs (BI): Expansion of the area with the use of bioinputs by 13 million hectares, with estimated mitigation of 23.4 Mt CO_2 eq by 2030;
- Irrigated Systems (IS): Expansion of the irrigated production area by 3.0 million hectares, with mitigation of 50 Mt CO_2 eq by 2030;
- Management of Livestock Production Waste (MLPW): Increase of the volume of managed livestock production waste by 208.4 million m3, with mitigation of 277.8 Mt CO_2 eq by 2030;
- Intensive Finishing (IF): Increase of the number of animals in intensive finishing by 5 million head, with mitigation of 16.4 Mt CO_2 eq by 2030.

3.4.3 (continued)

The estimates of the mitigation targets expected for the ABC+ Plan were based on the results achieved by the ABC Plan between 2010 and 2020, with an increase of 208.4 million cubic meters of managed livestock production waste and five million head of cattle in intensive finishing.

The parameters used to estimate the expected GHG emission reductions in the ABC+ Plan were the same as those used to estimate the GHG emission reductions achieved in the ABC Plan, in the period from 2010 to 2020, as described in Appendix 3.III.a.

Achieved estimates:

For this reporting item, the country needed flexibility, in light of its capabilities, as described below:

- Description of flexibility used:

Flexibility was applied in the reporting of estimates of achieved emission reductions during the NDC implementation period.

- Clarification of the capacity constraint that makes it impossible to provide the information:

In the context of the ABC+ Plan, the SINABC (Integrated Information System of the Sectoral Plan for the Consolidation of a Low Carbon Emission Economy in Agriculture) is at an advanced stage of development.

SINABC is made up of 3 pillars, 2 systems and 1 platform[28]. Its scope is to consolidate and systematize the outcomes resulting from the implementation of the Sectoral Plan for a Low Carbon Emission Economy in Agriculture, by consolidating primary data and information. The ABC Platform pillar of this system is being developed in a partnership established through a technical cooperation agreement (TCA) between the Department of Innovation, Sustainable Development, Irrigation and Cooperativism of the Ministry of Agriculture and Livestock (MAPA) and the Federal Data Processing Service (SERPRO).

Without SINABC being fully operational, the work of obtaining data, processing and consolidating reports becomes more complex and time-consuming, as well as being subject to a greater risk of inaccuracy.

- Ongoing or planned measures to overcome capacity constraints:

The information consolidated in the SINABC supports the next layer of the governance system, the CTABC - Technical Committee for Monitoring of the ABC Plan (Comitê Técnico de Acompanhamento do Plano ABC), in the monitoring, tracking and evaluation of the ABC+ Plan, allowing for the consolidation and reporting of primary data resulting from the actions of the national agriculture sector in tackling climate change.

The SIGABC pillar is being finalized, having been developed according to the definitions of the GOV.BR platform. It is currently in the final stages of approval. As soon as this stage is completed, training of those responsible for entering the data into the system will begin.

The SICOR pillar has been finalized. In order for it to be made publicly available, a legal opinion has been requested from this Ministry on the feasibility of making it fully publicly available.

- Timeframe for implementing the necessary improvements and progress made regarding the improvements:

SINABC is expected to be completed in 2025.

28 I. Governance System of the ABC Plan (SIGABC, Sistema de Governança do Plano ABC), in which CGMC - General Coordination for the Adaptation of Cities to Climate Change (Coordenação-Geral de Adaptação das Cidades às Mudanças Climáticas)/ DEPROS - Health Prevention and Promotion Department (Departamento de Prevenção e Promoção da Saúde)/SDI – Secretariat of Innovation, Rural Development and Irrigation (Secretaria de Inovação, Desenvolvimento Rural e Irrigação)/MAPA monitor data on the direct implementation of ABC+ by MAPA, monitoring the actions and targets established in the Operational Plan (OP);
II. Rural Credit and Proagro Operations System (SICOR, Sistema de Operações do Crédito Rural e do Proagro), whose data comes from the Central Bank, regarding credit contracted by farmers with the ABC Program, and regarding the adoption of SPSABC, and;
III. Multi-institutional Platform for Monitoring Greenhouse Gas Emission Reductions (ABC Platform), responsible for data on the adoption of SPSABC, in terms of area or volume, and their respective contributions in terms of GHG adaptation and mitigation, which help track the achievement of the respective pre-established targets. The ABC Platform also includes tools and information technologies used in the monitoring, reporting and verification of data.

3.4.4 Increase of electricity supply from renewable sources

Description:

The renewal of the Brazilian energy matrix was largely dependent on energy policies decided in the past, such as the preferential option for the hydroelectric power source (with greater investments in the 1950s), the share of wind, biomass and small hydroelectric plants (SHP) sources in the electricity matrix with the establishment of PROINFA – Program of Incentives for Alternative Electricity Sources (Programa de Incentivo às Fontes Alternativas de Energia Elétrica) (from 2002) and the set of regulations for Distributed Generation (from 2012). In addition, in the last decades, tenders have been held for new ventures to supply electricity. More recently, intermittent renewable sources, especially wind and photovoltaic, have become increasingly prominent in the Free Energy Market (ACL, Ambiente de Contratação Livre)[29].

The regulations governing the electricity trade established that distribution service companies had to guarantee the supply to their electricity market. Tenders have, therefore, been held with the purpose, among others, of contracting energy at the lowest possible price and attracting investors to build new plants with a view to expanding generation, including by hydroelectric plants and small hydroelectric plants, wind power, solar photovoltaic generation and biomass thermoelectric plants.

In 2012, the National Energy Agency (ANEEL Agência Nacional de Energia Elétrica) published Normative Resolution No. 482, which established the general conditions for distributed microgeneration and minigeneration access to electricity distribution systems and for the electricity compensation system. This resolution was followed by ANEEL Normative Resolution No. 687 in 2015, which makes up a set of regulations for Distributed Generation that allows Brazilian consumers to generate their own electricity and supply the surplus to their local distribution network. In 2023, Resolution 687 was updated by ANEEL Normative Resolution 1.059, which improved the regulations for connecting and billing distributed microgeneration and minigeneration plants in electricity distribution systems, as well as the rules of the Electricity Compensation System.

From 2010 to 2020, the country went from 44.7% to 48.7% renewable energy in the matrix, with solar and wind energy expanding from 0.2% to 2.3%.

Objective: To increase the installed capacity of renewable sources (hydroelectric, SHP, biomass, wind, solar) in the national electricity matrix.

Type of Instrument: Regulatory.

Status: Implemented.

Sectors affected: Energy.

Gases affected: CO_2, CH_4, N_2O, NO_x, CO, NMVOC and SO_2.

Implementing Entity or Entities: Ministry of Mines and Energy.

Start year of implementation: 2015.

Results:

- Increase of 1,758 MW in the Installed Capacity of Wind Power Plants in 2020 and of 11,536 MW from 2021 to 2023.
- Increase of 3,457 MW in the Installed Capacity of Photovoltaic Solar Power Plants in 2020 and of 29,921 MW from 2021 to 2023.
- Increase of 316 MW in the Installed Capacity of Biomass Thermal Power Plants in 2020 and of 1,445 MW from 2021 to 2023.
- Increase of 28 MW in the installed capacity of Hydroelectric Plants in 2020. From 2021 to 2023, there was an increase of 171 MW.
- Increase of 138 MW in the Installed Capacity of Small Hydroelectric Plants in 2020 and of 457 MW from 2021 to 2023.

29 A market segment in which the purchase and sale of electricity is carried out, subject to freely negotiated bilateral contracts, in accordance with specific trading rules and procedures.

3.4.4 (continued)

Estimates of GHG emission reductions (CO_2 eq):

For this reporting item, the country needed flexibility, in light of its capabilities, as described below:

- Description of flexibility used:

Flexibility was applied in the reporting of estimates of expected and achieved emission reductions during the NDC implementation period.

- Clarification of the capacity constraint that makes it impossible to provide the information:

Quantified targets have not yet been set due to the lack of appropriate methodologies for defining and monitoring emission reductions resulting from the implementation of increased electricity supply from renewable sources.

- Ongoing or planned measures to overcome capacity constraints:

Within the scope of the Climate Plan, methodologies will be developed for monitoring and evaluating sectoral targets, including the estimates of emissions reduction resulting from the increase in the supply of electricity from renewable sources.

- Timeframe for implementing the necessary improvements and progress made regarding the improvements:

The development of appropriate methodologies for defining and monitoring quantified emission reduction targets is scheduled for 2025.

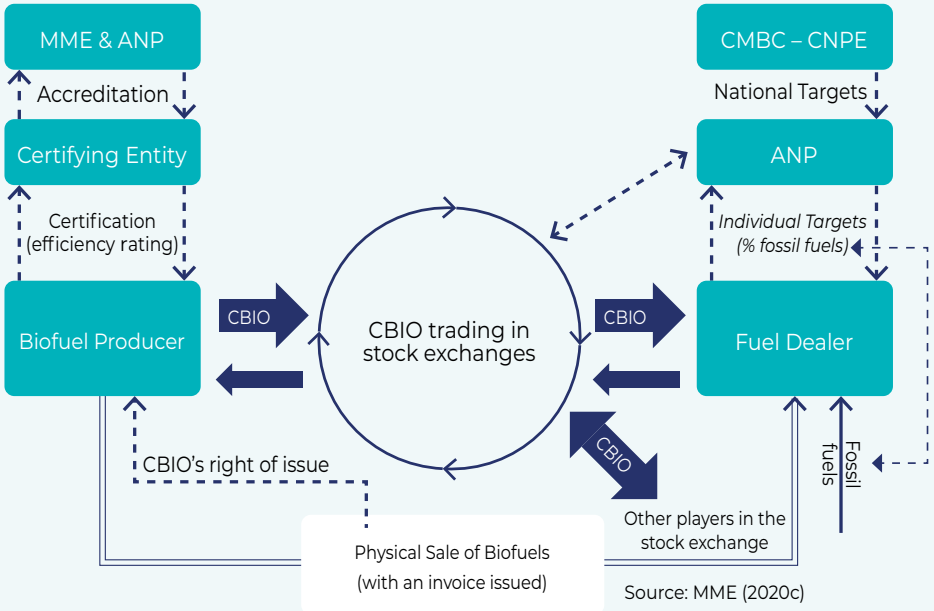
3.4.5 National Biofuels Policy (RenovaBio)

Description:

The National Biofuels Policy - RenovaBio (Law No. 13,576/2017) aims to promote the adequate increase of biofuels in the energy matrix, promoting the regularity of fuel supply in the market and inducing gains in energy efficiency and reduction of GHG emissions. This incentive translates into the granting of Decarbonization Credits (CBIO) to fuel distributors, based on the Energy-Environmental Efficiency Rating associated with the biofuels they sell.

The program establishes annual decarbonization targets, which are set by the CNPE –National Energy Policy Council (Conselho Nacional de Política Energética) and broken down by the ANP – National Agency of Petroleum, Natural Gas and Biofuels (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis) into individual targets for fuel distributors. By 2033, the target is to reach 71.29 million CBIOs.

The following diagram summarizes RenovaBio's operating model (MME – Ministry of Mines and Energy (Ministério de Minas e Energia), 2020c; 2020d).



The plan's actions promoted the supply of ethyl alcohol (Anhydrous and Hydrous) to replace gasoline and encouraged the supply of Biodiesel. As a result, the share of sustainable biofuels in the energy mix rose from 27.1% to 28.1% between 2010 and 2020.

Objective: To promote the supply of ethyl alcohol (Anhydrous and Hydrous) to replace gasoline and encourage the supply of Biodiesel.

Type of Instrument: Regulatory.

Status: Implemented.

Sectors affected: Energy.

Gases affected: CO_2, CH_4, N_2O, NO_x, CO, NMVOC and SO_2.

Implementing Entity or Entities: Ministry of Mines and Energy.

Start year of implementation: 2017.

Results:

- Supply of 32,600,000 m³ of Ethyl Alcohol added to the fuel matrix in 2020 and of 60,500,000 m³ between 2021 and 2022.
- Supply of 6,432,000 m³ of Biodiesel added to the fuel matrix in 2020 and of 13,025,000 m³ in the period from 2021 to 2022.

3.4.5 (continued)

Estimates of GHG emission reductions (CO_2 eq):

For this reporting item, the country needed flexibility, in light of its capabilities, as described below:

- Description of flexibility used:
Flexibility was applied in the reporting of estimates of expected and achieved emission reductions during the NDC implementation period.
- Clarification of the capacity constraint that makes it impossible to provide the information:
Quantified emission reduction targets have not yet been set due to the lack of appropriate methodologies for defining and monitoring emission reductions resulting from the implementation of RenovaBio.
- Ongoing or planned measures to overcome capacity constraints:
Within the scope of the Climate Plan, methodologies will be developed for monitoring and evaluating sectoral targets, including the estimates of emissions reduction resulting from the implementation of RenovaBio.
- Timeframe for implementing the necessary improvements and progress made regarding the improvements:
The development of appropriate methodologies for defining and monitoring quantified emission reduction targets is scheduled for 2025.

3.4.6 PROCEL – National Electricity Conservation Program (Programa Nacional de Conservação de Energia Elétrica) - Procel Seal

Description:

The National Electricity Conservation Program - Procel - was created in 1985 with the purpose of promoting energy efficiency in different sectors of the economy. One of its most important sub-programs is the Procel Energy Saving Seal, or simply Procel Seal. The Procel Seal, established in 1993, aims to guide consumers when making a purchase by indicating the products with the best levels of energy efficiency in each category, thus providing information for consumers' purchasing decisions and, consequently, savings on their electricity bills if they purchase a product with the Seal. The program also encourages the manufacturing and marketing of more efficient products, contributing to technological development and environmental preservation. Joining the program is voluntary. Due to the high recognition of the Procel seal in Brazil, the number of equipment manufacturers that joined the program is high.

In 2016, with the enactment of Law No.13,280, Procel had a new source of resources and the definition of annual plans for the use of these resources. These plans are drawn up and approved, after a public consultation process, by committees made up of Government representatives and agents from the national energy sector, which provides transparency and credibility to the investments made.

In 2020, due to the COVID-19 pandemic, when homes became both personal and professional spaces in the daily lives of many Brazilians, the search for more comfort was combined with the need to reduce expenses, a context in which the subject of energy efficiency became even more relevant. Interestingly, among Procel's many achievements, the year was marked by the launch of the Procel Residential Buildings Seal.

Objective: To promote the use, manufacture and marketing of highly energy-efficient electrical equipment.

Type of Instrument: Regulatory.

Status: Implemented.

Sectors affected: Energy.

Gases affected: CO_2, CH_4, N_2O, NO_x, CO, NMVOC and SO_2.

Implementing Entity or Entities: Ministry of Mines and Energy and Empresa Brasileira de Participações em Energia Nuclear e Binacional (ENBPar).

Start year of implementation: 2016.

Results:

- Reduction of 22,020 GWh in the country's electricity consumption in 2020.
- Reduction of 22,730 GWh in the country's electricity consumption in 2021.
- Reduction of 22,100 GWh in the country's electricity consumption by 2022.
- Supply of 4,439 models of electrical equipment with the PROCEL seal by 2023.

Estimates of GHG emission reductions (CO_2 eq):

Expected estimates:

For this reporting item, the country needed flexibility, in light of its capabilities, as described below:

- Description of flexibility used:

Flexibility was applied in the reporting of estimates of expected emission reductions during the NDC implementation period.

- Clarification of the capacity constraint that makes it impossible to provide the information:

Quantified emission reduction targets have not yet been set due to the lack of appropriate methodologies for defining emission reductions resulting from the implementation of the Procel Seal.

- Ongoing or planned measures to overcome capacity constraints:

Within the scope of the Climate Plan, methodologies will be developed for monitoring and evaluating sectoral targets, including the estimates of emissions reduction resulting from the implementation of the Procel Seal.

- Timeframe for implementing the necessary improvements and progress made regarding the improvements:

The development of appropriate methodologies for the monitoring of quantified emission reduction targets is scheduled for 2025.

Achieved estimates:

- 1.36 Mt CO_2 eq in 2020
- 2.87 Mt CO_2 eq in 2021
- 942 kt CO_2 eq in 2022

The methodologies and assumptions used to estimate the GHG emission reductions achieved, shown above, are described in Appendix 3.III.b.

3.4.7 National Program for the Rationalization of the Use of Oil Derivatives and Natural Gas (Conpet, Programa Nacional de Racionalização do Uso dos Derivados do Petróleo e do Gás Natural) Conpet Seal

Description:

The Conpet Program was created in 1991 to promote the conservation and rational use of oil and natural gas derivatives. One of the Program's most important sub-programs is the CONPET Energy Efficiency Seal (or simply CONPET Seal), which has been in force since August 2005, and is aimed at equipment that use oil and natural gas products that had the lowest fuel consumption rates or the highest energy efficiency rates. The Conpet Seal is currently awarded to light-duty vehicles, gas stoves and ovens and gas water heaters.

Obtaining the CONPET seal is an award that is widely publicized in the press and awarded to vehicles that achieve a high level of fuel consumption efficiency, based on the Brazilian Labeling Program.

Conpet contributes to forming a culture among consumers of permanent concern about the efficient use of energy and fossil fuels, such as oil and gas, and the respective emissions that result from burning them.

Coordinated by the Ministry of Mines and Energy, its implementing entity has been Petróleo Brasileiro S.A. - Petrobras, since its creation. The Ministry of Mines and Energy is currently evaluating the appointment of a new entity to implement Conpet. However, the Conpet Seal continues to be used on the basis of previously established criteria.

Objective: To promote the use of equipment that uses oil and natural gas products with a high level of energy efficiency as its energy source.

Type of Instrument: Regulatory.

Status: Implemented.

Sectors affected: Energy.

Gases affected: CO_2, CH_4, N_2O, NO_x, CO, NMVOC and SO_2.

Implementing Entity or Entities: Ministry of Mines and Energy.

Start year of implementation: 2005.

Results:

- Supply 139 vehicle models with the CONPET seal in 2020.

Estimates of GHG emission reductions (CO_2 eq):

For this reporting item, the country needed flexibility, in light of its capabilities, as described below:

- Description of flexibility used:
Flexibility was applied in the reporting of estimates of expected and achieved emission reductions during the NDC implementation period.

- Clarification of the capacity constraint that makes it impossible to provide the information:
Quantified emission reduction targets have not yet been set due to the lack of appropriate methodologies for defining and monitoring emission reductions resulting from the implementation of the Conpet Seal.

- Ongoing or planned measures to overcome capacity constraints:
Within the scope of the new Climate Plan, methodologies will be developed for monitoring and evaluating sectoral targets, including the estimates of emissions reduction resulting from the implementation of the Conpet Seal.

- Timeframe for implementing the necessary improvements and progress made regarding the improvements:
The development of appropriate methodologies for the monitoring of quantified emission reduction targets is scheduled for 2025.

3.5 Summary of greenhouse gas emissions and removals

Information on Brazil's GHG emissions and removals is provided in Chapter 2., "National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases", of this Report, as well as the details presented in Brazil's National Inventory Report (NIR 2024).

Nevertheless, a summary of net emissions (in kt CO_2 eq) for the time series from 1990 to 2022 is presented below.

SECTOR	NET EMISSIONS (kt CO_2 eq)										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL	**1,588,395**	**1,428,422**	**1,552,595**	**1,603,544**	**1,602,577**	**2,748,731**	**2,014,089**	**1,713,281**	**1,997,993**	**1,968,105**	**2,048,689**
1. ENERGY	196,119	199,709	204,745	208,971	217,727	233,681	250,761	266.948	274,713	284,685	291,613
2. IPPU	56,870	61,809	60,109	62,931	62,926	67,651	67,127	70,241	74,440	73,874	77,809
3. AGRICULTURE	394,743	406,182	412,339	418,084	426,689	430,657	404,854	413,141	419,662	425,255	440,797
4. LULUCF	908,066	726,204	839,122	874,712	854,112	1,973,225	1,245,647	915,577	1,179,953	1,132,596	1,184,464
5. WASTE	32,596	34,517	36,281	38,847	41,121	43,516	45,700	47,374	49,225	51,696	54,006
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
TOTAL	**2,019,047**	**2,246,261**	**3,360,112**	**3,596,053**	**2,561,246**	**2,196,460**	**1,850,441**	**1,990,232**	**1,356,216**	**1,352,807**	**1,423,603**
1. ENERGY	300,269	298,946	292,016	307,869	318,363	322,870	336,288	355,898	344,452	377,678	390,598
2. IPPU	74,447	78,932	79,839	83,540	83,335	83,914	88,978	87,279	77,407	87,353	94,143
3. AGRICULTURE	457,789	469,719	499,763	520,394	520,260	519,892	504,549	514,042	520,528	538,559	541,626
4. LULUCF	1,129,709	1,339,596	2,427,048	2,621,326	1,573,714	1,201,775	852,790	963,934	342,440	277,144	324,150
5. WASTE	56,832	59,067	61,445	62,923	65,574	68,008	67,836	69,079	71,389	72,073	73,086

SECTOR	NET EMISSIONS (kt CO_2 eq)										
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TOTAL	**1,305,805**	**1,586,905**	**1,465,525**	**1,562,802**	**1,603,968**	**1,493,407**	**1,523,108**	**1,727,820**	**1,824,760**	**2,116,314**	**2,039,236**
1. ENERGY	423,887	455,039	481,449	457,340	424,610	432,090	409,953	409,287	390,210	436,516	418,451
2. IPPU	95,464	97,042	94,725	95,670	93,931	97,958	99,422	95,394	96,992	105,846	102,317
3. AGRICULTURE	539,920	544,717	550,226	555,694	567,146	565,120	564,395	568,286	583,740	600,474	622,014
4. LULUCF	172,897	411,276	259,775	373,264	436,546	313,282	362,156	567,067	665,084	882,478	805,694
5. WASTE	73,636	78,832	79,350	80,833	81,735	84,956	87,184	87,785	88,735	90,999	90,761

Notes: IPPU - Industrial Processes and Product Use; LULUCF - Land Use, Land-Use Change and Forestry

Source: Brazil's National Inventory Report, 2024.

3.6 Projections of greenhouse gas emissions and removals, as applicable

The Brazilian Government, through the MCTI and with the support of the European Union Climate Dialogues initiative (EUCDs-GIZ), has contracted the Center for Energy and Environmental Economics (Cenergia, Centro de Economia Energética e Ambiental) of the Energy Planning Program of the Federal University of Rio de Janeiro (COPPE (Programa de Planejamento Energético)/UFRJ (Universidade Federal do Rio de Janeiro)) to draw up projections of GHG emissions and removals, with the aim of guiding the prioritization and improvement of policy instruments that will help Brazil meet the targets of the NDCs, including the commitment to climate neutrality in 2050, with greater economy-wide cost-effectiveness.

The definitions of the actions of the sectoral plans of the Climate Plan will take into account other factors besides the mitigation potential indicated in the scenarios, such as the level of technological readiness, impacts on biodiversity and the environment, competitive advantages for the country, alignment with national development policies and the institutional framework.

The work is underway and the researchers have enlisted the help of the ministries that are members of the CIM to define the key assumptions and parameters needed to draw up GHG emissions scenarios for Brazil up to 2060.

The projections are made using the integrated assessment model (IAM) called BLUES (Brazilian Land Use and Energy System), which is a perfect-foresight optimization model built on the MESSAGE (Model for Energy Supply Strategy Alternatives and their General Environmental Impacts) platform (ROCHEDO *et al.*, 2018). MESSAGE is a linear programming optimization software platform designed to facilitate the development of models, with the aim of evaluating energy supply alternatives subject to restrictions related to investments, variable and fixed operating costs, fuel prices and availability, environmental regulations, technology market penetration rate and any other restrictions that can be incorporated by taking advantage of MESSAGE's mathematical possibilities.

The BLUES model is an intertemporal least-cost optimization model designed for Brazil that uses data such as costs, performance characteristics of more than 24,000 technological alternatives, such as efficiencies, capacity factors and environmental indicators as input parameters. This model is capable of evaluating all sectors of the Brazilian economy, taking into account the energy sector and the land use sector, making it possible to examine the interaction between the economy, society and the environment, its "objective function"[30] seeks to minimize costs, subject to technological and environmental restrictions.

The parameters considered in the model are based on the best scientific information available; each technology is associated with a total cost and greenhouse gas emissions, including a breakdown by type of gas. In this way, the choice of technologies

30 Concept in optimization, used to describe the mathematical function that one wishes to maximize or minimize in a specific problem.

follows the minimization of the overall cost of the entire system, obeying the set of assumptions and boundary conditions that represent real-world constraints.

The assumptions used for the model projections follow the SSP2 projections (Shared Socioeconomic Pathways - RIAHI *et al.*, 2017). SSP2 is a type of pathway considered as intermediate or "Middle of the Road", i.e., it considers medium challenges for mitigation and adaptation, where social, economic and technological trends do not deviate markedly from historical patterns. Development and income growth continue unevenly, with some countries making relatively good progress, while others fall short of expectations. Global and national institutions are working towards achieving the sustainable development goals, but with slow progress. Environmental systems suffer degradation, although there are some improvements and, in general, the intensity of resource and energy use decreases. World population growth is moderate and stabilizes in the second half of the century. Income inequality persists or improves slowly, with challenges remaining in reducing vulnerability to social and environmental changes.

The main assumptions and parameters for projecting GHG emission scenarios for Brazil include achievement of the NDC targets for 2025 and 2030, whose emission pathways are given by the national GHG reduction strategies. After 2030, the pathways converge until they reach net-zero GHG emissions in 2050.

At the time of approval of this BTR1, the Brazilian Government was in the process of analyzing and validating the results of the GHG emissions projections. Although the results have not yet been submitted in this BTR, the country has been making progress in its GHG emissions projections and scenarios. The duly completed and validated projections will be submitted in the next BTR.

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Appendix 3.I.

Information on progress in the implementation of Brazil's Nationally Appropriate Mitigation Actions (NAMAs)

Brazil has established the National Policy on Climate Change (PNMC)[31] as an instrument for implementing and complying with mitigation actions. The PNMC established the voluntary commitment to adopt mitigation actions with a view to reducing its GHG emissions by between 36.1% and 38.9% in relation to the emissions projected for 2020. In absolute values, this target consisted of GHG emissions of between 1,977 and 2,068 Mt CO_2 eq (GWP SAR) in 2020, with the projected value in the reference scenario for 2020 being of 3,236 Mt CO_2 eq (GWP-SAR).

Following the legal definition of this national mitigation commitment, two regulatory decrees were issued (Decrees No. 7,390/2010, subsequently revoked by Decree No. 9,578/2018), defining the action plans for the prevention and control of deforestation in the biomes, and the sectoral plans for mitigation and adaptation to climate change. These frameworks established a set of actions that served as the basis for drawing up the Nationally Appropriate Mitigation Actions (NAMAs) under the Convention. As a record of the progress in implementing the NAMAs, Table 1 shows the results of the plans implemented to achieve the targets, considering the time horizon up to 2020.[32]

It should be noted that, in addition to the specific results of the physical and emission reduction targets, **Brazil fulfilled its voluntary commitment in 2020 with an overall emission reduction of 47%**, surpassing the established target of 36.1% to 38.9%, and **the emission record of 1,715 Mt CO_2 eq (GWP-SAR)**, compared to the value projected in the reference scenario of 3,236 Mt CO_2 eq (GWP-SAR).

31 Law No. 12,187, dated December 29, 2009.

32 Available at: https://unfccc.int/sites/default/files/resource/docs/2011/awglca14/eng/inf01.pdf

TABLE 1 | CONSOLIDATION OF INFORMATION RELATED TO THE NATIONAL COMMITMENT TO MITIGATION ACTIONS IN BRAZIL BY 2020

	NAMAs (FCCC/AWGLCA/ 2011/INF.1)	GHG emission reduction target in 2020 (FCCC/AWGLCA/ 2011/INF.1)	Sectoral Targets for 2020[33]	Results of sectoral physical targets in 2020	Achievement of the Sectoral Targets	GHG emission reduction results in 2020	Compliance with NAMAs
A	Reduction of Deforestation in the Amazon	564 Mt CO_2 eq	80% reduction in annual deforestation rates in the Legal Amazon compared to the average between 1996 and 2005 (1,953,500 hectares)	Deforestation rate of 1,085,100 hectares, which is equivalent to a 44% reduction in relation to the average for the period between 1996 and 2005 [a]	Partial achievement of 55% of the target	421.26 Mt CO_2 eq [b]	Partial achievement of 75% of the target
B	Reduction of Deforestation in the Cerrado	104 Mt CO_2 eq	40% reduction in annual deforestation rates in the Cerrado Biome compared to the average between 1999 and 2008 (1,570,000 hectares)	Deforestation rate of 709,516 hectares. Which is equivalent to a 50% reduction compared to the average for the period between 1999 and 2008 [a]	Yes	160.34 Mt CO_2 eq [b]	Yes
C	Recovery of Degraded Pastures	83 to 104 Mt CO_2 eq	Recovery of 15 million hectares of degraded pastures	Recovery of 26.8 million hectares of degraded pastures.	Yes	36.1 Mt CO_2 eq c	Partial achievement of 43% of the target
D	Integrated Crop-Livestock-Forestry	18 to 22 Mt CO_2 eq	Expansion of the crop-livestock-forestry integration system by 4 million hectares	Expansion of the crop-livestock-forestry integration system by 10,76 million hectares	Yes	40.78 Mt CO_2 eq [c]	Yes
E	No-till Farming System	16 to 20 Mt CO_2 eq	Expansion of no-till farming over straw by 8 million hectares	Expansion of no-till farming by 14.59 million hectares	Yes	26.7 Mt CO_2 eq [c]	Yes
F	Biological Nitrogen Fixation	16 to 20 Mt CO_2 eq	Expansion of biological nitrogen fixation by 5.5 million hectares of cultivated areas, replacing the use of nitrogen fertilizers	Expansion of biological nitrogen fixation by 11.78 million hectares	Yes	21.56 Mt CO_2 eq [c]	Yes

33 Established via Decree No. 7390/2010, later revoked by Decree No. 9.578/2018.

	NAMAs (FCCC/AWGLCA/ 2011/INF.1)	GHG emission reduction target in 2020 (FCCC/AWGLCA/ 2011/INF.1)	Sectoral Targets for 2020[33]	Results of sectoral physical targets in 2020	Achievement of the Sectoral Targets	GHG emission reduction results in 2020	Compliance with NAMAs
G	Energy Efficiency	12 to 15 Mt CO_2 eq	Expansion of the hydroelectric supply, the supply of alternative renewable sources, notably wind power plants, small hydroelectric plants and bioelectricity, the supply of biofuels, and an increase in energy efficiency.	Expansion from 44.7% to 48.7% of renewable energies in the energy matrix, with solar and wind energy expanding from 0.2 to 2.3%. The share of sustainable biofuels in the energy mix increased from 27.1% to 28.1% between 2010 and 2020. Reduction of 22,020 GWh in the country's electricity consumption in 2020.	Yes	Not estimated	Not estimated
H	Increased use of biofuels	48 to 60 Mt CO_2 eq				Not estimated	Not estimated
I	Increased energy supply from hydroelectric plants	79 to 99 Mt CO_2 eq				Not estimated	Not estimated
J	Increase in alternative energies	26 to 33 Mt CO_2 eq				Not estimated	Not estimated
K	Iron and Steel - replacement of charcoal obtained from wood from deforestation with wood from planted forests	8 to 10 Mt CO_2 eq	Increase in the use of charcoal from planted forests in the steel industry and improvement in the efficiency of the carbonization process	11.2% of national crude steel production was obtained through the charcoal route. Of this total, 84% of the wood used to produce charcoal came from self-owned forests, 13% from forests planted by third parties and 2% from legalized forest waste.	Yes	Not estimated	Not estimated

Source: Brazil's First Biennial Transparency Report, 2024.

Notes:
[a] Obtained from Prodes - Project for Satellite Monitoring of Deforestation in the Legal Amazon (Projeto de Monitoramento do Desmatamento na Amazônia Legal por Satélite) data, compared to the rates projected in Decree No. 7390/2010.
[b] Calculated based on the deforestation rates presented in Prodes[a] and the calculation parameters (e.g., carbon stock) from Decree No. 7390/2010.
[c] Information obtained from the ABC Plan.

The results of GHG emissions indicated as "Not estimated" are due to the lack of specific parameters for an accurate estimate that can relate the actions implemented to emission reductions for the period.

Appendix 3.II.

Technologies used by the ABC Plan (2010-2020):

Recovery of Degraded Pastures (RDP)

Pasture degradation is the process of loss of vigor, productivity and the capacity for natural recovery to sustain animal production, impacting on the production system's ability to overcome the harmful effects of pests, diseases and invasive plant species, due to inadequate management. As pasture degradation progresses, there is a loss of vegetation cover and a reduction in the soil's organic matter content, leading to an increase in CO_2 emissions into the atmosphere. Recovering degraded pastures while maintaining their productivity helps to mitigate greenhouse gas emissions.

Integrated Crop-Livestock-Forestry (ICLF) and Agroforestry Systems (AFS)

ICLF is a sustainable production strategy that integrates agricultural, livestock or forestry activities carried out in the same area, in intercropping, succession or rotation farming systems, seeking synergistic effects between the components of the agro-ecosystem. AFS, on the other hand, are systems of land use and land occupation in which perennial woody plants are managed in association with herbaceous plants, shrubs, trees, agricultural crops and forage, in the same management unit, according to the spatial and temporal arrangement, with a high diversity of species and interactions between these components.

ICLF and AFS contribute to the recovery of degraded areas, the maintenance and reconstitution of forest cover, the promotion and generation of employment and income, the adoption of good agricultural practices (GAP), the improvement of social conditions, the adaptation of the production unit to environmental legislation and the enhancement of the environmental services offered by agrosystems, such as: conservation of water and soil resources; shelter for pollinating agents and natural control of insect pests and diseases; carbon and nitrogen fixation; reduction of greenhouse gas emissions; nutrient recycling; soil bioremediation; maintenance and sustainable use of biodiversity. The ICLF strategy and the Agroforestry Systems include four modalities of systems, characterized as follows: Integrated Crop-Livestock (Agropastoral); Integrated Crop-Livestock-Forestry (Agrosilvipastoral); Integrated Livestock-Forestry (Silvipastoral) and Integrated Crop-Forestry (Silviagricultural).

No-Till Farming System (NTFS)

The NTFS is a complex of technological processes designed to exploit productive agricultural systems, employing tillage only in the sowing line or pit, permanent maintenance of soil cover, diversification of species and minimization or suppression of the time interval between harvesting and sowing. This system is associated with conservation agriculture in order to contribute to soil and water conservation, increasing fertilizer efficiency, increasing soil organic matter content, increasing the benefit/cost ratio, reducing fossil energy consumption and pesticide use, mitigating greenhouse gas emissions and contributing to increasing soil resilience.

Biological Nitrogen Fixation (BNF)

Increased agricultural production is particularly dependent on the supply of nitrogen, one of the main factors that limit productivity in tropical and subtropical soils. Approximately 78% of the atmosphere is made up of nitrogen (N_2), which is unavailable to most organisms. Only a limited number of microorganism species have the ability to convert N_2 into reactive nitrogen (assimilated by plants) through Biological Nitrogen Fixation (BNF). This process is indispensable for maintaining life on the planet and is strategic for sustainability in agriculture. BNF is widely recognized as reducing the cost of production, reducing risks to the environment by reducing greenhouse gas emissions, as well as increasing organic matter content (carbon sequestration) and improving soil fertility.

Planted Forests (PF)

The production of (economic) planted forests on rural properties has four basic objectives: to provide a long-term source of income for the farmer's family; to increase the supply of wood for industrial purposes (pulp and paper, furniture and wood panels), energy (charcoal and fuelwood), construction and other uses; to reduce the pressure on native forests and to capture CO_2 from the atmosphere, reducing the effects of global warming.

Manure Treatment (MT)

The correct disposal of manure and effluents from the rearing of confined animals is an important factor in the environmental compliance of rural properties. The proper treatment of these effluents and manure contributes to reducing methane emissions, as well as increasing farmers' income, either through the organic compost generated or through the generation of automotive, thermal and electrical energy through the use of biogas. Biodigestion and composting processes are already well known and reduce production costs by avoiding energy consumption and chemical inputs, reducing environmental risks and reducing GHG emissions. It includes providing farmers, cooperatives and associations that work in the swine, cattle and poultry farming chains with the appropriate and necessary investments and infrastructures.

Appendix 3.III.

Methodologies and assumptions used to estimate GHG emission reductions or removals resulting from mitigation policies and measures, actions and plans related to the implementation and achievement of the NDC

III.a. ABC+ Plan "Low Carbon Emission Agriculture Plan (2021-2030)"

In general, the main strategies for reducing GHG emissions consist of reducing the burning of fossil fuels and reducing deforestation and fires, proper soil management, and strategies for maximizing carbon sequestration (CARVALHO *et al*., 2008). In Brazil, mitigating GHG emissions necessarily involves developing and adopting agricultural production systems with the potential to retain atmospheric CO_2 in soil organic matter (SOM) and reduce emissions of CH_4 and N_2O into the atmosphere (COSTA *et al*, 2008). This principle has guided the work of researchers in the search for appropriate production technologies, with scientific and technological support, to be promoted in the agriculture sector.

Soil is the world's third largest carbon pool, estimated at 2,300 Petagrams (Pg). This potential is especially relevant in countries such as Brazil, where the energy base depends less on fossil fuels, compared to other developing or industrialized countries (BODDEY *et al*., 2012). The soil's capacity to sequester and store carbon depends on its physical, chemical and biological characteristics. These characteristics can be enhanced through management strategies. For example, it is possible to improve soil structure by including forage species, especially grasses, in grain production systems or other annual crops (LAL, 1991). It should be noted that well-managed pastures have the capacity to increase the content of stable organic matter (SOM) to above the original levels observed with native vegetation (SOUSA *et al*., 1997).

Methodologies and assumptions used to estimate GHG emission reductions or removals, according to ABC+ Plan technologies:

1. Practices for the Recovery of Degraded Pastures (PRDP)

There is no consensus among the experts in Brazil with regard to the total area of pastureland in Brazil. According to the IBGE, it is around 162 million hectares; the Brazilian Agricultural Research Corporation (Embrapa) states that it is 180 million hectares; and the Image Processing and Geoprocessing Laboratory of the Federal University of Goiás (UFG, Universidade Federal de Goiás) points to an area of around 171 million hectares. It is estimated that around 70% of the pastures have some degree of degradation, ranging from mild to moderate or severe. However, there is still no consensus among the country's various experts on the precise definition of the area of degraded pastures and its different levels of degradation. In this regard, in 2019, one of the RDP Program's priorities was to carry out a survey aimed at better defining the total area of pastures in Brazil and assessing their levels of degradation. A survey was also carried out to identify

areas of degraded pastures that have undergone some form of recovery process. To this end, it was supported by the Image Processing and Geoprocessing Laboratory (LAPIG, Laboratório de Processamento de Imagens e Geoprocessamento) of the Federal University of Goiás (UFG), and the area of RDP in the national territory was assessed from 2010 to 2018 using satellite images from the Landsat series. The study used an innovative method to evaluate the recovered area and not just the total area of degraded pasture, providing important information on RDP areas and serving as a guide for identifying priority degraded pasture areas for the ABC+ Plan.

In order to quantify the relevance of the expansion in RDP for mitigating GHG emissions, the value of 9.5 million ha was used (SANTOS *et al*., 2022), corresponding to the areas of severely degraded pasture that changed class (no longer showed signs of severe degradation). The emission factor for this technology is 3.79 t CO_2 eq ha^{-1} $year^{-1}$ (BRASIL, 2012).

2. Integration Systems (INS)

In the ABC+ Plan, two types of systems will be promoted: Integrated Crop-Livestock-Forestry (ICLF) and Agroforestry Systems (AFS) The ICLF strategy includes four modalities of systems: Integrated Crop-Livestock (Agropastoral); Integrated Crop-Livestock-Forestry (Agrosilvipastoral); Integrated Livestock-Forestry (Silvipastoral) and Integrated Crop-Forestry (Silviagricultural). In order to publicize the ICLF technology, MAPA has prepared folders and a technical information bulletin on the subject to be distributed to farmers through direct or indirect actions.

Of the total funds invested via the ABC Program, between 2013 and 2020, 6% were allocated to ICLF and AFS projects (ABC Integration), amounting to around 464,000 hectares with the technology. In the first ten years of the Plan, Embrapa developed 105 research projects focused on the problems and opportunities related to the improvement and expansion of ICLF systems in Brazil, with the productive sector as its main client.

Within the scope of the ABC Plan, the proposed target for ICLF was conservative, since the complexity of the system poses a challenge to its adoption by farmers. In order to analyze the evolution of the adoption of this technology, we used data obtained from 3 scenarios of ICLF area projections for Brazil, using growth projections based on simple linear models. The study used research data published by Embrapa. The estimates projected for 2015-2030 were considered, as they represent the average projection of the scenarios evaluated.

The emission factor for this technology is 3.79 t CO_2 eq ha^{-1} $year^{-1}$ (BRASIL, 2012).

3. No-Till Farming System (NTFS)

The NTFS is a complex of technological processes designed to exploit productive agricultural systems, employing tillage only in the sowing line or pit, permanent maintenance of soil cover, diversification of species and minimization or suppression of the time interval between harvesting and sowing. This system contributes to soil and water conservation, increasing fertilizer efficiency, increasing soil organic matter content, increasing the benefit/cost ratio, reducing fossil energy consumption and pesticide use and mitigating greenhouse gas emissions (BRASIL, 2012).

The NTFS proposal is already well known to the national production sector. However,

efforts are still needed to clarify its processes and benefits. In order to publicize the ICLF technology, MAPA has prepared folders and a technical information bulletin on the subject to be distributed to farmers.

During the first decade of the ABC Plan, Embrapa developed 61 new research projects related to improving NTFS technology. Between 2013 and 2020, the ABC Program funded the development of NTFS projects and capacity-building and technology transfer actions on 2.6 million hectares in rural areas in Brazil.

NTFS has an important impact on soil structure and, consequently, on its carbon sequestration and storage capacity, as well as preventing emissions. The accumulation of stable organic matter (SOM) in NTFS and, consequently, its potential for carbon sequestration in Brazil has already been proven by several authors, such as Machado (1976), Muzilli (1983), Derpsch *et al*. (1991), Sá (1993), Corazza (1999), Sá *et al*. (2001), Sá *et al*. (2004), Sá *et al*. (2008), Boddey *et al*. (2012) and Sá *et al*. (2015).

One of the central aspects of soils managed with NTFS is the maintenance of straw, a layer of leftovers from previous crops that keeps the soil covered, and the reduction of soil turning, which optimizes the maintenance of a healthier soil structure, allowing a grain production system to go from being a source of CO_2 that is released into the atmosphere (generated by frequent soil turning) to sequestering and storing CO_2 in the soil (SÁ *et al*., 2004).

According to Sá *et al*. (2008), the adoption and maintenance of NTFS over a long period of time, without any type of interspersed tillage, associated with crop rotation systems with an intensive contribution of crop residues, allows the recovery of the SOM stock, after losses of Total Organic Carbon (TOC) due to the conversion of natural vegetation into croplands with soil preparation. The authors quote carbon losses due to oxidation that are 2.08 times lower with NTFS compared to conventional tillage. In addition, they report a continuous carbon sequestration rate with NTFS, with a high carbon addition, of more than 0.7 t ha^{-1}.

Bayer *et al*. (2006) reported an estimated average carbon stock rate in soils under NTFS, for the (tropical) Cerrado, of 0.35 t ha^{-1} $year^{-1}$, similar to the 0.34 t ha^{-1} $year^{-1}$ reported for soils in temperate regions, but lower than the 0.48 t ha^{-1} $year^{-1}$ estimated for soils in southern Brazil (subtropical area). On the other hand, Corbeels *et al*. (2016) concluded that after 11 to 14 years, soil carbon stocks under NTFS increased and equaled the levels of the natural Cerrado. Average annual soil carbon sequestration rates in NTFS were equivalent to 1.61 and 1.48 t ha^{-1} $year^{-1}$, for samples taken in 2003 and 2011, respectively.

The emission factor for this technology is 1.83 t CO_2 eq ha^{-1} $year^{-1}$ (BRASIL, 2012).

4. Bioinputs (BI)

The growing importance of the use of microorganisms and other active ingredients in the country's agriculture sector has driven the Brazilian Government to launch the National Bioinputs Program. Of these, inoculants withmicroorganisms that favor plant growth are some of the most widely used in Brazil. Included in the ABC Plan, through the encouragement of Biological Nitrogen Fixation (BNF), they continue being the object of promotion in the ABC+ Plan. In this new phase, other plant growth-promoting microorganisms (PGPM) and multifunctional microorganisms that act to improve the fixation and/

or availability of nutrients will be included, as well as microorganisms and macroorganisms for biological control. Although microorganisms related to BNF and other plant growth-promoting processes exist in nature, their benefits to crops can be enhanced by enrichment through the application of bioinputs. ABC+ renamed the technology previously known as "Biological Nitrogen Fixation (BNF)" as "Bioinputs", broadening its scope. The adequate supply of nutrients to crops is fundamental to guaranteeing the necessary increases in agricultural production. Nutrients can be supplied through inorganic N fertilizers, although the country imports an average of 84% of the nitrogen, phosphorus and potassium it consumes, implying in high external dependence, high costs and the influence of exchange rate fluctuations. In addition, the use of inorganic N fertilizers can lead to greater environmental impacts, losses caused by leaching and higher GHG emissions, in the latter case linked to both the synthesis and processing, as well as the transportation and use of these agricultural inputs. Thus, when chemical fertilizers are replaced by microorganisms, there can be great economic, social, environmental and productive returns.

The ABC Plan has set a target for the expansion of areas using BNF equivalent to 5.5 million hectares, with a respective mitigation contribution of 10 t CO_2 eq. The study by Manzatto *et al.* (2020), updated with data from the 2020 Municipal Agricultural and Livestock Survey for the period from 2010 to 2019, resulted in an area with the adoption of 11.78 million ha of BNF. In order to support the achievement of the target of expanding the country's productive area by 5.5 million hectares using BNF, 473 tons of inoculants were distributed to 893 family farmers and land reform settlements. Publicity materials were also produced, explaining and promoting its use. Embrapa has signed agreements with institutions that have trained more than 40 cooperatives on the subject in the states of RS, SC, PR, MG and SP. In addition, the institution has developed 91 new research projects that consider BNF in crops other than soybeans, such as beans, sugarcane, rice, corn and wheat. It has also developed a program to validate and transfer BNF management practices to cowpeas in various regions of the country.

The emission factor for this technology is 1.83 t CO_2 eq ha^{-1} $year^{-1}$ (BRASIL, 2012).

5. Planted Forests (PF)

The first objective of the ABC Plan's Planted Forests (PF) program was to promote the area of planted forests to support the steel and energy industries, reducing the pressure on native forest areas originally used for the operation of these industries. It was expected that this would support the Steel Sectoral Plan under the PNMC, increase the supply of wood for industrial, energy and construction purposes, and promote the capture of carbon dioxide from the atmosphere. The aim was also to diversify farmers' income, based on a systemic view of agricultural production systems.

The area of planted forests between 2010 and 2020 increased from 7.8 to 9.8 million hectares. Eucalyptus productivity in Brazil was estimated at 32.7 m^3/ha/year (with bark), with an average cycle length of 6.7 years; while pine productivity was estimated at 30.9 m^3/ha.year (with bark), with an average cycle length of 16.3 years (IBÁ - Brazilian Tree Industry (Indústria Brasileira de Árvores), 2023).

In order to disseminate the technology among farmers, MAPA has produced a booklet and a technical bulletin specifically on the subject.However, during the first decade of the ABC Plan, Embrapa developed 94 research projects related to the development of indicators for GHG emissions from PF.

In order to estimate GHG mitigation associated with the increase in the area of planted forests, the total carbon sequestered in the above-ground part of plant biomass and the carbon stored in the soil are taken into account, using the coefficient for carbon sequestration in the soil determined by Lima *et al.* (2006), whose value is of 0.80 t CO_2 eq ha^{-1} $year^{-1}$. In order to calculate the value sequestered by above-ground biomass, the emission coefficient determined by Bustamante *et al.* (2015), whose value is of 3.89 t CO_2 eq ha^{-1} $year^{-1}$ is used.

6. Management of Livestock Production Waste (MLPW)

Formerly known as "Manure Treatment (MT)", the "Management of Livestock Production Waste (MLPW)" encompasses technologies for the management of all types of waste from livestock production, such as liquid waste (made up of a mixture of cleaning water, feces, urine and food scraps), litter, carcasses of dead animals that have not been slaughtered and physiological waste, among others, and the proper stabilization of their effluents. The management of livestock production waste is an alternative to storing it in lagoons (manure storage facilities), a system that emits a lot of GHG, especially methane. There are two main technologies used for the Management of Livestock Production Waste (MLPW): biodigestion (or liquid route) and composting (or solid route). In both of them, it is possible to use all types of waste (liquid and solid). It is expected that, within the scope of the ABC+ Plan, the volume of managed waste from the rearing of confined animals, especially swine, cattle and poultry will be increased, boosting the synergy between economic and environmental gains on rural properties and reducing the impact of intensified systems on soil and water. In addition, the decomposition of waste and proper stabilization of effluents contribute to reducing GHG emissions resulting from the corresponding fermentation process.

Materials produced as part of the "Low Carbon Swine Farming" and "Low Carbon Livestock Farming" projects, were coordinated by MAPA with the support of the Inter-American Institute for Cooperation on Agriculture (IICA), with the aim of evaluating and disseminating economically viable alternatives for the management of livestock waste. The materials produced on the Management of Livestock Production Waste and Low Carbon Swine Farming include: Survey of livestock waste management technologies for small-scale swine farmers; Cleaner production technology and economic use of waste from swine production; Production technology for beef and dairy cattle in confined systems; and Teaching material on the Management of Livestock Production Waste.

Itaipu Binacional, together with various partners, has been working to provide a favorable environment for the development of energy generation from renewable sources in the region of the power plant reservoir, resulting in the creation of the International Center for Renewable Energies-Biogas (CIBiogás, Centro Internacional de Energias Renováveis-Biogás), based at the Itaipu Technology Park (PTI, Parque Tecnológico Itaipu).

The Center currently has 11 national units and one international demonstration unit, which aim to encourage the use of biogas, as well as developing strategies related to the generation of knowledge and the transfer of technology. In addition, during the first phase of the ABC Plan, various studies were carried out by Itaipu Binacional and Embrapa, a partner entity in the Manure Treatment (MT) Program. Itaipu, through CIBiogás, has developed a platform of distance learning and on-site courses, which trained 1,481 people between 2010 and 2020. It has also produced maps, manuals, technical notes, e-books and various reports on the MT program.

The National Energy Agency (Aneel, Agência Nacional de Energia Elétrica), which acted as an Indirect Partner in the implementation of the actions of the ABC Plan, supported nine projects, totaling around BRL 129 million invested, for research and strategic development in the generation of electricity from biogas produced in waste and liquid effluent treatment plants, for adhesion by companies in the electricity sector within the scope of the Research and Technological Development Program of the Electricity Sector. Embrapa has developed 19 research projects related to obtaining indicators of GHG emissions from swine farming, in addition to various studies on cross-cutting actions of the ABC Plan.

The high target values achieved for this technology suggest that, when the ABC Plan was drawn up, its adoption potential was underestimated due to the scarcity of information that existed at the time on the potential of the MT technology. In 2019, the study on "Diagnosis of the expansion of the adoption of the technology for Manure Treatment (MT) in Brazil between 2010 and 2019" was carried out. Within the scope of the ABC Cerrado Project, it was possible to update and better measure the potential of the MT program, reflecting the promotion of this technology and Brazil's ability to adopt it.

The emission factor for this technology is 1.56 t CO_2 eq m^3 (BRASIL, 2012).

7. Irrigated Systems (IS)

Irrigation should not be considered separately, but as part of a set of technologies, taking into account planting systems, crop rotation possibilities, soil protection, among others. In other words, it must be part of the Irrigated Systems concept. As part of the IS concept and with new technologies, equipment and technical knowledge, it has been implemented in a sustainable way, i.e., using water obtained in accordance with the legal precepts (concession) in an efficient manner. The country has great potential for the growth of irrigated agriculture in areas of intensification and expansion over pasture areas. Increased productivity in a sustainable manner, GHG mitigation and the achievement of national food security and development targets are some of the benefits obtained from the implementation of IS.

The emission factor for this technology is 3.03 t CO_2 eq ha^{-1} $year^{-1}$ (CAMPOS *et al.*, 2020).

8. Intensive Finishing (IF)

IF is one of the new SPSABC that has been incorporated into the ABC+ Plan, due to its proven scientific efficiency in reducing GHG emissions and promoting adaptation by allowing greater flexibility and adjustment of the use strategy for pastures. IF consists of intensifying feed management in the final production phase of cattle destined for slaughtering, mainly by adopting

confinement, semi-confinement and pasture supplementation regimes. In these regimes, as a strategy, the supply of energy is increased, mainly, but not exclusively, through the use of grains, bran, additives and by-products. Thus, IF reduces emission intensity directly, by reducing methane emissions during rumen fermentation, and indirectly, by shortening the production cycle, allowing the slaughtering of younger animals. The importance of including IF in the ABC+ Plan lies in its complementarity to other technologies that it promotes, such as DPRP, BI, IS, MLPW and INS. There is, therefore, great potential for its expansion to a wider range of producers and in production systems already provided for in this public policy. Thus, it is hoped that the ABC+ Plan will encourage the adoption of IF among beef cattle farmers who carry out cattle rearing and fattening, contributing to the overall efficiency of the beef production chain in the different biomes of the Brazilian territory.

GHG emission mitigation potential of 16.24 Mt CO_2 eq, considering that the growth in the herd submitted to Intensive Finishing is of 500,000 animals per year, with mitigation potential of approximately 11.4 kg CO_2 eq/ kg carcass, equivalent to 3,250 kg CO_2 eq/ animal of 19@.

III.b. PROCEL – National Electricity Conservation Program (Programa Nacional de Conservação de Energia Elétrica) - Procel Seal

Procel's annual results reports[34] indicate the methodology used to estimate electricity savings, especially as a result of the Procel Seal Program, as well as the rates used to estimate avoided GHG emissions.

In order to evaluate and monitor energy conservation measures, each annual report uses a model for evaluating the results of the Procel Seal, taking into account increases in energy savings. These are defined based on a baseline that can be defined in various ways, for example, taking into account the fact that the equipment does not change its efficiency or that this efficiency evolves naturally, i.e., without the existence of the seal. Thus, the total energy savings (*total ES*) for a given period and equipment will be provided by:

Total ES = EC baseline - EC after technology adoption

In which:
EC baseline: is the energy consumption as a function of the baseline (BL);

EC after technology adoption: is the energy consumption after the adoption of energy efficiency measures.

This savings value incorporates the free rider effect, when there are energy gains not directly attributable to Procel, as well as the positive effect associated with energy savings induced by the program.

34 Available at the Procelinfo website at: http://www.procelinfo.com.br/main.asp?View=%7bEC4300F8-43FE-4406-8281-08DDF478F35B%7d

Thus, net energy savings (*net ES*) can be estimated as:

Net ES = Total ES + Indirect ES - Free rider ES

In which:

Indirect ES is the savings not directly associated with the Procel Seal;

Free rider ES is the savings related to the equipment in the period considered in relation to the baseline.

In the context of the Procel Seal applied to equipment, the free rider effect is related to the technological evolution applied to all products, while indirect energy savings refer to purchases of efficient equipment, regardless of whether consumers are aware of the existence of the Procel Seal.

This approach also includes the effects of equipment efficiency degradation over its shelf life, the average ambient operating temperature and the evolution of the equipment fleet, the latter resulting from variations associated with sales and scrapping. This methodology takes as its baseline the consumption of the equipment fleet if the Procel Seal did not exist, also taking into account the effects of energy efficiency degradation.

It should be noted that Procel is also based on criteria established by the International Performance Measurement and Verification Protocol (IPMVP), specifically on the following points:

- Evaluation of the energy impact over the equipment's shelf life.
- Baseline survey to determine energy gains;
- Verification of the consistency of the model.

The total and net energy savings are obtained based on the values of the energy performance of the equipment and the hypotheses of equipment fleet in the electricity consumer market - which, in turn, depends on the initial stock, sales and scrapping observed.

With regard to the hypotheses relating to the composition of the equipment fleet, the first one refers to a fictitious market made up only of baseline products, i.e., if the fleet installed in the country was made up only of equipment without the Procel Seal. The second one refers to the real situation of the composition of the installed fleet, i.e., part of the equipment fleet with the Procel Seal and part without it. Finally, the third hypothesis for the composition of the equipment fleet refers to a fictitious potential market for the Procel Seal, where all the equipment installed in the country is efficient.

FIRST
BIENNIAL TRANSPARENCY REPORT
OF BRAZIL

TO THE UNITED NATIONS
FRAMEWORK CONVENTION
ON CLIMATE CHANGE

chapter 4

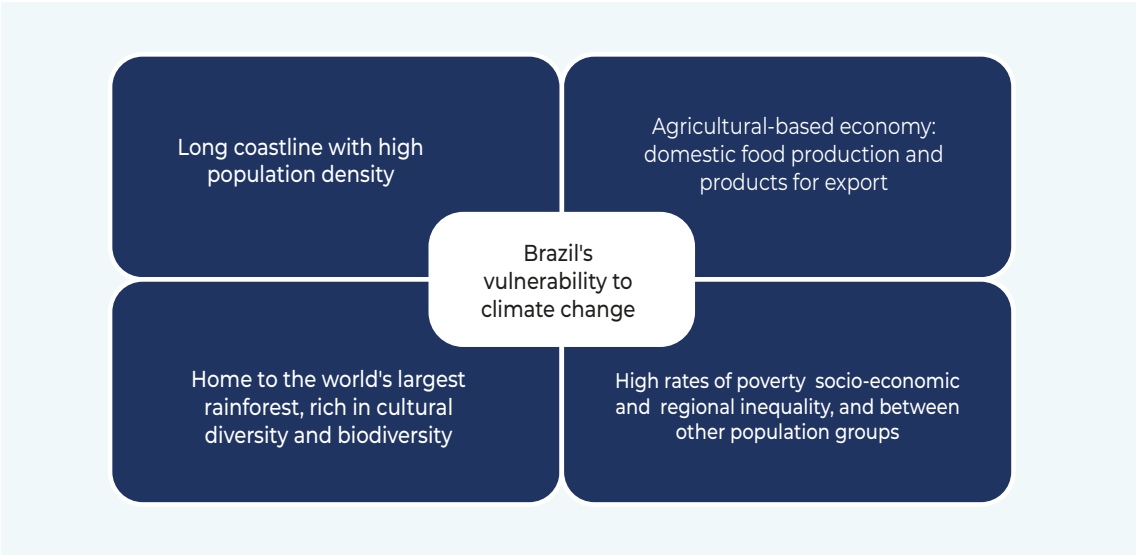
INFORMATION RELATED TO CLIMATE CHANGE IMPACTS AND ADAPTATION UNDER ARTICLE 7 OF THE PARIS AGREEMENT

4.1 National circumstances, institutional arrangements and legal framework

Information on Brazil's biogeophysical, demographic, economic and infrastructural characteristics is detailed in Chapter 1., "National context", of this Report. Additional information is provided below regarding Brazil's circumstances related to its adaptive capacity and the existence of vulnerabilities.

Brazil is a country with medium to high socio-environmental vulnerability to climate change (Figure 4.1) (VIOLA; FRANCHINI, 2014); (i) because it has a long coastline with a high population density (LEAL FILHO *et al.,* 2018); (ii) because it is a food-based country, both in terms of food production and the production of agricultural and livestock products for the international market (LAPOLA *et al.*2014; MARTINELLI; FILOSO, 2008); (iii) because it is home to the largest tropical rainforest in the world, which is rich in biodiversity and cultural diversity (MAFFI, 2005; MITTERMEIER, ROBLES-GIL; MITTERMEIER, 1997); and also (iv) because it has high rates of poverty and socio-economic inequality, especially in precarious urban settlements, which hinder access to health, education and income (CEDEPLAR/MMA/PNUD, 2017; DARELA *et al.*, 2016; PINHO *et al.*, 2014). These reasons, together with Brazil's climate diversity and vast territory, of more than 8,000 km^2, make the challenge of adaptation even greater.

FIGURE 4.1 | FACTORS OF BRAZIL'S VULNERABILITY TO CLIMATE CHANGE



Source: Based on Viola; Franchini, (2014); Leal Filho *et al.* (2018); Lapola *et al.* (2014); Martinelli, Filoso (2008); Maffi (2005); Mittermeier *et al.* (1997); Cedeplar/MMA/PNUD (2017); Darela *et al.* (2016); Pinho *et al.* (2014).

These vulnerabilities are reflected at the local level, affecting communities in different ways. On the coastline, in addition to the high concentration of population and urban centers, various economic activities that are relevant to the country are affected, such as tourism and maritime transportation. Traditional peoples and communities living in these regions, such as fishermen and shellfish gatherers, depend on natural resources for their livelihoods and are most affected by gradual climate change, such as rising sea temperatures and rising sea levels.

Climate shocks affect food production, affecting both large producers who have greater capacity to recover, and family and subsistence farmers who lack resources and preparation. The result is an impact not only on the income and livelihood of this population, but also on the price of food, which harms the poorest and most vulnerable population. Brazil's high levels of poverty and low income are also relevant factors to characterize the country's vulnerability, since the population has a lower capacity to adapt and greater sensitivity, being disproportionately affected by climate-related impacts.

With regard to the occurrence of extreme weather events, rainfall (due to its excess or scarcity) is the main factor responsible for triggering the physical processes that put the population and their economic activities at risk in Brazil, because although there are different types of disasters, almost all of them are related to hydro-meteorological and climatological events (BRASIL, 2021a). For example, some regions of the country have steep slopes and experience heavy rainfall, which increases the risk of landslides. The impact of climate change is treated as one of the factors that contribute to increased disaster risks in the country (BRASIL, 2016).

However, it is not only the physical and climate-related factors that are responsible for impacting the Brazilian population. Sensitivity issues, such as demographic, social and economic indicators are what makes some groups more vulnerable than others. In the Brazilian circumstances, access to infrastructure, education and income should be noted, as well as characteristics such as age, gender, color and ethnicity.

With regard to infrastructure, a vulnerability factor is the location of housing in risk areas. The process of urban expansion, characteristic of the last 60 years, has resulted in the concentration of the most vulnerable population in areas that are spatially more susceptible to risks. With occupation taking place without adequate urban planning, low-income communities have settled near rivers and on hills, and often without basic sanitation (DI GIULIO, TORRES, LAPOLA *et al*., 2019; SAITO, DIAS, ALVALÁ *et al.,* 2019).

In 2022, 24.3% of the population still lived in households with precarious sewage solutions, with significant regional disparities: while the Southeast has 90.7% of the population with adequate sanitation, the North has only 46.4% (IBGE, 2024). Children, black, mixed-race and indigenous people are the population groups with the least access to sanitation infrastructure, with children aged 0 to 4 being the most affected, especially in the North and Northeast Regions, which have the worst indicators. Within these regions, the younger age group has greater restrictions on access to basic sanitation than the older age group (IBGE, 2024). In addition, the proportion of the population living in households with sewage collection by a sewage system, rainwater or septic tank varies significantly between different racial groups: 91.8% among people of yellow

skin color or race, 83.5% among people of white skin color or race, 75.0% of people of black skin color or race, 68.9% of people of brown skin color or mixed-race, and 29.9% of people of indigenous skin color or race (IBGE, 2024).

The demographic profile of the Brazilian population also expresses vulnerability factors. Among the observed and future trends is the rapid ageing of the population. In 2022, Brazil had 10.9% of its total population made up of elderly people, an increase of 57.4% compared to 2010, when they represented 7.4% of the population. In terms of sex ratio, women are the majority of the population, with 94.25 men for every 100 women, which accentuates the historical trend of female predominance. From the 25 to 29 age group onwards, the female population becomes the majority in all regions of the country, increasing at older ages, due to the lower mortality rate of women at these ages as well.[35]

The higher proportion of women in the Brazilian population reflects an important layer of vulnerability, as they are disproportionately affected by climate change, even more so considering other factors, such as poverty. Item 4.2.2.2.3 explores factors that increase the risk for this population group, as well as the factors relating to color, race and ethnicity.

The racial and gender disparities were even more striking when analyzing the[36] data on poverty. In 2022, 40% of black or mixed-race people were living in poverty, double the rate observed among the white population (21%), highlighting the persistence of deep social and economic inequalities in Brazil. Poverty was higher in households headed by black or mixed-race women, without a spouse and with children under 14 years old, where 72.2% of household members were living in poverty and 22.6% were living in extreme poverty[37]. Around 32.3% of women in the country were living below the poverty line in 2022, of which 41.3% were black or mixed-race women, compared to 21.3% of white women.[38]

The capacity of the population and of the territories to deal with the increased risk of disasters is also relevant to adaptation, which is closely related to urban policies, municipal public investment capacity, population income and management of urban services aimed at minimizing the occurrence and/or the impacts of disasters in cities. However, these characteristics are not fully found in the country, indicating that most cities still have a low response capacity. The existence of zoning and land-use and occupation legislation is an instrument that generally has average levels of compliance, demonstrating the importance of improving urban land management in most Brazilian municipalities, including reducing the exposure of the population living in risk areas.[39]

Political and institutional capacity is key to preventing disasters and responding to them. In Brazil, this scenario is marked by

35 2022 Census: the number of people aged 65 and over has increased by 57.4% in 12 years. Available at: https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/38186-censo-2022-numero-de-pessoas-com-65-anos-ou-mais-de-idade-cresceu-57-4-em-12-anos. Accessed on: Mar 15, 2024.

36 Poverty data adopted: Poverty: up to USD 6.85 per day; Extreme poverty: USD 2.15 per day - *per capita* household income values according to World Bank criteria (IBGE, 2023b).

37 Poverty falls to 31.6% of the population in 2022, after reaching 36.7% in 2021. 2023. Available at: https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/38545-pobreza-cai-para-31-6-da-populacao-em-2022-apos-alcancar-36-7-em-2021. Accessed on: May 15, 2024.

38 Black or mixed-race women spend more time on domestic chores, participate less in the labor market and are more affected by poverty. Available at: <https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/39358-mulheres-pretas-ou-pardas-gastam-mais-tempo-em-tarefas-domesticas-participam-menos-do-mercado-de-trabalho-e-sao-mais-afetadas-pela-pobreza>. Accessed on: Jun 15, 2024.

39 Strategic Sector: Geo-hydrological disasters - Municipal capacity in citizenship and sectoral policies. n.d.a. Available at: https://sistema.adaptabrasil.mcti.gov.br/60008/1/2015/null/BR/estado/. Accessed on: Jul 17, 2024.

challenges related to coordination between levels of Government, lack of resources and limited infrastructure in many regions. Although the country has made progress in national risk management policies, local implementation is still limited. Brazil has a low number of municipalities that have Contingency Plans, Early Warning Systems, Risk Reduction Actions, risk management institutions, among others.[40] In order to improve this capacity, it is essential to strengthen the integration between federal, state and municipal governments, guarantee adequate funding for prevention and response, and expand the training and capacity-building of technical teams. Investing in monitoring technologies and early warning systems are also key strategies for improving resilience and reducing the impacts of disasters. Research carried out in 2020 by the IBGE – Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística) shows, for example, that although 76% of Brazilian municipalities have institutions that perform the role of Civil Defense, only 21% have a person exclusively responsible for this duty and 17% have resources provided for in the Annual Budget Law, demonstrating that, in practice, the capacity of these institutions to act is reduced (IBGE, 2021).

Among the public facilities that are important for adaptive capacity are healthcare facilities, because the greater the capacity of healthcare facilities, the better the response to society's needs, both in normal conditions and in extreme events. The level of healthcare in Brazil shows significant regional inequalities, with the North and Northeast regions having a considerably lower level compared to the other regions, which contributes to climate injustice.[41]

In terms of reducing poverty and extreme poverty, governmental social programs contributed with 67.0% of the household income of people living in extreme poverty in 2022, while income from employment accounted for only 27.4% for this group. Among poor households, social benefits made up 20.5% of their income, compared to 63.1% from employment. The absence of these social programs would have significantly exacerbated the situation, increasing the proportion of people living in poverty from 31.6% to 35.4% and increasing extreme poverty by 80%, from 5.9% to 10.6%. In addition, inequality in income distribution, as measured by the Gini Index, would have been 5.5% higher, jumping from 0.518 to 0.548, reinforcing the importance of these social policies in reducing poverty and promoting a more equitable society[42] (IBGE, 2023).

The country's water, energy and food security are also likely to be affected by climate change. Although there are positive aspects of public policies that contribute to adaptive capacity, the physical challenges that already exist are significant. With regard to water resources, the country has approximately 12% of the planet's surface fresh water, which is unevenly distributed throughout the territory in 12 river basins (ANA – National Water Agency (Agência Nacional de Águas), 2019). For example, of the 255,000 m^3/s of water that flow through Brazil on average, almost 80% is found in the Amazon basin (ANA, 2023).

40 Strategic Sector: Geo-hydrological disasters - Governance and disaster risk management of floods, flash floods and inundations. n.d.b. Available at: https://sistema.adaptabrasil.mcti.gov.br/60007/1/2015/null/BR/estado/. Accessed on: Jul 17, 2024.

41 Strategic Sector: Geo-hydrological disasters - Level of healthcare provided by healthcare facilities. Available at: https://sistema.adaptabrasil.mcti.gov.br/60028/1/2015/null/BR/municipio/. Accessed on: Jul 17, 2024.

42 Poverty fell to 31.6% of the population in 2022, after reaching 36.7% in 2021. Available at: https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/38545-pobreza-cai-para-31-6-da-populacao-em-2022-apos-alcancar-36-7-em-2021. Accessed on: Mar 10, 2024.

Brazil's basins are used for various purposes, such as irrigation, human, industrial and animal supply, energy generation, mining, aquaculture, navigation, tourism and leisure. Currently, the main use of water in the country, in terms of quantity used, is irrigation, with more than 900 m^3/s (ANA, 2019). These multiple uses of water reflect a vulnerability factor in Brazil. The water crises that have occurred in various regions show that the vulnerability of a river basin goes beyond water availability and its natural characteristics, but is also related to high demands and water quality (BRASIL, 2021a).

Energy generation in the country is highly dependent on hydroelectric plants, making it vulnerable to changes in rainfall patterns. The Brazilian Interconnected System (SIN) allows energy to be transferred between regions, taking advantage of the diversity of the hydrological regimes of the basins, which makes it possible to complement areas with different wet and dry periods (ONS – National Electric System Operator (Operador Nacional do Sistema Elétrico), 2019). Thermoelectric plants, located close to the main load centers, are activated according to hydrological conditions, helping to manage water stocks in hydroelectric reservoirs to guarantee future supply (ONS, 2019).

Water is also used in the production of biofuels. The country is the second largest producer of ethanol and biodiesel in the world, with large-scale production as a vehicle fuel and the generation of bioelectricity for the SIN, from surplus sugarcane bagasse in distilleries (VIDAL, 2022; IEA, 2023). Biodiesel in Brazil is produced exclusively for domestic supply, considering the mandatory minimum percentage of blending in diesel (Federal Law No. 13.033/2014).

As described in Chapter 1. "National context", the Agriculture sector in Brazil is of great economic importance and is also highly dependent on climate factors. Irrigation and the adoption of sustainable practices such as crop rotation, soil rest, protection and recovery of slopes and riparian forests, among others, contribute to reducing vulnerability, as they improve the quality of ecosystem services related to agricultural activities. However, there is still room to increase efficiency and improve current practices (ADAPTABRASIL, n.d.a.; BRASIL. MCTI, 2021; SOUZA;HADDAD, 2021; YOUNG, 2023).

Within the agriculture and livestock sector, there is a group that is extremely important for food production at the national level: family farmers. There are an estimated 5 million agricultural establishments in Brazil, of which 3.8 million, or 77%, are family farms. Only 9.6% of these establishments in Brazil have irrigation. In terms of area, this percentage is even lower, at 3.7%, with some critical regions, such as the semi-arid region, which has only 2% of irrigated area. The education level of family farmers in general is low, with 26.4% being illiterate, 18% never having attended school and only 2.7% having higher education (IBGE, 2019). Because they are less educated, have less access to credit and use less irrigation, this group is more vulnerable to the effects of climate change.

4.1.1 Institutional arrangements and legal framework

In order to meet a wide range of demands for mitigating and adapting to climate change, the Government has set up an institutional arrangement that addresses the issue cross-sectionally, through coordinated activities at different levels (national and subnational), as presented in Chapter 1. "National context", of this Report. Therefore, the topic of mitigation

follows the frameworks and guidelines contained in the National Policy on Climate Change (PNMC) and includes the institutions and duties contained in the CIM. In 2023, one of the decisions made by the Interministerial Committee on Climate Change (CIM) was to start drawing up the National Climate Change Plan called Climate Plan, which has an adaptation component and will be detailed in item 4.3.1 of this Report.

In addition to the provisions of the CIM, some institutions that are relevant to progress on the issue of adaptation in the country are described below.

- **National Secretariat for Climate Change of the Ministry of the Environment and Climate Change (MMA)**

In the area of adaptation, since 2023, the National Secretariat for Climate Change (SMC, Secretaria de Mudança do Clima) has been coordinating policies and plans aimed at promoting adaptation to the impacts of climate change on a national scale, in line with the objectives set out in the PNMC and with the purpose of increasing national resilience to observed and future climate change.

Under this Secretariat is the Department of Mitigation and Adaptation Policies and Implementation Instruments (DPMA, Departamento de Políticas de Mitigação, Adaptação e Instrumentos de Implementação), which, among other duties, is responsible for developing policies and strategies for climate change mitigation and adaptation; coordinating the implementation, monitoring and evaluation of the National Plan for Adaptation to Climate Change; coordinating the formulation, review and monitoring of instruments for climate change mitigation and adaptation; and promoting the coordination between federal entities and civil society, with a view to reducing the vulnerabilities resulting from the adverse effects of climate change.

The Department of Ocean and Coastal Management (DOceano, Departamento de Oceano e Gestão Costeira), which is responsible for coastal and marine management, and for including the ocean and coastal zone in climate policy in an integral and permanent way, was also established under the SMC. Its duties related to adaptation include coordinating plans, projects and initiatives for the conservation of the marine environment and mitigation of environmental impacts, for the promotion of ecosystem services and for the maintenance of environmental services in the face of climate change, among other duties related to the development of guidelines and technical support for the integration of adaptation into the management of aquatic ecosystems and coastal management[43].

- **National Institute for Space Research (INPE, Instituto Nacional de Pesquisas Espaciais)**

The National Institute for Space Research (INPE), under the Ministry of Science, Technology and Innovation (MCTI), is a Brazilian scientific and technological research institution, which, in addition to its other activities, aims to expand and consolidate competencies in science, technology and innovation in the areas of space and terrestrial environment in order to respond to national challenges. Since 1995, through its Center for Weather Forecasting and Climate Studies (CPTEC, Centro de Previsão de Tempo e Estudos Climáticos), INPE has been providing short- and medium-term weather forecasts, as well as mastering highly complex numerical modeling techniques for the atmosphere and oceans to predict future conditions[44].

43 Department of Ocean and Coastal Management. Available at: <https://www.gov.br/mma/pt-br/composicao/smc/doceano>. Accessed on: Jun 16, 2024.

44 About CPTEC. Available at: https://www.cptec.inpe.br/sobreocptec.shtml. Accessed on: Apr 20, 2024.

- **National Center for Monitoring and Warnings of Natural Disasters (CEMADEN, Centro Nacional de Monitoramento e Alerta de Desastres Naturais)**

Established in July 2011, the National Center for Monitoring and Warning of Natural Disasters (CEMADEN), under the Ministry of Science, Technology and Innovation (MCTI), adopts a specialized technical-scientific structure, developing scientific, technological and innovation capacity to continuously improve natural disaster warnings. The institution's main objective is to monitor and issue warnings of natural disasters to help safeguard lives and reduce the social, environmental and economic vulnerability resulting from these events (BRASIL, 2021a).

With regard to the legal framework, as stated in Chapter 1. "National context", there is an increasing incorporation of the theme of adaptation into sectoral policies that have been drawn up recently. It is worth highlighting the approval of guidelines[45] for the preparation of climate change adaptation plans, with the aim of implementing measures to reduce the vulnerability and exposure to risks of the environmental, social, economic and infrastructure systems in the face of the current and expected adverse effects of climate change.

According to this legal instrument, adaptation plans will establish measures to include climate change risk management in existing sectoral and thematic public plans and policies and in local and national development strategies, and will also be integrated into plans that include the mitigation of greenhouse gas emissions. Funding for the implementation of local adaptation plans (at municipal, district and state level) can be provided through the National Climate Change Fund (FNMC, Fundo Nacional sobre Mudança do Clima), among other funding sources.

The legislation also reinforces the importance of establishing economic, financial and socio-environmental public policy instruments that ensure the viability and effectiveness of adaptation and the adoption of nature-based solutions as part of the strategies, integrating adaptation and mitigation outcomes. The promotion of research, development and innovation is another element of the instrument's guidelines.

4.2 Impacts, risks and vulnerabilities

The main impacts, risks and vulnerabilities in Brazil that will be presented below are based on analyses contained in Brazil's Fourth National Communication to the Climate Convention (BRASIL, 2021a), as well as recent scientific publications focused on the national territory. Item 4.2.1 will present observed climate changes and projections of future scenarios and item 4.2.2 will present an overview of climate-related impacts that have been occurring in Brazil, with examples of the most significant occurrences and the main conclusions. Finally, section 4.2.3 details the methodologies used in the analysis of the previous items and some of the uncertainties and challenges identified.

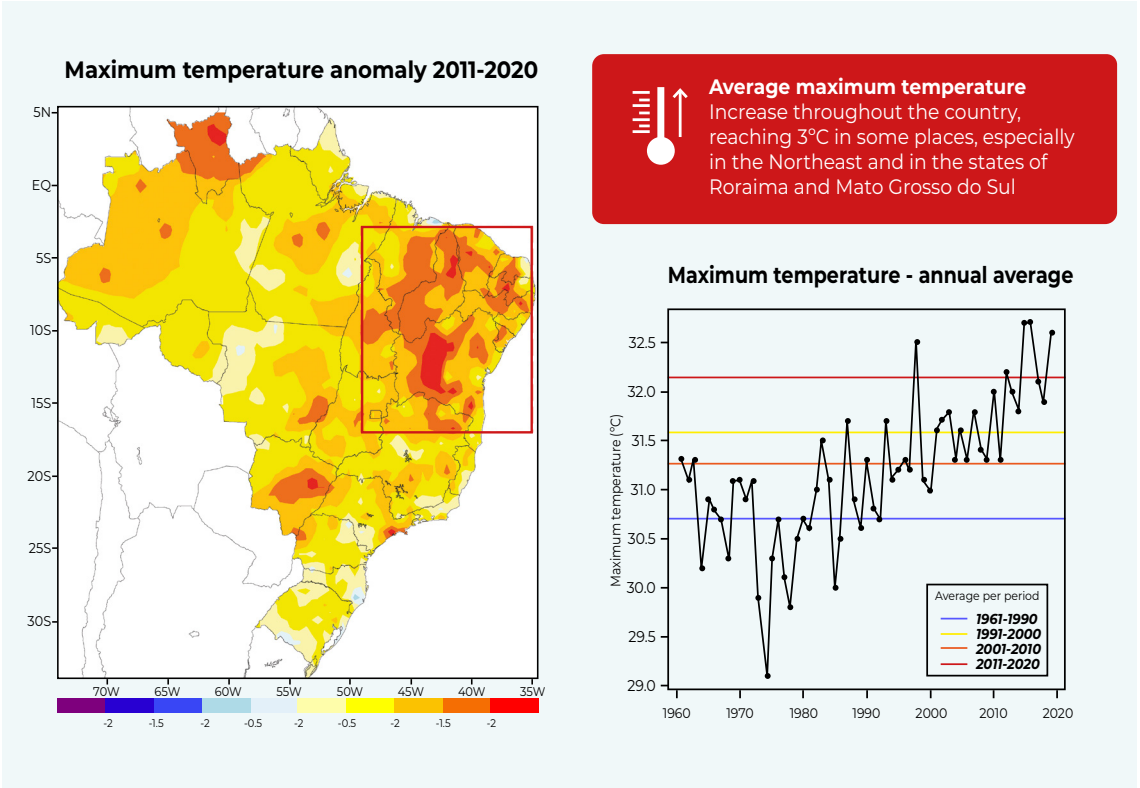
45 Law No. 14.904, of June 27, 2024.

4.2.1 Observed trends and projected climate risks

4.2.1.1 Current climate change trends

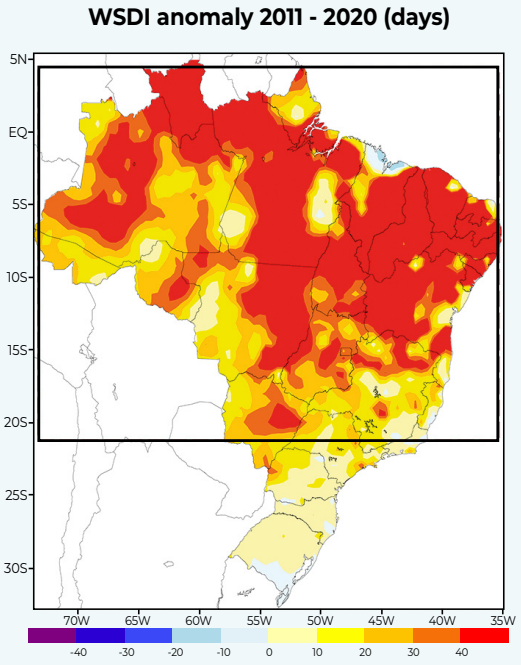
In order to analyze climate change in Brazil, the National Institute for Space Research (INPE) developed a study using observational data on temperature and precipitation. The differences between the averages in each of the selected decades, with the 1961-1990 period as a reference for comparison, allowed us to reach a conclusion regarding the distribution and magnitude of the changes observed in the country. The following maps and charts illustrate the results and main conclusions obtained for the variables analyzed (Figures 4.2, 4.3, 4.4, 4.5 and 4.6).

FIGURE 4.2 | OBSERVED MAXIMUM TEMPERATURE ANOMALY FOR 2011-2020, USING THE 1961-1990 PERIOD AS A REFERENCE WITH THE AREA OF INTEREST SELECTED ON THE MAP AND TIME SERIES OF ANNUAL AVERAGE MAXIMUM TEMPERATURE VALUES IN THE SELECTED AREA (CHART ON THE RIGHT), INCLUDING THE AVERAGE LINES BY PERIOD

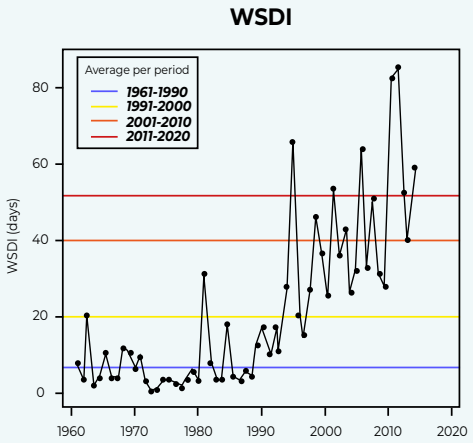


Source: INPE, 2023.

FIGURE 4.3 | WARM SPELL DURATION ANOMALY (WSDI, WARM SPELL DURATION INDEX[46]) OBSERVED FOR 2011-2020, USING THE 1961-1990 PERIOD AS A REFERENCE WITH THE AREA OF INTEREST SELECTED ON THE MAP AND ITS TIME SERIES OF ANNUAL WSDI VALUES (ON THE RIGHT), INCLUDING THE AVERAGE LINES BY PERIOD



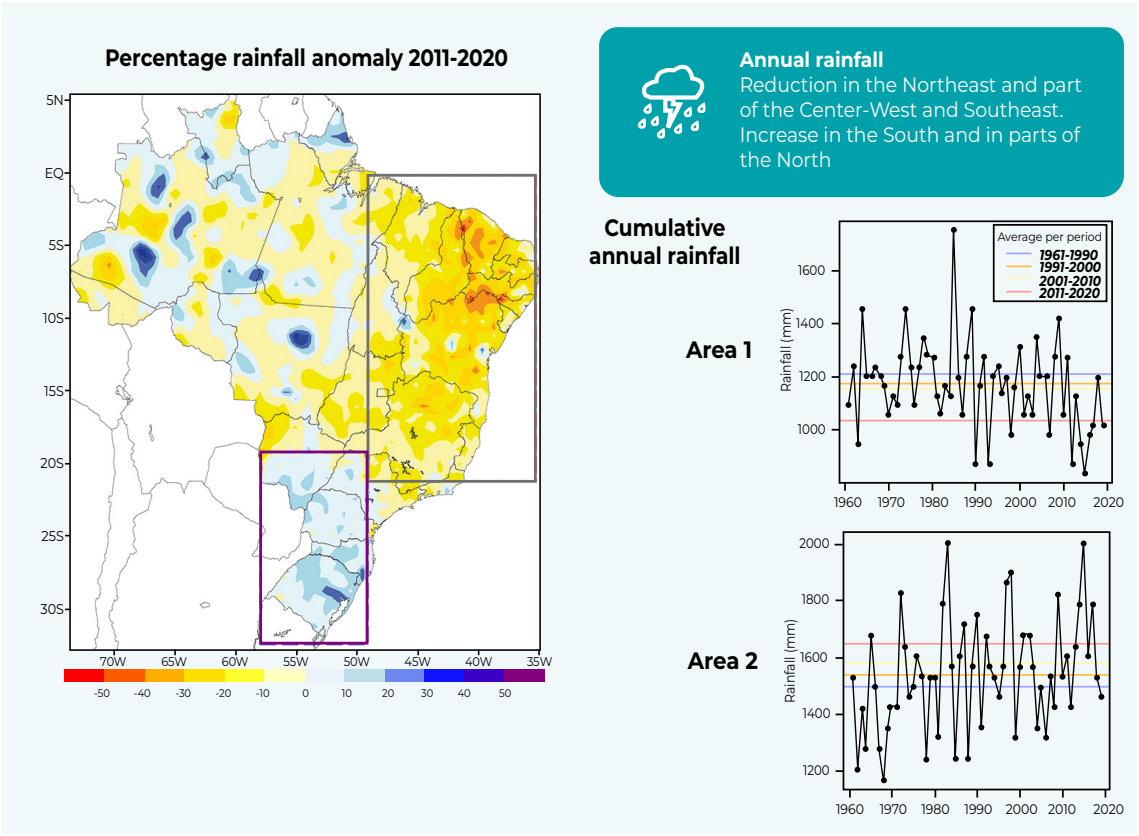
Heat waves
Significant increase in practically all of Brazil, from 7 days in the historical period to 52 days between 2011 and 2020. In other words, an 8-fold increase



Source: INPE, 2023.

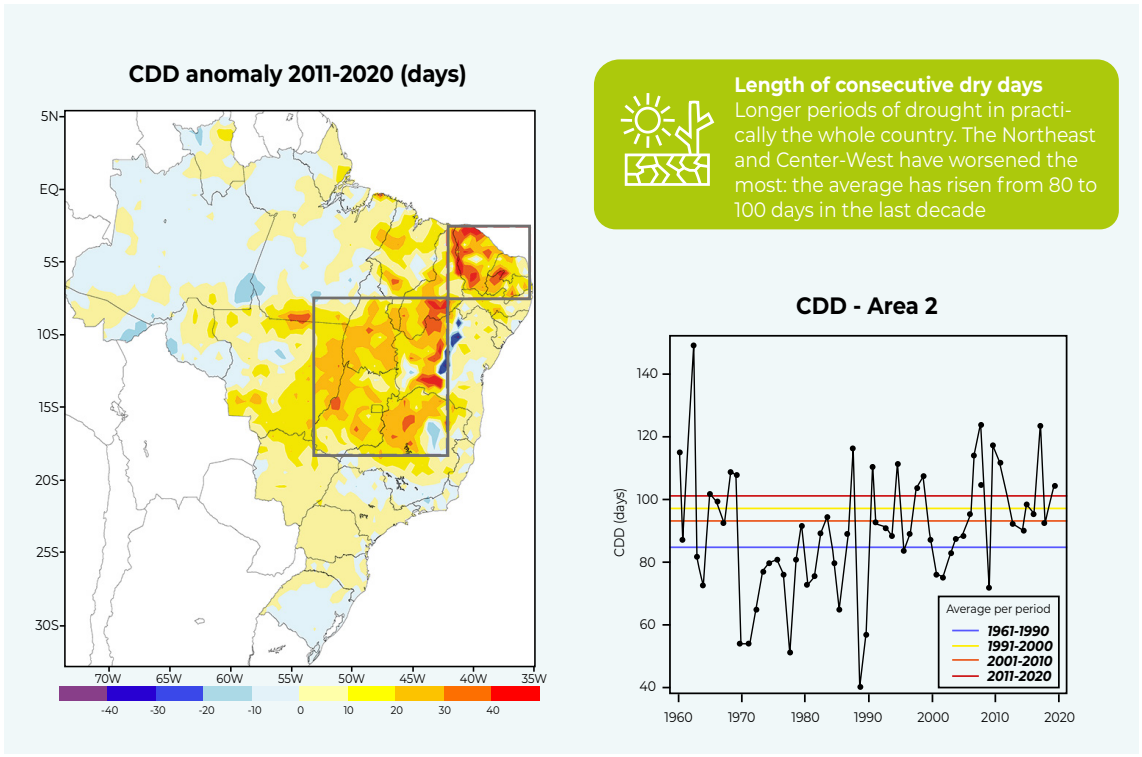
46 The WSDI is obtained by computing only those days that make up spells of at least 6 consecutive days in which the maximum temperature was higher than the 90th percentile of the maximum temperature (centered on a 5-day moving window) of the reference period (1961-1990).

FIGURE 4.4 | PERCENTAGE RAINFALL ANOMALY OBSERVED FOR 2011-2020, USING THE 1961-1990 PERIOD AS A REFERENCE WITH THE AREAS OF INTEREST SELECTED IN THE GRAY (AREA 1) AND PURPLE (AREA 2) BOXES AND THEIR CORRESPONDING SERIES OF AVERAGE ANNUAL RAINFALL VALUES (ON THE RIGHT), INCLUDING THE AVERAGE LINES BY PERIOD



Source: INPE, 2023.

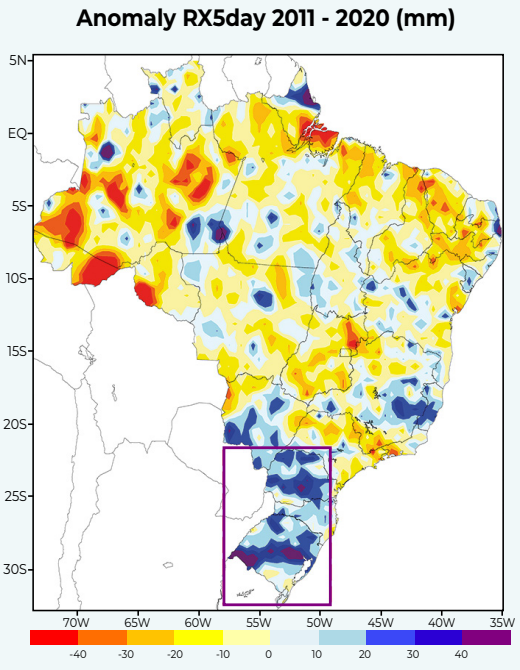
FIGURE 4.5 | CONSECUTIVE DRY DAYS (CDD[47]) ANOMALY OBSERVED FOR 2011-2020, USING THE 1961-1990 PERIOD AS A REFERENCE WITH THE AREAS OF INTEREST SELECTED IN THE GRAY BOX AND THEIR CORRESPONDING TIME SERIES OF ANNUAL CDD VALUES (ON THE RIGHT), INCLUDING THE AVERAGE LINES BY PERIOD



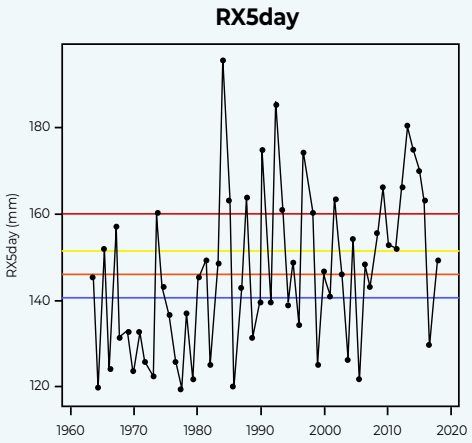
Source: INPE, 2023.

47 The Consecutive Dry Days (CDD) Index indicates the maximum number of consecutive dry days with daily precipitation of less than 1 millimeter.

FIGURE 4.6 | OBSERVED RX5DAY ANOMALY FOR 2011-2020, USING THE 1961-1990 PERIOD AS A REFERENCE WITH THE AREA OF INTEREST SELECTED IN THE PURPLE BOX AND ITS TIME SERIES OF ANNUAL RX5DAY VALUES (ON THE RIGHT), INCLUDING THE AVERAGE LINES BY PERIOD



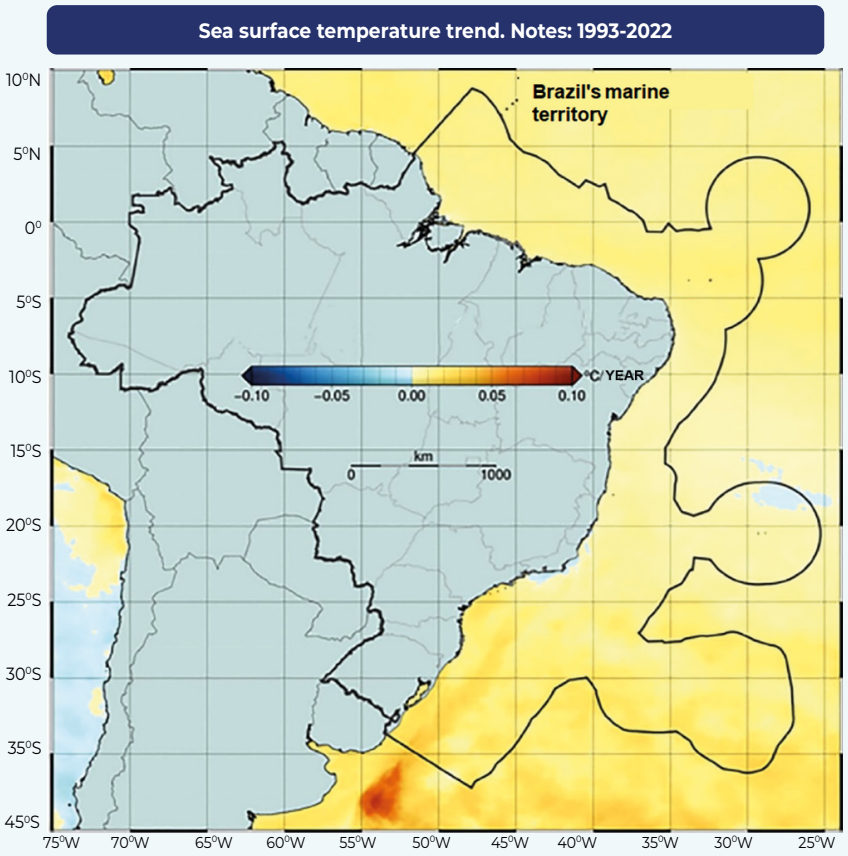
Prolonged heavy rainfall:
The southern region has been the most affected in recent decades, with an increase in average values from 140 mm to 160 mm. The states of MG (Minas Gerasi), ES (Espírito Santo), AP (Amapá) and MS (Mato Grosso do Sul) also worsened



Source: INPE, 2023.

With regard to the coastal-marine territory, there is a trend for sea surface temperature to rise, as shown in the following figure, with the anomaly for the period between 1992 and 2022.

FIGURE 4.7 | OCEAN SURFACE TEMPERATURE CHANGE TREND IN THE SOUTH ATLANTIC, WITH DELIMITATION OF THE COASTAL-MARINE SYSTEM



Source: CPTEC/INPE.

4.2.1.2 Future climate change trends

In addition to the assessment of climate change observed in the Brazilian territory, the main data sources and references were considered for the systematization of future climate trends, analyzing scenarios of global warming levels of 1.5 °C and 2 °C. Dataframe 4.1 illustrates the sign of change for 14 climate-related threats and five Brazilian macro-regions for scenarios of global warming levels of 1.5 °C and 2 °C. The assessment also includes an estimate of the level of *evidence* of the signs of change and the *confidence* level of the trends (key messages)[48]. This analysis is essential in order to consider the uncertainties.

[48] The confidence level or uncertainty of the key messages is based on two points: i) the quality of the evidence, which refers to the robustness, consistency and number of studies available on a given topic; and ii) the degree of agreement, which refers to the level of agreement between different studies and lines of evidence.

DATAFRAME 4.1 | OBSERVED (OBS.) AND FUTURE (1.5ºC AND 2ºC) CHANGES BY MACRO-REGION FOR DIFFERENT TYPES OF CLIMATE THREATS

Climate Threats	North			Northeast			Center-west			Southeast			South		
	Obs.	Future		Obs.	Future		Obs.	Future		Obs.	Future		Obs.	Future	
		1.5 °C	2 °C		1.5 °C	2 °C		1.5 °C	2 °C		1.5 °C	2 °C		1.5 °C	2 °C
Average temperature	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Maximum temperature	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Minimum temperature	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Heatwaves	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Annual rainfall	—*	▼	▼	▼	▼	—*	—*	▼	▼	▼	▲	▲	▲	▲	▲
Extreme rainfall	▲	▲	▲	▼	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Persistent extreme rainfall	▲*	▲	▲	▼*	▲	▲	—*	▲	▲	▲*	▲	▲	▲	▲	▲
Frequency of drought	—	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼
Drought duration	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▲	▲
Severe wind	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Mean sea level	▲	▲	▲	▲	▲	▲				▲	▲	▲	▲	▲	▲
Sea surface temperature	▲	▲	▲	▲	▲	▲				▲	▲	▲	▲	▲	▲
Marine heatwaves	▲	▲	▲	▲	▲	▲				▲	▲	▲	▲	▲	▲
Ocean acidification	▲	▲	▲	▲	▲	▲				▲	▲	▲	▲	▲	▲

▲ : increase with a lot of evidence (more than half of the sources agree)
▲ : increase with some evidence (half or less of the sources agree)
▼ : decrease with a lot of evidence (more than half of the sources agree)
▼ : decrease with some evidence (half or less of the sources agree)
— : undefined (no evidence or sources with opposite signs of change)
* : shows differences in the signs of change within the macro-region

: plausible trend (high confidence)
: possible trend (medium confidence)
: uncertain trend
: not applicable

Source: Based on AVILA-DIAZ *et al.* (2020); BALLARIN *et al.* (2023); DUNN et al. (2020); GUTIÉRREZ *et al.* (2024); INMET (2024); INPE (2024); IPCC (2023); LI *et al.* (2021); NASA (2024); OLIVER *et al.* (2018); PES *et al.* (2017); PIRES *et al.* (2021); REGOTO *et al.* (2021); TOMASELLA *et al.*, (2022); VOUSDOUKAS *et al.* (2018).

Most of the observed and future trends in climate change have a high confidence level and indicate plausible futures. Even with the efforts to achieve the Paris Agreement's target of limiting global warming to 1.5 °C, all regions of the country will continue to experience changes in climate patterns.

Climate change in Brazil is already happening and has been intensifying in recent decades.

In short, the most *plausible* changes, those that are most certain to occur in the future, are:

- increase in temperature and heat waves in all macro-regions;
- increase in annual rainfall in the South;
- increase in extreme rainfall in the North, Southeast and South;
- increase in droughts in the Northeast, Center-West and Southeast regions;
- increase in severe wind in the North, Northeast, Southeast and South; and
- rising sea levels, sea temperature, marine heat waves and ocean acidification along the entire Brazilian coast.

The **main trends** regarding climate change in Brazil, together with the confidence level assigned to these key messages, are detailed in Dataframe 4.2.

It is important to note that for some threats and macro-regions, there may be regional differences in the sign of change. The main regional disparities are: (i) locations with increased or decreased annual rainfall in the North, Northeast and Center-West; and (ii) locations with persistent extreme rainfall in the North, Northeast, Center-West and Southeast. In many cases, these sub-regional differences are associated with proximity to the ocean and the topography of the coastal zone, factors that influence rainfall patterns (CAVALCANTI *et al.*, 2009).

DATAFRAME 4.2 | KEY MESSAGES ON CLIMATE CHANGE IN BRAZIL BY THREAT CATEGORY

Category	Key messages
Temperature and heat wave	An **increase** in average, maximum and minimum temperature and heat waves is being observed in **all of Brazil's macro-regions**, and it is *plausible* that this upward trend will continue in the future.
Rainfall	An **increase** in annual rainfall is being observed in the **South** region, and it is *plausible* that this upward trend will continue in the future.
	A **downward** trend is *possible* in the **North, Northeast and Center-West** regions. However, some sub-regions may experience an increase.
	The annual rainfall trend in the **Southeast** region is *uncertain*.
Extreme rainfall	An **increase** in the magnitude of extreme rainfall is being observed in **the North, Southeast and South** regions, and it is *plausible* that this upward trend will continue in the future.
	An **upward** trend in the magnitude of extreme rainfall in the **Center-West** region is *possible*.
	The trend in the magnitude of extreme rainfall and persistent extreme rainfall in the **Northeast** region is *uncertain*.
	An **increase** in persistent extreme rainfall is being observed in the **Southeast and South** regions and it is *plausible* that this upward trend will continue in the future.
	An **upward** trend in persistent extreme rainfall is *possible* in the **North and Center-West** regions. However, some sub-regions may experience a **downward** trend.
Drought	An **increase** in the frequency and duration of droughts is being observed in the **Northeast, Center-West and Southeast** regions, and it is *plausible* that this upward trend will continue in the future.
	An **upward** trend in the frequency and duration of droughts in the **North** region is *possible*. On the other hand, a **downward** trend in the frequency of droughts in the **South** region is *possible*.
	The trend in the duration of the drought in the **South** region is *uncertain*.
Wind	An **increase** in severe wind is being observed in the **North, Northeast, Southeast and South** regions, and it is *plausible* that this upward trend will continue in the future.
	An **upward** trend in severe winds in the **Center-West** region is *possible*.
Ocean	An **increase** in mean sea level, sea surface temperature, marine heat waves and ocean acidification is being observed in **all regions of the coastal zone**, and it is *plausible* that this upward trend will continue in the future.

Confidence level of the key message:

High	Medium	Low

Source: Based on AVILA-DIAZ *et al.* (2020); BALLARIN *et al.* (2023); DUNN et al. (2020); GUTIÉRREZ *et al.* (2024); INMET (2024); INPE (2024); IPCC (2023); LI *et al.* (2021); NASA (2024); OLIVER *et al.* (2018); PES *et al.* (2017); PIRES *et al.* (2021); REGOTO *et al.* (2021); TOMASELLA *et al.*, (2022); VOUSDOUKAS *et al.* (2018).

Severe impacts of multiple climate events

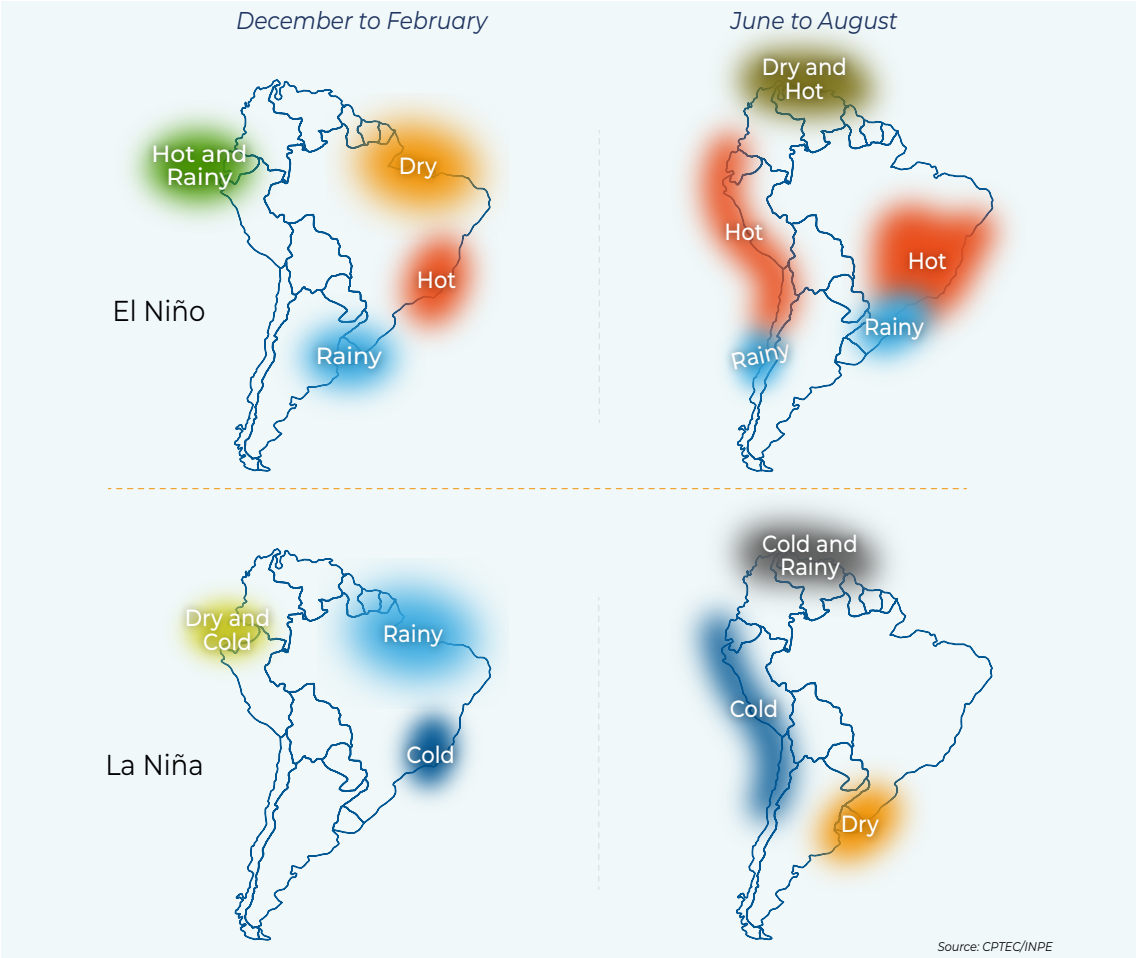
Climate change adaptation planning also needs to take into account the capacity to deal with compound events, in which multiple climate events occur simultaneously or in sequence. This is because such **compound events generate more significant and complex impacts than an isolated event**.

For example, a severe drought combined with a heatwave may result in water shortages and ideal conditions for wildfires. Or the combination of heavy rain with high tides and rising sea levels can result in severe coastal flooding. In addition, droughts followed by heavy rainfall may cause flash floods and flooding, as the soil, previously parched and devoid of vegetation cover, becomes less permeable, causing water to run off instead of being absorbed by the soil (IPCC, 2023).

All the country's macro-regions show a strong trend towards an increase in at least six climate threats, as shown in Dataframe 4.1. Therefore, it is essential that the possibility that they will face impacts resulting from compound events be taken into account.

In addition, Brazil is under the climatic influence of the El Niño Southern Oscillation (ENSO), which are atmospheric-oceanic phenomena that bring specific climatic conditions to each region (Figure 4.8). However, in each event, the rainfall distribution patterns can be different, which is due to the combination of atmospheric and oceanic conditions of the period, such as the temperature conditions of the Atlantic Ocean.

FIGURE 4.8 | IMPACTS OF THE ENSO PHENOMENON IN SOUTH AMERICA FOR THE SUMMER (DECEMBER, JANUARY AND FEBRUARY) AND WINTER (JUNE, JULY AND AUGUST) PERIODS



Source: MCTI, based on CPTEC/INPE.

Under the influence of *El Niño*, droughts are increasing in the North and Northeast regions, increasing the risk of wildfires and water shortages. In the south, on the other hand, there is persistent rainfall in the spring and heavy rainfall in the fall, with an increase in the average temperature. In the Southeast, temperatures tend to be above average during *El Niño*. In the south of Mato Grosso do Sul, there is also evidence of above-average rainfall and temperatures. During *La Niña*, these patterns are reversed. The North and Northeast are experiencing an increase in rainfall and flows, while the South is facing scarce rainfall (GRIMM; TEDESCHI, 2009).

Significant progress has been made in understanding ENSO, with more sophisticated climate models, capable of forecasting its occurrence months in advance. This ability to project ENSO is crucial to guide the preparation for its impacts (KUSHNIR *et al.*, 2019) on the national territory, such as the droughts in the Amazon and the devastating floods in southern Brazil in 2023 and 2024, when the El Niño phenomenon occurred. These two phenomena will be detailed as cases in section 4.5, loss and damage

In addition to the trends shown for Brazil and phenomena such as ENSO, studies signal the dangers of reaching a tipping point in the climate system (Box 4.1).

BOX 4.1 – Tipping points. What would happen in Brazil if we reached climate tipping points?

A climate tipping point is a limit that, when reached, no longer allows a return to a previous climate condition. This change would lead to **abrupt, irreversible and extremely dangerous impacts**, with serious implications for humanity (LENTON *et al*., 2019).

In Brazil, global warming of more than 1.5 °C above the pre-industrial period, in combination with increasing deforestation and wildfires, would lead to the collapse of the integrity of the Amazon ecosystem (FLORES *et al*., 2024). This would cause significant changes in Brazil's climate, such as reduced rainfall in the Center-West and Southeast, since much of the rainfall in these regions is the result of moisture transported from the Amazon and evapotranspiration from the forest (MARENGO *et al*., 2012). In order to strengthen regional cooperation regarding the protection of the Amazon biome, Brazil hosted the "Amazon Summit" in August 2023, bringing together the leaders of the eight signatory countries of the Amazon Cooperation Treaty. The Summit resulted in the adoption of the Belém Declaration, which marked the first political document to recognize the risk of the biome's tipping point. The Belém Declaration also established a new common agenda for regional cooperation for the sustainable development of the Amazon, with social inclusion, promotion of science, technology and innovation, stimulation of the local economy and appreciation of indigenous peoples and local and traditional communities and their ancestral knowledge.

A point of no return with a direct impact on Brazil concerns the extinction of coral reefs, indicated by the IPCC as the first ecosystem to become functionally extinct due to climate change. Brazil has the only reef environments in the South Atlantic and this tropical water ecosystem is facing unprecedented ongoing anthropogenic threats to its existence as a functional and biodiverse ecosystem, which hundreds of millions of people depend on (PEARCE-KELLY et al., 2024).

Other phenomena that can reach the tipping point and are critical for the country are the Atlantic Meridional Overturning Circulation (AMOC), the convection in the Labrador-Irminger Seas, the West Antarctic ice sheet and the Greenland ice sheet. The eventual collapse or slowdown of the AMOC could destabilize the *El Niño* Southern Oscillation (ENSO), which in turn could accelerate coral bleaching, destabilize the Amazon rainforest and the West Antarctic ice cover, which in turn accelerates the melting of Greenland, which in turn could destabilize the AMOC (WUNDERLING et al., 2024).

BOX 4.1 (continued)

In Brazil, the collapse of the AMOC would cause temperatures to rise and the Intertropical Convergence Zone (ITCZ) to shift, affecting the rainfall regime in the semi-arid region and in the Amazon. The collapse of the convection in the L*abrador-Irminger* seas would also affect the ITCZ and this would happen in just 10 years after the average global temperature exceeded 1.8 °C. The collapse of the West Antarctic and Greenland ice sheets would raise sea levels by three and seven meters, respectively (WUNDERLING *et al*., 2021).

In addition, reaching the tipping point of one of these systems would destabilize other systems and generate a domino effect that would lead to a much higher average global temperature than in the last 1.2 million years, resulting in serious consequences for society and ecosystems (STEFFEN *et al*., 2018).

4.2.2 Observed impacts and climate risks

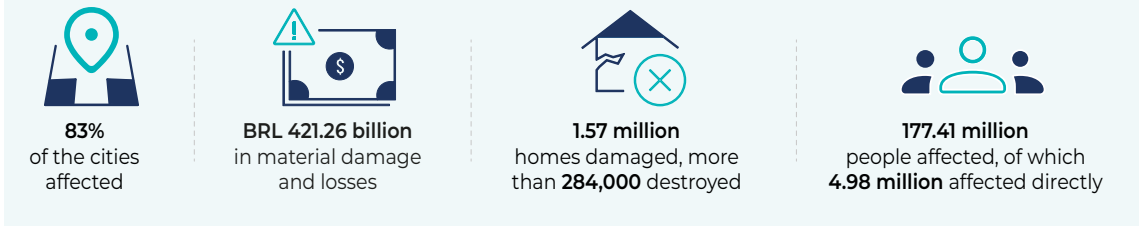
4.2.2.1 Observed impacts

With the increased occurrence of extreme climate events in recent decades, all regions of Brazil have suffered intensified climate-related impacts, which demonstrates the urgency of putting adaptation actions into practice in the country. Loss of life, damage to health, losses in crop harvests, compromised water supply, energy generation and damage to infrastructure are some of the impacts that affect Brazilians. The information available on climate change, as well as advanced forms of analysis provide support for the planning and implementation of adaptation measures.

The rate, frequency and magnitude of disasters are increasing.

According to data from the Ministry of Integration and Regional Development, published in the Digital Atlas of Disasters in Brazil (Atlas Digital de Desastres no Brasil) (BRASIL, 2024), disasters have caused the following general impacts in the country over the last decade (2014-2023):

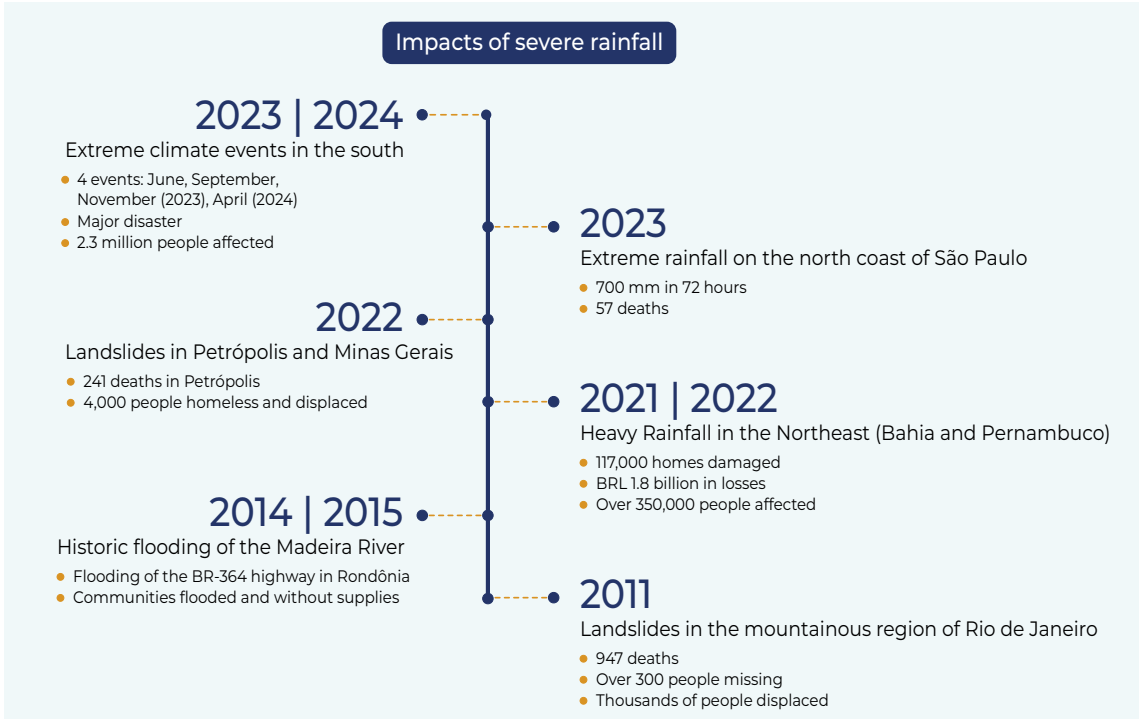
FIGURE 4.9 | IMPACTS OF CLIMATE DISASTERS IN THE LAST 10 YEARS IN BRAZIL



Source: Digital Atlas of Disasters in Brazil (BRASIL, 2024).

In recent years, the Brazilian population has experienced extreme events in different regions of the country.[49] The following figure highlights some of the main events related to **severe changes in rainfall patterns**.

FIGURE 4.10 | EXTREME CLIMATE EVENTS RELATED TO FLOODS AND LANDSLIDES IN BRAZIL



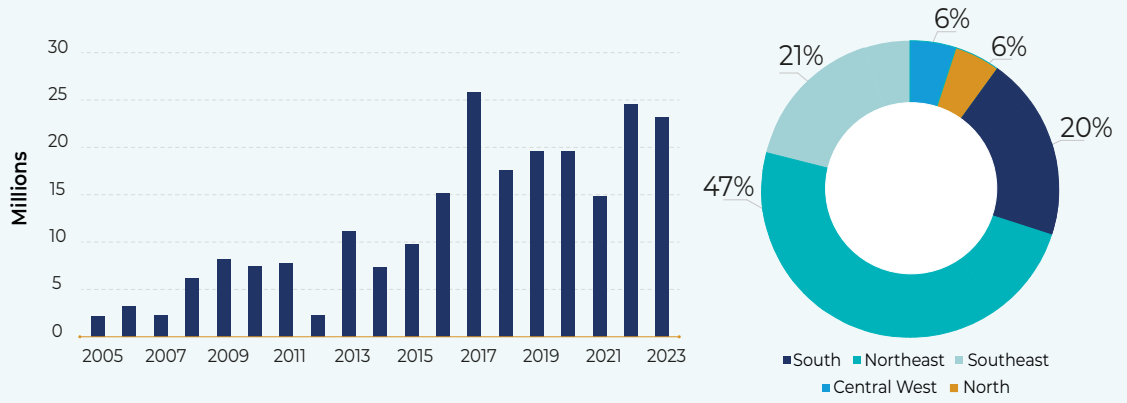
Source: Brasil, 2024.

49 The disasters and extreme events highlighted serve as an example of the severity and frequency with which they occur in Brazil, but there was no attempt to present an exhaustive literature review, so several other events that have occurred in Brazilian regions may not have been mentioned.

Most of the Brazilian population is already suffering from the impacts of climate change.

Although disasters caused by climatological and hydrological events have occurred throughout history in various regions of the country, there has been a consistent increase in the number of people affected[50] in recent years by droughts, heat waves, wildfires, floods and landslides, as shown by the following charts.

CHART 4.1 | PEOPLE AFFECTED PER YEAR AND REGIONAL DISTRIBUTION, CONSIDERING CLIMATOLOGICAL, HYDROLOGICAL AND METEOROLOGICAL DISASTER GROUPS

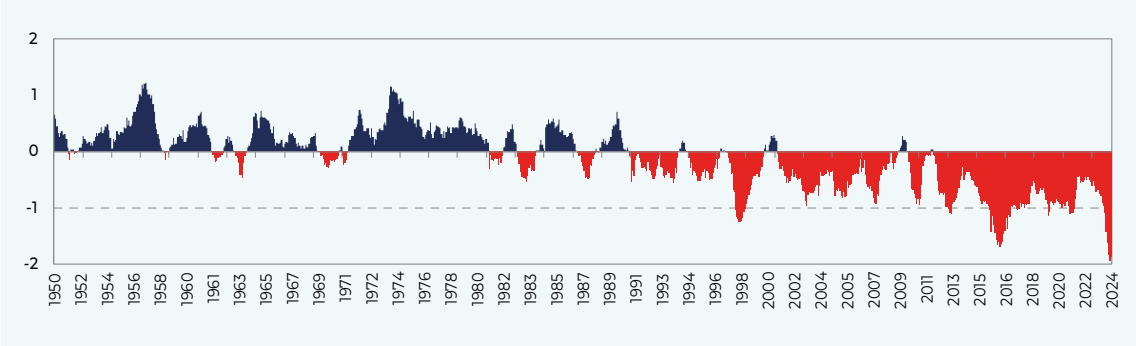


Source: Digital Atlas of Disasters in Brazil (BRASIL, 2024).

50 The number of people affected is the sum of the records made using the Disaster Information Form (FIDE, Formulário de Informações do Desastre), which includes the number of dead, injured, sick, homeless, displaced, missing and other people affected.

Severe droughts and fires - Since the 1990s, droughts in Brazil have become more frequent and severe (more negative SPEI (Standardized Precipitation-Evapotranspiration Index) values[51]). According to the data (Figure 4.11), the country has faced three major droughts (negative SPEI peaks): the first one between 1997 and 1998, the second one between 2015 and 2016, and the last one in 2023 and 2024. It is worth noting that the drought of 2015-2016 surpassed that of 1997-1998, but the current one (2023-2024), even with partial data, already shows more negative SPEI values, indicating that it is the most severe and extensive one in the time series. In terms of extension, the 2023-2024 drought leads the way, covering around 5 million km², which corresponds to approximately 59% of Brazil's territory (CEMADEN, 2024).

FIGURE 4.11 | TEMPORAL EVOLUTION OF DROUGHTS IN BRAZIL CONSIDERING THE STANDARDIZED PRECIPITATION AND EVAPOTRANSPIRATION INDEX FROM DECEMBER 1951 TO APRIL 2024



Note: The blue bars indicate periods with above-average rainfall, while the red bars indicate periods with below-average rainfall.

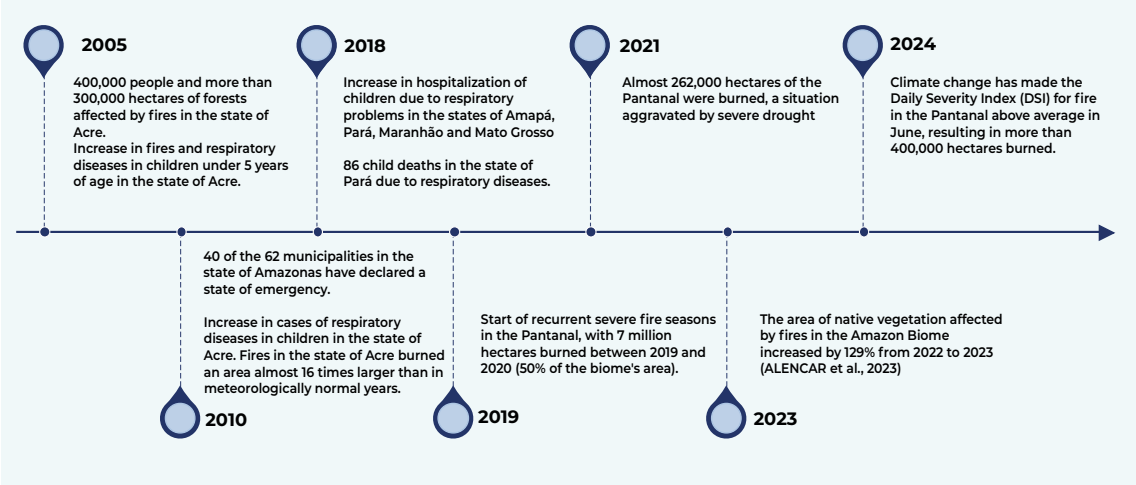
Source: CEMADEN, 2024.

The Amazon and the Pantanal are experiencing a significant increase in the number of hotspots due to fires during the droughts, which have become more frequent. In addition to increasing frequency, the duration of droughts in regions of Brazil's territory is getting longer. A technical note published by the National Center for Monitoring and Warning of Natural Disasters (CEMADEN) shows that in the region stretching from the states of Acre and Amazonas to the state of São Paulo and the Triângulo Mineiro (The Minas Gerais State Triangle), the drought that began in the second half of 2023 lasted for 12 months in many municipalities[52]. Below are some examples of the impacts caused by severe droughts in recent years.

51 The Standardized Precipitation Evapotranspiration Index (SPEI) is a tool used to measure and monitor drought. The SPEI takes into account two main aspects: the amount of rain that falls and the amount of water that is lost through evaporation (soil, rivers, etc.) and plant transpiration. Evapotranspiration depends on temperature and available water, while evaporation depends on temperature: the warmer it is, the more water evaporates (CEMADEN, 2024).

52 TECHNICAL NOTE No. 529/2024/SEI-Digital Information System (Sistema Eletrônico de Informações)-CEMADEN. Available at: <https://www.gov.br/cemaden/pt-br/assuntos/monitoramento/monitoramento-de-seca-para-o-brasil/monitoramento-de-secas-e-impactos-no-brasil-agosto-2024/NOTATECNICAN529202SEICEMADENSECAS.pdf>. Accessed on: Sep 13, 2024.

FIGURE 4.12 | TIMELINE WITH SOME EPISODES OF FIRES AND WILDFIRES



Source: Based on Brown et al. (2006); Smith et al. (2015); Pinho, 2016; Alencar et al. (2023); Barnes, Santos, Libonati et al. (2024).

The 2020 fires in the Pantanal biome caused severe impacts on biodiversity, with at least 17 million vertebrates estimated to have been directly killed by fire, of which more than 79% were reptiles, just over 15% mammals, 4% amphibians and less than 2% birds (WWF, 2021[53]). The fires affected areas of forest formations that do not normally burn, drastically reducing the availability of refuges for the animals and, thus, limiting their survival strategies. Natural regeneration may be compromised if severe fires occur for several consecutive years, a real risk considering climate change (WWF, 2021).

Droughts and floods in the territory - Droughts also impact the same regions that suffer from periods of extreme rainfall. In the last two decades, the Amazon biome has been hit hard by both droughts and extreme floods (MARENGO *et al.*, 2013; PINHO; MARENGO; SMITH, 2015; TOMASELLA *et al.*, 2013). In 2023, the level of the Acre River rose 17.55 meters and around 56,000 people in Rio Branco were affected. In that same year, an unprecedented drought and heat wave severely impacted the waters of the Amazon, leading to high mortality rates of fish and river dolphins. In 2023, the water level in the port of Manaus, in the state of Amazonas, reached its lowest level since 1902, when measurements began, affecting navigability and, consequently, the transportation of goods and people living along the riverbanks (ESPINOZA *et al.*, 2024).

Agricultural and livestock activity - Between 2014 and 2023, the losses to agricultural and livestock activity caused by rainfall and droughts (especially droughts) totaled BRL 282 billion, with droughts causing losses of BRL 59.2 billion in 2022 alone, equivalent to 21% of the total for the period analyzed (BRASIL, 2024). The regions with the greatest damage and losses were the South and the Northeast, with 45.8% and 27% of the total, respectively.

53 WWF. Fire killed 17 million vertebrates in the Pantanal in 2020. Available at: https://www.wwf.org.br/?80048/Fire-killed-17-million-vertebrates-in-the-Pantanal-in-2020. Accessed on: Aug 28, 2024

Human mobility - Hard hit by climatic events, the most vulnerable population may be forced to move in search of better living conditions. In 2023, Brazil stood out as the country in the Americas with the highest number of internal displacements, with more than 745,000 displacements due to disasters, mainly due to events in Rio Grande do Sul (IDMC, 2024). This figure is even higher because the current calculation does not take into account all disaster-related migrations, such as those that occur slowly over the months following the event.

Ocean, coastal zone and biodiversity - At the mouth of the Amazon River, the advance of the sea is becoming more frequent, causing salinization of the waters that supply communities in Amapá and compromising activities, such as access to drinking water, fishing, family farming and açaí cultivation. In Baixada Santista, on the coast of the state of São Paulo, between 1993 and 2021, the rate of sea level rise was estimated at 2.38 to 3.39 mm per year, close to the averages for Ubatuba (2.24 mm per year) and Cananéia (2.23 mm per year) (MARENGO *et al.*, 2022). In the cities of Rio de Janeiro and Atafona (RJ), the rise in sea level observed from 1990 to 2020 reached 13 cm (UN, 2024).

In 2023, five of the 10 lakes monitored in the Amazon showed exceptionally high daytime temperatures (>37°C). This extreme warming of the Amazon's waters follows a long-term increase of 0.6 °C/decade revealed by satellite estimates in the region's lakes between 1990 and 2023 (FLEISCHMANN *et al.*, 2024).

Changes in land use have always played a major historical role in changing terrestrial ecosystems and marine environments (JOLY *et al.*, 2019). By 1970 there was an estimated 22.6% reduction in the average abundance of species, with a small contribution from climate change (OMETTO *et al.*, 2018). A study by CEMADEN and INPE found that areas of the country's semi-arid region have increased at an average rate of more than 75,000 km^2 every decade. In the last period considered, 1990-2020, we observed the appearance of an area defined as arid in the north of the state of Bahia, which had never been observed in previous decades.[54]

If the pace of emissions and deforestation continues, the decrease in biodiversity may reach 45% by 2050.

54 Technical Note: Preparation of Aridity Index and Total Accumulated Precipitation Maps for Brazil. https://www.gov.br/cemaden/pt-br/assuntos/noticias-cemaden/estudo-do-cemaden-e-do-inpe-identifica-pela-primeira-vez-a-ocorrencia-de-uma-regiao-arida-no-pais/nota-tecnica_aridas.pdf.

Ocean acidification, the result of the absorption of carbon dioxide (CO_2) from the atmosphere, has serious consequences for all marine life, especially organisms with calcareous structures, such as corals, mollusks and crustaceans (IPCC, 2019). On the other hand, ocean warming contributes to rising sea levels, a higher incidence of extreme events, and has led to the loss of coral reefs, mangroves, seaweed beds and sea grasses (CRAMER *et al.*, 2014; OPPENHEUMER *et al.*, 2014), weakening their ecosystem services, such as food security and natural protection of ocean cities.

Since the beginning of 2023, mass bleaching of coral reefs has been confirmed throughout the tropics. This is the 4th global bleaching event considered as the most severe in recent decades, in which high mortality has already been recorded in northeastern waters with average sea surface temperatures reaching 33°C (NOAA, 2024).

Water shortages and water supply - In recent decades, all regions of Brazil have experienced impacts related to water shortages. Records show that these impacts are becoming increasingly frequent, mainly due to changes in rainfall patterns, increased water use in agricultural areas, increased deforestation and other changes in land use and occupation. To illustrate the seriousness of the water issue in the face of climate change, the following are some of the repercussions of severe climate events that have already been systematized in publications:

- Severe droughts hit the Northeast region for seven years in a row, between 2011 and 2017, affecting more than 80% of the municipalities (IBGE, 2017). Among the impacts caused by drought in this region are the emergence and/or increase of areas with desertification; the depletion and contamination of water reservoirs with consequences for human and animal supply; outbreaks of diarrhea; hospitalizations and deaths of children and the elderly (RUFINO *et al.,* 2016; IBGE, 2017). Thirty million people were affected, taking into account only the historic drought of 2012 (NOVAES; FELIX; SOUZA, 2013).

- The water crisis of 2013 to 2016 in the Southeast affected the production capacity of industry, energy generation, agricultural productivity and even the operation of hospitals and schools (NOBRE *et al.*, 2016), as well as the Cantareira urban supply system in São Paulo. Activities on the Tietê-Paraná Waterway, one of the most important in the country, were also affected (ANA, 2019), as well as the sugarcane harvest, especially in the states of São Paulo and Minas Gerais (UNICA, 2014; NOBRE *et al.,* 2016).

- The critical drought faced by the northern region of Brazil, which has persisted for more than 12 months, and in some areas for up to 24 months, has been aggravated by the increased risk of fires and the severe impact on rivers, which began the year with extremely low levels due to the rainfall deficit and high temperatures during the dry and rainy seasons of 2023. In the state of Acre, a severe hydrological drought was recorded between October 2023 and January 2024. Although the rainfall from February to April 2024 provided some relief, river levels remained below average. From May onwards, the severe drought returned and persisted until September 2024, with the 2024 dry season starting earlier and being more severe than usual, further exacerbating the water crisis (CEMADEN, 2024).

Energy generation - Over the last few years, the rainfall observed in some of the main river basins with hydroelectric plants that make up the SIN, in an aggregated way, has been significantly below the historical average. As a result, in the period between December 2020 and November 2021, there was the worst hydropower condition ever seen for this period in history, and a reduction of 8.5% in the supply of energy from hydroelectric power sources compared to the previous year (EPE, 2022).

In addition, there is an analysis of the behavior of the equivalent storage of the National Integrated System (EAR - Stored Energy (Energia Armazenada)) on a daily basis between 2000 and 2022. Moving averages were calculated for two ten-year windows, which resulted in 68% EARmax[55] (Maximum Stored Energy) (from 2003 to 2012) and 41% EARmax (from 2013 to 2022), respectively. In other words, there was a decrease of approximately 27 percentage points (p.p.) in this indicator, which shows the reduction in energy available from hydropower sources. It should be noted, however, that in addition to the worsening of the average hydro-meteorological conditions in recent years, the decrease in storage capacity (mainly due to the lack of generation from new reservoirs entering the system) has also been a decisive factor in the relative decrease in EARmax capacity compared to the growing total demand for electricity.

As a result, especially in the reported period, there was a need for the use of additional thermoelectric plants, using fossil fuels, which emit more greenhouse gases (GHG), and there was an increase in the cost of electricity generation.

Heat stress and heat waves - One of the consequences of rising temperatures is the appearance of heat stress in people, animals and plants. Since the beginning of the century, there has been an increase in the number of days with maximum temperatures above 35°C and heat waves in all regions. In the last decade, cities such as Brasilia, Fortaleza, Manaus, Rio de Janeiro and São Paulo have faced a significant increase in the number of consecutive hours of heat stress. This means that weather conditions that exceed the human body's ability to withstand them without suffering health problems have become more frequent and prolonged, lasting for up to 12 consecutive hours of heat stress (MIRANDA *et al.*, 2023).

The North and Northeast regions have experienced more than 50 heat waves per year (SILVA *et al.*, 2022). In 2022, a heat wave hit Rio Grande do Sul, where for about two weeks the maximum temperatures exceeded 40°C in several cities. In 2023, extreme heat waves were recorded in most parts of the country, such as Cuiabá and São Paulo, which had the warmest winter in 63 years (INMET – National Institute of Meteorology (Instituto Nacional de Meteorologia), 2023).

Impacts on health - As previously mentioned, the impacts of climate change on health are complex and involve several dimensions, given that health and disease are the result of biological, social and environmental processes, which are interconnected at the individual and collective levels. The implications of climate change can be direct and indirect, considering the increase in costs, the burden on the health system and health workers, chronic effects, among others.

55 Stored energy (% of Maximum Stored Energy - %EARmax) represents the energy associated with the volume of water available in the reservoirs that can be converted into generation at the plant itself and at all the plants downstream in the cascade, the variation of which is directly related to the volume of the reservoirs of the hydropower projects (ONS – National Electric System Operator (Operador Nacional do Sistema Elétrico), 2022).

There are many health implications being studied in the country. Just to illustrate this with events that have already been observed, we can mention the increase in hospitalizations and deaths due to air pollution caused by fires, and the growth in dengue cases related to the increase in temperature and extreme rainfall in the states of Maranhão (SILVA *et al.*, 2016), Amazonas (Horta *et al.*, 2014), and Rio de Janeiro (GOMES; NOBRE; CRUZ, 2012), and in the main Brazilian cities (BARCELLOS; LOWE, 2014).

The mapping of all the impacts related to climate change is still in its early stages in the country, with some typologies that have more robust systems and indicators that are constantly monitored, such as disasters and health, and others that are still in need of further investigation, such as the effects on biodiversity and on the coastal zone. However, even though there is room for improvement in the collection and management of data for scientific research, **there is clear evidence that the impacts of climate change are worsening throughout the country and at a faster rate than indicated by the projections**. This demonstrates the existing vulnerabilities and indicates an urgent need for effective adaptation and resilience measures (CLARKE *et al.*, 2024a).

BOX 4.2 – Extreme event attribution

Immediately after an extreme weather event, the question arises as "To what extent has human-caused climate change contributed to the likelihood or severity of the event?". The emerging scientific field of extreme event attribution has made it possible to answer this question (OTTO *et al.*, 2022) and there are already studies that demonstrate this relationship in Brazil. In the tragedy that occurred in Rio Grande do Sul in May 2024, which resulted in more than 169 deaths and 1.9 million people affected, it was found that, although the El Niño climate phenomenon contributed to intensifying rainfall, global warming doubled the probability of this type of event occurring and increased its intensity by between 6 and 9% (CLARKE *et al.*, 2024b).

The exceptional water shortage that affected 30 million people in the Amazon River Basin between 2023 and 2024 was the result of low rainfall and high temperatures caused by El Niño and, above all, human-caused climate change (CLARKE *et al.,* 2024a). The heatwaves in the spring of 2023, which exceeded 40 °C in most parts of Brazil, were strongly influenced by human action, increasing the likelihood of this type of event occurring by at least 100 times (KEW *et al.*, 2023).

BOX 4.2. (continued)

After the 2022 disaster in the city of Recife (PE - state of Pernambuco), which resulted in the death of 138 people and more than 25,000 homeless people, scientists concluded that climate change had made rainfall around 20% heavier than it would have been under normal conditions (ZACARIAH *et al*., 2022). The water shortages experienced in southern Brazil in 2022 and 2023, although driven by the natural phenomenon of La Niña, were exacerbated by the increase in temperatures caused by climate change (ARIAS *et al*., 2023).

Combined drought and heat wave (CDHW) conditions have played a key role in fires in the Pantanal since 2019 (MARENGO, CUNHA, CUARTAS *et al*., 2021; LIBONATI *et al*., 2022). Climate change has caused the Daily Severity Index (DSI) for fire to be above average for the month in June 2024, resulting in more than 400,000 hectares burned (BARNES, SANTOS, LIBONATI *et al*., 2024). Fires in this period were around 40% more impactful and between 4 and 5 times more likely compared to the observed data. These trends will continue with future warming (BARNES, SANTOS, LIBONATI *et al*., 2024).

Attribution studies have shown that climate change is already happening and that its effects can no longer be ignored, helping to raise awareness among the population and government officials. They also help to identify critical regions, prioritize measures and assess the scale of new infrastructures (OTTO *et al*., 2022).

4.2.2.2 Risks and vulnerabilities

In order to better understand the risks and vulnerabilities existing in the national territory, considering their complexities and interdependencies, the following key topics were considered: (a) water, energy and food security; (b) disasters, health, migration and biodiversity. Various sectors, thematic areas, systems and populations interact in this context in a direct or cross-cutting manner and are being worked on by the Brazilian Government in the Climate Plan's Adaptation Strategy, within the scope of the Sectoral and Thematic Plans, which are being drawn up during 2024 and are expected to be published in 2025.

4.2.2.2.1 Water, energy and food security

The security of access to water, energy and adequate and healthy food is related to the availability of resources and to the elements linked to sustainability, such as the possibility of having access to and the fair distribution of resources among the population, environmental protection and economic development, and it involves

political, circumstantial and institutional issues. The main risks and vulnerabilities in these sectors are briefly described below.

WATER SECURITY - **Projections indicate a reduction in long-period flow rates (Q90[56]) and an increase in episodes of extreme drought**, especially in the Center-West. Non-climatic pressure factors are added to climate change, such as the increase in demand for multiple uses of water, such as supplying large cities, agriculture and industry. The quality of water resources is also impacted by diffuse pollution, inefficiencies in solid waste management, as well as low sewage collection rates, as demonstrated by national circumstances.

In the Northeast and Southeast regions, scenarios indicate **reduced flow rates and the intensification of extreme drought and flood events**. In the South, despite the current high availability of water, socio-economic pressures and the use of water for irrigation constitute fragilities that aggravate future conditions, given the increase in drought and flood events. In the coastal zone and ocean there is **saturation and salinization of basins** that flow into the ocean, as well as worsening coastal flooding.

With regard to **governance**, although Brazilian legislation emphasizes the decentralization of water management, Brazil shows enormous variation in terms of institutional capacity between states and municipalities. There is potential for strengthening and improving water resource management to deal with extreme events and conflicts over water use, by **considering climate change** in existing instruments, such as **Water Resource Plans and Basin Committees** and the cistern program.[57]

ENERGY SECURITY - By affecting the water balance in different regions of the country, climate change has an impact on national energy security. In 2022, around 62% of Brazil's electricity matrix came from hydroelectric generation (EPE, 2023).

According to a study carried out by the National Water and Basic Sanitation Agency (ANA, 2024), water availability could fall by more than 40% in hydrographic regions in the North, Northeast, Center-West and part of the Southeast by 2040. On the other hand, in the southern region of the country, there is a trend for water availability to increase by up to 5% by 2040, but with greater unpredictability and an increase in the frequency of floods, as has been the case in the region in recent years.

On the other hand, according to estimates made for Brazil's Fourth National Communication to the United Nations Framework Convention on Climate Change (BRASIL, 2021), the effect of climate change on flows and affluent natural energy (ANE) indicates scenarios of a **decrease of between 6% and 41% in Brazil's hydroelectric generation capacity**.

It can be seen that the increase in the frequency and duration of droughts, the increase in average, maximum and minimum temperatures, the decrease in annual rainfall and the increase and frequency of heat waves are the main climate threats related to energy security,

[56] The Q90 flow rate is a practical value obtained from the permanence curve in hydrology. It represents the **minimum flow rate in the watercourse 90% of the time**, indicating a situation of low water availability. This measure is applied to the management of water resources and is especially relevant for setting limits for concessions and making decisions regarding water use. https://s3-sa-east-1.amazonaws.com/abrh/Eventos/Trabalhos/60/PAP023283.pdf

[57] Available at: https://www.gov.br/mds/pt-br/acoes-e-programas/acesso-a-alimentos-e-a-agua/programa-cisternas

with the potential to have a significant impact on the operation of the SIN – Brazilian Interconnected System, **increasing its costs and requiring greater flexibility** from other complementary sources, possibly at a higher energy cost. Ultimately, measures aimed at forcibly reducing electricity demand could be necessary, reducing the pressure on the system. It is important to note, however, that these measures affect society differently, having a greater impact on vulnerable populations and lower-income groups.

Another vulnerability that was identified is the stagnation of the country's hydroelectric reservoir capacity, since the policy of generation from hydroelectric plants with reservoirs (considered to be firm energy) has been discontinued over the last decade, while at the same time there has been an increase in the use of intermittent renewable sources (wind and solar power), which need to be complemented when there is no production. In the recent water crises, maintaining energy security resulted, for example, in the alternative use of non-renewable sources.

In addition, the increase in temperature implies a **growth in the demand for electricity for cooling throughout the country**, especially in the Southeast, due to the concentration of population, but it is also critical in the North, Northeast and Center-West, which are projected to have a greater increase in temperature. Rising temperatures also have an impact on reduced efficiency and increased maintenance and cooling of equipment, plants and systems.

Electricity transmission and distribution infrastructures, which connect the different regions and are very extensive, have become more exposed to extreme weather events throughout the country, especially in the case of the storms in the South.

With regard to the production of biofuels, the projected reduction in areas of low agro-climatic risk for soybeans (around 80%) and sugarcane (more than 30%) affects the production of biodiesel and ethanol, respectively. Areas with drier soil will lead to a greater need for irrigation, among other potential impacts for the energy sector, with possible conflicts of choice (trade-offs) with other sectors and issues, since there will be a reduction in water availability.

FOOD AND NUTRITIONAL SECURITY - Food supply is negatively affected by climate change due to the reduction in areas suitable for agricultural production, varying according to the crop cultivation, and can reach up to 80% for crops that are more sensitive to water stress in more pessimistic scenarios. With longer periods of drought and variability in rainfall, there will be a greater need for irrigation, especially in the Cerrado and Caatinga. The demand for irrigation is expected to increase by 66% by 2040 (ANA, 2021b), requiring compatibility with other water uses. The intensification of extreme events may also require greater allocation of financial resources for agricultural insurance and reduce producer profits.

In fisheries and aquaculture, the increase in surface water temperature has a direct impact on the survival and reproduction capacity of fish, as well as on other biological processes of aquatic ecosystems, such as changes in water pH that affect the availability of nutrients. These changes could lead to the migration of shoals or even to their death and a reduction in production (catches) throughout the coastline, rivers and lakes, increasing the role of aquaculture in ensuring fisheries production and directly influencing food security.

Along with climatic factors, other elements affect the current and future prospects of food and nutrition sovereignty and security in the country. Population growth and *per capita* food consumption, combined with the dynamics of food systems that operate to generate exportable goods, known as commodities, as well as for domestic supply, put pressure on the population's access to food and access to land and territories, exposing the most vulnerable social groups. The Northern region has vulnerabilities associated with socio-biodiversity and the subsistence production of traditional peoples and communities and land conflicts. The South and Southeast are characterized by intense occupation, productive diversity and land use, as well as high demand for food. The Northeast, on the other hand, has 35% of the country's family farming area and high losses due to droughts. The Center-West is where the largest irrigated area in the country is concentrated.

The pressures of climate change on food production have a direct impact on the availability, supply, price and quality of food, which mainly affects the population in peripheral regions, at risk of social vulnerability and extreme poverty. In addition to the importance of the urban context, color, gender and age are also related to food insecurity. The PENSSAN - Brazilian Research Network on Food and Nutrition Sovereignty and Security (Rede Brasileira de Pesquisa em Soberania e Segurança Alimentar e Nutricional) national survey shows that 65% of households headed by black or mixed-race people face food restrictions at any level, and in households headed by women, hunger rose from 11.2% to 19.3% between 2021 and 2022. In the same period, hunger doubled in families with children under 10 years old - from 9.4% in 2020 to 18.1% in 2022 (PENSSAN, 2022).

In 2023, food insecurity was found in 21.6 million households, of which 3.2 million faced severe food insecurity. The data also alerts us to the need to pay close attention to women and black people, who headed 59.4% and 69.7%, respectively, of households experiencing some degree of food insecurity. In addition, 18.3 million households were located in cities, which are places that are frequently affected by climate disasters (IBGE, 2024).

The most socially vulnerable populations are the most impacted, demanding actions that promote social and environmental justice.

These populations are the most affected by the reduction in availability, supply and access to fresh and minimally processed foods and the increase in ultra-processed foods, especially in certain places known as food deserts, which forces people to move to other regions to obtain healthy food (IDEC - Consumer Protection Institute (Instituto de Defesa do Consumidor), 2019a).

In addition, the high volume of food losses and waste in the country leads to an increase in the costs and prices of healthy food, also affecting availability and access

by the most vulnerable populations. It is estimated that losses along the production and supply chains vary between 10 and 30%, reaching 40% in some cases (SACCARO JUNIOR; VIEIRA FILHO, 2018).

All these situations aggravate food and nutrition insecurity and all forms of malnutrition (undernutrition, obesity and nutritional deficiencies) in these populations, who also suffer disproportionately with the global syndemic - the synergy of undernutrition, obesity and climate change pandemics that interact with each other, coexist in time and space and share common fundamental social factors (IDEC, 2019b).

CRITICAL INFRASTRUCTURES - Some of the country's critical infrastructures (such as those related to water supply, electricity generation and transmission, roads and ports) are already vulnerable to the current climate due to low levels of efficiency and/or poor maintenance (IIS, 2019). Given the long distances in the Brazilian territory, the increased occurrence of extreme weather events can impact the infrastructure of various systems, such as energy and transportation, representing a greater risk of interruption in the supply of inputs, services and food, as well as causing systemic and cascading effects.

4.2.2.2.2 Risks and vulnerabilities of socio-ecological systems

DISASTERS - There has been a worsening of disasters related to climatic and geo-hydrological processes[58] in recent decades (CEPED – University Center for Studies and Research on Disasters (Centro de estudos e pesquisas em desastres), 2019), according to the information and data available in the Digital Atlas of Disasters in Brazil[59]. The intensification of extreme weather events, when combined with aspects of vulnerability and exposure, causes increasing damage to people (dead, injured, ill, homeless, displaced, isolated, missing or affected people), material damage and environmental damage, as well as high social and economic losses, affecting relationships, security and the well-being of communities.

The increase in the frequency and/or magnitude of climate extremes interacts with the structural dimensions of poverty, such as socio-economic inequalities, socio-spatial segregation, the level of access to basic services (such as health, education and social services) and infrastructure (housing and sanitation), marginalization by gender and ethnicity (such as indigenous peoples, traditional communities, black people) and the institutional capacity of government actors to tackle climate change. The population's exposure is greater in areas with a high population density, especially in urban centers, where the most marginalized and poorest populations are most at risk.

Projections indicate that the prolonged heavy rains that cause mass movements and landslides are likely to increase even more in the South and Southeast, especially in the coastal zone, where most of Brazil's population is concentrated (54.8%), according to the 2022 Census, and the

58 Listed in the Brazilian Classification and Codification of Disasters (Cobrade, Classificação e Codificação Brasileira de Desastres). Available at: https://www.gov.br/mdr/pt-br/centrais-de-conteudo/publicacoes/protecao-e-defesa-civil-sedec/DOCU_cobrade2.pdf. Accessed on: Oct 01, 2024.

59 Digital Atlas of Disasters in Brazil. Available at: https://atlasdigital.mdr.gov.br/. Accessed on: Oct 01, 2024.

country's capitals (IBGE, 2023). The increase in heavy rainfall also causes inundations, flash floods and flooding, which are strongly associated with precarious urbanization, and which in the coastal zone can be exacerbated by sea level rising events, such as storm tides. The critical areas for flooding and landslides are concentrated in the Southeast, Northeast and South. Incorrect generation and disposal of solid urban waste, combined with deficiencies in drainage systems, also contribute to worsening disasters such as flooding and inundations.

HEALTH - Rising temperatures, heat waves and extreme rainfall events (CAMPBELL-LENDRUMAND; WOODRUFF, 2007) can cause changes in the environment, such as changes to ecosystems and biological, hydrological and geographical cycles, which, in turn, can increase the incidence of infectious diseases, such as water-borne diseases (e.g. leptospirosis). These diseases are also associated with social factors, such as low-income population agglomeration, inadequate sanitation conditions and infestation of disease transmitters, which are also aggravated by climate change. Projections indicate an increase in the incidence of diarrhea in children in the North and in the semi-arid northeastern region, places characterized by low basic sanitation level.

In addition, the distribution of the incidence of vector-borne diseases is expected to change, especially of dengue, yellow fever, visceral leishmaniasis and malaria, since the climate influences their respective transmission cycles. The increase in temperature, the occurrence of prolonged droughts and heavy rains, together with the lack of basic sanitation, can contribute to the geographical expansion and seasonal abundance of these diseases, including the introduction of new arboviral diseases (IPCC, 2014).

Projections indicate that areas of high climatic suitability for dengue continue to predominate in most of the Northeastern states, with an increase in potential distribution along the coastline towards Bahia and Espírito Santo. With regard to yellow fever, the suitable area will increase significantly in future scenarios, especially in the Center-West and North regions.

As the level of global warming increases, so do the number of deaths and hospitalizations attributable to the temperature. **It is projected that the capitals of the North and Northeast regions and some of the Southeast will have more than 90% of the days in the year in critical condition, in a more pessimistic scenario.** Considering the risks of death from cardiovascular diseases due to heat stress (WBGT> 28 °C[60]), scenarios indicate a higher number of deaths, but the impacts differ according to the location and characteristics of the outcomes assessed. High temperatures lead to an increase in the percentage of deaths and hospitalizations due to respiratory diseases, which will be more critical in the North, Southeast and South of Brazil.

HUMAN MOBILITY - Climate variability and the increase in areas affected by desertification affect family farmers with harvest losses, loss of livelihoods and increased food prices, which can exacerbate migration to precarious urban settlements and increase poverty (OLSSON *et al.*, 2014). Drought events in the Northeast

[60] Wet-Bulb Globe Temperature (WBGT), which represents exposure to climatic conditions that influence the body's ability to maintain thermoregulation, i.e., exposure to heat that implies thermal stress (WBGT ≥28 °C).

may become even more frequent with climate change (CUNHA *et al.*, 2019), with an increase in aridity and rainfall deficit, bringing the risk of desertification (MARENGO; BERNASCONI, 2015; VIEIRA *et al.*, 2015), which could encourage new migration flows to other regions of the country. In future scenarios, practically all the northeastern states will suffer from the loss of land for farming, which could lead not only to an increase in migratory processes, but also to food insecurity for Brazilians.

BIODIVERSITY AND ECOSYSTEM SERVICES - Brazil's biodiversity accounts for 10 to 20% of global species diversity (MOTTA, 2015) and comprises around 30% of the world's tropical forests (MYERS *et al.*, 2000). Various factors have been causing pressure on ecosystems and loss of biodiversity, such as changes in land use, population growth, changes in consumption and technological patterns and socio-economic activities.

With climate change, species of animals, plants and other forms of life are likely to be impacted in different ways, such as changes in geographical distribution, abundance and life cycle (SILVA, 2018). **Scenarios indicate changes in the climatic suitability of ecosystems in all biomes**, with loss of biodiversity and ecosystem services generated by nature, such as the supply of drinking water, pollination, food and medicinal resources, soil fertility, air quality, tourism, among many others.

Traditional populations and communities, indigenous peoples and family farmers who depend directly on the integrity of natural environments and on their ecosystem services, which makes these groups highly vulnerable to the impacts of environmental degradation and climate change, should also be considered.

The **Amazon** is highly vulnerable, as the loss of resilience associated with climate change can be aggravated by the dynamics of changes in land use, such as deforestation, the occurrence of fires and urbanization. **Future scenarios indicate an increase in tree mortality, reduced forest biomass and a higher incidence of fire episodes, which aggravate the loss of biodiversity and ecosystem services** (ANJOS; TOLEDO, 2018; OMETTO *et al.*, 2014; SILVA *et al.*, 2018).

The **Cerrado** is considered one of the biodiversity hotspots on the planet, places that are home to thousands of species that only exist in those places, called endemic species. Projections indicate the expansion of this biome to other regions, but with ecological impoverishment. The biome has a high demand for agriculture and livestock, and low coverage of protected areas. **An increase in the days of critical fire danger is expected (from 20% to 32% by the end of the century).** In the **Pantanal**, the scenarios indicate an increase in exceptional droughts that affect flood pulses, which are natural water cycles that are essential for maintaining life in the largest continental wetland on the planet.

In the **Caatinga**, the range of climatic suitability is very narrow, with a greater trend towards the process of aridization, which, together with environmental degradation, can lead to an expansion of areas of desertification. Under climate change scenarios, the Caatinga biome could expand to the coastal zone, the Southeast and Center-West regions of the country, over the Atlantic Forest and Cerrado biomes.

The high fragmentation of the **Atlantic Forest** diminishes its adaptive capacity. This biome is a biodiversity hotspot, but it is affected by high population density and low

original vegetation cover (14% remaining) and protected areas. Urbanization along the Brazilian coast has been a major driver of the loss of native vegetation and ecosystem services. With regard to the **Pampa**, the biome loses climatic suitability in all scenarios, with expansion to other areas occupied by the Cerrado, but with a loss of biodiversity, compromising the functionality and provision of its ecosystem services.

In the **coastal zone and ocean**, unplanned or inadequately planned urban infrastructure and tourism, as well as a lack of efficient basic sanitation, cause impacts such as contamination and loss of ecosystems and their ecosystem services. Overfishing and illegal fishing also affect fish stocks and, consequently, the availability of provisioning ecosystem services, such as those based on food (SCHERER *et al.*, 2024). Other activities, such as oil and gas exploration, may also have an impact on coastal and marine environments. The resulting loss of provisioning, supporting, regulating and/or cultural ecosystem services affects human well-being and socio-economic activities (BUSTAMANTE; METZGER *et al.*, 2019).

Climate change puts additional pressure on cities and coastal and marine ecosystems, impacting ecosystem services, such as those that benefit the fishing sector, as well as leading to impacts on port regions, especially on maritime and river transportation. Changes in water quality are also expected, due to increased temperature and acidification, as well as saturation and salinization of the basins that flow into the coast (ALFREDINI *et al.*, 2013; HARARI; FRANÇA; CAMARGO, 2007; MARENGO *et al.*, 2018c). It can be said that, from 2 °C of global warming, coral reef and calcareous algae environments are at risk of disappearing (ROY *et al.*, 2018).

In addition, the effects of climate change tend to aggravate flooding and erosion processes caused by rising sea levels and extreme events (COPERTINO *et al.*, 2017). Areas at lower topographic elevations along the entire coast are more exposed to coastal flooding events, particularly in the southern and southeastern states, where there is a greater influence from frontal systems and the amplitude of meteorological tides. In the North, the tides have a greater astronomical influence, affecting the entire coastal plain and coastline.

As far as salinization is concerned, the locations most affected will be the coastal plains, where the influx of seawater can have an effect on the extent of the salt wedge, jeopardizing the use of water for crop irrigation, aquaculture/mariculture or even industrial purposes.

4.2.2.2.3 Gender, climate justice and territories

For the purposes of the Climate Adaptation Plan, climate justice is understood as a human-centered approach to tackling climate change, safeguarding the rights of people in situations of vulnerability and sharing the burdens and benefits of climate change and its impacts in an equitable and fair manner (IPCC, 2022 and MRFCJ, 2011).

Climate change has affected the Brazilian population in an unequal way. Socio-economically disadvantaged groups, who

generally contribute less to carbon emissions, face greater vulnerability to the adverse effects of climate change and have limited access to means of adaptation (OLSSON *et al*., 2014; IPCC, 2022). **In the Brazilian context, climate impacts become yet another pressure factor for historically vulnerable and marginalized populations, who have less access to infrastructure and opportunities.**

This is related to **intersectionality**, considering that each person has intersectional axes of identity which can be race, ethnicity, class, sexual orientation, religion, geographical origin, among many others. **The more axes intersect, the more marginalized a person is within society**, so that specificities emerge at these intersections, which are not obvious to everyone. **Climate change should be seen as another axis of exclusion** that can be analyzed in the light of intersectionality, since it disproportionately impacts specific groups and populations, especially black and indigenous women (LOUBACK, 2022). The climate justice approach, therefore, requires a broad understanding of the historical social and institutional inequalities that exacerbate vulnerability to climate change and influence the responses to these changes (NEWELL *et al*., 2021).

In Brazil, gender and race inequalities are evident in various socio-economic aspects, as shown by the data presented in the sub-chapter on national circumstances**.** For example, one in seven women does not have access to drinking water, and one in four does not have an adequate sewage treatment system, especially in the North and Northeast regions. In the labor market, women are paid 24% less than men for comparable jobs and own less land (LOUBACK, 2022). Racial inequality makes the situation even worse. According to the IBGE, in 2022, 72.7% of people living in poverty were black or mixed-race, totaling 38.1 million individuals.[61]

Socio-economic inequalities and socio-spatial segregation are factors that have repercussions on the impacts observed in Brazil, and on the climate risk to which these populations are exposed. In the case of disasters, for example, social vulnerability is intrinsically linked to exposure to geological and hydrological disasters, such as landslides and floods, especially in regions with low levels of formal education and income, especially among the non-white population (ADAPTABRASIL, n.d.b; ASSIS DIAS *et al*., 2020; SAITO *et al*., 2019; BRASIL, 2023). There are many mixed-race and black people living in slums and communities that lack adequate infrastructure, which increases the disproportionate climate impacts on these populations, both in disaster situations and in droughts (Box 4.3) and heat waves (Box 4.4). Poverty, limited access to urban services and spatial segregation resulting from a lack of urban mobility significantly compromise the ability of these groups to cope with and recover from disasters. This unequal distribution of climate impacts highlights an environmental injustice, where black communities face the most severe consequences, despite their minimal historical contribution to current climate problems (DIAS, 2023; PEREIRA E AMPARO, 2023; MORAES-FILHO *et al*., 2024; CARVALHO *et al*., 2022; FREITAS *et al*., 2019).

61 Poverty fell to 31.6% of the population in 2022, after reaching 36.7% in 2021. Available in: <https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/38545-pobreza-cai-para-31-6-da-populacao-em-2022-apos-alcancar-36-7-em-2021#:~:text=Essas%20desigualdades%20tamb%C3%A9m%20se%20mantiveram,brancos%20(3%2C5%25).>. Accessed on: Aug 19, 2024.

BOX 4.3 – Impacts of droughts and climate justice and gender

Extreme droughts have become increasingly frequent and widespread, affecting different population groups unequally. The water crisis from 2013 to 2016 resulted in around 40 million people in a situation of water supply risk in the Southeast. As a way of coping with the water shortage, it was observed that in the metropolitan region of São Paulo, families from more privileged neighborhoods have more alternatives to reduce consumption, adopting measures such as saving on washing machines and dish washers, while families from peripheral areas, which have lower water consumption, adopt saving measures related to personal and domestic hygiene (CLARKE, 2024; CUMPLIDO *et al*., 2023; FRACALANZA and PAZ, 2018; SOUZA, 2023).

In this event, the most vulnerable populations, particularly black and mixed-race populations, faced disproportionate adversity. Often living in areas with poor infrastructure and limited access to basic services, these communities have suffered intensely from the shortage of drinking water. This critical scenario has triggered negative consequences, severely affecting physical and emotional health, due to the increase in water-borne diseases and unsanitary housing conditions. The crisis also worsened living conditions, perpetuating racial and social stigmas and making it difficult to maintain personal hygiene. In addition, water shortage has negatively impacted employment opportunities and sociability, restricting the ability to engage in social activities and exacerbating the stigma associated with poverty and environmental vulnerability, highlighting the deep inequalities and the urgency of inclusive and efficient water resource management policies (SANTOS *et al*., 2021).

Box 4.4 – Impacts of heat waves by color, gender and age

Heat waves are increasingly affecting large Brazilian cities and are linked to deaths from respiratory and cardiovascular diseases. In Brazil, the relative increase in mortality during heat wave events has varied between 21% and 60% of excess deaths over the last two decades, with a greater increase in the last five years. Future scenarios point to an increase in respiratory and cardiovascular diseases in the elderly population, and an increase in the annual mortality rate of this population, averaging between 95 and 149 deaths per 100,000 inhabitants, varying more or less according to the scenario, the disease, the gender and the period in the future. It is noteworthy that some population groups are more affected by cardiovascular diseases due to heat waves, such as the elderly, women, non-white and less educated people, emphasizing the importance of reducing social inequalities (MONTEIRO DOS SANTOS et al., 2024; SOUSA *et al*., 2018).

BOX 4.4. (continued)

The unequal distribution of climate impacts on non-white populations is seen in the higher heat-related mortality of black and mixed-race people, especially in large Brazilian urban centers. Between 2000 and 2018, a study highlighted significant racial inequalities in heat-related excess mortality in large Brazilian cities, showing that in Rio de Janeiro (RJ) and São Paulo (SP), the rate for black and mixed-race people was 32% and 44%, respectively, in contrast to 23% and 36% for white people, while in Fortaleza (CE), heat-related excess mortality reached 17% for black and mixed-race people, against 11% for white people, showing a clear pattern of racial inequality in the impacts of extreme heat (MONTEIRO DOS SANTOS, 2024).

There is also a historical omission on the part of the States to develop public policies that prioritize the right of non-white populations to a pathway towards environmental and racial justice. This leads to a lack of government protection and support in times of climate crisis (COSTA, 2023; DIAS, 2023). Another relevant issue is the lack of some important data to support the definition of the political agenda. For example, the lack of data stratified by race on the occurrence of cardiovascular diseases during episodes of heat waves was highlighted in a study from the IT Department of the Brazilian National Health System (DATASUS) that analyzed daily mortality data for the period from 2000 to 2018, indicating possible under-reporting, which may affect the understanding of racial vulnerability (MONTEIRO DOS SANTOS, 2024).

4.2.3 Approaches, methodologies and instruments, as well as uncertainties and challenges associated with the previous items

For the analysis of observed climate change, observational data from conventional meteorological stations and rain gauges were used for the period from 1961 to 2020, interpolated on a 0.1° x 0.1° grid (XAVIER *et al.*, 2022). In addition to the average maximum temperature and average annual rainfall, three climate extremes indexes were considered: the CDD, the number of consecutive dry days (with rainfall of less than 1mm); the RX5day, the highest amount of rainfall in 5 days; and the WSDI, which represents the sum of days with heat waves in the year. The indexes anomalies were obtained from the difference between the averages of the variables calculated in each of the selected decades (1991-2000, 2001-2010 and 2011-2020) and the reference period: 1961-1990.

The methodology for analyzing current and future trends was based on the method of MASTRANDREA *et al.*, (2011), which is used to deal with uncertainties in IPCC reports. The level of uncertainty, or confidence, of the key messages is based on the level of **agreement** between the conclusions of various data sources and references, as

well as the degree of **evidence** associated with each of them. Sixteen sources of data and references were considered, including analyses by the National Institute for Space Research (INPE), information from the National Institute of Meteorology (INMET) website, the IPCC's sixth report, the IPCC's climate atlas and peer-reviewed scientific articles published in relevant journals (Tables 3 and Appendix 4.I). In this approach, each source is given a score, +1 being for an increase conclusion and -1 for a decrease conclusion. If the source indicates some uncertainty (e.g., low agreement between models), then the conclusion value is equal to +0.5 or -0.5, for increase and decrease, respectively. If more than half of the sources agree with an increase (or decrease), then **a lot of evidence**, i.e., a sign of change equal to ▲ (or ▼ for a decrease). Otherwise, result equal to **some evidence**, i.e., a sign of change equal to ▲ (or ▼ for a decrease). If at least one source concludes a change with a sign that is the opposite of the sign of the other sources, or all sources show no change (sign = 0), then, the sign of change is undefined, i.e., (**—**). In addition, the plausibility of a given future scenario was estimated, i.e., the level of **confidence**. If both the observed and future time periods agree on the sign of change and show **a lot of evidence**, then the future scenario is **plausible** (high confidence), otherwise the future scenario is **possible** (medium confidence). If there is disagreement on the sign of change between the time periods, then the future scenario is ***uncertain***. This confidence analysis of key messages helps prioritize risks associated with climate threats with *plausible* or *possible* futures, and define adaptation actions (e.g., prioritizing no-regret actions for risks associated with **possible** or **uncertain** futures). Appendix 4.I shows the references used for each of the variables analyzed.

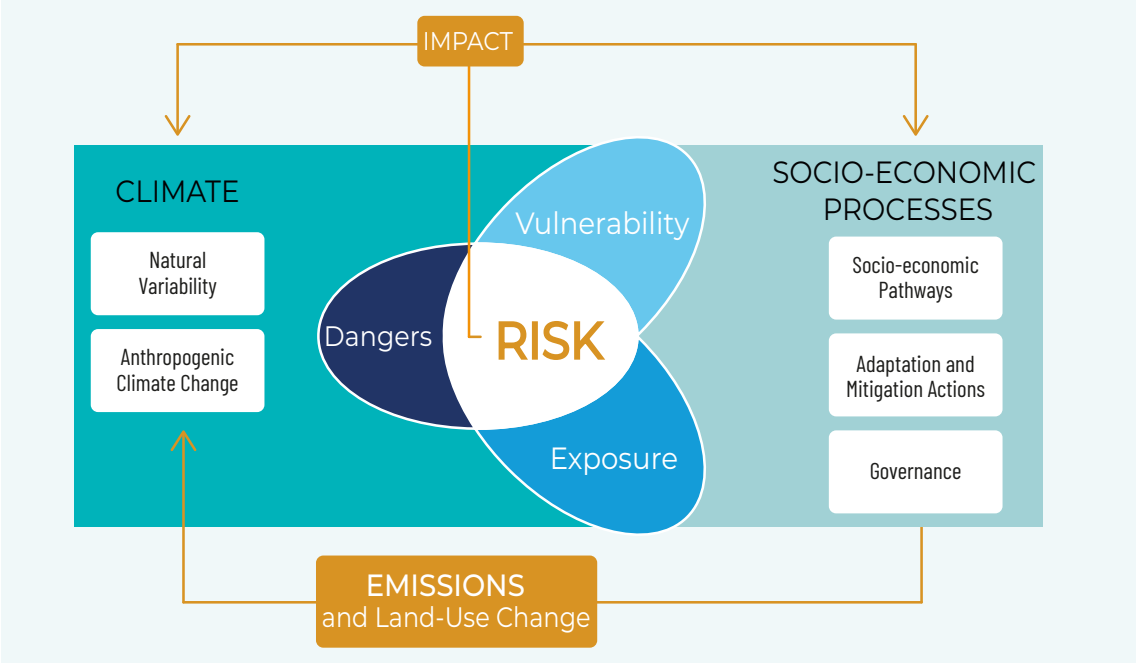
The survey of observed impacts was carried out using public sources and research, with emphasis on the database of the National Civil Defense Secretariat of the Ministry of Integration and Regional Development (MIDR), which has historical records collected on the impacts of climatological, hydrological and meteorological disasters in the national territory (BRASIL, 2024). Although the database has limitations because it is generated from self-declaration by affected municipalities and is, therefore, subject to errors such as duplications or gaps, it is the most complete database in the country and the MIDR has made an effort to process the data in order to continuously improve its quality. Current, high-impact scientific literature was also used to complement data that is not systematically analyzed by official databases. However, despite using robust methodologies and presenting reliable results, these studies represent regional, territorial, system and/or population group analyses, making it possible to identify and exemplify some trends for the country.

When it comes to the most vulnerable populations, there is evidence that traditional communities, indigenous peoples, *quilombolas* and family farmers suffer from direct and indirect impacts related to climate change and face challenges in adapting to extreme climate events due to poverty, social exclusion and a lack of public policies. Similarly, specific, sporadic and spontaneous studies indicate that women, black and mixed-race populations, indigenous peoples and traditional peoples and communities are more impacted by events related to climate change. However, the lack of systematic and regular data and information on the impacts of climate change stratified by gender, color, income and age makes it

difficult to understand climate injustice in the Brazilian territory in a general and regionalized way, so that adaptation actions can be planned in a way that is consistent with the Brazilian reality and in order to reduce climate injustice.

With regard to risks and vulnerabilities, the analyses were carried out following the methodologies recorded in the Fourth National Communication and the methodological bases of the IPCC (2014, 2022), which proposes the adoption of a conceptual framework that integrates both climatic and socio-economic and biophysical information, due to the multi-causal nature of the risks (Figure 4.13).

FIGURE 4.13 | RISK ANALYSIS AS A COMPOSITE OF THREAT, EXPOSURE AND VULNERABILITY



Source: IPCC, 2014.

This is also the methodological basis of the Information and Analysis System on the Impacts of Climate Change- AdaptaBrasil- to consolidate, integrate and disseminate information that makes it possible to advance the analysis of the observed and projected impacts of climate change in the national territory and for various strategic sectors, providing inputs to the authorities responsible for adaptation actions.[62] This data is provided at municipal level, but it can also be visualized for states, macro-regions and Brazil.

Among the uncertainties and challenges regarding the information and the analyses carried out, which were not listed above, is

62 It is described in more detail and with additional information in A. National circumstances and E. Adaptation Progress.

the lack of a single system that compiles all the observed data related to climate change, in addition to data on disasters, such as data on biodiversity, health, infrastructure, among others. Some data is already collected by the responsible bodies, but it is decentralized, unavailable to the general public and is not used for analyses that support climate change adaptation. Other data still needs to be collected more comprehensively, generating important information gaps, such as the rise in sea levels and data on observed impacts, risk analyses in the present and future for vulnerable populations, such as traditional peoples and communities, indigenous peoples, black and mixed-race populations, women, the elderly and children.

Another challenge worth noting relates to climate change attribution studies. A better understanding of how much and how climate change is affecting the rate, magnitude and frequency of events is fundamental information for structuring the framework of loss and damage and communicating more assertively about its urgency and severity, as well as supporting studies on climate risks or those related to future climate.

Finally, it is important to develop adaptation indicators and targets that can help monitor risks and identify whether they are increasing or decreasing. The current review process of the National Adaptation Plan by the Federal Government has the ambition of setting objectives, targets and indicators for this purpose, as well as moving forward with strategies to fill the gaps mentioned above.

4.3 Adaptation priorities, strategies, plans and actions

4.3.1 Climate Adaptation Plan (Plano Clima Adaptação)

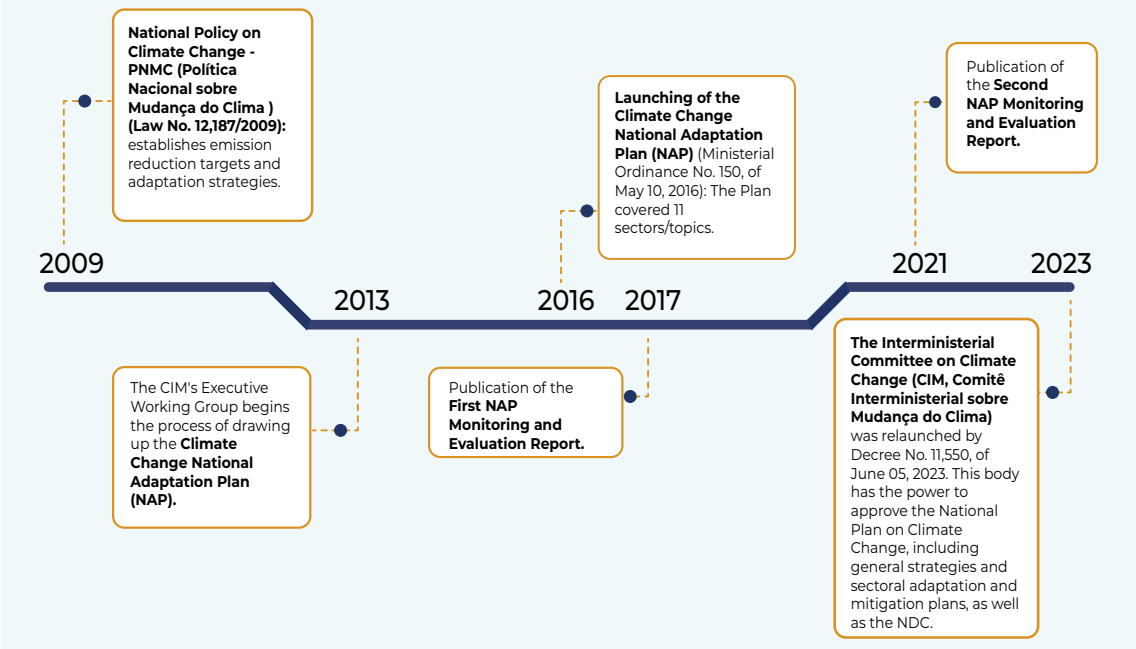
- **Background information regarding the process of drawing up the national climate change adaptation strategy**

In 2013, the Executive Group of the Interministerial Committee on Climate Change (CIM) began the activities of the Adaptation Working Group, which established the process for drawing up the National Climate Change Adaptation Plan (NAP, National Adaptation Plan), leading to its launch in 2016. The preparation of the NAP, provided for in the PNMC, was marked by the mainstreaming of adaptation in other agendas that had already been established, and by the growing availability of information on the impacts of climate change, such as the regionalized climate models released since 2012 (BRIANT; IGARI, 2023).

The NAP launched in 2016 was drawn up by the Federal Government in collaboration with civil society, the private sector and state governments, covering 11 sectors (BRASIL, 2016): Agriculture, Water Resources, Food and Nutrition Security, Biodiversity and Ecosystems, Cities, Disaster Risk Management, Industry and Mining, Infrastructure, Vulnerable Peoples and Populations, Health, and Coastal

Zones. This instrument is considered to be a milestone in the country's climate policy, having served as the basis for drawing up adaptation and/or climate action plans in some Brazilian states and municipalities and contributed to knowledge gain on climate-related impacts, risks and vulnerabilities in the country, in addition to incorporating aspects of climate change into planning. Two Monitoring and Evaluation Reports were published in 2017 and 2021, respectively (Figure 4.14).

FIGURE 4.14 | TIMELINE WITH THE MAIN ADAPTATION MILESTONES IN BRAZIL



Source: Adapted from Briant and Igari, 2023.

Among the lessons learned in the first cycle are: i) the need to ensure coordination at strategic levels of the Federal Government and the maturing of the governance structure, fostering integration between sectors and different federal levels; ii) the need to guarantee concrete targets for adaptation, linked to monitorable indicators within the plan's timeframe, focused on the country's priorities; and iii) more capacity-building actions, stimulating the generation of knowledge to deal with the climate crisis (BRASIL, 2021b).

Review process of the National Climate Change Adaptation Plan

Based on the 2016 NAP, Brazil began the process of drawing up the National Strategy for Climate Change Adaptation in 2023, the so-called "Climate Adaptation Plan", which is part of the National Climate Change Plan (Climate Plan)-described in Chapter 1., "National context" The Climate Plan will consolidate the strategy for implementing Brazil's climate policy in its mitigation and adaptation dimensions and will include

sectoral and thematic plans (7 mitigation plans and 16 adaptation plans), including targets and means of implementation. The Climate Plan will be in force for 12 years and will be reviewed every four years.

The revision of the NAP includes 23 of the 37 Ministries of the Brazilian Government. With climate justice as its guiding principle, with a view to promoting socio-environmental rights, the Climate Plan aims to set sectoral adaptation targets related to the main risks and means of implementation, and to adopt broad, participatory governance as a premise, involving local governments, productive sectors and society in order to achieve a democratic, fair country where sustainable development is a reality. The sectors and themes involved are: Agriculture and Livestock Farming; Biodiversity; Cities; Risk and Disaster Management; Industry; Energy; Transportation; Racial Equality and Combating Racism; Traditional Peoples and Communities; Indigenous Peoples; Water Resources; Health; Food and Nutrition Security; Ocean and Coastal Zone; Tourism; and Family Farming.

The Climate Adaptation Plan is coordinated by the Ministry of the Environment and Climate Change (MMA), with the technical and scientific coordination of the Ministry of Science, Technology and Innovation (MCTI). The sectoral and thematic plans set out in the Climate Adaptation Plan have the designation of focal points in the ministries, who are responsible for the internal coordination and development of each plan.

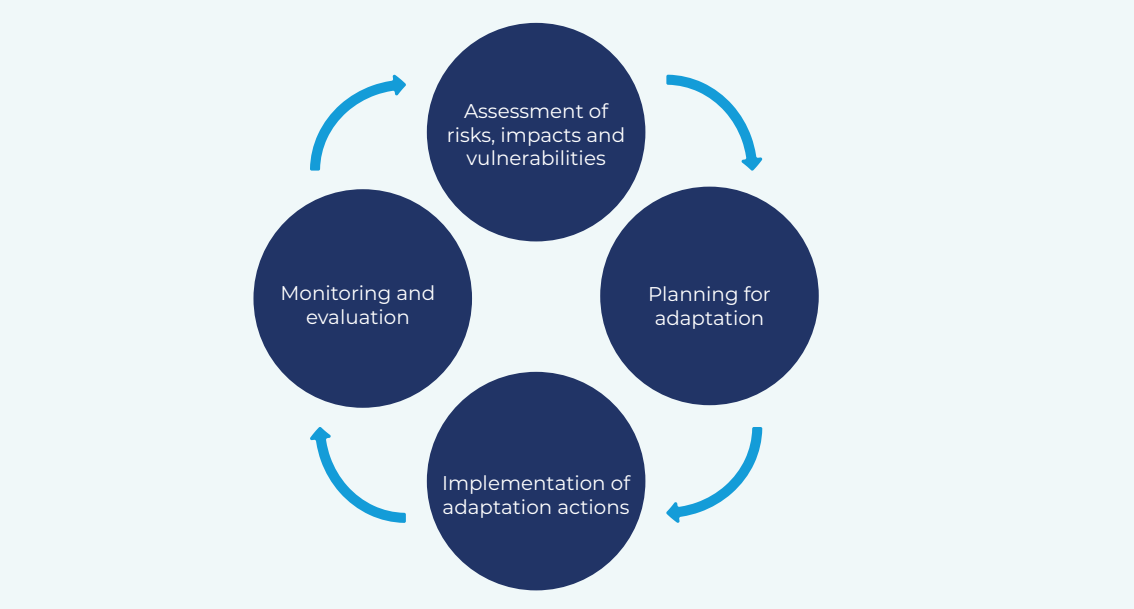
The process of drawing up the sectoral and thematic plans includes the establishment of an agenda for technical capacity-building on the theme of climate risk and adaptation, the provision of tools and workshops. A guiding model for the plans was drawn up with the purpose of guaranteeing a consistent content between the sectors and themes, facilitating dialogue and the monitoring of actions, as well as serving as the basis for the programming of capacity-building and the development of the tools used.

Science in the Climate Adaptation Plan

The development of the adaptation agenda is based on the scientific foundations consolidated in the IPCC's Sixth Assessment Report (AR6), on recent high-impact scientific literature, as well as on contributions from research institutes, such as INPE.

The development of the Climate Adaptation Plan is based on the Adaptation Cycle methodology (Figure 4.15). The cycle was used to guide the alignment content of technical workshops and guidance models (templates), used to support the process of drawing up Sectoral and Thematic Adaptation Plans by the Ministries responsible for those plans.

FIGURE 4.15 | ADAPTATION CYCLE USED AS A METHODOLOGY FOR DRAWING UP THE CLIMATE ADAPTATION PLAN



Source: UNFCCC, 2019.

The first stage of the cycle - the identification of risks, impacts and vulnerabilities - and, partially, the second stage - planning for adaptation - relied on scientific inputs drawn up in partnership between the MCTI and researchers from the Brazilian Research Network on Climate Change (Rede Clima). The process included a survey of scientific literature and consolidated information provided by Government bodies and other institutions, indications of new references by the Climate Network's appointed researcher, summarized records of information related to the observed impacts; risks and their dimensions; adaptation; and climate justice, and was used as the basis for the production of technical and scientific inputs. In total, 763 references on climate change were collected for screening, and 246 were selected and indicated through 13 summaries.

- **Gender mainstreaming and consideration of local knowledge in the Climate Adaptation Plan**

Considering the relevance of the themes of gender, color and territory to the Brazilian circumstances (item 4.2.2.2.3), the review of the Climate Adaptation Plan includes thematic plans for indigenous peoples, racial equality and combating racism and Traditional Peoples and Communities (PCTs – Traditional peoples and communities (Povos e Comunidades Tradicionais)). The Ministry of Women has made a technical team available to contribute to all the Sectoral and Thematic Plans of the Climate Adaptation Plan, so that they incorporate gender mainstreaming, in addition to active participation in the process.

The strategy adopted to include gender mainstreaming, as well as local and traditional knowledge, was specific to each social group, varying between the drafting of each Sectoral and Thematic Plan, and included public consultations, workshops and webinars and active participation in the drafting of the sectoral plan (Dataframe 4.3).

DATAFRAME 4.3 | STRATEGIES CONSIDERED FOR GENDER MAINSTREAMING AND FOR CONSIDERATION OF THE KNOWLEDGE OF INDIGENOUS PEOPLES AND TRADITIONAL PEOPLES AND COMMUNITIES

Strategic groups for gender and climate justice	Strategy for inclusion of mainstreaming and knowledge
Gender	Gender is a cross-cutting theme in the Climate Adaptation Plan. The strategy is based on an approach coordinated by the Ministry of Women, in partnership with the MMA and with the support of the Project for the Strengthening of Women from Traditional Peoples and Communities (PCTs) of the German Technical Cooperation Agency (GIZ), as well as a participatory process to identify priorities for the agenda. To this end, regional activities on gender and climate are being carried out to support a Gender Action Plan from the Ministry of Women, in order to complement the efforts made and taking into account the Climate Adaptation Plan. Within the scope of the Climate Adaptation Plan, a sectoral workshop and a webinar were held to guide the climate justice and gender mainstreaming into the sectoral and thematic plans (Dataframe 4.4).
Indigenous Peoples	In order to draw up the Thematic Adaptation Plan for Indigenous Peoples, the Ministry of Indigenous Peoples (MPI, Ministério dos Povos Indígenas) set up a working group made up of representatives of indigenous peoples, namely: APIB – Brazil's Indigenous People Articulation (Articulação dos Povos Indígenas do Brasil), ARPINSUL- Articulation of Indigenous Peoples of the Southern Region (Articulação dos Povos Indígenas da Região Sul) and ANMIGA - National Articulation of Indigenous Women Warriors of Ancestry (Articulação Nacional das Mulheres Indígenas Guerreiras da Ancestralidade) This structure makes it possible for the knowledge of native peoples to be taken into account in the process of drawing up the plan. An online public consultation process and an on-site workshop with representatives of indigenous peoples and the MPI were also held on September 05 and 06, 2024.[63]
Traditional Peoples and Communities	A Technical Chamber was appointed at the 18th Meeting of the National Council of Traditional Peoples and Communities (CNPCT, Comissão Nacional de Desenvolvimento Sustentável dos Povos e Comunidades Tradicionais) to discuss the PCT Sectoral Plan. PCT representatives attended meetings to draw up related Sectoral Plans, such as the plans on Biodiversity, Ocean and Coastal Zone and the Gender and Climate Change Action Plan workshops. A thematic workshop was also held on this theme with the support of GIZ's Project for the Strengthening of Women from Traditional Peoples and Communities (PCT) on August 27 and 28, 2024.

Source: Brazil's First Biennial Transparency Report, 2024.

63 The MPI launches an online platform for specific consultation on indigenous peoples for the "Climate Plan: Adaptation". Available at: <https://www.gov.br/povosindigenas/pt-br/assuntos/noticias/2024/08/mpi-lanca-plataforma-online-de-consulta-especifica-sobre-os-povos-indigenas-para-o-201cplano-clima-adaptacao201d>. Accessed on: Aug 27, 2024.

Events and workshops

As part of the process of drawing up the Climate Plan, a series of workshops, seminars and meetings were held with the aim of providing technical training, promoting transparency in the process and the participation of different sectors of society. The following Dataframe summarizes the events that were held.

DATAFRAME 4.4 | EVENTS HELD DURING THE PROCESS OF REVIEWING THE CLIMATE ADAPTATION PLAN (UPDATED UP TO JUNE 2024)

Event	Objective:	Date	Target audience	Format	Participants
Climate Justice Seminar	Promoting engagement with the topic of climate justice	Sep 4, 2023	Civil society	On-site with transmission	258
Climate Emergency Seminar	Discussing the topic of climate emergency	Oct 28-29, 2023	Federal Government and experts	On-site	254
Technical meeting: Adaptation Science	Presenting data and methodologies for adaptation	Nov 8, 2023	Sectoral TWG	On-site	115
General Strategy Workshop	Discussing the structure of the general strategy, vision and objectives	Jan 25-26, 2024	Sectoral TWG	On-site	90
Sectoral Workshop - Circumstances	Aligning the structure and presentation of tools in the chapter on Circumstances	Feb 2, 2024	Sectoral TWG	Online	142
Sector Workshop - Impacts and Risks	Aligning risk and vulnerability theory and initial risk assessment	Mar 7, 2024	Sectoral TWG	On-site	140
Workshop: Climate Federalism	Promoting engagement and collecting information from subnational entities.	Mar 19, 2024	Representatives of subnational governments	On-site	348
Sectoral workshop: risk integration	Presenting the risks assessed by the sectors and promoting sectoral integration	Apr 18, 2024	Sectoral TWG	On-site	158
Webinar: Adaptation Actions	Presenting the theoretical alignment and tools for drawing up adaptation actions	Apr 23, 2024	Sectoral TWG	Online	70
Dialogues to develop the Climate Adaptation Plan	Presenting the model proposed for the sectoral and thematic adaptation plans and receiving contributions from social movements	May 17, 2024 May 24, 2024	Civil Society	Online - Open	5200 + views
Webinar on "Introduction to Ecosystem-based Adaptation (EbA) for integration into climate change adaptation instruments"	Presenting the theory of ecosystem-based adaptation	May 23, 2024	Sectoral TWG	Online - closed	n/d

Event	Objective:	Date	Target audience	Format	Participants
Sectoral Workshop: AbE and climate justice	Discussing elements of climate justice and ecosystem-based adaptation and promoting sectoral integration	May 29, 2024	Sectoral TWG	On-site	124
Webinar: objectives, targets and indicators	Presenting guidelines for the development of the Plan's objectives, targets and indicators	Jun 14, 2024	Sectoral TWG	Online	120
Business Forum on Adaptation	Engaging the private sector in drawing up the climate adaptation plan	Jun 26-27, 2024	Business sector and members of ministries	On-site - open	150
Webinar: Climate justice and gender	Presenting concepts of climate justice and gender, aligning them technically and providing guidance on how to apply them when drawing up sectoral adaptation plans	Jul 5, 2024	Sectoral TWG	Online	80
Workshop: Improving the development of adaptation objectives and actions	Presenting concepts, aligning and practicing the drawing up of adaptation objectives and actions that will be developed in the sectoral and thematic plans	Jul 9, 2024	Sectoral TWG	On-site	115

Source: Brazil's First Biennial Transparency Report, 2024.

4.3.2 Adaptation actions planned and under development

Even with the ongoing review of the Climate Adaptation Plan, a series of studies and tools have been developed to advance the understanding of climate risks in different sectors. Some recent plans and programs have also been designed including adaptation efforts, taking into account the main risks and vulnerabilities in the country. The Ministry of Women, concerned about women and girls affected by climate events, such as the one that occurred in Rio Grande do Sul, drew up "Guidelines for the protection of women and girls in climate emergencies", to care for women and girls in shelters, making proposals to prioritize care for women that ensure their survival upon return to their homes.

Below are some of the initiatives developed at the federal level.

4.3.2.1 Studies and tools

DATAFRAME 4.5 | STUDIES AND TOOLS DEVELOPED ON THE SUBJECT OF CLIMATE RISKS AND ADAPTATION IN BRAZIL

Initiative	Brief description	Alignment with adaptation
AdaptaBrasil System[64]	The AdaptaBrasil platform has eight strategic sectors available: (Water Resources, Food Security, Energy Security, Health, Port Infrastructure, Geo-Hydrological Disasters, Railway Infrastructure, and Road Infrastructure) and another three sectors under development (Biodiversity, Indigenous Peoples, and Coastal Zones), with climate risk analyses for the present and the future, allowing the user to navigate through the risk indicators and their dimensions (Threat, Vulnerability and Exposure) at the subnational level.	The AdaptaBrasil platform plays a fundamental role in the dissemination of knowledge and decision-making related to climate adaptation in the country, through the analysis of increasingly integrated and up-to-date information on climate and climate risks in Brazil.
Digital Atlas of Disasters in Brazil[65]	The Atlas of Disasters centralizes and systematizes the disaster record kept by the SEDEC – The National Civil Defense Secretariat (Secretaria Nacional de Defesa Civil) of the Ministry of Integration and Regional Development (MIDR). It is aligned with international efforts, such as the Sendai Framework[66], and aims to serve as a decision-making support tool for public policies related to disaster risk reduction. The data used to create it is taken from the records made by states and municipalities in the Integrated Disaster Information System (S2ID, Sistema Integrado de Informações sobre Desastres).	On the platform, it is possible to view the data on a dashboard with graphs of disaster records, human and material damage and losses for a time series between 1991 and 2023, with monthly distribution and the possibility of selecting disaster categories and by municipalities. The data can also be viewed on an interactive map.
Study on Impact of Climate Change on water resources[67]	Prepared by the National Water and Basic Sanitation Agency (ANA), the first edition of the study was launched in 2024 to survey the effects of climate change on water availability, considering the sub-basin scale used in the planning and management of the water resources and basic sanitation sectors by basin committees, public bodies, researchers and water users.	As part of the ANA's permanent agenda on the subject, this study represents an initial process to analyze how water resources are impacted by climate change and the possibilities for adapting to these changes.
AdaptaVias Project[68]	The general objective of the AdaptaVias Project is to carry out a survey of the impacts and risks of climate change on the existing and projected federal land transport infrastructure (roads and railways), as an input for the development of strategies for adaptation to the impacts caused by climate change.	The initiative is a starting point for reviewing and improving the sector's regulatory process and a driver of public policies on the subject, since land transportation is the main means of transporting assets, goods and people between the different regions of Brazil.
Study on Climate impact on Brazilian coastal public ports[69]	The National Waterway Transport Agency, in partnership with the German Technical Cooperation Agency (GIZ), prepared a study containing a survey of the main climate threats, risks and impacts of climate change for 21 public coastal ports in Brazil, which resulted in a ranking of the ports analyzed under greater climate risk today and for the years of 2030 and 2050. In addition, the possible adaptation measures to be implemented to increase resilience to the impacts of climate change were surveyed.	According to data from the Waterway Statistics, produced by the National Waterway Transport Agency (Antaq, Agência Nacional de Transportes Aquaviários, 2019), around 95% of the country's foreign trade (in tons) go through the port sector, with an average turnover of BRL 293 billion annually, around 14.2% of Brazil's GDP. In this sense, the study is an important technical input for proposing adaptive measures for the Brazilian port sector.

64 Available at: https://sistema.adaptabrasil.mcti.gov.br/. Accessed on: Sep 4, 2024

65 Available at: https://atlasdigital.mdr.gov.br/. Accessed on: Sep 4, 2024

66 **The Sendai Framework for Disaster Risk Reduction** is a global plan that aims to reduce disaster-related mortality and impacts by 2030. Available at: marco_sendai_2015_enbr.pdf (www.gov.br).

67 Available at: <https://www.gov.br/ana/pt-br/assuntos/noticias-e-eventos/noticias/ana-lanca-estudo-sobre-impactos-da-mudanca-climatica-nos-recursos-hidricos-das-diferentes-regioes-do-brasil/resumo-executivo_26012024.pdf>. Accessed on: Jun 20, 2024

68 Available at: <https://www.gov.br/transportes/pt-br/assuntos/sustentabilidade/projeto-adaptavias>. Accessed on: Jun 20, 2024.

69 Available at: <https://www.adaptacao.eco.br/_biblioteca/impactos-e-riscos-da-mudanca-do-clima-nos-portos-publicos-costeiros-brasileiros-relatorio-completo/>. Accessed on: Jun 24, 2024.

4.3.2.2 Plans and Programs

DATAFRAME 4.6 | PLANS AND PROGRAMS RELATED TO CLIMATE ADAPTATION IN BRAZIL

Initiative	Brief description	Alignment with adaptation
National Civil Protection and Defense Plan[70]	The National Civil Protection and Defense Plan consists of an instrument and set of mechanisms for disaster risk management in Brazil, with guidelines, strategies and targets for integrated and coordinated disaster risk management between the Federal Government, the States, the Federal District and the Municipalities. The drafting of the Plan began in 2023 with guidelines and strategies for Civil Defense action on five fronts: prevention, mitigation, preparedness, response, and recovery.	The Plan aims to provide strategies for the country to deal with the risks of disasters, which are related to the occurrence of extreme events that have worsened with climate change.
Sectoral Plan for Adaptation to Climate Change and Low Carbon Emissions in Agriculture and Livestock Farming (ABC+ Plan (Plano ABC +))[71]	In 2020, the ABC+ Plan was launched as the second phase of the ABC Plan, created in 2010 in line with the PNMC. The ABC+ Plan includes strategies, such as the sustainable intensification of livestock farming and sustainable irrigated systems.	The Plan aims to organize and plan measures to encourage Brazilian farmers to adopt sustainable technologies, chosen to increase productivity, economic profitability and the resilience of national agricultural systems, while reducing emissions from the sector. The details and results of this Plan are presented in Chapter 3 of this Report.
National Water Resources Plan (PNRH, Plano Nacional de Recursos Hídricos)[72]	The National Water Resources Plan (PNRH) is the guiding instrument for the implementation of the National Water Resources Policy and the work of the National Water Resources Management System (SINGREH, Sistema Nacional de Gerenciamento de Recursos Hídricos), which involves institutions at the federal, state, federal district and river basin levels. The PNRH for 2022-2040 has a short (2026), medium (2030) and long-term (2040) time horizon (BRASIL, 2022).	The PNRH has a sub-programme for climate change adaptation measures, with the purpose of assessing the impact of climate change on water resources, including extreme drought and flood events, in order to support the definition of adaptation strategies in water resource management.
National Energy Plan (PNE, Plano Nacional de Energia)	It is an instrument with an indicative vision of the sector's long-term planning, drawn up by the MME and EPE, whose objective is to guide trends and indicate alternatives for the expansion of this segment over the coming decades.	Climate change is one of the nine cross-cutting issues addressed in the PNE 2050 (MME/EPE, 2020). Adaptation efforts stand out as a line of action in the energy sector that involves significant challenges related to the effects of climate change on energy supply and supply security. In addition, simulations were carried out considering the reduction in the supply of hydroelectric power due to changes in water availability. The PNE 2055 is currently being drafted, and is scheduled to be completed by the second half of 2025.

70 Available at: <https://pndc.com.br/>. Accessed on: Jun 25, 2024

71 Available at: <https://www.gov.br/agricultura/pt-br/assuntos/sustentabilidade/planoabc-abcmais/publicacoes/final-isbn-plano-setorial-para-adaptacao-a-mudanca-do-clima-e-baixa-emissao-de-carbono-na-agropecuaria-compactado.pdf>. Accessed on: Jun 27, 2024

72 Available at: <https://www.gov.br/mdr/pt-br/assuntos/seguranca-hidrica/cnrh/deliberacoes-cnrh-1/resolucoes/resolucao_232.pdf>. Accessed on: Aug 25, 2024.

Initiative	Brief description	Alignment with adaptation
Ten-Year Energy Expansion Plan (PDE, Plano Decenal de Energy)	It is an instrument with the indicative short- and medium-term vision (10-year time horizon) of sectoral planning.	The Plan seeks to discuss challenges and opportunities related to energy and climate change, based on an analysis of adaptation measures. In addition, in the PDE 2031, a sensitivity analysis (what if) was carried out in order to assess the robustness, or resilience, of the planned system in the face of possible changes in the hydrological regime, considering the recent history of flows (EPE, 2022b). The PDE 2034 is expected to be published by the end of 2024.
National Energy Transition Policy (PNTE, Política Nacional de Transição Energética)	Established by the CNPE's – National Energy Policy Council (Conselho Nacional de Política Energética) Resolution 05/2024, its aim is to guide the transformation of Brazil's energy matrix into a low-carbon structure.	With the establishment of the PNTE, the dissemination of information related to the plan, its implementation and monitoring and evaluation, will be taken to the National Energy Transition Forum (FONTE, Fórum Nacional de Transição Energética), in order to ensure greater transparency and debate with the target audience, as well as supporting the drafting and reviews of the National Energy Transition Plan (PLANTE, Plano Nacional de Transição Energética). FONTE acts as a space for dialogue between the government, civil society and the productive sector. FONTE is responsible for drawing up recommendations and promoting transparency and social participation in the formulation of energy policies. This forum seeks to ensure that the energy transition is conducted in an equitable manner, respecting regional diversity and promoting social inclusion. PLANTE establishes a set of long-term actions aimed at emissions neutrality and sustainable economic development. PLANTE is coordinated by the Ministry of Mines and Energy, with support from the Energy Research Office (EPE) and other ministries involved. It is reviewed periodically to adjust to changes and challenges in the energy sector.
New Industry Brazil (NIB, Nova Indústria Brasil)[73]	It is an industrial policy launched in 2024, with a ten-year time horizon, drawn up based on a broad dialogue in the working groups of the National Industrial Development Council (CNDI, Conselho Nacional de Desenvolvimento Industrial). The NIB is a systemic, long-term policy that interacts with other policies and is made up of a set of public instruments to support the productive sector.	The policy's missions include the promotion of sustainable and digital agro-industrial chains for food, nutrition and energy security (Mission 1); A resilient economic-industrial healthcare complex to reduce the vulnerabilities of the Brazilian National Health System (SUS, Sistema Único de Saúde) and expand access to healthcare (Mission 2); and Sustainable infrastructure, sanitation, housing and mobility for productive integration and well-being in cities (Mission 3). These themes are related to improving infrastructure and reducing vulnerabilities, thus connecting with the adaptation agenda (BRAZIL, 2024).
Ecological Transformation Plan (PTE, Plano de Transformação Ecológica)[74]	The Ecological Transformation Plan (PTE) aims to promote a change in economic, technological and cultural paradigms, with a view to sustainable development in harmony with nature and its biomes, backed by a pact between the three branches of government: executive, legislative and judicial. This plan seeks to enable the generation of wealth and its fair and shared distribution, with improvements in the quality of life of present and future generations.	Among the lines of action to achieve the three objectives: social justice, environmental sustainability, and employment and productivity, is the "New green infrastructure and adaptation axis", which aims to guide actions based on the climate lens.

73 Available at: https://www.gov.br/mcom/pt-br/noticias/2024/janeiro/governo-federal-lanca-nova-industria-brasil. Accessed on: Jun 30, 2024

74 Available at: https://www.gov.br/fazenda/pt-br/acesso-a-informacao/acoes-e-programas/transformacao-ecologica. Accessed on: Aug 28, 2024.

Initiative	Brief description	Alignment with adaptation
Resilient Green Cities Program[75]	The Resilient Green Cities Program (PCVR, Programa Cidades Verdes Resilientes), established in June 2024, aims to increase the environmental quality and resilience of Brazilian cities in the face of the impacts caused by climate change, by integrating urban, environmental and climate policies, encouraging sustainable practices and valuing the ecosystem services of urban greenery.	With priority for action in metropolitan regions and in municipalities with high social and climate vulnerability, the PCVR's actions focus on the population of urban areas, meeting the criteria of diversity of gender, race, ethnicity, age, disability, income and location in the territory. The program will be implemented primarily in the most vulnerable areas of cities, with a view to reducing social inequalities and climate risks (BRASIL, 2024).
Cisterns Program[76]	The Cisterns Program is a Federal Government initiative that aims to guarantee access to drinking water for household supply and for use by small farmers in order to promote social and productive inclusion in vulnerable regions of Brazil (MDS - Ministry of Development and Social Assistance (Ministério do Desenvolvimento e Assistência Social), 2023). The program was created in 2003 and has built more than 1.14 million cisterns, mainly in Brazil's semi-arid region, but also in other regions, including the Amazon. The technologies include rainwater harvesting and the installation of household sanitation (MDS, 2023).	The program's implementation model involves partnerships with public entities and civil society organizations, which are responsible for social mobilization, capacity-building and organization of the construction process. The program aims to reduce significant regional inequalities, contributing to climate justice by serving the population facing water shortages. In addition to the cisterns, there are social and productive follow-up actions and the transfer of non-refundable financial resources for productive projects, benefiting low-income families (MDS, 2023).
National Program for the Conservation and Sustainable Use of Brazil's Mangroves (ProManguezal)[77]	ProManguezal aims to conserve, recover and sustainably use the biodiversity and ecosystem services associated with the country's mangroves, taking into account the various pressures on the ecosystem, including climate change.	The Program's guidelines include recognizing the ecosystem services of mangroves and their role in climate change mitigation and adaptation, as well as incorporating climate-related risk management into the action plans. It also takes into account increasing the resilience of mangroves to protect the coastline against extreme events and reducing the vulnerabilities of the coastal zone accentuated by climate change, as well as promoting climate justice, combating environmental racism and increasing the resilience of vulnerable populations and traditional peoples and communities who depend on the mangroves.
Recovery Plan for the Regularization Reservoirs of the Country's Hydroelectric Power Plants (PRR, Plano de Recuperação dos Reservatórios de Regularização de Usinas Hidrelétricas)[78]	The Recovery Plan for the Regularization Reservoirs of the Country's Hydroelectric Power Plants (PRR) includes actions aimed at promoting water and energy security, to be developed under the coordination of the Ministry of Mines and Energy.	The plan incorporates climate change into the planning and dimensioning stages, searching for solutions and strategies aimed at increasing the resilience of the energy system. The main actions include creating a database of socio-environmental indicators and statistics on climate risks, mitigation and adaptation strategies in the energy sector, drawing up a roadmap to strengthen the resilience of the electricity sector, improving methodologies for generating hydrological scenarios considering climate change, and identifying improvements in expansion planning processes with a focus on climate risks.

75 Available at: https://www.gov.br/mma/pt-br/assuntos/qualidade-ambiental-e-meio-ambiente-urbano/cidades-verdes-resilientes. Accessed on: Jun 30, 2024

76 Available at: https://www.gov.br/mds/pt-br/noticias-e-conteudos/desenvolvimento-social/noticias-desenvolvimento-social/mds-retoma-programa-cisternas-com-investimento-de-mais-de-r-562-milhoes. Accessed on: Jun 20, 2024

77 Decree No. 12,045, of June 5, 2024. Available at: https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2024/decreto/D12045.htm. Accessed on: Jun 30, 2024.

78 Available at: https://www.gov.br/mme/pt-br/assuntos/secretarias/secretaria-nacional-energia-eletrica/plano-de-recuperacao-de-reservatorios-prr. Accessed on: Aug 20, 2024.

Initiative	Brief description	Alignment with adaptation
Fresh Water Program[79]	The Fresh Water Program (PAD) aims to establish a permanent public policy of access to quality water for human consumption through the sustainable use of groundwater, incorporating technical, environmental and social care in the implementation and management of desalination systems, primarily in the Brazilian semi-arid region, taking into account the characteristic presence of salts in groundwater in this region.	The Program is based on the PNMC and aims to guarantee to the population of the Semi-Arid region access to water and to minimize the effects of the region's intense climate variability[80], accentuated by climate change.
Feeding the Cities (Alimenta Cidades)[81]	The Feeding the Cities (Alimenta Cidades) Strategy will be implemented in priority municipalities, listed in MDS Ordinance No. 987, of May 22, 2024, including actions brought about and supported by the federal government and initiatives that take into account the specific circumstances of the territories. The aim is to increase the production, access, availability and consumption of adequate and healthy food, prioritizing urban peripheral areas and populations in situations of vulnerability and social risk.	The proposal is in line with numerous government initiatives, such as the Climate Adaptation Plan. The intention is to contribute to the integrated planning and intersectoral coordination of actions related to urban feeding, as well as to strengthen the perspective of the right to citizenshipand the human right to adequate food, reducing social inequalities and vulnerabilities related to the risk of food insecurity.

Other initiatives, although not directly aligned with climate adaptation, stand out for their significant contribution to reducing the vulnerabilities of the Brazilian population. This is the case of the Universal Social Assistance System (SUAS, Sistema Único de Assistência Social)[82], which has several social assistance programs; Family Allowance (Bolsa Família[83]), Brazil's largest cash transfer program, recognized for its ability to fight hunger and poverty; the Brazil Without Hunger Plan[84] (Plano Brasil sem Fome), launched in response to Brazil's return to the Hunger Map in 2022 and which also includes nutritional food security; among others.

79 Available at: https://www.gov.br/mdr/pt-br/assuntos/seguranca-hidrica/programa-agua-doce/Folder_Institucional_AJUSTADO.pdf. Accessed on: Aug 26, 2023.

80 Brazil. Federal Court of Auditors. Water security in the semi-arid region / Rapporteur Minister Aroldo Cedraz - Brasília: TCU - Federal Court of Auditors (Tribunal de Contas da União), 2009.

81 Available at: https://www.gov.br/mds/pt-br/acoes-e-programas/promocao-da-alimentacao-adequada-e-saudavel/alimenta-cidades. Accessed on: Aug 27, 2024

82 Available at: https://www.gov.br/mds/pt-br/acoes-e-programas/suas. Accessed on: Sep 4, 2024

83 Available at: https://www.gov.br/mds/pt-br/acoes-e-programas/bolsa-familia. Accessed on: Sep 4, 2024

84 Available at: https://www.gov.br/mds/pt-br/acoes-e-programas/brasil-sem-fome. Accessed on: Sep 4, 2024

4.3.3 Challenges, gaps and barriers

Climate adaptation efforts consider the dimensions of governance, planning, scientific knowledge, and climate justice, among others, as mentioned in this Chapter 4. However, challenges that have already been identified and taken into account when drawing up the Climate Adaptation Plan are highlighted below (Dataframe 4.7). Brazil relies on international cooperation to fill the gaps in the means of implementation and welcomes financial, technological and capacity-building resources to do so.

DATAFRAME 4.7 | CHALLENGES FOR ADAPTATION IN BRAZIL

Dimensions	Main challenges
Scientific and non-scientific knowledge	■ Providing periodically updated information on trends in observed climate-related impacts for the national territory; ■ Assessing and prioritizing climate risks systematically and periodically; ■ Deepening understanding of regional and territorial differences and the different groups of vulnerable populations in studies of observed impacts, climate risks and others; ■ Continuously improving climate scenarios, using the main global models; ■ Broadening and deepening knowledge about the co-benefits and trade-offs between adaptation actions and between adaptation and mitigation actions; ■ Including local and traditional knowledge in the identification of risks, impacts, vulnerabilities and adaptation actions; ■ Quantifying the costs of adaptation and inaction; ■ Developing studies related to the loss and damage agenda; ■ Improving indicators for monitoring and evaluating actions, based on evidence; ■ Systematizing information and conducting studies on the impacts of cross-border climate risks on the country's economy; ■ Developing methodologies to incorporate listening and traditional knowledge into diagnostic and decision-making processes; ■ Improving and systematizing disaggregated data on gender, race, generation and ethnicity; ■ Systematizing the good practices of women who are climate defenders as part of the solution and not just as victims.
Means of implementation	■ Guaranteeing funding for the different stages of the adaptation cycle; ■ Promoting alignment between the public and private sectors in order to expand sources of funding for the implementation of adaptation; ■ Expanding the implementation of transformational adaptation actions that promote more systemic and long-term interventions; ■ Expanding the technical and institutional capacities of the public and private sectors and of civil society to act on the adaptation agenda; ■ Incorporating the climate lens into the planning of all government sectors, using aspects related to climate change as a criterion for decision-making; ■ Increasing the capacity to access different types of funding; ■ Incorporating the gender lens into climate policies, seeking greater financial support for women's participation.
Governance	■ Implementing the governance structures proposed in the Climate Adaptation Plan; ■ Ensuring the sectoral integration of actions, in order to strengthen joint actions and the sharing of responsibilities for implementation, and to find fair and socially, environmentally and economically balanced solutions. ■ Promoting coordination between federal, state and municipal entities for the efficient implementation of the PNMC, as well as joint learning to continuously improve the adaptation cycle in the country; ■ Implementing and guaranteeing gender parity and the participation of women in decision-making spaces

Dimensions	Main challenges
Monitoring, evaluation and transparency	■ Consolidating a monitoring and evaluation system and improving it progressively; ■ Providing transparency reports on implementation and M&E periodically; ■ Defining bases and criteria for evaluating the effectiveness of adaptation actions.
Structural social issues	■ Implementing adaptation actions in such a way as not to increase the structural socio-economic inequalities that exist in the country; ■ Considering new infrastructure models and not reproducing unsustainable patterns; ■ Combating socio-economic inequalities in the implementation of the climate agenda in the country; ■ Promoting cultural changes in behavior by raising awareness among the population.

4.4 Progress in the implementation of adaptation and monitoring and evaluation of adaptation measures and processes

As detailed in section 4.3.1., the National Climate Change Adaptation Plan (NAP), launched in May 2016, provided for four-year implementation cycles with their respective reviews, in accordance with the legal guidelines set out in the National Climate Change Plan. Thus, in June 2017, the first Monitoring and Evaluation Report 2016-2017 of the NAP was released[85], which provided information on the progress of the national targets and guidelines for adaptation and made it possible to measure the existing challenges to achieving the targets set.

Between 2019 and 2020, with a view to completing the NAP's First Cycle, the MMA, in conjunction with public and private bodies and entities, held dialogues with and carried out qualitative and quantitative data collection from the focal points of the strategic sectors of the NAP, as well as from the business sector. This process provided inputs for the preparation of the NAP's Final Monitoring and Evaluation Report - 2016-2020 Cycle, which represented the second and final stage of monitoring. The Report seeks to evaluate the progress of the targets and guidelines from 2016 to 2020, as well as carrying out a final evaluation of the Plan's First Cycle, with the purpose of making the progress made in the Plan's sectoral and/or thematic strategies over this period available to Brazilian society

The report concluded that the First NAP Cycle had achieved its main objective of promoting better knowledge on managing and reducing climate risk in the country in the face of the adverse effects associated with climate change. Progress has been made in increasing scientific knowledge about adaptation to climate change and integrating the issue into other sectoral agendas. The actions reported also indicated the alignment of national adaptation initiatives with the challenges of the international agenda, such as the 2030 Agenda and its respective Sustainable Development Goals (SDGs).

The implementation challenges that were mapped include the discontinuity of actions started by the sectors and the scarcity

85 The 1st NAP Monitoring and Evaluation Report 2016-2017. Available at: https://www.mma.gov.br/images/arquivo/80182/GTTm/RelatorioMonitoramento.pdf. Accessed on: Nov 28, 2019.

or lack of access to financial resources; difficulties linked to the characteristics of the NAP's governance and management model, including slowness and excessive bureaucracy and changes in the NAP's governance and management model; the lack of inter-ministerial and inter-sectoral coordination, integration and synergy; and difficulties in implementing specific programs and policies, among others.

Based on these challenges, the NAP sectors identified the need to adopt additional actions, such as: fostering integration and synergy between strategic sectors and bodies responsible for the NAP; initiatives to raise awareness of climate risks and the visibility of the adaptation agenda in society as a whole; improvements to the Plan's governance process, so that it is not restricted to the technical level; greater access to financial resources; intensified monitoring of the impact of ongoing adaptation actions; and continuous generation of knowledge and tools for climate risk management.

The recommendations for the next cycle identified the need to continue integrating the adaptation agenda with other Government agendas through the strategic involvement of the upper echelons of the Federal Government. The generation of progressive awareness of the need to adapt to climate change in the different sectors was more restricted to the circle of Federal Government representatives and departments directly involved in the technical development of the NAP, and did not necessarily lead to a commitment at the more strategic levels of the ministries or sectors.

It was also suggested that concrete adaptation targets be proposed, linked to indicators that can be monitored within the plan's timeframe, with a more concise NAP focused on the country's priorities. Likewise, in order to effectively manage the Plan, it is important to establish a system for monitoring the implementation of the planned activities, so that any measures to ensure that the targets are met can be identified and adopted. Finally, more capacity-building actions were suggested, stimulating the generation of useful knowledge for decision-making.

This assessment has been taken into account in the ongoing NAP review process, which aims to structure a more effective monitoring and evaluation system, with the establishment of adaptation targets and indicators and in line with Decision 2 / CMA.5, which establishes the framework for the global adaptation objective (United Arab Emirates Framework for Global Climate Resilience).

4.5 Information related to preventing, minimizing and dealing with loss and damage associated with the impacts of climate change

Under the Paris Agreement, the topics of loss and damage (Article 8) and adaptation (Article 7) are treated differently, although both are directly related to the impacts of climate change. Loss and damage refer to climate effects that cannot be avoided or completely mitigated, even with the adoption of adaptation measures, and their severity is such that they require differentiated responses.

Extreme and unprecedented events in recent years illustrate that loss and damage are already a reality in the country. The intensification of the frequency and magnitude of climate-related impacts demonstrates the importance of incorporating loss and damage at the national level. Brazil recognizes the importance of this issue, but it still needs to strengthen its institutional, financial and technical capacities to address loss and damage in a more structured way and present systematized data and information that can reflect the national circumstances.

Although the topic is still being incorporated in the country, some bodies and systems already deal with data and response actions, as presented in the previous subchapters. As a result of severe and critical damage, new strategies have been developed to support the recovery of people, infrastructure and businesses.

The following is a compilation of data on loss and damage to the country caused by disasters and two recent cases that illustrate the magnitude of the impacts of extreme events in opposite regions of the country: the floods in the south and the droughts in the north. In terms of future projections, the main results of a study on the cost of inaction will be presented, based on modeling that considers changes in average temperature and impacts on energy, food and water security to estimate changes in the country's GDP in a scenario of inaction.

4.5.1 Historical loss and damage

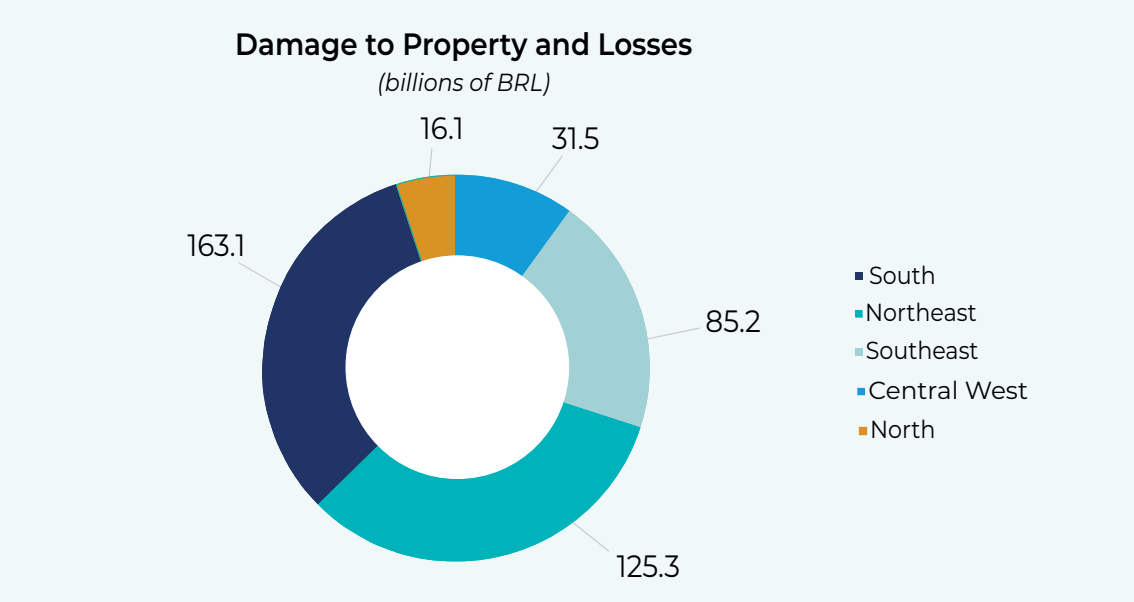
In the 10-year period between 2014 and 2023, Brazil accumulated more than BRL 421 billion in material damage and losses (USD 84 billion).[86] The South of the country accumulated the greatest material damage and losses (38.7%), followed by the Northeast (29.7%) and the Southeast (20.23%) (Chart 4.2) The last three years, the period from 2020 to 2023, concentrated 55% of the total loss and damage (BRASIL, 2024).

Material damage refers to the amounts corresponding to the damage or destruction caused to housing units,

86 For the sake of simplicity, the conversion from BRL 1 to USD 5 was used.

public facilities for health, education, other services, community use and sites with public infrastructure. Loss refers to the estimated value of public economic losses related to damaged essential services and private losses related to losses in the agriculture, livestock, industry, trade and services sectors as a direct result of the effects of disasters. The recorded losses are related to the value of the loss caused by the disaster, and not the amount needed, for example, to restore or recover the damaged roads, which is classified as material damage.[87]

CHART 4.2 | DISTRIBUTION OF MATERIAL DAMAGE AND LOSSES BY REGION, CAUSED BY DISASTERS BETWEEN 2014 AND 2023



Source: Digital Atlas of Disasters (2024a).

Case: Flooding in Rio Grande do Sul – April and May 2024

The state of Rio Grande do Sul (RS), located in the southern region of Brazil, was hit by massive flooding between April and May 2024. According to historical records, this would have been one of the most severe climatic events of heavy rainfall in the state in recent decades (ZUFFO *et al.*, 2024). It is estimated that by June 27, 2024, the impact area will have reached an area of approximately 16,126 km² and will have affected 484 (93%) of the state's 497 municipalities (Ipea – Institute of Applied Economic Research (Instituto de Pesquisa Econômica Aplicada), 2024).

87 Available at: https://atlasdigital.mdr.gov.br/arquivos/Atlas_Digital_Desastres_Manual_Aplicacao.pdf. Accessed on: Sep 4, 2024

The state of Rio Grande do Sul has an estimated population of 10.9 million inhabitants, which represents 5.3% of the Brazilian population. The state's GDP accounts for 6.5% of the national GDP, and this share is highest in agriculture (12.7%) and the manufacturing industry (8.4%). The areas most affected by the rains represent 48.5% of the population and 53.3% of the GDP of Rio Grande do Sul (BC - Brazil's Central Bank (Banco Central do Brasil), 2024).

In order to promote transparency in the budget implementation of extraordinary expenses incurred as a result of this event, the Ministry of Planning and Budgeting created a display panel[88] of the amounts involved based on the establishment of a budget identifier. By August 2024, the table showed an allocation of more than BRL 48 billion (USD 9.6 billion) in extraordinary credits to the state, with this figure being updated constantly.

It is not yet possible to estimate all the impacts caused by this event, but some published studies provide specific data and conclusions. In the 418 municipalities in a state of calamity or emergency, it is estimated that at least 23.3 thousand private establishments (9.5% of the total) and more than 334.6 thousand (13.7% of work places) have been directly affected. This estimate was made by cross-referencing the georeferenced information on the addresses of the establishments with the flooded area affected by floods and landslides. The result was used as an input for the emergency income transfer program for workers with a formal job contract who were affected by the floods in the state, developed by the Ministry of Labor (IPEA, 2024).

Among other measures taken by the Federal Government after the disaster was the creation of financial support for displaced or homeless families in municipalities in Rio Grande do Sul in a state of public calamity or emergency recognized by the federal Executive Branch. According to Provisional Measure No. 1219, of May 15, 2024, the financial support is aimed at tackling the public calamity and its social and economic consequences resulting from climatic events in the state of Rio Grande do Sul and consists of a single payment of BRL 5,100 (five thousand one hundred reais) per family, preferably paid to women. It should be noted that in order to identify the areas affected by floods and mass movements for the payment of aid, a joint effort was made by several Brazilian institutions using satellite images and computer models, such as INPE, CEMADEN, UFRGS - Federal University of Rio Grande do Sul (Universidade Federal do Rio Grande do Sul), the Brazilian Army and the Government of the state of Rio Grande do Sul (INPE, 2024).

Another measure adopted to support the families who lost their homes was the adaptation of an existing housing program, the "Minha Casa, Minha Vida" (My Home, My Life) Program (PMCMV, Programa Minha Casa, Minha Vida). Since its implementation in 2009, the Program has become one of the country's main housing policies and is focused on reducing the quantitative housing deficit by increasing the housing stock, and it prioritizes low-income families (BRASIL, 2020). In the context of the event that occurred in the state of Rio Grande do Sul, an Ordinance from the Ministry of Cities established the procedures to be adopted for defining the families eligible for housing assistance under the Program, as a result of the emergency or state of public calamity, benefiting families with a gross monthly income of up to BRL 2,400.00.

88 Available at: https://www1.siop.planejamento.gov.br/QvAJAXZfc/opendoc.htm?document=IAS%2FExecucao_Orcamentaria.qvw&host=QVS%40pqlk04&anonymous=true. Accessed on: Aug 27, 2024

The Central Bank of Brazil (Banco Central do Brasil) and the National Monetary Council (CMN, Conselho Monetário Nacional) have also developed measures to better mitigate the economic effects of the public calamity situation on the National Financial System (SFN, Sistema Financeiro Nacional). Those measures include the implementation of more robust procedures to monitor supervised entities whose headquarters are located or who carry out important work in the region, whose reports were submitted to a crisis monitoring group in a timely manner. Within the scope of the Agricultural Activity Guarantee Program (Proagro, Programa de Garantia da Atividade Agropecuária)[89], considering the travelling difficulties, the technical surveys necessary for the payment of the program's indemnities can now be carried out using remote sensing and parametric data on the productivity of the municipalities, with the aim of speeding up the payment of indemnities to farmers affected by the floods (BC, 2024).

In addition to government public policies, there are private initiatives that can help minimize damage and losses, such as insurance. Climate adaptation insurance transfers, in specific situations, the risk from an insured person, object or organization to an insurer (EU, 2018). In Brazil, for example, 17% of Brazilian households are covered by a home insurance policy, but less than 1% are covered against flooding (CNSeg - National Confederation of Insurers (Confederação Nacional das Seguradoras), 2024).

89 Available at: https://www.gov.br/agricultura/pt-br/assuntos/riscos-seguro/programa-nacional-de-zoneamento-agricola-de-risco-climatico/proagro

Case: Droughts in the Pantanal and Amazon – 2020 to 2024

Recurrent severe fire seasons in the Pantanal began in 2019, with 7 million hectares burned between 2019 and 2020 (50% of its area) (BARNES, SANTOS, LIBONATI *et al*., 2024). By the beginning of the second half of 2024, the burnt area had reached more than 2 million hectares[90] [91]. Studies indicate that the fires of 2024 were 40% more severe due to climate change (BARNES, SANTOS, LIBONATI *et al.*, 2024[92]). Fire caused by drought is part of the natural dynamics of the biome, but the severity and duration of the 2020 fires were abnormal (BARNES, SANTOS, LIBONATI *et al.*, 2024, WWF, 2021). Socio-economic impacts related to the fires have been identified, such as the overcrowding of health centers and hospitals and the overloading of urban infrastructure and equipment (BARNES, SANTOS, LIBONATI *et al*., 2024, GUARDIAN, 2024).

The drought has also hit the Amazon Biome, with severe impacts on the population and biodiversity. Using the United States drought monitoring classification system, in 2023 the Amazon experienced exceptional drought (D4), and according to attribution studies it would have been a "severe drought" (D2) without the effects of climate change (CLARKE *et al.*, 2024). In addition, there was an intensification of wildfires and burning events, which affected an area of 107,572 km² in the biome in 2023, 36% more than the area burned in the same period in 2022.[93]

90 Last search carried out on 08/28/2024. Therefore, the value shown does not represent the whole of 2024.

91 ALARM CALLS Available at: <https://alarmes.lasa.ufrj.br/platform/dashboard/9091>. Accessed on: Aug 28, 2024

92 Guardian. Devastation as world's biggest wetland burns: 'those that cannot run don't stand a chance'. Available at: <https://www.theguardian.com/environment/article/2024/jul/09/devastation-as-worlds-biggest-wetland-burns-those-that-cannot-run-dont-stand-a-chance-brazil-pantanal>. Accessed on: Aug 28, 2024.

93 Technical Note No. 12. AMAZON ON FIRE: UNDERSTANDING THE RELATIONSHIP BETWEEN FIRE AND DEFORESTATION IN 2023. Available at: <https://ipam.org.br/wp-content/uploads/2024/06/Amazonia-em-Chamas-12_v01.pdf>. Accessed on: Aug 28, 2024.

Highly vulnerable populations were disproportionately affected by this drought. Small farmers, indigenous, rural and riverine communities throughout the region were among the most vulnerable due to high poverty rates and high dependence on agricultural food production, freshwater availability and imports of goods transported by rivers (CLARKE *et al.*, 2024). The sharp drop in river levels has had a significant impact on the lives of the region's inhabitants, making it difficult for riverside populations to travel and transport people, food and other essential supplies by river, as well as impacting on the transportation of goods from the ports of the state of Amazonas to other ports in the country via cabotage (domestic transportation via coastal waters), destined for other countries (export) (BC, 2024).[94]

Another impact was the sharp decrease in the amount of resources imported by the state of Amazonas, due to the bottleneck in river navigation, making it impossible for ships to arrive with essential inputs for industrial production in the Manaus Free Trade Zone, negatively impacting the export of electronic products, motorcycles and beverages. The Industry Center of the State of Amazonas (CIEAM, Centro da Indústria do Estado do Amazonas) estimates the loss to be of BRL 1.4 billion for the industry in the State of Amazonas due to extraordinary logistics expenses, such as trans-shipment, stay and freight, caused by the interruption of large-scale shipping to Manaus, which lasted almost 60 days. This had a negative impact on industrial production, leading to a 7.3% drop in the state's industry in the quarter ending in November 2023 and mainly affecting the rubber and plastics, computer equipment, electronic and optical products, machinery, electrical appliances and materials, other transportation equipment (two- wheeled equipment) and miscellaneous products segments.[95]

In 2024, the drought became severe again, with the following impacts: the suspension of navigation, the declaration by the National Water and Sanitation Agency of critical seasons of scarcity in some bodies of water and the declaration of a state of emergency in the entire state of Amazonas, six municipalities in Acre and 18 in Rondônia in June 2024[96]. In the state of Amazonas alone, approximately 287,700 people - or 71,900 families - were affected by August 2024.[97]

Case: Hydropower crisis in the 2020-2021 biennium[98]

Looking at the scenario of the 2020-2021 biennium, in which Brazil faced a situation of severe water shortage, coinciding with the start of the dry season, the reservoirs in the Southeast and Center-West, responsible for, approximately, 70% of the country's storage, reached a historic low level of 26%.

94 Drought that affected the Amazon in 2023 caused the biggest drop in river levels ever recorded, and is related to climate change, as demonstrated by a study. Available at: <https://jornal.unesp.br/2024/04/24/seca-que-afetou-a-amazonia-em-2023-causou-a-maior-queda-nos-niveis-dos-rios-ja-registrada-e-esta-relacionada-a-mudancas-climaticas-mostra-estudo/#:~:text=A%20Amaz%C3%B4nia%20experimentou%20em%202023,alimento%20e%20outros%20suprimentos%20essenciais.>. Accessed on: Aug 28, 2024.

95 Drought in the state of Amazonas: impacts on foreign trade and industrial production. Available at: https://www.bcb.gov.br/noticiablogbc/16/noticia. Accessed on: Aug 28, 2024

96 Legal Amazon Newsletter July/2024 edition. Available at: https://www.gov.br/censipam/pt-br/publicacoes/boletim-informativo-da-AM-Legal/arquivos/julho-2024-boletim-informativo-da-amazonia-legal.pdf. Accessed on: Aug 28, 2024.

97 Drought in Amazonas: More than 287,000 people affected, says state government. Available at: https://www.cnnbrasil.com.br/nacional/seca-no-amazonas-mais-de-287-mil-pessoas-atingidas-diz-governo-estadual/. Accessed on: Aug 28, 2024.

98 NATIONAL ENERGY POLICY COUNCIL. **Final Report** - Working Group: Reservoir Recovery Plan. Brasília: CNPE – National Energy Policy Council (Conselho Nacional de Política Energética), 2024.Available at: https://www.gov.br/mme/pt-br/assuntos/secretarias/secretaria-nacional-energia-eletrica/plano-de-recuperacao-de-reservatorios-prr/2Relatorio_Final_Grupo_de_TrabalhoPRR.pdf.

The inflows to the power stations located in some of the basins that make up the SIN – Brazilian Interconnected System (Sistema Interligado Nacional) were below the historical average, and, in some cases, the worst hydrological sequences in the entire 91-year flow history (1931/2021) were seen. Considered in an aggregated manner, the flows to the entire SIN, in the period between December 2020 and November 2021, consisted in the worst hydropower condition ever seen for this period in history.

In this context, it is worth noting the unfavorable hydrological situation of the Paraná river basin, which includes the Paranaíba, Grande, Tietê and Paranapanema river basins, considering the Itaipu Power Plant as a point of interest, and in which the main regularization reservoirs of the SIN are located. These power plants and their respective reservoirs are extremely important for the operation of the SIN, as the resources stored in them are capable of guaranteeing power supply during dry periods, when there are no significant contributions from the plants installed in the north of the country, which greatly help to meet the SIN's load during rainy periods.

The reservoirs of the plants located in the Paraná River basin account for 76% of the maximum storage capacity of the Southeast/Center-West Subsystem and just over half (53%) of the storage capacity of the entire SIN.

After evaluating this scenario, the Electricity Sector Monitoring Committee (CMSE, Comitê de Monitoramento do Setor Elétrico), at its 248th Extraordinary Meeting, held on May 27, 2021, decided to "Recognize the severity of the current hydropower situation in the main hydrographic basins of the SIN, which recorded the worst hydrological period from September 2020 to May 2021, with the risk of compromising the generation of electricity to serve the SIN, and, in view of the serious specific situation experienced in the region covered by the Paraná River Basin, to recommend to the National Water and Basic Sanitation Agency - ANA that a situation of water shortage be recognized in the Paraná River Basin, also encompassing the Grande, Paranaíba, Tietê and Paranapanema Rivers."

On the same date, the first Water Emergency Alert was issued by the National Meteorology System (SNM, Sistema Nacional de Meteorologia), according to a Joint Note from INMET/INPE/CENSIPAM - Management and Operational Center of the Amazon Protection System (Centro Gestor e Operacional do Sistema de Proteção da Amazonia), associated with a shortage of precipitation for the Paraná Basin Hydrographic Region, which covers the states of Minas Gerais, Goiás, Mato Grosso do Sul, São Paulo and Paraná for the period from June to September 2021. Subsequently, the National Water and Basic Sanitation Agency (ANA) declared the critical situation of quantitative shortage of water resources in the Paraná Hydrographic Region, through ANA's Resolution No. 77/2021, of June 1, 2021.

Thus, the extremely exceptional water shortage experienced in 2021 in the SIN indicated the need for coordination at a level beyond the electricity sector, which motivated the establishment of the Chamber for Exceptional Rules for Hydropower Management (CREG, Câmara de Regras Excepcionais para Gestão Hidroenergética), through Provisional Measure (MP, Medida Provisória) No. 1,055, of June 28, 2021, based on the need for greater coordination between bodies and entities responsible for activities dependent on water resources - including

the management of multiple uses of water, energy generation, the environment, agriculture and transport. This was aimed at the adoption of exceptional measures to preserve the security and continuity of the electricity supply, with the purpose of making energy, water resources and environmental policies compatible.

CREG was made up of the State Ministers of Mines and Energy, who chaired it; Economy; Infrastructure; Agriculture, Livestock and Food Supply; Environment; and Regional Development, and its remit was to define mandatory guidelines for the establishment of exceptional and temporary conditions for the operation of the reservoirs of the country's hydroelectric plants, involving definitions for limits on use, storage and flow. In order to deal with these adverse conditions, since October 2020 the Electricity Sector Monitoring Committee (CMSE) has indicated the need for exceptional measures, and throughout 2021, the additional actions issued by CREG to guarantee the security of supply have been implemented with the necessary timing, based on technical studies, assessing their effectiveness, associated costs and the relevance of decision-making. These measures include:

- Activation of additional thermoelectric generation and enabling of additional generation supply to the system;
- Energy imports from Argentina and Uruguay;
- Flexibilization of hydraulic restrictions, in order to preserve the governability of the SIN's hydraulic cascades and the multiple uses of water;
- Flexibilization of the limits of exchanges between regions, with a corresponding increase in the transfer of power between them;
- Rational use of electricity by the population based on awareness campaigns and incentives;
- Anticipation of generation and transmission works;
- Publication of Ordinance No. 22/2021, on August 23, 2021, establishing guidelines for the Voluntary Electricity Demand Reduction - RVD (Redução Voluntária de Demanda) to serve the Brazilian Interconnected System - SIN (program for free consumers);
- Implementation of the program for the incentive to the voluntary reduction of electricity consumption for regulated consumers, for the period from September to December 2021;
- Implementation of a specific level of the Tariff Flag, entitled "Water Shortage";
- Specific guidelines regarding the generation from thermoelectric plants, as well as resources not ordered by the ONS – National Electric System Operator (Operador Nacional do Sistema Elétrico).

The exceptional measures indicated by the CMSE and CREG were fundamental for guaranteeing the security of service to the SIN and enabled significant storage gains of around 14 percentage points of the maximum stored energy of the Southeast/Central-West subsystem, assessed up to September 2021. As assessed, without the actions taken by the CMSE and CREG, the adverse hydrological conditions experienced in 2021 would have led to severe difficulties in guaranteeing the country's electric power supply.

Therefore, with these measures, the security of supply to Brazilian electricity consumers and the management of water use have been guaranteed, while complying with the necessary legal certainty in the

implementation of the necessary actions for the benefit of Brazilian society, through the synergistic and coordinated action of all those who can contribute to the solutions (bodies, entities and concessionaires), seeking to reduce the impacts on the environment and water resources.

Impacts of climate change on the Commodity Index - Brazil (IC, Índice de Commodities -Br)

Climate change has had a significant impact on the *Commodities Index* - Brazil (IC-Br), reflected in higher prices of various agricultural products, such as coffee, oranges, cocoa, wheat and *in natura* products in general. In addition to the observed increase, the GDP projection for 2024 was reduced due to irregular rainfall and high temperatures in Brazil's main producing regions (BCB – Brazil's Central Bank (Banco Central do Brasil), 2024).

Climatic phenomena intensified by climate change, *El Niño* and *La Niña* (Figure 4.8) have had an impact on agricultural production, affecting the IC-Br. In 2021 and 2022, *La Niña* caused severe water shortages and increased prices of commodities, with heavy rains in the last quarter of 2022. The transition to *El Niño* in 2023 brought additional risks for the agricultural sector and food prices in 2024, highlighting negative impacts on the global productivity of corn, rice and wheat. *El Niño* has been identified as a significant risk for the Supply of Agricultural Commodities, affecting rice and sugar prices due to drier weather in Southeast Asia. Imports into the Northern region of Brazil were hampered by drought in the Amazon basin in 2023 (BCB, 2024).

4.5.2 Potential loss and damage

Building resilience by overcoming socio-economic challenges

Building Brazilian resilience is directly related to overcoming socio-economic challenges. Working Group II of Assessment Report 6 - AR6 emphasized the importance of combating hunger, poverty and inequalities in order to strengthen the capacity of communities to face and adapt to these adversities of climate change. Communities with fewer economic and social resources are more vulnerable to the impacts of climate change, so overcoming challenges, such as poverty and inequality is essential to reducing this vulnerability. This involves guaranteeing access to basic resources, such as drinking water, food, healthcare and education, which are fundamental to resilience (IPCC, 2022).

In addition, social cohesion and effective governance are pillars for climate resilience. Cohesive societies, in which there is trust in institutions and community participation, are better able to implement adaptation strategies and mobilize resources and mutual support in extreme events. This includes implementing policies that promote equal opportunities and social inclusion, ensuring that all members of society have access to the resources they need to thrive (IPCC, 2022).

Strengthening the capacity of communities to respond to extreme events is also crucial. This can be achieved through investments

in resilient infrastructure, early warning systems and environmental education focused on climate risks. By enabling communities to prepare for and respond effectively to disasters, it is possible to minimize negative impacts and speed up post-event recovery (IPCC, 2022). Building resilience is, therefore, not just a matter of physical infrastructure, but also of social and economic strengthening. By addressing socio-economic challenges in an integrated way, it is possible to create a more resilient, fair and sustainable environment.

The Cost of Inaction

As described in section 4.2. Impacts, risks and vulnerabilities, climate-related impacts have been intensifying in Brazil, with future worsening scenarios. These impacts directly affect people's lives and ecosystems, as well as key sectors of the country's economy. The integrated modeling study of the economic impacts of climate change in Brazil shows that the impacts of climate change on the water, energy and food systems generate cross-cutting and cumulative effects (SCHAEFFER *et al.*, 2022). This includes medium- to long-term damage, as well as obstacles to economic development, due to restrictions on the availability of and access to resources and services, which results in limitations to production chains.

Scenario with and without mitigation and adaptation actions. The future scenario of possible impacts on water, energy and food security without the implementation of adaptation actions in the country was projected based on computable general equilibrium (CGE) models and integrated assessment models (IAM). The result is lower productivity, higher production costs and higher prices for these three securities.

The effects on agricultural activity are among the most relevant from an economic point of view, as they interfere with the capacity to generate income and employment locally, as well as with food prices, increasing the cost of living for families. In addition to the climate effect, changes in land use can increase deforestation by displacing agricultural activities.

The impact scenario (scenario without actions) was compared to a scenario in which mitigation actions on a national and global scale would be implemented and climate impacts would not worsen (scenario with actions). The difference in economic indicators between the two scenarios corresponds to the cost of inaction, i.e., the economic impact of the country not promoting adaptation or mitigation.

The comparative scenario shows that by not taking mitigation and adaptation measures, the country would have a **20.6% lower accumulated growth in its GDP**, which corresponds to 0.35% less per year on average. In addition, **3.4 million jobs would no longer be created in the country by 2050, around 112,000 jobs per year.**

All regions of the country would be significantly negatively affected by inaction.

It has been estimated that the cost of inaction would represent a difference of BRL 1.8 trillion in Brazil's GDP by 2050.

In terms of GDP and jobs, the Center-West and Southeast would be the regions with the biggest losses. Due to the high dependence on agricultural activity and the growing demand for water, the results indicate that the North, Northeast and Center-West regions would potentially be the most affected in these indicators.

The costs of inaction are much higher than the costs of action. However, we need to start immediately, because the window of opportunity to avoid serious economic, social and environmental losses, guaranteeing a livable and sustainable future, is getting smaller and smaller. Although actions to tackle climate change involve substantial initial investments and can cause significant changes in the economic structure, these challenges can be mitigated through appropriate public policies (IPCC, 2023).

Despite including important dimensions for the Brazilian circumstances when considering the impact of security, the study does not address possible costs related to the occurrence of disasters, such as impacts on infrastructure, industry and housing. The costs related to the impacts on public health, among other widely affected sectors, were also not included in the model. Therefore, the study makes great progress in understanding the possible impacts of climate change on the Brazilian economy, but it presents results that are underestimated in relation to the cost of inaction for adaptation actions in a more comprehensive way and in different sectors.

It is, therefore, important to advance methodologies and studies that make projections of the potential loss and damage caused by climate change. Such projections require greater efforts to systematize existing data scattered across different databases and sectors and to produce those that are not yet available. This information is fundamental to better communicate the impacts of climate change on the national territory and for institutions and society to be adequately prepared to deal with them.

4.6 Cooperation, good practices, experiences and lessons learned

A series of partnerships and structures has been important in helping to advance climate adaptation in the country. These elements have become good practices, as they have been established over many years and are continually being improved and enhanced. Below is a non-exhaustive list of some experiences related to the development of tools, partnerships or pilot projects, which have become a reference for the evolution of adaptation at national level.

DATAFRAME 4.8 | GOOD PRACTICES AND LESSONS LEARNED FROM CLIMATE ADAPTATION INITIATIVES IN BRAZIL

Initiative	Brief description	Good practice or lesson learned
Brazilian Research Network on Global Climate Change (Rede Clima)[99]	Rede Clima is included in the PNMC and brings together more than 19 research institutions. In addition to carrying out analyses on the state of knowledge of climate change in Brazil, along the lines of the Intergovernmental Panel on Climate Change (IPCC) reports, the Rede Clima adopts more specific sectoral approaches. These analyses support the formulation of national and international public policies, offering support to Brazilian diplomacy in international negotiations on the subject.	Rede Clima works with the country's leading experts to advance climate science in different areas of knowledge. It has more than 350 researchers and has contributed with 1,560 publications in journals, 253 books and 330 book chapters.
AdaptaBrasil System[100]	AdaptaBrasil was developed through cooperation between the National Institute for Space Research (INPE) and the National Research and Education Network (RNP, Rede Nacional de Pesquisa e Ensino), with funding from the Ministry of Science, Technology and Innovation (MCTI). It consists of an interactive platform presenting climate risk indexes for different sectors and analyses at municipal level.	The AdaptaBrasil System (Sistema AdaptaBrasil) (MCTI) relies on the collaboration of several partner institutions, which play key roles in the development and improvement of the platform. These institutions, with their expertise and specific knowledge, contribute to strengthening and continuously improving AdaptaBrasil, making it an increasingly robust and reliable tool for analyzing and understanding the impacts of climate change in Brazil.
Monan Mathematical Model[101]	MONAN (*Model for Ocean-laNd-Atmosphere PredictioN*) is a community model of the Unified Earth System whose main objective is to be a numerical model that covers all scales, geographical and temporal, of the entire Earth system and its implications. It is a "community model" because it brings together the efforts of various Brazilian national institutions, such as universities, research centers, operational centers and various authorities in the field of meteorology, the environment, oceans and others. It can also receive support from international centers and universities, as well as from the private sector.	The name Monan was also inspired by ancestry, which in the Tupi-Guarani culture means 'land without evil'. The mathematical model under development aims to obtain more accurate climate and weather forecasts for tropical and subtropical conditions in Brazil and South America. The computer system will represent an effective progress in the quality, reliability and predictability time frame of extreme weather events, such as rainfall and heat waves, by generating numerical weather, climate and environmental forecast products.
Climate and Health Observatory[102] **(Observatório de Clima e Saúde)**	The Climate and Health Observatory is an initiative of the Oswaldo Cruz Foundation (Fundação Oswaldo Cruz) (Fiocruz), linked to the Ministry of Health (MS, Ministério da Saúde), which carries out studies to identify climate patterns and their effects on health. It was created to unify environmental, climatic, socio-economic, epidemiological and public health data, which had previously been scattered among various institutions.	The project is developed by various institutions specializing in the subject and makes a vast array of data, studies and methodologies available in an accessible manner and free of charge. Its mission is to centralize and share information, technologies and knowledge that promote networks of researchers and studies on the impacts of environmental and climate change on the health of the Brazilian population.

99 Available at: https://redeclima.cemaden.gov.br/. Accessed on: Sep 4, 2024

100 Available at: https://sistema.adaptabrasil.mcti.gov.br/. Accessed on: Sep 4, 2024

101 Available at: https://monanadmin.github.io/. Accessed on: Sep 4, 2024

102 Available at: https://climaesaude.icict.fiocruz.br/. Accessed on: Sep 4, 2024

Initiative	Brief description	Good practice or lesson learned
Climate Change Committee (UK)[103]	A partnership between the Brazilian Ministry of Science, Technology and Innovation (MCTI) and the UK Climate Change Committee (CCC), with the support of the UK Embassy in Brazil. Part of the UK PACT Skill-Share Program, it aims to promote Green and Inclusive Growth, strengthening Brazil's capacity to face the challenges posed by climate change.	Through the exchange of experiences and methodologies, this collaboration seeks to improve the development and implementation of effective public policies for climate adaptation in Brazil. This cooperation involves representatives of the ministries that make up the Interministerial Committee on Climate Change (CIM), promoting an integrated and intersectoral approach.
ProAdapta[104]	Started in 2017, this initiative is the result of a partnership between the Brazilian Ministry of the Environment (MMA) and the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV, in its German acronym), in the context of the International Climate Initiative (IKI, in its German acronym) and implemented by the German Technical Cooperation Agency (GIZ). ProAdapta aims to support the Brazilian Government in implementing the national agenda for adaptation to climate change, including actors from different levels of Government, the private sector and civil society.	Through projects with subnational entities, the private sector and the Federal Government, the initiative supports the development of climate risk analyses, the coordination between different sectors and the development of capacity-building courses, guides and action plans in the area of adaptation.
Investments in Science and Technology[105]	The Brazilian Government, through the MCTI, the National Council for Scientific and Technological Development (CNPq) and partner institutions, fosters scientific and technological development in the field of climate adaptation through funding calls for tender. This funding encourages the development of sustainable technologies, resilience strategies and effective public policies, promoting collaboration between scientists, governments and society.	The following are some of the good practices included in the calls for tender: the allocation of a minimum percentage to women researchers and institutions located in regions that historically receive less funding, such as the North and Northeast; the linking of research with the SDG agenda; the establishment of "National Science and Technology Institutes"; a research program called INCT – National Science and Technology Institute (Instituto Nacional de Ciência e Tecnologia) for Climate Change; and a call for tender made in partnership with the BRICS-STI.
Civil Defense Warning[106]	Pilot project for the National Civil Defense's new warning system, Civil Defense Warning (Defesa Civil Alerta). The new technology was created in partnership with the National Telecommunications Agency (Anatel, Agência Nacional de Telecomunicações) and telephone companies operating in the country.	As this is a pilot project, 11 municipalities were selected for the first tests. The technology uses the cell phone network to issue the warning with a warning sound, suspending any content in use on the user's screen. Residents in risk areas will receive warnings without the need to register beforehand.
Synthesis Center for Environmental and Climate Change (SIMAClim, Centro de Síntese em Mudanças Ambientais e Climáticas)[107]	Starting its activities in 2024, SIMAClim will work on the need to integrate scientific data and information in order to move forward more quickly and contribute to the development of Brazilian public policies on climate change.	Research focused on knowledge synthesis has strong co-production characteristics, seeking the involvement of various actors, not only from the academic and non-academic communities, but also from decision-makers from the public and private sectors. Such research is not regularly conducted in discipline-based research structures.

103 Available at: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/noticias/2024/04/brasil-e-reino-unido-promovem-oficina-sobre-estrategia-e-planejamento-de-adaptacao-climatica. Accessed on: Sep 4, 2024

104 Available at: https://www.adaptacao.eco.br/. Accessed on: Sep 4, 2024

105 CNPq's – National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico) call for tenders. Available at: <http://memoria2.cnpq.br/web/guest/chamadas-publicas>. Accessed on: Aug 28, 2024

106 Available at: https://www.gov.br/mdr/pt-br/assuntos/protecao-e-defesa-civil/defesa-civil-alerta. Accessed on: Sep 4, 2024

107 Available at: https://simaclim.com.br/. Accessed on: Sep 4, 2024

One of the positive points observed in the practices listed above is networking, with various institutions working together and contributing to achieve common results. Considering the complexity of climate risk identification and adaptation, this collaboration is essential in order to unify data and systems that allow for more agile and accessible analysis for decision-making.

Another good practice identified that is present in many partnerships is the gearing of the development of solutions based on the needs or gaps found. The identification of precise needs by different actors is important so that more assertive analyses can be made and more effective initiatives can be developed.

References – Chapter 4

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Appendix 4.I

Description of data sources and references included

List of climate threats considered by data source and reference

	Data sources and references															
Climate Threats	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Average temperature	■			■	■	■		■								
Maximum temperature	■	■		■	■		■	■	■					■		
Minimum temperature	■	■		■	■			■						■		
Heatwaves [a]	■	■	■	■	■		■	■	■					■		
Annual rainfall	■	■	■	■	■	■	■	■						■	■	
Extreme rainfall [b]	■	■	■	■	■			■	■					■		
Persistent extreme rainfall [c]	■		■	■	■		■	■	■					■		
Frequency of drought [d]				■	■			■							■	
Drought duration [e]	■		■	■	■		■	■						■		
Severe wind [f]		■		■	■			■				■	■			
Mean sea level				■				■		■						■
Sea surface temperature				■				■		■	■					
Marine Heatwaves				■				■			■					
Ocean acidification				■				■								

[a] warm spell duration index (WSDI); percentage of days in the year when the maximum temperature is higher than the 90th percentile (TX90).

[b] maximum annual 1-day precipitation (Rx1day).

[c] maximum consecutive precipitation over a 5-day period in the year (Rx5day).

[d] standardized precipitation index (SPI).

[e] maximum duration of the drought period in the year (CDD).

[f] maximum annual extreme wind; surface wind; percentage of days in the year when the surface wind is greater than the 90th percentile; 50-year return period.

No.	Reference
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3	DUNN, R. J. H. *et al.* Development of an Updated Global Land in Situ-Based Data Set of Temperature and Precipitation Extremes: HadEX3. **Journal of Geophysical Research: Atmospheres,** v. 125, n. 16, p. e2019JD032263, 27 ago. 2020.
4	GUTIÉRREZ, J. M. *et al.* IPCC WGI Interactive Atlas: Regional information (Advanced). **Dataset**: CMIP6. Available at: <http://interactive-atlas.ipcc.ch/>. Accessed on: Apr 01, 2024.
5	GUTIÉRREZ, J. M. *et al.* IPCC WGI Interactive Atlas: Regional information (Advanced). **Dataset**: CORDEX South America. Available at: <http://interactive-atlas.ipcc.ch/>. Accessed on: Apr 01, 2024
6	INMET. **Normais climatológicas do Brasil**: Variações Climáticas. Available at: <https://clima.inmet.gov.br/VariacoesClimaticas/1961-1990/diferenca_precipitacao>. Accessed on: Apr 01, 2024.
7	INPE. **Análise de mudanças observadas para o período de 1961 a 2020**. Contribuição para a estratégia geral do Plano Clima Adaptação. 2023. Available at: <https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/cgcl/noticias/numero-de-dias-com-ondas-de-calor-passou-de-7-para-52-em-30-anos>. Accessed on: Apr 01, 2024.
8	IPCC. **Climate Change 2021** – The Physical Science Basis: Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. 1. ed. [s.l.] Cambridge University Press, 2023.
9	LI, C. *et al.* Changes in Annual Extremes of Daily Temperature and Precipitation in CMIP6 Models. **Journal of Climate**, v. 34, n. 9, p. 34413460, maio 2021.
10	NASA/JPL. **NASA Sea Level Portal**. Data Analysis Tool 2.0. Available at: <https://sealevel.nasa.gov/data-analysis-tool/>. Accessed on: Apr 04, 2024.
11	OLIVER, E. C. J. *et al.* Longer and more frequent marine heatwaves over the past century. **Nature Communications**, v. 9, n. 1, p. 1324, 10 abr. 2018
12	PES, M. P. *et al.* Climate trends on the extreme winds in Brazil. **Renewable Energy**, v. 109, p. 110–120, ago. 2017.
13	PIRES, A. V. *et al.* Updated Design Wind Map for Brazil and Impacts on the Reliability of Built Structures. ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, **Part A: Civil Engineering**, v. 7, n. 4, p. 04021058, dez. 2021.
14	REGOTO, P. *et al.* Observed changes in air temperature and precipitation extremes over Brazil. **International Journal of Climatology**, v. 41, n. 11, p. 5125–5142, set. 2021.
15	TOMASELLA, J. *et al.* Assessment of trends, variability and impacts of droughts across Brazil over the period 1980–2019. **Natural Hazards**, 16 dez. 2022.
16	VOUSDOUKAS, M. I. *et al.* Global probabilistic projections of extreme sea levels show intensification of coastal flood hazard. **Nature Communications**, v. 9, n. 1, p. 2360, 18 jun. 2018.

FIRST
BIENNIAL TRANSPARENCY REPORT
OF BRAZIL

TO THE UNITED NATIONS
FRAMEWORK CONVENTION
ON CLIMATE CHANGE

chapter 5

INFORMATION ON FINANCIAL, TECHNOLOGY DEVELOPMENT AND TRANSFER AND CAPACITY-BUILDING SUPPORT NEEDED AND RECEIVED UNDER ARTICLES 9 — 11 OF THE PARIS AGREEMENT

5.1 National circumstances, institutional arrangements and country-driven strategies

Climate financing from external multilateral and bilateral sources plays a key role in advancing climate action in Brazil. This financing contributes significantly to the implementation of public policies and programs. It mobilizes private resources for investments aimed at low carbon emissions and at increasing climate resilience, including supporting initiatives by civil society organizations. However, since 2018, as reported in Brazil's last two Biennial Update Reports (BUR)[108], there has been a reduction in the amounts provided by cooperating countries and entities.

At the international level, Article 9[109] of the Paris Agreement establishes a finance mechanism to support developing countries in tackling climate change. This mechanism includes special funds and their operating entities, such as the Global Environment Facility (GEF)[110] and the Green Climate Fund (GCF)[111]. The GCF, created with the purpose of managing a flow of resources of 100 billion dollars a year from contributions from developed countries, acts as the operational entity of the Convention's Financial Mechanism. In Brazil, entities such as the National Bank for Economic and Social Development (BNDES), Caixa Econômica Federal (Federal Savings Bank) and the Brazilian Biodiversity Fund (Funbio, Fundo Brasileiro para a Biodiversidade) are accredited by the GCF and are qualified to submit projects to raise funds under the mechanism.

Before the GCF, the Climate Investment Funds (CIF) already operated under the leadership of the World Bank, serving as a laboratory for the Convention's financial mechanism. The CIF continues to receive donations and operate, which benefits Brazil through the Forest Investment Program (FIP Brasil[112]), which deals with forest issues and recently approved a 70-million-dollar investment plan in the renewable energy integration line (CIF REI)[113].

There is also the Adaptation Fund (AF), a mechanism of the Convention aimed at directing resources exclusively from donations to adaptation projects, with a total ceiling of 20 million dollars per country for projects. It is worth noting that Brazil has not yet accessed resources from this mechanism, but is in the process of structuring its internal governance to the Fund in order to create the conditions to develop projects and apply for such resources. Originally created to serve the least developed countries (LDCs) and supported by 2% of the carbon credits from the Clean Development Mechanism (CDM), the Fund now finances all developing countries and receives donations directly from developed countries. In addition, Decisions 2/CP.27 and 2/CMA.4 of the Convention established the creation of a

108 Available at: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/cgcl/paginas/relatorios-de-atualizacao-bienal-bur

109 Article 9 of the Paris Agreement deals with capacity-building and technical and financial support for developing countries to help them implement actions for climate change, mitigation and adaptation. This article highlights the importance of international cooperation and continued support to ensure that all countries can effectively contribute to the goals of the Paris Agreement. Available at: https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

110 Available at: https://www.thegef.org/

111 Available at: https://www.greenclimate.fund/

112 Forest Investment Program. Available at: https://snif.florestal.gov.br/pt-br/bioma-cerrado/projetos-do-fip.

113 Available at: https://www.cif.org/country/brazil. Accessed in: August 2024.

specific fund for loss and damage related to climate change[114].

Since 2008, the Amazon Fund has been an important mechanism for reducing deforestation, by financing environmental policies through results-based compensation. The partnership formed by the Governments of Germany, Norway and the United Kingdom in 2014 to support results-based financing for REDD+[115] stands out as a successful example. Norway, in particular, has pledged to provide approximately 3 billion dollars a year for REDD+, with a specific pledge of 1 billion dollars for Brazil in 2008. In a recent report[116], it was noted that the Amazon Fund had, by the end of 2023, an exceptional operating result, with the approval of nine new projects in the amount of BRL 553 million and two new calls for tender launched in the amount of BRL 786 million - exceeding BRL 1.3 billion in resource allocation. As a result, the Fund ended 2023 with a portfolio of 107 contracted projects, worth a total of BRL 1,856,024,088.05. It should be noted that, between 2019 and 2022, there was a reduction in disbursements due to the stoppage of approvals and contracting of new projects. During this period the Amazon Fund had its governance changed by Decree No. 9,759, of April 11, 2019, with the extinction of its steering committee.

The Sectoral Plan for Adaptation and Low Carbon Emission in Agriculture (ABC+ Plan)[117] is a relevant policy for adaptation and mitigation of greenhouse gas (GHG) emissions in agriculture. Of particular note is the Harvest Plan (Plano Safra), a Brazilian Government program that provides domestic financial resources to finance agricultural production. The 2023/2024 Harvest Plan encourages the strengthening of environmentally sustainable production systems, with funding in the amount of BRL 364.22 billion.[118]

However, it should be noted that the resources available, both national and international, are insufficient to meet the complex demands made by climate change. In addition, most of the funds are geared towards mitigation, leaving adaptation actions underfunded. The lack of equity in the distribution of resources perpetuates inequalities, as the most vulnerable populations often lack the financial means to face climate challenges. It is, therefore, imperative to increase the availability of resources and rebalance investments, dedicating a significant portion to adaptation strategies.

114 Available at: https://unfccc.int/loss-and-damage-fund-joint-interim-secretariat

115 Acronym for Reduction of Greenhouse Gas Emissions Resulting from Deforestation and Forest Degradation; Sustainable Management of Forests; and Conservation and Enhancement of Forest Carbon Stocks.

116 Available at: https://www.fundoamazonia.gov.br/export/sites/default/pt/galleries/documentos/rafa/RAFA_2023_port.pdf. Accessed in: September 2024.

117 Available at: https://www.gov.br/agricultura/pt-br/assuntos/sustentabilidade/planoabc-abcmais/abc/programas-e-estrategias. More details are provided in Chapter 3 of this biennial report.

118 Available at: https://www.gov.br/agricultura/pt-br/assuntos/noticias/presidente-anuncia-plano-safra-2023-2024

5.1.1 Institutional arrangement for managing information on climate financing in Brazil

In recognition of the urgency and complexity of climate challenges, the Brazilian Government has developed a multi-faceted structure, involving various bodies and mechanisms, which is essential for ensuring transparency, efficiency and effectiveness in the allocation of resources earmarked for climate change mitigation and adaptation actions in the country.

The country's political, social, economic, climatic and environmental aspects are detailed in Chapter 1. "National context", of this Report. However, the following are some of the collegiate bodies, instruments and entities that are relevant to the process of managing climate finance information.

Interministerial Committee on Climate Change (CIM): The committee is made up of 23 ministries and plays a key role in coordinating climate policies and overseeing financing strategies and it is the country's main permanent climate governance body. Its duties include ensuring that climate policies are aligned with financing objectives and that there is effective integration between the different areas of Government.

National Climate Change Fund (Climate Fund (Fundo Clima)) The Climate Fund is a central financing mechanism under the National Climate Change Policy (PNMC), designed to support climate change mitigation and adaptation projects. Linked to the Ministry of the Environment and Climate Change, the Climate Fund provides resources in two modalities, reimbursable and non-reimbursable. Reimbursable resources are managed by the National Bank for Economic and Social Development (BNDES), while non-reimbursable resources are operated by the MMA. The main objective of the Fund, in both modalities, is to finance actions and initiatives that contribute to reducing GHG emissions and strengthening the resilience of Brazilian communities and ecosystems. Considered one of the main instruments of the PNMC, the Climate Fund will have a 26-fold increase in reimbursable resources in 2024, increasing from BRL 400 million/year by 2022 to BRL 10.4 billion in 2024[119]. This exponential increase was made possible by Brazil's unprecedented issuance of sustainable Government bonds. The objective is to expand and scale up actions to reduce GHG emissions and adaptation actions, in line with the Ministry of Finance's Ecological Transformation Plan, in order to boost the country's sustainable development, with economic growth, social inclusion and environmental conservation.

As a developing country, Brazil relies on international cooperation and receives financial resources, especially from developed countries and international financial institutions, to mobilize financing for the Climate Fund.

Secretariat for International Affairs (SAIN, Secretaria de Assuntos Internacionais) of the Ministry of Finance: The SAIN, through the General Coordination of Sustainable Finance under the Ministry of Finance's Undersecretariat for Financing Sustainable Development, acts as the Ministry of Finance's focal point for discussions on international climate financing seeking to

119 Available at: https://www.gov.br/mma/pt-br/assuntos/mudanca-do-clima/fundo. Accessed in: September 2024.

create strategies to help obtain resources for projects related to the effects of climate change in the country. Specifically, SAIN acts as the Designated National Authority for the Green Climate Fund (GCF) and represents Brazil in the Climate Investment Funds (CIF).

COFIEX - Committee for External Financing (Comissão de Financiamentos Externos) panel: Provides information on public sector's projects and programs that have external funding from multilateral and bilateral organizations, within the scope of the responsibilities of the Secretariat for International Economic Affairs of the Ministry of Planning and Budgeting (MPO, Ministério do Planejamento e Orçamento) and the Committee for External Financing (COFIEX).[120]

National Bank for Economic and Social Development (BNDES): The BNDES has adopted a policy aimed at integrating the economic, social, environmental and climate agenda, with a view to helping the country achieve the United Nations (UN) Sustainable Development Goals (SDGs), make the just transition to a carbon-neutral economy and achieve economic prosperity. This translates into financing initiatives that contribute to reducing greenhouse gas emissions and achieving Brazil's Nationally Determined Contribution (NDC) targets, agreed in the Paris Agreement.[121]

As a developing country, Brazil relies on international cooperation and receives financial resources, especially from developed countries and international financial institutions, to support and/or complement BNDES' actions.

General Coordination of Climate Science (CGCL, Coordenação-Geral de Ciência do Clima e Sustentabilidade): The CGCL of the Ministry of Science, Technology and Innovation (MCTI) acts as the National Designated Entity (NDE) for the Convention's Technology Mechanism in the country. Therefore, the CGCL is responsible for assessing the technological needs for implementing climate action plans in Brazil and for drawing up Technology Action Plans (TAPs), considering priority sectors and key technologies, with a view to achieving the mitigation targets presented in Brazil's Nationally Determined Contribution (NDC).

120 Available at: https://painel-cofiex.economia.gov.br/painel-cofiex. Accessed in: August 2024.

121 Available at: https://www.bndes.gov.br/wps/portal/site/home/desenvolvimento-sustentavel/resultados/emissoes-evitadas/painel-desembolsos-NDC-no-index. Accessed in: August 2024.

5.2 Underlying assumptions, definitions and methodologies

This Chapter 5 of Brazil's BTR1 was prepared in accordance with Decisions 18/CMA.1 and 5/CMA.1, and presents information on resources committed to Brazilian entities through multilateral institutions and bilateral channels from 2020 to 2022. Despite the difficulties and restrictions inherent in this exercise, the Brazilian Government has endeavored to provide the most disaggregated information possible, in the common tabular format.

Due to the size of the country and its diversity in terms of social, economic and environmental factors, the information presented in this chapter should be considered non-exhaustive, since there is still a need for a structured reflection on the issue in the country and the strengthening of arrangements for gathering information, considering all aspects that are relevant to the identification of constraints and gaps and related financial, technical and capacity-building needs.

In order to present the information regarding the financial support received, a number of criteria have been defined, which are listed below:

- Appendix 5.I of this chapter presents Tables 5.I.1 and 5.II.2, consistent with Annex III of Decision 5/CMA.1, which include resources on a grant or concessional basis received from bilateral or multilateral channels, for climate-specific actions, in accordance with the principle of climate finance additionality, as per Article 4.3 of the UNFCCC.
- The original amounts of the resources received are presented in US dollars (USD), with the resources presented in domestic currency. The exchange rate of USD 1 = BRL 5 (Brazilian Reais) was used.
- Due to the lack of available information, resources destined to the private sector have not been included; and
- The tables do not include external resources received directly by sub-national entities.

Some partners in the promotion of sustainable development in Brazil through bilateral cooperation were not included in the tables due to different approaches used in the accounting of the support and cooperation received, which could not be efficiently assessed or were not included in the above criteria.

When collecting data, the information from multilateral institutions proved to be more transparent, accessible, complete and comparable than the data available from bilateral flows. It becomes challenging, for example, to identify and access information about a flow of climate finance from a bilateral donor to a civil society organization when there is no federal government involvement. Due to these constraints, information on bilateral channels only includes resources that have been internalized through a public entity or implemented under the coordination of a public entity (whether federal, state or municipal).

In terms of the climate relevance of individual projects, the percentage of the climate component for multilateral resources was based on the criteria of the funding institution.

5.3 Information on financial support needed by developing country Parties under Article 9 of the Paris Agreement

The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) highlights the importance of increasing finance for developing countries, such as Brazil, in order to promote and accelerate actions that help achieve global climate targets, while promoting local and regional benefits. Through public funding and clear signals to investors, governments can reduce economic barriers and direct essential resources to mitigation and adaptation actions in these countries. Investors and private banks, as well as national and international companies committed to environmental and social sustainability standards, play a crucial role in promoting a sustainable transition. In addition, political commitment, policy coordination, international cooperation, effective ecosystem management and inclusive governance are key to effective and equitable climate action. Sharing appropriate technologies, knowledge and policies, together with adequate funding, will allow all communities to participate in reducing emissions and avoiding processes and products with a high carbon footprint. Substantial investments in adaptation are also essential to prevent or mitigate growing risks, especially for vulnerable groups and regions.

Given the importance of international finance in catalyzing action for climate change, Brazil has stressed the need for the financial contribution to be adequate, predictable, sustainable, new and additional. Recalling the commitment established in the Paris Agreement by developed countries to mobilizing USD 100 billion a year by 2020, Brazil stresses that there is little transparency about the current state of compliance with this commitment.

In the context of mitigation actions, as reported in Brazil's Fourth Biennial Update Report (BUR4)[122], financial support needs were listed for:

- Promoting research and technological development;
- Improving the emissions measurement, reporting and verification system (domestic MRV system); and
- Generating information through climate and economic modeling.

Nevertheless, it will only be after the updating of the National Climate Change Plan (climate Plan) has been completed that it will be possible to have more clarity about the support needs, based on the strategies that will be adopted, mainly related to the achievement of the Brazilian NDC (further details can be found in Chapter 3 of this BTR). The process of drawing up the Climate Plan is ongoing and will be completed in 2025.

Some areas can be singled out for financial support, such as Sustainable Transport, Energy Efficiency, Sustainable Agriculture, Waste Management, Industry, the Forestry Sector and Renewable Energy Technologies. These additional areas represent significant

122 Available at: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/cgcl/arquivos/relatorios-de-atualizacao-bienal-bur/quarto-relatorio-de-atualizacao-bienal-do-brasil.pdf

opportunities to reduce GHG emissions and promote sustainable development in Brazil. Adequate financing in these sectors can complement the above-mentioned initiatives and help the country achieve its climate targets more comprehensively and effectively.

However, in relation to the needs for adaptation actions, within the scope of the Climate Adaptation Plan (detailed in Chapter 4 of this BTR), the following aspects have already been raised:

- Guaranteeing funding for the different stages of the adaptation cycle;
- Promoting alignment between the public and private sectors in order to expand funding sources for the implementation of adaptation;
- Expanding the implementation of transformational adaptation actions that promote more systemic and long-term interventions;
- Expanding the technical and institutional capacities of the public and private sectors and of civil society to act on the adaptation agenda; and
- Consolidating a monitoring and evaluation system and improving it progressively;

In addition, the Technology Action Plans (TAP)[123] drawn up by the country under the Project: 'Technology Needs Assessment for the Implementation of Climate Actions Plans in Brazil (TNA_BRAZIL) estimated the need for an amount of approximately BRL 328 million, equivalent to around 65 million dollars. The costs are related to the prioritized actions related to: floating photovoltaic solar energy (BRL 2.8 million), hybrid *flex* vehicles (BRL 8.3 million), electric vehicles (battery-powered, fuel-powered, ethanol-powered) (BRL 25.5 million), use of agricultural and agro-industrial waste (BRL 4.2 million), photovoltaic solar stoves with induction (BRL 2.6 million), innovative materials for cement (BRL 5.9 million), industry 4.0 (BRL 15.1 million), precision agriculture (BRL 13.8 million), animal genetic improvement in beef cattle farming (BRL 9.4 million), silviculture and genetic improvement of native species (BRL 16.3 million), silviculture with mixed plantations for restoration (BRL 31.4 million), satellite monitoring (BRL 193 million).

5.4 Information on financial support received by developing country Parties under Article 9 of the Paris Agreement

The contribution of resources to Brazil in the 2020-2022 period totaled approximately USD 516 million. The information on the financial support received was gathered through the contribution of the General Coordination of Sustainable Finance, from the Ministry of Finance's Undersecretariat for Financing Sustainable Development.

123 Available at: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/publicacoes/tna_brazil

The data is available in Table 5.I.1 of Appendix 5.I, in the common tabular format established in accordance with Decision 5/CMA.3. The table shows Climate Investment Fund initiatives, amounting to USD 196 million, as well as resources received or planned from the Green Climate Fund (GCF) and the Global Environment Facility (GEF), which account for approximately USD 214 million and USD 106 million, respectively.

It should be noted that resources destined to the private sector and external resources received directly by sub-national entities are not included.

Compared to the provision of resources in the 2018-2019 period (USD 1.879 billion), reported in BUR4[124], there has been a 72% reduction in the financial support received by the country.

5.5 Information on technology development and transfer support needed by developing country Parties under Article 10 of the Paris Agreement

The Brazilian Government is currently working on updating the National Climate Change Plan (Climate Plan), which will have mitigation and adaptation axes, each with national strategies and sectoral plans, as well as specific targets and means of implementation to be defined. The details of the Climate Plan are presented in Chapters 1, 3 and 4 of this report. The process of drawing up the Climate Plan is ongoing and will be completed in 2025.

It is worth noting that the Technology Action Plans, developed on the basis of the prioritization carried out in the TNA_Brazil of sectors and technologies for achieving the NDC targets, point to the need to incorporate and develop technology for floating photovoltaic solar energy, for hybrid *flex* vehicles, for electric vehicles (battery-powered, fuel-powered, ethanol-powered), for the use of agricultural and agro-industrial waste, for photovoltaic solar stoves with induction, for innovative materials for cement, for precision agriculture, for animal genetic improvement in beef cattle farming, for silviculture and genetic improvement of native species, for silviculture with mixed plantations for restoration, as well as for satellite monitoring.

In addition, for the implementation of other mitigation and adaptation actions, the following can also be considered in terms of technology development and transfer: means of quantifying reductions in greenhouse gas emissions by production chain; fostering research and technological development; improving the emissions measurement, reporting and verification system; generating information through climate, GHG emission pathways and economic modeling; implementation of adaptation alternatives that do not increase the structural socio-economic inequalities existing in the country; incorporation of new sustainable infrastructure models; systematization of the monitoring and analyses of climate impacts and risks.

124 https://unfccc.int/documents/267661

5.6 Information on technology development and transfer support received by developing country Parties under Article 10 of the Paris Agreement

To date, there is no data available on the support received by the country for technology development and transfer. However, it should be noted that Brazil has carried out a meticulous process to identify technological needs for mitigation, the results of which are available in the TNA ('Technology Needs Assessment') Report, prepared in 2021.

It is expected that in subsequent Biennial Transparency Reports there will be consistent data on the support for technology development and transfer received for reporting.

5.7 Information on capacity-building support needed by developing country Parties under Article 11 of the Paris Agreement

As part of its efforts to comply with the climate transparency agenda, the Brazilian Government, in its previous process of preparation of Biennial Update Reports (BUR), recognized the need for capacity building to strengthen the institutional structure for preparing National Inventories, which allows them to be prepared biennially, with data collection and the application of higher Tier methodologies, especially for the Land Use, Land-Use Change and Forestry (LULUCF) and the Industrial Processes and Product Use (IPPU) sectors.

In addition, there are capacity-building needs related to:

- Training of experts in traceability and certification systems as part of the national measurement, reporting and verification (MRV) system;
- Support for the dissemination of knowledge;
- Support for digital interaction between data recording and knowledge management platforms from public bodies; and
- Technical training on the application of methodology, implementation of new technologies and respective infrastructures, and conduct of studies that will support actions to combat climate change.

Additionally, as provided for in Chapter 4 of this BTR, in accordance with the challenges and needs identified in the review of the National Adaptation Plan, the following aspects can be considered as capacity-building needs:

- Assessing and prioritizing climate risks systematically and periodically;
- Deepening the understanding on the differences between groups of vulnerable populations in studies of observed impacts, climate risks and others;

- Continuous improvement of the analyses of climate scenarios, using the main global models;
- Deepening the knowledge about the co-benefits and trade-offs between adaptation actions and between adaptation and mitigation actions;
- Including local and traditional knowledge in the identification of risks, impacts, vulnerabilities and adaptation actions;
- Quantifying the costs of adaptation and the costs of inaction;
- Developing studies related to the loss and damage agenda;
- Improving indicators for monitoring and evaluating actions, based on evidence;
- Systematizing information and conducting studies on the impacts of cross-border climate risks on the country's economy;
- Promoting alignment between the public and private sectors in order to expand funding sources for the implementation of adaptation;
- Expanding the implementation of transformational adaptation actions that promote more systemic and long-term interventions;
- Expanding the technical and institutional capacities of the public and private sectors and of civil society to act on the adaptation agenda;
- Incorporating the climate lens into the planning of all government sectors, using aspects related to climate change as a criterion for decision-making;
- Ensuring the sectoral integration of actions, in order to strengthen joint actions and the sharing of responsibilities for implementation, and finding fair and socially, environmentally and economically balanced solutions.
- Promoting coordination between Federal, State and Municipal entities for the efficient implementation of the PNMC, as well as joint learning to continuously improve the adaptation cycle in the country; and
- Promoting cultural changes in behavior by raising awareness among the population.

5.8 Information on capacity-building support received by developing country Parties under Article 11 of the Paris Agreement

The resources for the implementation of the project of the Fifth National Communication and Biennial Transparency Reports, financed by the Global Environment Facility (GEF), are, to some extent, directed towards capacity building and strengthening institutional arrangements to improve the country's Transparency actions. Generally speaking, all the activities and results expected from this project have a consistent relationship with the development of institutional arrangements and domestic capacity building. So that, through this project, it will be possible to provide improved inputs for the formulation, monitoring and implementation of climate

policies, as well as preparing the country to meet the technical requirements of the Paris Agreement's Enhanced Transparency Framework. The preparation of the National Communications and of the BTRs supports the national plan, as it presents the emission profile of the economic sectors and subsectors to be prioritized in the plan, with a view to reducing GHG emissions, as well as the vulnerable sectors and populations to be considered in the adaptation policies. In addition, institutional capacity is expected to be strengthened to incorporate gender mainstreaming through training for public officials directly involved with the project, stakeholders and Government focal points, identifying opportunities to include, expand or strengthen the topic of gender and climate change.

In addition, through training and webinars held by the UNFCCC, it was possible to improve the capacities of the government's and project's team for structuring and developing this first BTR. Some of these training courses were held online and others were held on-site, with the UNFCCC and UNDP covering the cost of tickets and per diems. Additional information is available in Table 5.I.2 of Appendix 5.I.

5.9 Information on support needed and received by developing country Parties for the implementation of Article 13 of the Paris Agreement and transparency-related activities, including for transparency-related capacity-building

The preparation of Brazil's first BTR was made possible by the financial support received from the Global Environment Facility (GEF). This support is important to ensure that the updating of the information provided, without which the data collection could be compromised.

The GEF's financial support for the preparation of the Biennial Transparency Reports (BTR), amounting to USD 1,725,000, was made possible through a joint project for the preparation of Brazil's Fifth National Communication. This project is executed by the Ministry of Science, Technology and Innovation (MCTI) and implemented in partnership with the United Nations Development Programme (UNDP). Through this project, it will be possible to develop the First, Second and Third BTRs.

It should be clarified that the resources for the preparation of this document are not restricted to those received from the GEF. The institutions involved have significant support and contributions from different bodies and a great deal of engagement from teams from other projects and from the Government itself.

The Brazilian Government has prepared this first BTR with a view to increasing the transparency of its information, demonstrating its commitment to contributing to the global exercise, in order to facilitate and accelerate the

understanding of the challenges and needs for combating climate change.

Furthermore, the support received from the UNFCCC and the Consultative Group of Experts (CGE), through the organization of training courses and workshops aimed at preparing the BTR and the training of experts for the international review of these reports, which contributed considerably to facilitating the preparation of this document, is acknowledged.

Additional information is available in Table 5.I.2 of Appendix 5.I.

Appendix 5.I

Information on financial support received

TABLE 5.I.1 | INFORMATION ON THE FINANCIAL SUPPORT RECEIVED BY DEVELOPING COUNTRY PARTIES UNDER ARTICLE 9 OF THE PARIS AGREEMENT[125]

Exchange Rate used: USD 1 = BRL 5

Climate-specific amount received										Climate-specific amount received					
Title of the activity, programme, project or other	**Programme/project description**	**Channel**	**Recipient entity**	**Implementing entity**	**Domestic currency (BRL)**	**USD**	**Implementation time frame**	**Financial instrument**	**Status**	**Type of support**	**Sector**	**Contribution to technology development and transfer objectives**	**Contribution to capacity-building objectives**	**Status**	**Additional information**
Global Subnational Climate Fund (SnCF Global) Global - Equity	Global SnCF catalyzes long-term sub-national climate investments, attracting mainly private capital for mitigation and adaptation solutions.	Green Climate Fund	Medium-sized projects	Pegasus Capital Advisors	17,857,142.86	3,571,428.57	15 years	Equity	UA	Mitigation	Cities, energy and forests	UA	UA	Ongoing	This is a global programme involving 42 countries. The amount for Brazil was estimated by dividing the amount of the programme equally between all the countries. The figures mentioned are for GCF funding only, not including co-funding
Global Subnational Climate Fund (Global SnCF) Global - Technical Assistance	Global SnCF catalyzes long-term sub-national climate investments, attracting mainly private capital for mitigation and adaptation solutions.	Green Climate Fund	Medium-sized projects	Pegasus Capital Advisors	2,202,380.95	440,476.19	7 years	Grant	UA	Mitigation	Cities, energy and forests	UA	UA	Ongoing	This is a global programme involving 42 countries. The amount for Brazil was estimated by dividing the amount of the programme equally between all the countries. The figures mentioned are for GCF funding only, not including co-funding

125 The reporting structure presented in this Table is consistent with Table III.7, Annex III of Decision 5/CMA.1

Climate-specific amount received										Climate-specific amount received					
Title of the activity, programme, project or other	**Programme/project description**	**Channel**	**Recipient entity**	**Implementing entity**	**Domestic currency (BRL)**	**USD**	**Implementation time frame**	**Financial instrument**	**Status**	**Type of support**	**Sector**	**Contribution to technology development and transfer objectives**	**Contribution to capacity-building objectives**	**Status**	**Additional information**
Planting Climate Resilience in Rural Communities of the Northeast (PCRP)	The project aims to increase the resilience of vulnerable farmers in northeastern Brazil.	Green Climate Fund	Women, young people and traditional communities	International Fund for Agricultural Development	497,500,000.00	99,500,000.00	8 years	Grant and Loan	UA	Cross-cutting	Cities, ecosystems, forests, health and water and communities	UA	UA	Ongoing	The project only includes Brazil. Figures only relate to GCF funding; there is also co-funding, which is not included in these figures.
Amazon Bioeconomy Fund	It seeks to reduce the impacts of climate change on the Amazon, prioritizing natural capital and climate benefits.	Green Climate Fund	UA	Inter-American Development Bank	232,500,000.00	46,500,000.00	7 years	Grant, Loan and Equity	UA	Cross-cutting	Ecosystems, forests and communities	UA	UA	Ongoing	This is a regional programme involving 6 countries. The amount for Brazil was estimated by dividing the amount of the programme equally between all the countries. The figures mentioned are for GCF funding only, not including co-funding
CRAFT - Catalytic Capital for First Private Investment Fund for Adaptation Technologies in Developing Countries	It is a private investment fund for climate adaptation, which mobilizes capital to scale up climate resilience technologies in developing countries.	Green Climate Fund	UA	Pegasus Capital Advisors	83,333,333.33	16,666,666.67	12 years	Equity	UA	Adaptation	Water and health, infrastructure and communities	UA	UA	Ongoing	This is a regional programme involving 6 countries. The amount for Brazil was estimated by dividing the amount of the programme equally between all the countries. The figures mentioned are for GCF funding only, not including co-funding

Climate-specific amount received											Climate-specific amount received				
Title of the activity, programme, project or other	**Programme/project description**	**Channel**	**Recipient entity**	**Implementing entity**	**Domestic currency (BRL)**	**USD**	**Implementation time frame**	**Financial instrument**	**Status**	**Type of support**	**Sector**	**Contribution to technology development and transfer objectives**	**Contribution to capacity-building objectives**	**Status**	**Additional information**
Coral Reefs	It is a Blue Economy Fund, which will create a private equity fund to protect coral reefs, encouraging sustainable investments in 17 countries.	Green Climate Fund	UA	Pegasus Capital Advisors	36,764,705.88	7,352,941.18	UA	Equity	UA	Adaptation	Ecosystems, water and health, infrastructure and communities	UA	UA	Ongoing	This is a global programme involving 17 countries. The amount for Brazil was estimated by dividing the amount of the programme equally between all the countries. The figures mentioned are for GCF funding only, not including co-funding
Climate Investor Two (CI2)	It is a fund that supports the private sector for the development of climate-resilient infrastructure in developing countries in the areas of water, sanitation and oceans.	Green Climate Fund	UA	FMO - Nederlandse Financierings--Maatschappij voor Ontwikkelingslanden	38,157,894.74	7,631,578.95	20 years	Reimbursable Grant	UA	Cross--cutting	Cities, ecosystems, energy, forests, health and water, and infrastructure	UA	UA	Ongoing	This is a global programme involving 19 countries. The amount for Brazil was estimated by dividing the amount of the programme equally between all the countries. The figures mentioned are for GCF funding only, not including co-funding
GGC	It provides guarantees for climate bonds with significant adaptation and mitigation impacts and mobilizes global funds for climate projects in developing countries, mitigating risks and facilitating access to international capital.	Green Climate Fund	UA	MUFG Bank, Ltd	25,312,500.00	5,062,500.00	10 years	Equity	UA	Cross--cutting	Cities, energy, health and water, infrastructure and transport	UA	UA	Ongoing	This is a global programme involving 8 countries. The amount for Brazil was estimated by dividing the amount of the programme equally between all the countries. The figures mentioned are for GCF funding only, not including co-funding

Climate-specific amount received												Climate-specific amount received			
Title of the activity, programme, project or other	**Programme/project description**	**Channel**	**Recipient entity**	**Implementing entity**	**Domestic currency (BRL)**	**USD**	**Implementation time frame**	**Financial instrument**	**Status**	**Type of support**	**Sector**	**Contribution to technology development and transfer objectives**	**Contribution to capacity-building objectives**	**Status**	**Additional information**
&Green Fund	&Green Fund promotes the sustainable production of commodities and greater agricultural productivity in countries with tropical forests, reducing the pressure for deforestation.	Green Climate Fund	UA	FMO - Nederlandse Financierings--Maatschappij voor Ontwikkelingslanden	86,068,181.82	17,213,636.36	3 years	Grant, Loan	UA	Adaptation	Ecosystems, water and health, forests, communities	UA	UA	Ongoing	This is a global programme involving 11 countries. The amount for Brazil was estimated by dividing the amount of the programme equally between all the countries. The figures mentioned are for GCF funding only, not including co-funding
Marajó Resiliente	It aims at increasing the resilience of small farming communities in the Marajó archipelago by promoting diversified agroforestry systems (DAS).	Green Climate Fund	UA	Fundación Avina	49,444,615.00	9,888,923.00	5 years	Grant	UA	Adaptation	Ecosystems, water and health, communities	UA	UA	Ongoing	The project only includes Brazil.
Promoting zero-emission buildings in Brazil through climate technologies and policies (EDinova)	The project aims to decarbonize Brazil's construction sector, promoting net-zero buildings through innovative technologies and public policies.	Global Environment Facility	UA	UN Environment Programme	505,750,000.00	101,150,000.00	4 years	Grant	UA	Cross--cutting	Cities	Yes	Yes	Planned	The project only includes Brazil.
Restoration of Wetlands and other important Amazonia Ecosystems - Capacity--building, innovation, development and technological transfer for ecological restoration and climate change mitigation	The project aims to restore wetland ecosystems in the Amazon, focusing on floodplains and mangroves, as a nature-based solution to mitigate climate change and preserve biodiversity.	Global Environment Facility	UA	FAO Food and Agriculture Organization of the United Nations	27,375,000.00	5,475,000.00	4 years	Grant	UA	Cross--cutting	Forests	Yes	Yes	Planned	The project only includes Brazil.

Climate-specific amount received											Climate-specific amount received				
Title of the activity, programme, project or other	**Programme/project description**	**Channel**	**Recipient entity**	**Implementing entity**	**Domestic currency (BRL)**	**USD**	**Implementation time frame**	**Financial instrument**	**Status**	**Type of support**	**Sector**	**Contribution to technology development and transfer objectives**	**Contribution to capacity-building objectives**	**Status**	**Additional information**
Forest Investment Program (FIP)	FIP enables developing countries to manage their natural resources in a way that achieves the triple win of being good for forests, good for development and good for the climate. The program aims to reverse the impacts of human actions and climate change on our forest ecosystems.	Climate Investment Funds	UA	IBRD - International Bank for Reconstruction and Development; IADB - Interamerican Development Bank; IFC - International Finance Corporation	633,500,000.00	126,700,000.00	UA	Concessional loan and grant	UA	Cross-cutting	Forests	UA	UA	Ongoing	The program is divided into 8 projects, with different budgets, schedules and recipients.
Renewable Energy Integration Program (REI)	The program works through national and regional investment plans that address the technical, political and market barriers that prevent greater penetration of renewable energies into the grid. It promotes specific investments in enabling technologies, infrastructures or business models that can demonstrate the benefits of such an approach in developing countries. In addition, a dedicated private sector window can allow investments in countries or regions where the regulatory framework and market structure support direct investments in flexibility and innovations.	Climate Investment Funds	UA	BNB - Banco do Nordeste do Brasil	350,000,000.00	70,000,000.00	7 years	Concessional loan and grant	UA	Mitigation	Energy	UA	UA	Ongoing	

Notations: NA = Not applicable; UA = Information not available at the time of reporting.

Source: Brazil's First Biennial Transparency Report, 2024.

TABLE 5.I.2 | INFORMATION ON THE SUPPORT RECEIVED BY DEVELOPING COUNTRY PARTIES FOR THE IMPLEMENTATION OF ARTICLE 13 OF THE PARIS AGREEMENT AND TRANSPARENCY-RELATED ACTIVITIES, INCLUDING FOR TRANSPARENCY-RELATED CAPACITY BUILDING[126]

Exchange Rate used: USD 1 = BRL 5

					Amount				
Title of the activity, programme, project or other	**Objectives and description**	**Time frame**	**Channel (multilateral, bilateral, regional, other - specify)**	**Recipient entity**	**Domestic currency (BRL)**	**USD**	**Status of activity (planned, ongoing, completed)**	**Use, impact and estimated results**	**Additional information**
Fifth National Communication, Biennial Update Report and Biennial Transparency Reports to the United Nations Framework Convention on Climate Change (UNFCCC) - BRA/23/G31 (PIMS 6835) - 5NC	Enabling Activity Project to help Brazil prepare its Fifth National Communication (5NC) and the Biennial Transparency Reports (BTR) required to fulfill its obligations under the UNFCCC Transparency Agenda.	2023-2029	Multilateral Global Environment Facility (GEF)	Ministry of Science, Technology and Innovation (MCTI)	37,500,000.00	7,500,000.00	Ongoing	Through this project, it will be possible to expand the coverage of the National GHG Inventory, with a focus on sectors/gases that have a significant share of GHG emissions and/or have a large degree of data uncertainty. In addition, the assessment of climate scenarios and observed trends for Brazil will be improved using advanced and updated climate models to refine vulnerability analysis and identify adaptation measures for key sectors. This project will also help to develop and compile information associated with the implementation of mitigation actions in the country. The description of Brazil's national circumstances will be updated, as well as the measures to be taken or the measures planned to implement the Convention. In addition, it is expected that this project will enable the country to include gender mainstreaming in the planning and implementation of climate mitigation policies and measures. Lastly, the project will contribute to increasing institutional capacity for the implementation of the Convention in Brazil, including carrying out activities related to education and raising awareness about climate change.	

126 The reporting structure presented in this Table is consistent with Table III.13, Annex III of Decision 5/CMA.1

Title of the activity, programme, project or other	Objectives and description	Time frame	Amount: Channel (multilateral, bilateral, regional, other - specify)	Amount: Recipient entity	Amount: Domestic currency (BRL)	Amount: USD	Status of activity (planned, ongoing, completed)	Use, impact and estimated results	Additional information
Webinar on "Uncertainty Analysis in National Greenhouse Gas Inventories from Developing Countries"	Capacity building for the GHG Inventory team on uncertainty analysis.	2024	UNFCCC	Ministry of Science, Technology and Innovation (MCTI)	NA	NA	Completed	Development of capacity for the preparation of Brazil's National GHG Inventory.	Remote training.
Training program for technical experts participating in the technical expert review of biennial transparency reports	Capacity building for experts to review the BTR under the UNFCCC Transparency Agenda.	2024	UNFCCC	Ministry of Science, Technology and Innovation (MCTI)	NA	NA	Completed	Development of capacity for the preparation of Brazil's first BTR and future contribution of national experts to the review process of other countries' BTRs.	Remote training.
Training workshop on the role of Biennial Transparency Reports in confidence and capacity building	The purpose of this workshop was to share guidelines for the submission of the first BTRs by December 31, 2024.	2024	UNFCCC/UNPD	Ministry of Science, Technology and Innovation (MCTI)	NA	NA	Completed	Development of capacity to prepare Brazil's first BTR.	Support received to pay for tickets and per diems.
Taller virtual sobre el MEL en el marco de la adaptación	Capacity building on monitoring, evaluation and learning in the context of adaptation. Developing the technical capacities of the countries of the Spanish-speaking Latin American and Caribbean Climate Transparency Network for the implementation of monitoring, evaluation and learning (MEL) systems within the cyclical adaptation process. In addition, the workshop aims to create a space for dialogue and learning to exchange good practices and lessons learned between the countries.	2024	Climate Transparency Platform - CBIT-GSP, UNEP-CCC, UNEP	Ministry of Science, Technology and Innovation (MCTI)	NA	NA	Completed	Development of capacity to prepare Brazil's first BTR.	Remote training. https://climate-transparency-platform.org/events/taller-virtual-sobre-el-seguimiento-evaluacion-y-aprendizaje-en-el-marco-de-la-adaptacion

Title of the activity, programme, project or other	Objectives and description	Time frame	Channel (multilateral, bilateral, regional, other - specify)	Recipient entity	Amount: Domestic currency (BRL)	Amount: USD	Status of activity (planned, ongoing, completed)	Use, impact and estimated results	Additional information
CGE Hands-on Training Workshops for Latin-America and Caribbean region "Preparation of the Biennial Transparency Reports"	Capacity building for preparing the BTR under the UNFCCC Transparency Agenda.	2024	CGE-UNFCCC	Ministry of Science, Technology and Innovation (MCTI)	NA	NA	Completed	Development of capacity to prepare Brazil's first BTR.	Support received to pay for tickets and per diems. https://unfccc.int/event/cge-hands-on-training-workshops-for-latin-america-and-caribbean-region-preparation-of-the-biennial
DataClima+	Strengthening the national transparency framework in Brazil (DataClima+) to support the formulation of national policies and meet the requirements of the Enhanced Transparency Framework (ETF) under the Paris Agreement.	2023	Multilateral - Global Environment Facility (GEF)	Ministry of Science, Technology and Innovation (MCTI)	19,178,080.00	3,835,616.00	Being implemented		https://www.thegef.org/projects-operations/projects/10932

Notations: NA = Not applicable; UA = Information not available at the time of reporting.

Source: Brazil's First Biennial Transparency Report, 2024.

FIRST
BIENNIAL TRANSPARENCY REPORT
OF BRAZIL

TO THE UNITED NATIONS
FRAMEWORK CONVENTION
ON CLIMATE CHANGE

chapter 6

INFORMATION ON FLEXIBILITIES

With a view to promoting universal participation, the ETF and its MPGs include an inherent flexibility that takes into account the different capacities of the Parties and is based on the collective experience of developed and developing countries. The MPGs specify the flexibility provisions available to Parties that are developing countries and that need it, in light of their capacities, as provided for in Article 13, paragraph 2.

The application of the flexibility provided for in the provisions of the MPGs for Parties that are developing countries must be self-determined, i.e., the country will determine when the flexibility can be applied in light of its capacity constraint(s) and always in relation to a specific reporting requirement to which such flexibility can be applied.

In doing so, developing countries should clearly indicate the provision to which flexibility is applied, concisely explain the capacity constraints, noting that some constraints may be relevant to several provisions, and provide estimated and self-determined timeframes for improvements in relation to these capacity constraints.

Therefore, the flexibility provision under the Paris Agreement is essential to ensure the effective participation of all countries, taking into account their different circumstances and capacities. These provisions allow developing countries to adapt their commitments to their realities, ensuring progress in a sustainable and equitable way, while receiving the international support needed to strengthen their capacities over time.

Dataframes 6.1 and 6.2 present a general overview of the flexibility provisions of the MPGs for preparing the GHG inventory and tracking the progress of the NDC, respectively. In addition, an assessment is made as to whether or not Brazil has used these provisions, in light of its national capacities.

DATAFRAME 6.1 | FLEXIBILITY PROVISION USED BY BRAZIL TO PREPARE THE NATIONAL INVENTORY

MPG Reference (Annex to Decision 18/ CMA.1)	MPGs Provisions	Indication of the flexibility provision used by Brazil, in light of its capacities
Paragraph 25 Key category analysis	Parties should implement the key category analysis consistently with the IPCC guidelines (i.e., apply the 95% threshold defined in the IPCC Guidelines).	**Flexibility not used by the country.** The 95% threshold was used to identify the categories, in accordance with the IPCC Guidelines.
Paragraph 29 Assessment of uncertainty	Parties should quantitatively estimate and qualitatively discuss the uncertainty of emission and removal estimates for all categories, including the inventory totals, for at least the first and the last reporting year of the inventory time series, and should also estimate the trend uncertainty for these same categories/ inventory totals for the entire time series.	**Flexibility not used by the country.** Brazil estimated the uncertainties of the Inventory for all categories for the first year (1990) and for the last year of the time series (2022).
Paragraph 32 Use of the acronym "NE" (Not estimated)	A category should only be considered insignificant if the likely level of emissions is less than 0.05% of total national greenhouse gas emissions, excluding LULUCF, or 500 kt of CO_2 equivalent, whichever is lower. The aggregate national total of estimated emissions for all gases in categories considered insignificant must remain below 0.1% of the total national GHG emissions, excluding LULUCF.	**Flexibility not used by the country.** Brazil did not use the flexibility for the non-estimation of categories considered to be insignificant. Emissions were estimated and accounted for in the inventory for all the categories for which there were available data, without considering their degree of significance. For all the categories indicated by the country as not estimated, according to Section 2.7, Brazil will make efforts to improve the estimates in subsequent inventories.
Paragraph 34 Quality assurance / Quality control	Parties must prepare an inventory quality assurance and quality control plan in accordance with IPCC guidelines, including information on the inventory agency responsible for implementing these controls.	**Flexibility not used by the country.** Brazil has an inventory quality assurance and quality control plan. The Ministry of Science, Technology and Innovation (MCTI) is responsible for implementing this plan.
Paragraph 35 Quality assurance / Quality control	Parties should implement and provide information on general inventory quality control procedures in accordance with the quality assurance/quality control plan and the IPCC Guidelines.	**Flexibility not used by the country.** Brazil implements the inventory quality assurance and quality control plan.
Paragraph 48 Gases	The Parties should report seven gases: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3.	**Flexibility used by the country.** All the gases included in Brazil's NDC were reported, in accordance with Article 4 of the Paris Agreement. However, emissions of NF_3 were not estimated due to the lack of activity data because of the incipiency of the production activity in the country. The action plan includes liaising with the institutions responsible for the sources that emit NF_3, with the aim of collecting the necessary data over the next two years. This data will, then, be analyzed and the results presented in 2028.
Paragraph 57 Time series	Parties should report a consistent annual time series beginning in 1990.	**Flexibility not used by the country.** The annual time series begins in 1990.
Paragraph 58 Reporting year	The last reporting year should not be more than two years before the submission of the national inventory report.	**Flexibility not used by the country.** The last reporting year (2022) is not more than two years before the submission of the report (2024).

Source: Brazil's First Biennial Transparency Report, 2024.

DATAFRAME 6.2 | FLEXIBILITY PROVISION USED BY BRAZIL WITH REGARD TO TRACKING OF NDC PROGRESS

MPG Reference (Annex to Decision 18/ CMA.1)	MPGs Provisions	Indication of the flexibility provision used by Brazil, in light of its capacities
Paragraph 85 GHG emission reductions expected and achieved for the PAMs.	Parties should provide, to the extent possible, estimates of the GHG emission reductions expected and achieved by their actions, policies and measures (PAMs)	**Flexibility used by the country.** Brazil reported the mitigation policies and measures, actions and plans related to the implementation and achievement of the NDC in Chapter 3, section 3.4. However, it only reports the estimated emission reductions expected for the policy described in item 3.4.3, and the estimated emission reductions achieved for the policy described in item 3.4.6. Indications of capacity constraints, ongoing measures and the timeframe for implementing the necessary improvements are described in sections 3.4.1 to 3.4.7 of Chapter 3.
Paragraph 92 Projections of GHG emissions and removals	Each Party shall communicate the projections pursuant to paragraphs 93-101 of the MPGs	**Flexibility used by the country.** Until the approval stage of this BTR1, the Brazilian Government was in the process of analyzing and validating the results of the GHG emissions projections. The duly completed and validated projections will be submitted in BTR2.
Paragraph 95 Extension of projections	Projections should start in the most recent year of the Party's national inventory report and extend to, at least, 15 years beyond the following year ending in zero or five.	**Flexibility used by the country.** Until the approval stage of this BTR1, the Brazilian Government was in the process of analyzing and validating the results of the GHG emissions projections. The duly completed and validated projections will be submitted in BTR2.
Paragraph 102 Methodology or scope of projections	Parties that are developing countries and require flexibility can submit reports using a less detailed methodology or coverage.	**Flexibility used by the country.** Until the approval stage of this BTR1, the Brazilian Government was in the process of analyzing and validating the results of the GHG emissions projections. The duly completed and validated projections will be submitted in BTR2.

Source: Brazil's First Biennial Transparency Report, 2024.

FIRST **BIENNIAL TRANSPARENCY REPORT** OF BRAZIL

TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

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