BRASIL NORDESTE ECOLOGICAL TRANSFORMATION PLAN

OPEN SOCIETY FOUNDATIONS

MINISTÉRIO DA FAZENDA

GOVERNO DO BRASIL
DO LADO DO POVO BRASILEIRO

Brasil NORDESTE

CONSÓRCIO NORDESTE
O BRASIL QUE CRESCE UNIDO

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Support
Ministry of Finance
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International Council for Local Environmental Initiatives (ICLEI) — Local Governments for Sustainability

Graphic Design and Layout
Samantha Alves - Sagarana Digital

English Translation
Tamiris Volcean - Sagarana Digital

Proofreading
Laura Santos - Sagarana Digital

For the Northeast Interstate Consortium for Sustainable Development

Website: https://www.consorcionordeste.gov.br

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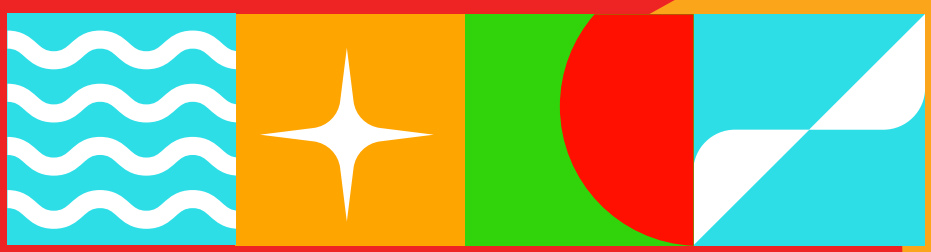
EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

➡ The Brazilian Northeast brings together natural, cultural, and productive potential that positions it as a key player in the country's ecological transformation. With one of the most renewable energy matrices in the world, rich biological and sociocultural diversity, and strong territorial vocations, the region has unique conditions to lead a regenerative, inclusive, and low-carbon development model. The Brasil Nordeste Ecological Transformation Plan (PTE-NE)[1] consolidates this vision by integrating public policies, innovation, sustainable finance, and climate justice, guiding the ecological transition based on regional vocations and the valorization of local knowledge and assets.

➡ The construction of the PTE-NE was carried out between March and October

1. The title Brasil Nordeste Ecological Transformation Plan has been rendered by maintaining the proper name *Brasil Nordeste* in Portuguese. This decision reflects standard international practice for institutionally consolidated programme names, as applied to instruments such as *Bolsa Família, Fome Zero*, and Novo PAC, where the original denomination is preserved to protect the institutional identity of the instrument. The acronym PTE-NE, derived from the Portuguese *Plano de Transformação Ecológica do Nordeste*, has equally been retained throughout the document as the primary technical identifier, as it circulates in this form across all official and intergovernmental documentation. Where context requires disambiguation for readers unfamiliar with the Brazilian institutional landscape, the full descriptive translation, Brasil Nordeste Ecological Transformation Plan, is used on first occurrence in each major section.

2025, coordinated by the *Consórcio Nordeste*[2] in partnership with the Ministry of Finance *(Ministério da Fazenda)*, the Organization of Ibero-American States *(Organização dos Estados Ibero-americanos - OEI)*[3], and the Open Society Foundations. The methodological process combined technical research, social listening, and interinstitutional cooperation, ensuring the legitimacy and robustness of the proposals. The stages involved **territorial diagnostics, comparative studies, participatory workshops in the nine states, and regional political coordination**, resulting in a document that adapts the six strategic pillars of the National Ecological Transformation Plan *(Novo Brasil - Plano de Transformação Ecológica)* to the Northeast context.

➡ The document is structured into complementary sections that articulate strategic vision, recommendation, and organizational guidelines for the implementation of actions. It then details the proposals organized by axis — Sustainable and Inclusive Finance; Technological Densification; Bioeconomy and Adapted Agri-food Systems; Energy Transition; Circular and Solidarity Economy; and New Green-Blue Infrastructure and Climate Adaptation — each with its own challenges, opportunities, priority activities, and specific vision.

AXIS 1
Sustainable and Inclusive Finance proposes to structure a financial and governance framework to accelerate the ecological transition in the Northeast, aligning public and private capital flows, with legal certainty and socioeconomic inclusion. The main proposals recommend the creation of the Northeast Sustainable Finance Fund (*Fundo Nordeste de Finanças Sustentáveis - FNFS*) and the Northeast Climate Investment Platform *(Plataforma Nordeste de Investimento Climático - NIC)*, which will work to standardize criteria, enable co-investment, and attract both national and international investors.

2. The *Consórcio Nordeste*, formally, the Northeast Interstate Consortium for Sustainable Development *(Consórcio Interestadual de Desenvolvimento Sustentável do Nordeste)*, has been retained in Portuguese throughout this document. Although an English rendering exists (Northeast Consortium), the Portuguese denomination functions as an institutional proper name with consolidated identity in intergovernmental and international documentation.

3. The Organisation of Ibero-American States for Education, Science and Culture, known by its Spanish and Portuguese acronym OEI *(Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura / Organização dos Estados Ibero-Americanos para a Educação, a Ciência e a Cultura),* has been rendered using its official English denomination, as adopted by the organisation itself in its international communications. The acronym OEI has been retained throughout the document, as it is the identifier used across all official languages, including English, in the organisation's own publications and institutional documentation. The Portuguese form *Organização dos Estados Ibero-americanos* appears in parentheses on first occurrence in the body text solely to facilitate cross-referencing with the Portuguese original of the PTE-NE.

AXIS 2

Technological Densification aims to strategically position the Northeast within the global economy of Industry 4.0 and low-carbon emissions. The proposals are related to decentralized technological densification, strengthening local economies, and valuing communities from the coast to the *sertão*[4]. Increasing regional competitiveness and productivity through technological innovation and higher value-added products, as well as ensuring qualified and well-paid jobs for the region's population, are central goals of the proposal.

AXIS 3

Bioeconomy and Adapted Agri-food Systems proposes to transform the Northeast into a hub of sustainable prosperity, leveraging the socio-biodiversity of the Caatinga and other Northeastern biomes as an economic asset. This axis aims to integrate the production of healthy food, community-based tourism, and sustainable forest management, highlighting the productive inclusion of family farming, the production of bioactives and bio-inputs from biodiversity, and the strengthening of the established network of cooperatives and social movements organized around agroecology and the popular and solidarity economy.

AXIS 4

Energy Transition proposes to consolidate the region as a national and international leader in renewable, fair, and inclusive energy generation, articulating solar, wind, biomass, and low-carbon hydrogen sources within an integrated sustainable development model. The strategy aims to strengthen local productive chains; drive green industrialization through powershoring; and ensure that the benefits of the energy transition reach the population, converting the region's energy advantage into industrial competitiveness and quality employment.

AXIS 5

Circular and Solidarity Economy seeks to create a regenerative productive model, integrating technological innovation, social inclusion, and environmental conservation in the Brazilian Northeast. The intention is to strengthen cooperatives and Local Productive Arrangements linked to reverse logistics, transforming the Northeast's waste infrastructure into an inclusive and competitive productive chain. Among the main proposals are the establishment of reuse and recycling hubs; the use of biodigesters and bio-inputs; decentralized renewable energy production; and the development of social technologies geared toward waste management and agroecology.

4. The term *sertão* has been retained in Portuguese throughout this document. Although approximate English renderings exist, most commonly hinterland, backcountry, or semi-arid interior, none captures the full semantic, cultural, and political weight of the original. *Sertão* designates not merely a geographic region (the semi-arid interior of the Brazilian Northeast) but a historical, literary, and identitary category: a territory with its own ecology, memory, and modes of life, shaped by centuries of coexistence with drought, scarcity, and resilience. The concept is inseparable from the social movements, traditional communities, and territorial policies that the PTE-NE seeks to address, including the *convivência com o semiárido* (coexistence with the semi-arid environment) paradigm that runs throughout the Plan. Translating *sertão* as hinterland would reduce it to a spatial qualifier, effacing the depth of meaning that makes it an irreducible concept in Brazilian culture and in the political vocabulary of the Northeast.

AXIS 6

New Green-Blue Infrastructure and Climate Adaptation proposes the integration between the *Caatinga* and the Blue Amazon, an essential objective to promote a low-carbon economy with higher added value, quality of life, and climate resilience. This transition is enabled by the combination of traditional infrastructure with Nature-Based Solutions (NbS), encompassing resilient water and sanitation systems, soil restoration, sustainable mobility, ecological corridors, disaster monitoring, agro-pastoral integration, protection of intangible heritage, and intersectional approaches.

The implementation of the PTE-NE will be carried out under cooperative and multi-scalar governance, which ensures political, technical, and social integration and allows the proposals of the Plan's axes to be applied transversally across territories through concrete projects. In this regard, the Consórcio Nordeste will serve as a platform for monitoring, coordination, and resource mobilization, articulating financing mechanisms. In doing so, the PTE-NE consolidates an innovative and collaborative governance model, oriented toward concrete and sustainable results, capable of transforming federative cooperation into a driver of ecological and inclusive development.

PROLOGUE

PROLOGUE

The Brazilian Northeast stands at the threshold of becoming the engine of sustainable development in Brazil, for it brings together a singular combination of potentialities: abundant renewable energy — home to the country's largest installed capacity in solar and wind power, alongside enormous potential in green hydrogen and biomass; a rich sociocultural heritage and wealth of traditional knowledge, capable of guiding innovative and regenerative solutions, while fostering community practices of coexistence with the semi-arid[5] environment[6] and the balanced stewardship of ecosystems. The region also harbors exceptional biodiversity, with particular distinction belonging to the Caatinga — a biome found exclusively in Brazil and responsible for more than 50% of the country's carbon capture and storage — as well as coastal and marine socio-biodiversity, that provide the foundation for bioeconomy productive chains and the export of socio-environmental technologies.

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5. The *semiárido* designates a specific climatic and ecological zone covering approximately one million square kilometres across nine Northeastern states and northern Minas Gerais, characterized by irregular rainfall, prolonged dry seasons, and high evapotranspiration rates. It is home to the Caatinga biome, the only biome found exclusively within Brazilian territory, and to more than 28 million people, many of whom belong to traditional communities, indigenous peoples, and family farming households whose livelihoods depend on sustainable management of the region's natural resources.

6. *Coexistence with the semi-arid environment* translates the Brazilian concept of *convivência com o semiárido*, a political, epistemological, and pedagogical paradigm developed by civil society organizations, social movements, and research institutions in the Brazilian Northeast, most notably the Brazilian Semi-arid Articulation *(Articulação Semiárido Brasileiro - ASA)*. The paradigm represents a deliberate departure from the historic framing of the semi-arid region as a problem to be solved, through large-scale hydraulic works, population relocation, or agricultural modernization, toward an affirmative understanding of the semi-arid as a territory with its own ecological logic, cultural wealth, and productive potential. *Convivência,* literally "living with" or "coexistence", implies adaptation, respect, and reciprocity rather than conquest or domination.

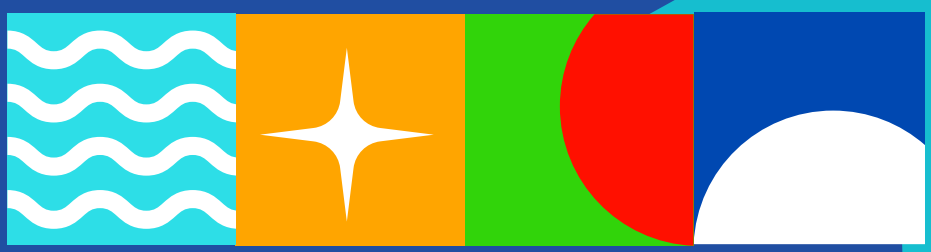
These are among the elements driving the formulation of the *Brasil Nordeste* Strategy, a fundamental guiding instrument for the territorialization of the Ecological Transformation Plan developed by the Ministry of Finance and launched in 2023. This represents a coordinated effort among the Northeastern states to implement a new development paradigm that integrates neo-industrialization, sustainability, and social justice, in collaboration with civil society organizations, social movements, universities, traditional communities, indigenous peoples, and all those committed to the ecological transformation of the Northeast.

The Plan presented in these pages was built by many hands, through listening processes held across all states, in an effort to capture the diverse range of perspectives on opportunities, challenges, ambitions, and proposals for ecological transformation across the six axes around which the Plan is organized. This methodological choice is deliberate: the Plan also aspires to strengthen interstate dialogue, cooperation, and coordination. The responsibility for leading the construction process therefore fell to the *Consórcio Nordeste*.

It is now this same Consortium that has the honor of presenting the first *Brasil Nordeste* Ecological Transformation Plan, which aims to support and provide the foundations for building a more sustainable, resilient, just, and prosperous future. To the men and women of the Northeast, we reaffirm with confidence: the Northeast will be the protagonist of our country's ecological transformation.

WE INVITE YOU TO READ ON.

OVERVIEW

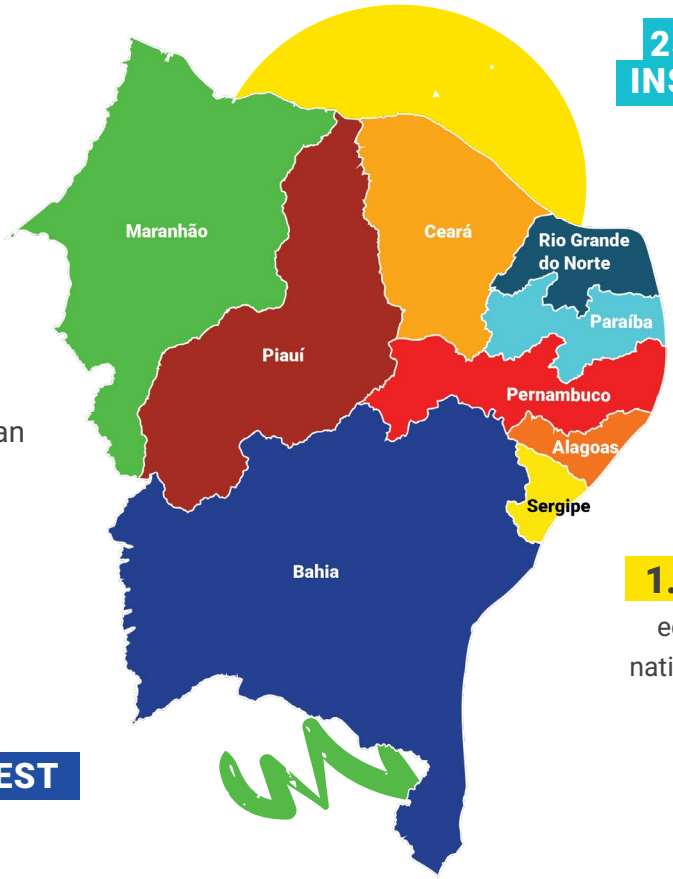


OVERVIEW

1/3 OF ALL TRADITIONAL COMMUNITIES
in Brazil live in the Northeast
(Census 2022)

54.6 MILLION INHABITANTS,
representing **26.9%** of the Brazilian population
(IBGE, 2022)

Encompasses four biomes:
CAATINGA, CERRADO, AMAZON, AND ATLANTIC FOREST



25.8% OF BRAZIL'S INSTALLED ENERGY MATRIX
91% of wind energy capacity and **63%** of solar capacity
(ANEEL)

Covers
9 BRAZILIAN STATES

1.55 MILLION KM²,
equivalent to 18.2% of the national territory and 40% of the coastal territory
(IBGE, 2024)

The Brazilian Northeast brings together a singular combination of natural, cultural, and productive potential that, when strategically leveraged , can position the region as the leading force in Brazil's ecological transformation. Endowed with unique environmental diversity, the region is home to three strategically significant biomes: the Caatinga, a historical space of agricultural production and a source of income for family farmers and traditional communities; the Cerrado, whose headwaters feed a substantial share of Brazil's river basins, which are fundamental to the agricultural sector; and the Atlantic Forest, a biodiversity hotspot and a living and productive space for traditional communities and indigenous peoples. This wealth is further enriched by other distinctive features — among them the fact that the Caatinga is the only biome found exclusively within Brazilian territory, covering 10% of the national landmass, and that the Northeast holds the country's longest coastline, with rich and endemic diversity. The region also benefits from exceptional opportunities, including outstanding renewable energy production and sustainable agriculture.

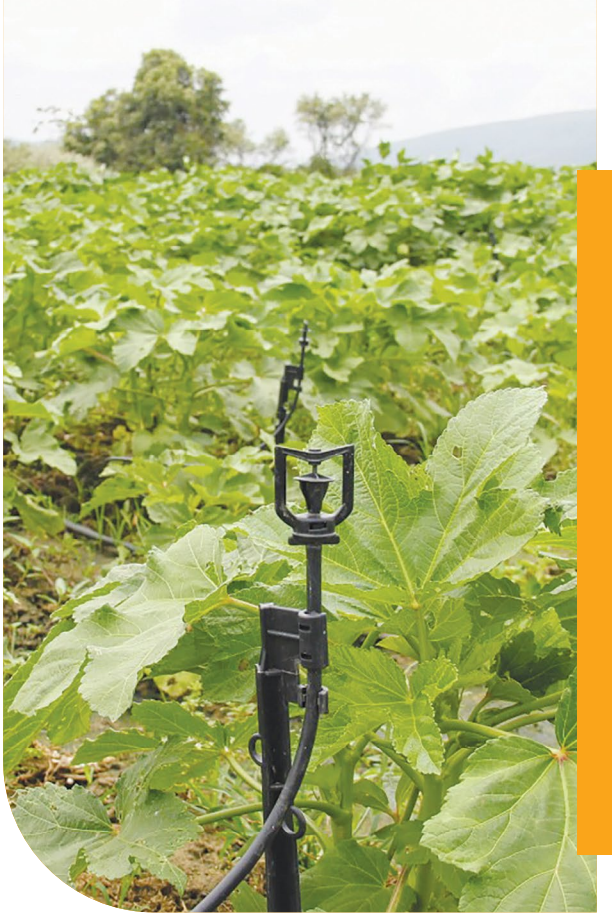
At the same time, the region navigates a complex landscape — from the socioeconomic, political, and institutional standpoints — when it comes to advancing ecological transformation. Among the most significant obstacles are the fragmentation of environmental data and information; the scarcity of stable, long-term financing; and the difficulty in translating robust legal and regulatory frameworks into concrete, far-reaching actions that effectively reach the base of society. These factors limit the capacity to measure the impact of policies and hinder the execution of sustainable projects, particularly in the most vulnerable territories of the semi-arid interior and coastal areas, thereby exacerbating persistent inequalities and compounding broader social challenges.

These longstanding vulnerabilities have been intensified by the effects of climate change, which disproportionately affect the most fragile territories and populations. Water insecurity, desertification, and rising sea levels place mounting pressure on the management of natural resources; raise the cost of living; undermine tourism; and aggravate poverty and forced migration.

Despite these challenges, the Northeast emerges as a strategic territory to lead the ecological transition and sustainable development. As noted, the region possesses a robust and diversified renewable energy matrix, with particular strength in solar, wind, and hydroelectric energy and green hydrogen, alongside significant potential in bioeconomy and sustainable agriculture adapted to local conditions. The region's sociocultural wealth and the traditional knowledge of local communities offer a distinctive competitive advantage, enabling innovative and regenerative solutions that respect ecosystems and promote community practices of sustainable coexistence with the semi-arid environment. Also noteworthy is the growing coordination among governments, academia, the private sector, and organized civil society, which strengthens the capacity for planning, implementation, and monitoring actions, driving the region toward a more sustainable and equitable future.

Within this context, the *Brasil Nordeste* Strategy builds upon and draws from state and federal initiatives to enhance the foundations of regional development in a sustainable and inclusive manner, advancing climate justice, environmental security, and productive opportunities anchored in the territorial vocations of the Northeast.

The formulation of the ***Brasil Nordeste* Plan**, as a component of the Strategy, thus stems from the recognition that ecological transformation must be guided by principles of equity, climate justice, participation, and the strengthening of regional institutional capacities, articulating development policies with structural measures for climate mitigation and adaptation.



Accordingly, the PTE-NE is organized around the same logic of six structural axes as the National Ecological Transformation Plan, with targeted adjustments in nomenclature. These are: **Sustainable and Inclusive Finance; Technological Densification; Bioeconomy and Adapted Agri-food Systems; Energy Transition; Circular and Solidarity Economy; and, finally, New Green-Blue Infrastructure and Climate Adaptation in the Northeast**. These axes reflect both the need to conceive and deliver integrated solutions and the regional vocation for generating sustainable economic opportunities, drawing on natural resources, human capital, and technological innovation.

Among the guiding principles that orient the formulation and implementation of the PTE-NE, the following stand out:

➞ **Sustainability and resilience** to ensure socioeconomic development that respects ecological limits and promotes the conservation and restoration of strategic biomes, such as the Caatinga;

➞ **Inclusion and climate justice,** guaranteeing the effective participation of traditional communities, indigenous peoples, and *quilombola*[7] communities[8], while seeking to integrate traditional knowledge and local expertise into the formulation, implementation, and monitoring of policies and projects, with a focus on social and gender equity;

7. The term *quilombola* has been retained in Portuguese throughout this document. It designates individuals and communities descended from *quilombos*, settlements historically formed by enslaved Africans who escaped captivity in Brazil, dating from the colonial period. The most celebrated example is the *Quilombo dos Palmares*, which resisted colonial forces for nearly a century in what is today the state of Alagoas. Over time, *quilombos* evolved into diverse forms of community organization, and today *quilombola* identity encompasses a broad range of Afro-Brazilian rural and semi-urban communities with distinct territorial, cultural, and spiritual practices.

8. In the contemporary Brazilian legal framework, *quilombola* communities hold constitutionally guaranteed rights to the permanent ownership of their ancestral lands (Article 68 of the 1988 Federal Constitution), recognition of their cultural heritage, and access to specific public policies, including the *Programa Brasil Quilombola* and targeted lines within Pronaf and the PAA. The term carries legal, political, and identitary weight that no English equivalent can fully render. "Maroon communities", used in some Caribbean and Latin American contexts to designate communities of escaped enslaved people, is the closest historical parallel, but its geographic and cultural associations differ significantly from the Brazilian *quilombola* experience and would risk misrepresenting a highly specific and legally recognized category.

➞ **Innovation and applied science,** integrating technical and scientific knowledge, research, and technological development to define adaptive and scalable solutions;

➞ **Collaborative governance and regional integration** aimed at promoting coordination among public entities, the private sector, universities, social movements, and organized civil society;

➞ **Territorial transformation and socio-environmental integration,** aligning green and blue infrastructure; sustainable urban and rural planning; restoration of degraded areas; and support for the circular economy and bioeconomy.

The PTE-NE thus represents more than a planning instrument: it is a **declaration of identity and commitment on the part of the region.** It consolidates the vision of the Northeast as a territory capable of leading Brazil's ecological transition, drawing on its natural, cultural, and productive wealth to generate shared prosperity, technological innovation, social inclusion, and environmental sustainability.

It reflects the region's transformative potential to articulate public policies, strategic investments, and social mobilization, with the aim of building a resilient, sustainable, and just Northeast, prepared to face the climate and socioeconomic challenges of the twenty-first century, and to drive Brazil toward a new economy that is sustainable, competitive, and rich in social and environmental value.

METHODOLOGY

METHODOLOGY

The construction of the PTE-NE was a process that demanded methodological rigor, broad social participation, and multi-sectoral political coordination. The Plan's primary objective is to territorialize and deepen, within the Northeastern context, the National Ecological Transformation Plan (PTE), launched in 2023 by the Ministry of Finance in cross-cutting partnership with other ministries. The National PTE proposes a new development paradigm for Brazil, structured around three fundamental pillars: neo-industrialization; social justice with income redistribution; and environmental sustainability.

The six strategic axes of the *Brasil Nordeste* Plan — **Sustainable and Inclusive Finance; Bioeconomy and Adapted Agri-food Systems; Energy Transition; Technological Densification; Circular and Solidarity Economy; and New Green-Blue Infrastructure and Climate Adaptation** — were adapted from the National PTE and reinterpreted in light of regional debates, territorial specificities, and the challenges and potentialities of the Northeast. This adaptation is the essence of the PTE-NE, which is born with the ambition of positioning the region as the driving force of the country's new cycle of sustainable development.

To this end, the methodology adopted in the construction of the PTE-NE was structured around five major stages.

4.1 RESEARCH AND DATA: TERRITORIAL DIAGNOSIS AND STRUCTURAL ANALYSIS

The process began with an extensive analysis of secondary data to understand the socioeconomic, environmental, and productive realities of the Northeast. This stage involved the collection and systematization of key indicators, including economic activity, social indicators, and productive structure, among others, as well as the mapping of existing initiatives and projects related to ecological transformation.

The analysis made it possible to build a robust territorial diagnosis, essential for identifying priority challenges and strategic potentialities within each axis of the Plan.

4.2 COMPARATIVE STUDIES: LESSONS FROM REGIONAL EXPERIENCES

Building on this diagnosis, the process advanced to a stage of comparative studies, examining plans and policies already implemented across the Northeastern states that engage with the PTE agenda. The initiatives studied included the ***Regional Development Plan for the Northeast (Plano Regional de Desenvolvimento do Nordeste - 2024); Visão Alagoas 2030[9] and the State Environmental Policy (Política Estadual de Meio Ambiente - AL); the Climate Mitigation Plan for Salvador[10] (Plano de Mitigação Climática - BA);***

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9. The name *Visão Alagoas* 2030 has been retained in Portuguese. It designates the long-term strategic development plan of the state of Alagoas, structured around a vision horizon of 2030. Although a descriptive English rendering — Alagoas Vision 2030 — is technically possible, the denomination functions as an official proper name with no consolidated English equivalent in intergovernmental or international documentation. This treatment is consistent with the broader editorial decision adopted throughout this translation, whereby official names of Brazilian state and federal programmes are preserved in their original form when no institutionally recognized English version exists. The same criterion has been applied to other state-level initiatives listed in this section, such as *Maranhão Verde, Floresta Viva, Maranhão Sem Queimadas, PerMeie*, and *Eco Piauí*, all of which have been retained in Portuguese as proper institutional names, with descriptive English translations provided in the body text where context requires additional clarity for the international reader.

10. The municipal climate plan of Salvador, Bahia, is referenced in the PTE-NE by its abbreviated designation. Its full official title is *Plano de Mitigação e Adaptação às Mudanças do Clima de Salvador (PMAMC)*, rendered in English as Salvador's Plan for Mitigation and Adaptation to Climate Change in documentation produced by ICLEI — Local Governments for Sustainability. The plan also circulates under the denomination *Plano de Ação Climática* (Salvador's Climate Action Plan), which is used in some international institutional contexts. This translation adopts Climate Mitigation Plan for Salvador as a concise working title consistent with the abbreviated form used in the original PTE-NE, with the full official English rendering noted here for reference and cross-identification purposes.

the Energy Transition Programme of Bahia (Programa de Transição Energética - Protener) and the State ABC+ Plan (Plano Estadual ABC+ - BA)[11]; the Bio Clima Plan (Plano de Biodiversidade e Adaptação (Bio-Clima) - CE); the State Climate Change Policy (Política Estadual sobre Mudanças Climáticas (PEMC/SE) and the Sergipe Green Economy Plan (Plano Sergipano de Economia Verde (PSEV) - SE); Maranhão Verde, Floresta Viva, and Maranhão Sem Queimadas (MA)[12]; the State Climate Change Policy (Política Estadual de Mudanças Climáticas - PB); Pernambuco Plan for Economic-Ecological Transformation (Plano Pernambucano de Mudança Econômico-Ecológica - PerMeie) (PE); the Sustainable Inclusive Piauí Plan (Plano Piauí Sustentável Inclusivo - PSI) and Eco Piauí (PI); the State Policy on Climate Change (Política Estadual sobre Mudança do Clima - RN), among others.

These plans and initiatives were examined with particular attention to their methodologies, governance structures, objectives, results, and lessons learned in order to identify scalable good practices, gaps to be addressed, and opportunities for synergy with the PTE-NE proposal. This stage ensured that the Plan was constructed incrementally, drawing on the trajectory and accumulated experience of the states.

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11. The State ABC+ Plan refers to the subnational implementation of Brazil's federal *Plano Setorial para Adaptação à Mudança do Clima e Baixa Emissão de Carbono na Agropecuária*, the Sectoral Plan for Climate Change Adaptation and Low-Carbon Emissions in Agriculture and Livestock Farming, rendered in English as the ABC+ Plan following the denomination adopted by the Ministry of Agriculture, Livestock and Food Supply in its international communications. Individual Northeastern states have developed their own versions of this sectoral plan; the PTE-NE references the Bahian state version. The plan's title abbreviation — ABC+ — derives from *Agricultura de Baixo Carbono* (Low-Carbon Agriculture), the framework under which Brazil's agricultural climate commitments are organized.

12. These two initiatives of the Government of Maranhão have been retained in Portuguese as official proper names, consistent with the editorial approach adopted throughout this translation for Brazilian state and federal programme denominations without consolidated English equivalents.

4.3 PARTICIPATORY WORKSHOPS: COLLABORATIVE AND TERRITORIALIZED CONSTRUCTION

The heart of the methodological process was the consultation space built through participatory co-construction workshops. These workshops were organized around two distinct moments:

➞ **Workshops with representatives of state governments and the administrative council of the *Consórcio Nordeste*:** two meetings were held in Brasília, DF. The first aimed to introduce the collaborative construction process of the Plan with the Northeastern states, establishing shared objectives and mobilization strategies for the territorial workshops to follow. The second brought representatives together to validate and revise the first draft of the PTE-NE's final text, inviting participants to propose adjustments and contributions in accordance with the objectives and particularities of sustainable development across the states that make up the Northeast.

➞ **Territorial workshops in the states:** held in each of the nine Northeastern states, with the support of state governments, the *Consórcio Nordeste*, and the Organization of Ibero-American States (OEI). Unlike the other meetings, these workshops brought together representatives from civil society, the productive sector, academia, state governments, social movements, and international organizations, with the aim of capturing the plurality of local realities and making the PTE-NE a plan that is both legitimate and territorially grounded.

As a methodological approach, the territorial workshops were structured around three stages. The first focused on a participatory diagnosis of the greatest challenges, opportunities, and visions for the future of Northeastern development. The second consisted of a joint, constructive, and collaborative review of the Base Text for the Brasil Nordeste Ecological Transformation Plan, inviting participants to analyze priority proposals and actions across each of the six thematic axes. Finally, in the third stage, contributions for each axis were shared in a general plenary session.

These workshops were fundamental in ensuring that the Plan's final text reflected not only a technical vision, but also the **real demands, local potentialities, and collective intelligence of the Northeastern territory.**

Workshop for the Development of the PTE-NE in Alagoas

Workshop for the Development of the PTE-NE in Bahia

Workshop for the Development of the PTE-NE in Ceará

Workshop for the Development of the PTE-NE in Maranhão

Workshop for the Development of the PTE-NE in Paraíba

Workshop for the Development of the PTE-NE in Piauí

Workshop for the Development of the PTE-NE in Rio Grande do Norte

Workshop for the Development of the PTE-NE in Pernambuco

Workshop for the Development of the PTE-NE in Sergipe

4.4 POLITICAL COMMITMENTS: ALIGNMENT AND GOVERNANCE

An essential element in the construction of the *Brasil Nordeste* Plan was the articulation of regional political commitments carried out by the *Consórcio Nordeste*, through letters of intent and commitment signed by the governors of all nine states, consolidating the strategic alignment of the states with the Plan.

The central moment of this alignment was the COP Nordeste, a side event held alongside the 3rd International Conference on Climate and Development in Arid, Semi-Arid, and Dry Sub-Humid Regions (ICID III), which took place in Fortaleza, Ceará, between 15 and 20 September 2025. The conference brought together governors, specialists, and political leaders to discuss the potential of the semi-arid region and the Northeast as the driving force of Brazil's ecological transformation. On that occasion, the Northeast Ecological Transformation Commitment Charter *(Carta Compromisso pela Transformação Ecológica do Nordeste)* was formally endorsed, establishing the following strategic directives:

1. Transform for the people;
2. Lead a just energy transition;
3. Drive sustainable neo-industrialization;
4. Promote bioeconomy and sustainable agriculture;
5. Strengthen education, science, and green innovation;
6. Expand the circular economy and waste management;
7. Guarantee water security and climate adaptation;
8. Preserve biodiversity and promote community-based sustainable tourism;
9. Integrate sustainable investments and strengthen international agency;
10. Conduct the ecological transformation with transparency and participation.

4.5 STRUCTURING THE PTE-NE: PROPOSALS AND PATHWAYS FOR ACTION

The final stage of the PTE-NE's elaboration consisted in the systematization of structural proposals drawn from the inputs of the workshops and the accumulated outputs of the preceding research stages. Following the structure of the Base Text, the proposals organized across the six strategic axes underwent modifications and additions, incorporating examples of ongoing projects, financing instruments, and public policy recommendations.

This structuring brought together both priority actions, such as the creation of green financial mechanisms and technology capacity-building programmes, and initiatives already underway, such as the implementation of bioeconomy corridors and climate-resilient infrastructure.

The Plan was carefully structured to serve as a planning instrument, technical reference, and strategic guide for governments, civil society, and the private sector. Its format is organized as follows:

➞ **Executive Summary:** a synthesis of the main objectives, directives, and proposals;
➞ **Prologue:** political and institutional contextualization of the Plan;
➞ **Overview:** a broad panorama of the Northeast and the global landscape of ecological transformation;
➞ **Methodology:** a detailed description of the participatory and technical elaboration process;
➞ **Vision for the Future:** the *Consórcio Nordeste*'s desired scenario for the region under this new paradigm, with the Brazilian Northeast as its protagonist;
➞ **Proposals by Axis:** content organized according to the six strategic axes, each subdivided into:

- ✔ Structural Challenges;
- ✔ Pathways and Opportunities;
- ✔ Axis-Specific Vision for the Future;
- ✔ Priority Proposals and Actions;

➞ **Final Considerations:** presenting the main mechanisms for implementing the *Brasil Nordeste* Plan.

The methodology behind the formulation of the Brasil Nordeste Ecological Transformation Plan thus combined science, politics, and social participation to produce a plan deeply rooted in the territory. By adapting the six axes of the National PTE to the realities and potentialities of the Northeast, the Plan consolidates the region as a living laboratory and driving force of Brazil's ecological transformation.

To conclude, the Plan detailed in these pages does not merely respond to the challenges of the present — it anticipates the opportunities of the future, positioning the Northeast as a center of green innovation, energy transition, and sustainable development, and above all as a territory capable of leading Brazil into a new global paradigm of prosperity with social justice and environmental balance.

METHODOLOGY IN NUMBERS

515 participants

47 proposals

11 workshops

324 priority actions

VISION FOR THE FUTURE

VISION FOR THE FUTURE

The Brazilian Northeast emerges at a singular and strategic moment in its history, one in which its undeniable potential and its capacity for reinvention converge to forge a future of shared prosperity, social justice, and environmental leadership. A land of abundant renewable energy, unique biodiversity, and the Caatinga as its exclusive biome, the Northeast is both rich in traditional knowledge and regenerative practices. Its historical asymmetries and the challenges posed by climate change are a call to action catalysts for the construction of an innovative and genuinely sustainable development model.

The PTE-NE, led by the Federal Government and the *Consórcio Nordeste*, was built in collaboration with the nine states and regional institutions, and represents the compass for navigating these challenges, converting them into concrete opportunities. The Plan solidifies a new way of thinking and making public policy in Brazil, renewing and strengthening regional planning in an ascending direction. The objective is to consolidate the Northeast as the engine of Brazil's sustainable development in the twenty-first century: a territory of creativity, innovation, dignity, and prosperity for all. It is understood that this process must be

guided by social participation, interfederative coordination, and governance anchored in an unwavering commitment to guaranteeing the fundamental right to life.

To bring this inclusive, bold, and transformative vision to fruition, the *Consórcio Nordeste* presents the following **Strategic Objectives of the Ecological Transformation Plan (PTE-NE)**, outlining clear goals and targets:

Lead the Just Energy Transition and Expand Renewable Capacity

We reaffirm our commitment to making the Northeast the heart of renewable energy in Brazil, driving a just energy transition, with careful attention to minimizing adverse impacts and distributing the dividends of this transformation equitably. Our target is to triple the installed capacity of solar and wind energy generation by 2030, in alignment with the global sustainable development goals, and to double energy efficiency within the regional matrix. Our leading role is already evident: we hold the greatest national installed capacity in both wind and solar energy. This capacity will be expanded to ensure affordable tariffs; generate green jobs and income; and establish mechanisms that guarantee energy justice for all communities and productive sectors. It is essential, however, to go beyond mere production: we must strengthen the transmission and distribution network and ensure increased load capacity, so that the energy generated is effectively harnessed for the region's development. To this end, we will invest in firm energy sources, such as small biomass-fired thermoelectric plants and next-generation solar-wind hybrid facilities, as well as in storage capacity through batteries and other technologies, to guarantee the security and stability of the energy system.

Drive Green Neo-Industrialization and a Low-Carbon Economy

We strongly advocate for the attraction of high value-added industries, converting the Northeast's immense energy advantage into a competitive hub for strategic sectors such as green chemistry, semiconductor production, sustainable fertilizers, and green hydrogen. This transformation, however, will only be just and lasting if accompanied by the capacity-building of the local workforce through technical, scientific, and entrepreneurial qualification programmes aimed at youth, women, and traditional communities, so that the benefits of the new economy translate into productive inclusion and a reduction of regional inequalities. We will create hundreds of thousands of new jobs in the coming years through the establishment of green industrial hubs that integrate sustainability, innovation, and human development.

Strengthen Regional Competitiveness and Sustainable Productive Chains

So that the Northeast may be not merely an exporter of energy commodities but a center of production and innovation, we will prioritize powershoring strategies, encouraging the use of regionally generated energy to deepen local productive chains. We also propose a strategy of Northeastern Export Processing Zones (EPZs), accelerating their creation and operation and enabling them to serve as production hubs for both external and domestic markets, capitalizing on tax reform and consolidating a favorable business environment. We will identify and develop the potential of the strategic and critical minerals available in the region, building value-added chains in a sustainable and technologically driven manner.

Valorize the Caatinga through the Promotion of Sustainable Bioeconomy

We will invest in the valorization, preservation, restoration, and strengthening of the Caatinga — Brazil's exclusive biome — and of the region's other ecosystems, reinforcing family farming, agroecology, and socio-biodiversity product chains. Through environmental restoration programmes, we will reforest vast areas and strengthen the capacities of family farmers, ensuring income generation with respect for nature and traditional knowledge, promoting a development model that honors our natural and cultural heritage. To finance these actions, we will pursue the Caatinga Fund as a strategic pathway for resource mobilization. The Northeastern Semi-Arid will take a leading role in Brazil's climate agenda, demonstrating innovative solutions for coexistence and prosperity in semi-arid regions.

Guarantee Water Security and Strengthen Climate Adaptation

We will strengthen resilient water management infrastructures, expanding rainwater harvesting systems, sustainable desalination, and ecological water treatment. Our commitment is to scale up Nature-based Solutions to **combat desertification** and ensure universal access to potable water in vulnerable communities. We aim to reach all rural families with cisterns in the coming years, while also investing in major water infrastructure projects and desalination programmes. At the same time, we will promote applied research, technological innovation, and detailed hydrogeological mapping to deepen knowledge of aquifers, springs, and underground reserves, ensuring the sustainable and integrated use of water resources across the entire Northeastern territory.

Strengthen Strategies to Expandthe Circular Economy and Integrated Waste Management

We will establish new industrial recycling hubs across all Northeastern states, integrating waste-picker cooperatives and promoting the productive inclusion of peripheral communities in the waste recovery chain. Recognizing the need to move beyond outdated disposal models, we aim to install multiple recycling hubs and strengthen waste-picker associations, expanding reverse

logistics and acknowledging the fundamental contribution of these services to a more sustainable and inclusive economy.

Valorize Marine Spatial Planning and the Blue Amazon

We recognize the immense wealth and strategic potential of our coastal zone and the Blue Amazon for the sustainable development of the Northeast. We will promote the integrated management and valorization of marine resources, encouraging sustainable fishing, innovative aquaculture, and coastal and community-based tourism that respects ecosystems and traditional communities. To advance this agenda, we will drive the creation of State Secretariats for Marine Spatial Planning, responsible for the public process of spatial and temporal allocation of human activities in marine areas, in pursuit of ecological, economic, and social objectives across the region's state, and we will invest in marine science and technology for the protection and conscious use of our oceans, consolidating the Northeast as a reference in the blue economy and ensuring the climate resilience of our coastal communities.

Promote the Creative Economy, Cultural Diversity, and the Solidarity Economy as Drivers of Inclusive Development

The Northeast, cradle of a vibrant cultural diversity and wealth of traditional knowledge, holds immeasurable potential to consolidate itself as a dynamic hub of the Creative Economy in Brazil and beyond. This intangible wealth, expressed in our music, visual arts, gastronomy, design, fashion, audiovisual production, and countless other manifestations, not only strengthens our identity but also represents a strategic driver for the generation of value, employment, and income with social inclusion. Aligned with this, we recognize the fundamental role of the Solidarity Economy, which the Federal Government has also revived and advanced, and we will integrate it into this development agenda, strengthening cooperatives, associations, and community enterprises that generate income and autonomy in a collective and sustainable manner. Our *Nordeste Criativo* Programme[13] will advance the fostering of democratic innovation and productive inclusion across the territory. To this end, we will invest in the continuous upskilling and reskilling of the regional workforce, preparing our citizens for the demands of the new green and creative economies.

Strengthen Resilient Infrastructure and Connectivity

We commit to modernizing and expanding the Northeast's transport and logistics infrastructure, ensuring that it is not only efficient but deeply resilient to climate change. This includes consolidating the *Transnordestina* railway as a state policy, essential for the

13. The *Nordeste Criativo* Programme has been retained in Portuguese as an official proper name. A descriptive English rendering, Creative Northeast Programme, is technically possible but has not been adopted. First, the denomination functions as an institutional proper name whose identity is inseparable from its territorial and cultural referent: Nordeste is a political and identitary category, one that carries the full weight of the regional belonging, cultural pride, and transformative aspiration that the Programme seeks to embody.

flow of production and regional integration, as well as developing new transport modes and logistics hubs that enhance the region's connectivity and competitiveness. We will encourage all new infrastructure to be conceived with principles of sustainability and resilience by design, preparing the region for future challenges and consolidating it as a strategic logistics hub.

Foster Science, Technology, and Innovation as a Pillar of Development

We recognize Science, Technology, and Innovation (ST&I) as essential enablers of ecological transformation and economic development in the Northeast. We will invest in research, the development of new technologies, and the formation of qualified human capital, creating innovation ecosystems that connect universities, research centers, and the productive sector. We will stimulate entrepreneurship and the adoption of innovative solutions across all sectors, from bioeconomy to energy transition, ensuring that the Northeast becomes a hub for generating knowledge and solutions to global challenges.

With determination and conviction, the governors of the Northeast, represented by their Consortium, affirm that the ecological transformation of the region will be forged with non-negotiable respect for our cultural identities, driven by innovation, and anchored in an unwavering commitment to life through the construction of robust and inclusive public policies. This transformation will be **sustained by shared and cooperative governance and an institutional reform** that strengthens multilateral cooperation for the financing of strategic projects and promotes integration between urban and rural territories, with special attention to the interior. **We will assess and, where necessary, propose cooperative improvements among regional institutions, such as the Superintendency for the Development of the Northeast *(Superintendência do Desenvolvimento do Nordeste - Sudene)*, the São Francisco and Parnaíba Valleys Development Company *(Companhia de Desenvolvimento dos Vales do São Francisco e do Parnaíba - Codevasf)*, and the Bank of the Northeast *(Banco do Nordeste - BNB)***, so that they operate in ever greater alignment with and effectiveness toward the objectives of the PTE-NE. This will be a participatory and plural process, built from regional good practices and through listening to all segments of Northeastern society.

The Northeast refuses to accept a future of vulnerability and passivity. We raise our voice to claim — and with resolute action, we will build — a future of agency, climate justice, and unrestricted prosperity. We recognize that a region cannot be fully developed, that deep social and income inequalities cannot be eliminated, without state policies guaranteed as enduring instruments for overcoming these historical asymmetries. This means ensuring equitable access and dignified continuity for all in the programmes and benefits generated by these policies.

It is through the effectiveness and breadth of these public policies that we will overcome social vulnerabilities, paving a path so that no man or woman of the Northeast is left behind, and so that dignity and opportunity are assured for all. Together, with the strength of our people and the audacity of our vision, we will convert every challenge into a historic opportunity to drive a new cycle of truly sustainable development, elevating the Northeast to the vanguard, as the engine of a Brazil that is more just, more equitable, and profoundly ecological.

PROPOSALS BY AXIS

PROPOSALS BY AXIS

The PTE-NE is structured around six strategic axes that guide the transition toward a sustainable, inclusive, and innovative development model in the region: **Sustainable and Inclusive Finance; Bioeconomy and Adapted Agri-food Systems; Energy Transition; Technological Densification; Circular and Solidarity Economy; and New Green-Blue Infrastructure and Climate Adaptation.** Each axis was conceived to address regional challenges and strengthen the Northeast's potentialities in relation to national and international sustainability agendas.

Within each axis, the PTE-NE presents an analysis of the main strategic perspectives, followed by the identification of structural challenges and bottlenecks that constrain the ecological transition across the territory. Building on this diagnosis, the pathways and opportunities that orient the productive and institutional redesign of each theme in the region are explored, highlighting the necessary instruments and outlining a vision for the future of the Northeast in relation to the strategic axis and its contribution to sustainable development.

Following this context, the **structural proposals** of each axis are presented, articulating **objectives, expected impacts, and strategic agents**, alongside examples of inspiring programmes and projects already underway. These proposals are accompanied by **priority activities** designed to enable their implementation and accelerate the consolidation of a green, solidarity-based, and low-carbon economy across the Northeastern territory.

PROPOSAL INDEX

AXIS 1 - SUSTAINABLE AND INCLUSIVE FINANCE

→ **FSI01** - Regional Financial Framework
→ **FSI02** - Northeast Climate Investment Platform
→ **FSI03** - Carbon Markets
→ **FSI04** - Sustainable Investment Monitoring
→ **FSI05** - Accessible Climate Protection
→ **FSI06** - Collaborative Fiscal Pact

AXIS 2 - TECHNOLOGICAL Ddensification

→ **ADT01** - Regulatory Improvement in Technology and Innovation
→ **ADT02** - Education for Green and Blue Jobs
→ **ADT03** - Research, Development, and Innovation for Neo-industrialization
→ **ADT04** - Diversification and Inland Expansion of the Green-Blue Economy
→ **ADT05** - Fostering Entrepreneurship and Social Technologies

AXIS 3 - BIOECONOMY AND ADAPTED AGRI-FOOD SYSTEMS

→ **BIO01** - Legal Instruments for Protection and Conservation
→ **BIO02** - Cooperation for Socio-environmental Solutions
→ **BIO03** - Productive Innovation for Bioeconomy
→ **BIO04** - Multi-sectoral Technical Cooperation for Bioeconomy
→ **BIO05** - Promoting Spaces for Knowledge Exchange
→ **BIO06** - Capacity-building and Technical Advisory with Age and Gender Equity
→ **BIO07** - Sustainable Commercialization of Products and Services

AXIS 4 - ENERGY TRANSITION

→ **TE01** - Territorialized Regulatory Framework
→ **TE02** - Energy Matrix Integration
→ **TE03** - Expansion and Integration of Energy Infrastructure
→ **TE04** - Participatory Governance in the Energy Transition
→ **TE05** - Professional Qualification for the Energy Transition
→ **TE06** - Diversification and Innovation in Renewable Energy
→ **TE07** - Energy-Industrial Powershoring
→ **TE08** - Low-Carbon Hydrogen
→ **TE09** - Optimizing Distribution and Reducing Waste
→ **TE10** - Bioenergy
→ **TE11** - Community Generation Programme and Energy Cooperatives
→ **TE12** - Strategic Minerals

AXIS 5 - CIRCULAR AND SOLIDARITY ECONOMY

→ **EC01** - Improvement of Regulatory Frameworks
→ **EC02** - Public Procurement in the Circular Economy
→ **EC03** - Strengthening Cooperatives
→ **EC04** - Closure of Open Dumpsites
→ **EC05** - Waste Valorization
→ **EC06** - Recycling and Efficient Logistics
→ **EC07** - Culture of the Circular Economy

AXIS 6 - NEW GREEN-BLUE INFRASTRUCTURE AND CLIMATE ADAPTATION

→ **NIVA01** - Resilient and Nature-based Water Infrastructure
→ **NIVA02** - Resilient Climate Spatial Planning
→ **NIVA03** - Sustainable Mobility
→ **NIVA04** - Biome and Soil Restoration
→ **NIVA05** - Northeast Ecological Corridors Network
→ **NIVA06** - Agricultural Climate Adaptation
→ **NIVA07** - Disaster Monitoring, Early Warning, and Response Platform
→ **NIVA08** - Territorial Governance for Climate Change
→ **NIVA09** - Protection Against Climate Disasters
→ **NIVA10** - Intersectional Approach to Climate Adaptation

6.1 AXIS 1 Sustainable and Inclusive Finance

The Sustainable and Inclusive Finance[14] axis aims to structure financial and regulatory mechanisms that transform the Northeast's comparative advantages into fair and shared growth. In brief, the primary challenge identified is the limited access to credit, particularly for local initiatives lacking traditional financial guarantees, which excludes family farmers, indigenous peoples, and traditional communities. This constraint is compounded by the absence of stable, long-term financing sources and an insurance market that remains nascent, limiting the scale of initiatives and perpetuating dependence on public subsidies.

The proposed **strategy is accordingly to position the region as a reference in investments oriented toward ecological transformation,** democratizing access to capital through inclusive regulations and innovative financial instruments.

It also seeks to redirect existing financial instruments in a centralized or integrated manner through local development banks as a means of focusing on financial solutions and structuring a cooperative fiscal framework.

The implementation of the proposed solutions requires governance coordination and strategic partnerships, led by the *Consórcio Nordeste*. Among the key strategic agents, the BNB stands out for its catalytic role in bond issuance, the expansion of credit operations, and local coordination to overcome barriers to the democratization of credit oriented toward ecological transformation. In this context, Sudene also emerges as a relevant institution for ensuring social participation, transparency, and socio-environmental safeguards, reinforcing institutional arrangements for local, integrated, and sustainable development.

6.1.1 Structural Challenges for Sustainable and Inclusive Finance in the Northeast

The primary challenge in structuring the financial and regulatory mechanisms of this axis lies in the **limited access to credit and financial instruments**, particularly for strategic ecological transformation initiatives and the most vulnerable populations. Although public financing initiatives exist, such as the **Constitutional Fund for Financing the Northeast *(Fundo Constitucional de Financiamento do Nordeste - FNE)***, access remains restricted for those who lack sufficient guarantees. This difficulty is compounded by the absence of specific criteria and credit guarantee al-

14. The term Sustainable and Inclusive Finance represents a deliberate conceptual expansion of the Sustainable Finance axis as formulated in the National Ecological Transformation Plan. By adapting it to the Northeastern context, the PTE-NE explicitly incorporates social inclusion; cooperative articulation among states; a focus on credit access alternatives in response to concentrated financialization; and socio-environmental sustainability. It is recommended that this approach reinforce the integration between regional development, social justice, and collaborative financial instruments in the region.

ternatives that could integrate indigenous peoples and traditional communities into the financial system.

Beyond the access problem, the Northeast faces a **scarcity of stable, long-term financing sources** to sustain the ecological transition agenda. Many states depend on external financing, which represents a persistent obstacle to the sustainability and scale of the proposed actions. Excessive bureaucracy and institutional limitations further hinder resource mobilization and broad access to public policies, as pointed out by several states. Establishing clear guidelines on priority sectors and target populations, integrating the environmental, social, and economic dimensions, is essential to overcoming these challenges.

6.1.2 Pathways and Opportunities for Sustainable and Inclusive Finance

The region possesses significant levers for developing sustainable and inclusive finance, beginning with credit lines already established and in operation, such as the FNE, which stands out in the energy sector and in support for microentrepreneurs. Programmes such as *CrediAmigo* and *AgroAmigo*, microcredit programs from Bank of the Northeast (BNB) aimed, respectively, at urban entrepreneurs and family farmers, have already demonstrated results in financial inclusion and can be expanded and adapted to finance activities linked to ecological transformation.

The most significant opportunities lie in **supporting sectors with high socio-environmental** potential, including the diversification of renewable energy generation; the strengthening of sustainable bioeconomy chains, such as fruit farming, agroextractivism, and phytotherapeutics; and industrial production oriented toward waste recovery. The BNB is seen as a strategic actor for participation in the **Sustainable Securities and Carbon Credits Market**, driving preservation and sustainable development projects, particularly within the Caatinga biome.

The region may also benefit from **alternative financing models** such as community banks, solidarity revolving funds, and local cooperatives, all of which promote financial inclusion in less economically

dynamic areas. States can further leverage sustainable finance instruments through fiscal mechanisms, such as the adoption of regional versions of the Ecological ICMS[15], rewarding companies committed to sustainable practices. The strengthening of the environmental assets market, through carbon credits and ecosystem services, represents another opportunity for revenue generation and the attraction of national and international investment.

6.1.3 Vision for the Future of Sustainable and Inclusive Finance in the Northeast

The vision for the future is to transform the region into a **reference for attracting investments that prioritize the ecological agenda**, capitalizing on its comparative advantages in bioeconomy and sustainable business. The expectation is that, through innovative credit lines and a cooperative and attractive tax structure, the states will be able to lead priority sectors in the green reindustrialization process.

This leadership should be accompanied by the promotion of productive sectors that integrate investment with technological innovation, biome conservation, and job and income generation. The ideal of shared prosperity must guide this trajectory, ensuring that the gains of development are distributed equitably across sectors and populations.

To bring this future to fruition, financial instruments will need to include **multilateral cooperation and the use of alternative credit mechanisms, such as collective or solidarity-based guarantees**. The expectation is that the attraction of investment, beyond promoting the financialization of the region, will be linked to the growth of economic complexity and social inclusion, supporting rural communities, traditional peoples, and the generation of qualified employment for youth and women.

6.1.4 Proposals for the Sustainable and Inclusive Finance Axis

The Sustainable and Inclusive Finance axis aims to structure financial instruments and governance mechanisms to promote ecological transformation and sustainable transition in the Northeast. It encompasses regional funds; climate investment platforms; carbon markets; climate insurance; and collaborative fiscal pacts, integrating governments, financial institutions, universities, and civil society. The objective is to mobilize resources, reduce risks, and stimulate long-term investment in sustainable and resilient productive chains.

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15. The ICMS *(Imposto sobre Circulação de Mercadorias e Serviços)* is a state-level value-added tax on the circulation of goods and services, the primary source of own revenue for Brazilian states, of which a constitutionally mandated share (25%) is redistributed to municipalities according to criteria defined by each state. The Ecological ICMS *(ICMS Ecológico)*, also known as the Green ICMS *(ICMS Verde)* in some states, builds on this redistributive mechanism by incorporating environmental performance indicators, such as conservation of native vegetation, management of protected areas, and solid waste management, into the municipal revenue-sharing formula, thereby financially incentivizing sustainable practices at the local level without altering the overall tax burden. With the Tax Reform (Constitutional Amendment No. 132/2023), the ICMS will be gradually replaced by the unified Tax on Goods and Services *(Imposto sobre Bens e Serviços — IBS)*, scheduled for full implementation by 2033, requiring the adaptation of the Ecological ICMS criteria and revenue-sharing mechanisms to the new fiscal framework.

The proposals are presented below:

FSI01 — Consolidate a regional financial framework, with local sub-funds aligned to sustainable taxonomy, to direct fiscal incentives, credit, and the selection of ecological transformation projects.

This proposal provides for the consolidation of a **regional financial framework**, with thematic sub-funds mandatorily linked to the Brazilian Sustainable Taxonomy *(Taxonomia Sustentável Brasileira)*, to guide fiscal incentives, public credit, and project eligibility. This arrangement, aligned with the Ecological Transformation Plan and federal sustainable finance guidelines, will make it possible to structure integrated financing mechanisms that expand the scale of green investments, drawing inspiration from existing experiences such as *FNE Verde* and *FNE Sol* (Bank of the Northeast), the Desertification Fund (*Fundo de Desertificação* - Rio Grande do Norte), and the Ecological ICMS (Alagoas).

It is proposed that states may create sub-accounts organized around strategic vocations, such as restoration and management of the Caatinga and other biomes; water infrastructure, and energy transition, using the taxonomy as an eligibility rule and the Ecological Transformation Plan targets as the basis for indicators. Complementary initiatives, such as community banks[16], strengthen financial inclusion instruments and the generation of sustainable revenues. The *Consórcio Nordeste* may act as a coordination body, awarding prioritization seals to interstate projects and working with the Ministry of Finance to govern the financial architecture and the regional investment portfolio with direct impact on the region's climate resilience, water management, and energy transition.

➞ **Strategic initiatives and agents:** Ministry of Finance; Bank of the Northeast (BNB); Superintendency for the Development of the Northeast (Sudene); *Consórcio Nordeste*; National Treasury *(Tesouro Nacional)*; National Bank for Economic and Social Development *(Banco Nacional de Desenvolvimento Econômico e Social - BNDES)*; International Development Banks; Ministry of the Environment and Climate Change *(Ministério do Meio Ambiente e Mudança do Clima - MMA)*; Ministry of Development, Industry, Trade and Services *(Ministério do Desenvolvimento, Indústria, Comércio e Serviços - MDIC)*; and Ministry of Integration and Regional Development *(Ministério da Integração e do Desenvolvimento Regional - MIDR)*.

16. Complementary initiatives include the Revolving Fund Management Board *(Conselho Gestor do Fundo Rotativo - Cogefur)* community bank in Bahia, which offers solidarity credit to family farmer cooperatives; tokenization experiments in Ceará, using digital technology to generate traceable and tradeable assets; and Payment for Environmental Services (Pagamento por Serviços Ambientais - PES) programmes in Alagoas, Ceará, and Maranhão, which compensate farmers and landowners for environmental conservation and restoration.

PRIORITY ACTIVITIES:

➞ Establish the FNFS, to be operated by the Bank of the Northeast, consolidating state funds[17] and sub-accounts under a single regulatory framework, eligibility criteria aligned to the Brazilian Sustainable Taxonomy and independent audit mechanisms with periodic accountability reporting.

➞ Adopt the sustainable taxonomy as a mandatory criterion in the credit operations of development banks and development agencies, tying credit approval to the ecological classification of projects, verification of resource use, and publication of compliance reports accompanied by technical capacity-building for state managers and bank analysts.

➞ Create financial mechanisms for risk mitigation and private leverage, including first-loss guarantees structured with support from the National Treasury or international funds, as well as performance insurance linked to verifiable socio-environmental targets, prioritizing hybrid public-private financing models (blended finance) conditioned on sustainable taxonomy metrics (performance-based finance).

➞ Consolidate a regional financial governance structure, coordinated by an intergovernmental committee (Ministry of Finance, Sudene, and *Consórcio Nordeste*), with the participation of the Bank of the Northeast, responsible for setting annual impact targets, approving interstate projects, and coordinating the regional project pipeline in alignment with the Ecological Transformation Plan.

➞ Improve and create specific financing lines directed at cooperatives, community associations, and collectives of traditional peoples and communities, intended for the implementation of projects that reconcile environmental conservation and income generation in strategic territories of ecological protection and conservation.

➞ Develop digital transparency and impact dashboards, publicly accessible and periodically updated, containing data on the project portfolio, socio-environmental indicators, financial execution, and audit reports, thereby ensuring mechanisms for social control and the participation of organized civil society.

➞ Promote inter-institutional cooperation arrangements that ensure long-term stability and legal certainty for the financial framework dedicated to the conservation and sustainable use of natural resources, through strategic partnerships with international climate funds, multilateral and development banks, and international development agencies.

17. It is worth highlighting the Caatinga Fund initiative, currently under an inter-cooperation process between the MMA and the *Consórcio Nordeste*, aimed at structuring and deliberating on its creation in coordination with the BNDES. The state fund initiative of Rio Grande do Norte should also be considered in this process of harmonizing state funds or of creating a regional fund at the operational level of the BNB.

FSI02 — Develop the Northeast Climate Investment Platform (NIC), with co-investment facilities and innovation hubs, to structure local development projects and attract public and private investment.

The NIC will function as a single window for the origination, curation, and promotion of projects aligned with the Brazilian Sustainable Taxonomy and the Ecological Transformation Plan, coordinated with the Brazilian Platform for Climate Investment and Ecological Transformation (*Plataforma Brasil de Investimentos Climáticos e para a Transformação Ecológica* - BIP-Brasil) to mobilize capital and standardize eligibility criteria[18]. It will operate co-investment facilities (an office or management structure) and innovation hubs with universities, the *Sistema S* network[19], and public banks, connecting the Sustainable Securities and Carbon Credits Market with regional instruments such as the Sustainable Investment Facility (*Facility de Investimentos Sustentáveis* - Fais). Governance will be anchored in cooperation between the Ministry of Finance and the *Consórcio Nordeste*, with operational integration with the Bank of the Northeast and the participation of state agencies.

The NIC will organize projects by sector, geography, and stage, with standardized data on risk, impact, and governance, **reducing information asymmetries** and promoting matchmaking with national and international funds. Regional university and technology hubs will serve as project offices and sectoral acceleration centers, including port hubs (Ceará, Piauí, and Pernambuco); the Metrópole Digital Institute *(Instituto Metrópole*

18. Decree No. 23,897 of 15 June 2025, issued by the Government of the State of Piauí, established the State System for the Management of Public Investment Projects *(Sistema Estadual de Gestão de Projetos de Investimento Público)*, creating a standardized methodology for the planning, evaluation, and monitoring of projects, with a mandatory climate risk matrix. This state regulatory milestone anticipates the technical and governance infrastructure required for the operationalization of the NIC at the state level, by offering a replicable model of a qualified pipeline of public and sustainable projects compatible with the curation and eligibility logic proposed by the Platform.

19. The *Sistema S* is a Brazilian network of autonomous, quasi-public institutions created and funded through mandatory payroll contributions levied on private sector enterprises. Each institution within the network is linked to a specific economic sector and is responsible for providing vocational training, technical education, social services, and support for productive innovation to workers and enterprises in that sector. The principal institutions comprising *Sistema S* are the following: SENAI (*Serviço Nacional de Aprendizagem Industrial* — National Industrial Learning Service), SENAC (*Serviço Nacional de Aprendizagem Comercial* — National Commercial Learning Service), SESI (*Serviço Social da Indústria* — Social Service of Industry), SESC (Serviço Social do Comércio — Social Service of Commerce), SENAR (Serviço Nacional de Aprendizagem Rural — National Rural Learning Service), SEST (Serviço Social do Transporte — Social Service of Land Transport), SENAT (*Serviço Nacional de Aprendizagem do Transporte* — National Land Transport Learning Service), SEBRAE (*Serviço Brasileiro de Apoio às Micro e Pequenas Empresas* — Brazilian Support Service for Micro and Small Enterprises), and SESCOOP (*Serviço Nacional de Aprendizagem do Cooperativismo* — National Cooperative Learning and Social Promotion Service). The network has no direct equivalent in other national systems, it operates outside the public administration proper, yet fulfills functions that in many countries would be performed by government agencies or public training institutions. Throughout this document, *Sistema S* has been retained in Portuguese as a proper institutional name, accompanied by the descriptor "network" to signal its collective and articulated character to the international reader.

Digital - IMD) and the Augusto Severo Scientific and Technological Park (*Parque Científico e Tecnológico Augusto Severo* - PAX) in Rio Grande do Norte; SergipeTec (Sergipe); the Bahia Technology Park *(Parque Tecnológico da Bahia)* and SoberanIA[20] (Piauí), all connected to the co-investment facilities. The Preliminary Intermediation Notification (*Notificação de Intermediação Preliminar* - NIP)[21] will drive prioritized business rounds and FNFS guarantees, and will showcase projects at regional and international events organized by state governments and strategic sectors, broadening access to capital and supporting the issuance of instruments such as debêntures[22] and green bonds[23].

➞ **Strategic initiatives and agents:** Ministry of Finance; *Consórcio Nordeste*; Bank of the Northeast (BNB); and Superintendency for the Development of the Northeast (Sudene), in cooperation with BNDES, the Ministry of the Environment and Climate Change (MMA), the Ministry of Development, Industry, Trade and Services (MDIC), and the Ministry of Integration and Regional Development (MIDR). Also participating will be universities and innovation centers, including the Federal University of Rio Grande do Norte *(Universidade Federal do Rio Grande do Norte - UFRN)*, the Federal University of Pernambuco *(Universidade Federal de Pernambuco - UFPE)*, the Federal University of Ceará *(Universidade Federal do Ceará - UFC)*, the Federal University of Bahia *(Universidade Federal da Bahia - UFBA)*, the Federal University of Sergipe *(Universidade Federal de Sergipe - UFS)*, IMD, PAX, SergipeTec, and SoberanIA, as well as the

20. SoberanIA is the first artificial intelligence language model (LLM) focused on public data, developed entirely in Portuguese and based in Piauí. Launched in June 2025, the project aims to guarantee national technological autonomy, data security, and an AI that better understands Brazilian culture and context, supporting public services.

21. The Preliminary Intermediation Notification (*Notificação de Intermediação Preliminar* - NIP) is a procedural instrument proposed within the governance architecture of the Northeast Climate Investment Platform (NIC) to formalize the preliminary stage of project intermediation between proponents and potential investors or financing institutions. It functions as an official signal of intent, documenting that a project has been identified, pre-screened for eligibility, and is being actively advanced toward structured financing, thereby providing a traceable and auditable record of the intermediation process. The NIP is a novel instrument specific to the NIC framework proposed in the PTE-NE and does not correspond to any pre-existing instrument in Brazilian or international financial regulation. Its closest functional analogues in international development finance practice would be the Letter of Interest or Expression of Interest used by multilateral development banks in early-stage project preparation, though the NIP is more specifically oriented toward the matching and prioritization functions of the Platform's co-investment facilities.

22. Although the English word "debentures" exists and shares the same etymological root, the two instruments are not equivalent: in anglophone financial systems, "debentures" typically designate unsecured long-term debt instruments backed solely by the issuer's general creditworthiness, with specific characteristics varying significantly between the United Kingdom and United States regulatory frameworks. Brazilian debêntures, by contrast, are governed by Law No. 6,404/1976 (the Brazilian Corporations Law) and the regulations of the Brazilian Securities and Exchange Commission (*Comissão de Valores Mobiliários* - CMV), and may be secured or unsecured, convertible or non-convertible into shares, and structured with a wide range of remuneration, maturity, and guarantee features not directly comparable to their anglophone nominal equivalents.

23. Green debêntures and green bonds are debt instruments designed to finance projects with verified environmental benefits. The NIP will direct these instruments toward mobilizing investment in bioeconomy, prioritizing sustainable productive chains and low-carbon projects in strategic territories.

Sistema S network, incubators, and technology parks, responsible for the acceleration hubs and regional project offices. The initiative will receive technical support from research and development institutions (the Brazilian Agricultural Research Corporation (*Empresa Brasileira de Agropecuária* - Embrapa), the National Semi-Arid Institute (*Instituto Nacional do Semiárido* - Insa); and the Oswaldo Cruz Foundation (*Fundação Oswaldo Cruz* - Fiocruz)), multilateral banks and international funds (the Green Climate Fund - GCF, the Global Environment Facility - GEF, the Inter-American Development Bank - IDB, and the World Bank); and collaboration from civil society organizations and green economy networks, such as the Brazilian Semi-arid Articulation (*Articulação Semiárido Brasileiro* - ASA)[24], Central da Caatinga, Arapyaú Institute, the Sustainable Connections Institute (*Instituto Conexões Sustentáveis* - Conexsus), and the Northeast Sustainable Finance Network *(Rede Nordeste de Finanças Sustentáveis)*. The NIC will be integrated into the BIP-Brasil ecosystem, connecting with market instruments such as the FNFS, FNE Verde, the Green Registry *(Cadastro Verde - Ceará)*, and the Sustainable Investment Facility (Fais).

PRIORITY ACTIVITIES:

➞ Structure co-investment facilities by state, or around shared vocations, to leverage private and philanthropic capital for community businesses and micro and small enterprises with FNFS guarantees and impact metrics calibrated to the sustainable taxonomy and BIP parameters for eligibility and socioeconomic co-benefits.

➞ Establish regional project hubs and offices with universities, the *Sistema S* network, and incubators, offering bankability tracks, sectoral acceleration, and financial modelling in coherence with the axes and sub-sectors prioritized by the BIP (Nature-based Solutions/bioeconomy, green-blue infrastructure, industry and mobility, energy).

➞ Create a permanent technical committee on sustainable finance, innovation, and public policy for project evaluation, strategic project certification, impact due diligence, and alignment with the BIP's minimum criteria: alignment with national plans, material environmental impact, need for capital mobilization, and socioeconomic co-benefits.

24. The *Articulação Semiárido Brasileiro* (ASA) — Brazilian Semi-Arid Articulation — is a civil society network comprising over three thousand organizations operating across the Brazilian semi-arid region, including rural unions, cooperatives, non-governmental organizations, community associations, and religious entities. Founded in 1999 on the margins of the third Conference of the Parties to the United Nations Convention to Combat Desertification (COP-3), held in Recife, ASA was established around the paradigm of convivência com o semiárido, rejecting the historic framing of drought as a natural catastrophe to be combated through large-scale engineering and affirming the semi-arid region as a viable territory whose communities possess the knowledge and capacity to develop their own sustainable solutions. ASA is internationally recognized for designing and implementing the One Million Cisterns Programme (*Programa Um Milhão de Cisternas* — P1MC) and the One Land and Two Waters Programme *(P1+2)*, two of the most celebrated community-based water access initiatives in the Global South, which have provided potable water and productive water harvesting infrastructure to millions of rural families across the semi-arid Northeast.

➞ Promote thematic business rounds and roadshows with a prioritized portfolio and FNFS guarantees, alongside financial modelling workshops and matchmaking events connecting entrepreneurs with national and international funds in synergy with the financial network articulated by the BIP.

➞ Integrate the sustainable securities and carbon credits market into the origination and structuring of infrastructure projects, with labelling, eligibility criteria, and audits in accordance with the sustainable taxonomy to prevent greenwashing and facilitate access for institutional and multilateral investors.

➞ Standardize data requirements, including eligibility criteria, safeguards, and impact indicators, following the sustainable taxonomy, with interoperability and comparability with international taxonomies to broaden access to global capital.

➞ Establish coordinated governance with a management board and executive secretariat modelled on the BIP, ensuring interministerial participation and operational integration with development banks and state agencies.

FSI03 — Strengthen carbon markets and ecosystem services, standardizing measurement, certification, and commercialization across circular economy productive chains and the sustainable management of the Caatinga[25].

This proposal aims to strengthen **carbon markets and ecosystem services** through the creation of a Northeast Environmental Assets Platform (*Plataforma de Ativos Ambientais do Nordeste* - PAAN), with digital MRV[26] and use of data from Data Nordeste (Sudene), integrated registries, and alignment with the Brazilian Emissions Trading System (*Sistema Brasileiro de Comércio de Emissões de Gases de Efeito Estufa* - SBCE), generating revenues for sustainable enterprises, family farmers, and waste-picker cooperatives, with a strategic focus on the Caatinga and compliance to Law No. 14,119/2021.

25. The prioritization of the Caatinga stems from its high climate vulnerability, significant carbon storage potential, and already consolidated institutional base for sustainable management. The biome faces barriers to attracting investment, justifying a strategic focus, while the Northeast's other biomes present their own vocations and comparative advantages.

26. Application of digital technologies for the Measurement/Monitoring, Reporting, and Verification (MRV) of Climate and Environmental Results, automating data collection, standardizing reporting, and enabling independent audits with end-to-end traceability.

Although encompassing other biomes of the Brazilian Northeast, implementation will **prioritize the Caatinga** through restoration, management, and degradation prevention projects, combining regulated credits and PES with independent verification and remote sensing, anchored by Insa/Embrapa and universities. Reference initiatives include state PES programmes and State PES Programmes (Propsa) in Alagoas, Sergipe, and Maranhão; Reducing Emissions from Deforestation and Forest Degradation (REDD+) in Private Conservation Units in Ceará; the *Regenera* Programme[27] in Rio Grande do Norte; and *Maranhão Verde*.

➞ **Strategic initiatives and agents:** coordination among the Ministry of the Environment and Climate Change (MMA), the Ministry of Finance, the *Consórcio Nordeste*, Sudene, BNB, and state governments with technical support from Insa, Embrapa, the Brazilian Institute of Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* - Ibama), and regional universities. Also participating will be BNDES, the Climate Fund *(Fundo Clima)*, and multilateral financial institutions (including the IDB, GCF, and GEF) to enable the PES-NE Fund and ensure the traceability and certification of carbon credits compatible with the Brazilian Emissions Trading System (SBCE). Implementation will involve partnerships with civil society organizations and territorial networks, such as the Brazilian Semi-arid Articulation (ASA), Caatinga Association, the National Union of Cooperatives of Family Agriculture and Solidarity Economy (*União Nacional das Cooperativas da Agricultura Familiar e Economia Solidária* - Unicafes), Conexsus, and waste-picker cooperatives, as well as State Secretariats of the Environment and of Science and Technology.

PRIORITY ACTIVITIES:

➞ Implement the Northeast Environmental Assets Platform (PAAN), integrating monitoring systems, eligible certifications, and carbon credit registries with standardized Payment for Environmental Services (PES) contracts, ensuring safeguards against double counting, full transaction transparency, and compatibility with the Brazilian Emissions Trading System (SBCE).

➞ Structure the Family Farming Food Acquisition Fund *(Fundo de Aquisição de Alimentos da Agricultura Familiar)*, dedicated to financing initiatives for the protection of water springs and river basins, maintenance of ecological corridors, biome restoration, and waste management with clear additionality rules, eligibility criteria,

27. The *Regenera* Programme in Rio Grande do Norte is an acceleration initiative of Sebrae-RN (Brazilian Micro and Small Business Support Service) focused on identifying, training, and rewarding startups and local businesses that have a strong positive socio-environmental impact.

periodic independent auditing, and governance mechanisms that ensure equity and transparency in the distribution of payments to beneficiaries.

➡ Execute pilot projects in the Caatinga, with detailed stratification by vegetation type, use of permanent plots for monitoring, satellite remote sensing, and collection of biodiversity, carbon, and productivity data, enabling precise scientific assessment of carbon sequestration and socio-environmental impacts, aligning evidence with current legislation and biome restoration guidelines.

➡ Develop PES models for circular economy initiatives, structuring payments around ecological and social feedback loops, including contracts tied to municipal selective waste collection targets, monitoring of landfill diversion, and productivity indicators.

➡ Promote coordination among state governments, municipalities, and local communities to create institutional arrangements that enable PES contracts, regulate payments for environmental services, and advance the socio-productive inclusion of family farmers, traditional peoples and communities, and circular economy enterprises.

➡ Develop digital monitoring tools, public dashboards, and periodic impact reports, enabling real-time tracking of project performance, efficiency metrics, volumes of credits generated, and resource utilization, while ensuring transparency, social oversight, and the dissemination of good practices for replication across other Northeastern biomes.

FSI04 — Foster participatory and transparent governance in the management of public investments and sustainable subsidies, to ensure legitimacy and predictability in resource allocation.

This proposal recommends the **strengthening of participatory and transparent governance in the management of public investments** and sustainable subsidies, ensuring the active participation of local communities, indigenous peoples, and representative councils in the definition of priorities, capacity-building, implementation, and evaluation of policies and funds. The proposal establishes accountability mechanisms including a regional open data platform and an ecological financial observatory, linking state sustainable investment portals and local funds.

It further proposes the adoption of standardized indicators, compliance tracks, and socio-environmental safeguards with independent audits and grievance mechanisms accessible to vulnerable communities and beneficiaries. The *Consórcio Nordeste* and state bodies should publish periodic agendas, collegiate decisions, and audit reports with action plans, reinforcing transparency and accountability across all axes of sustainable development policy, with particular emphasis on the renewable energy sector.

➞ **Strategic initiatives and agents:** the *Consórcio Nordeste*, in coordination with the Ministry of Finance, the Ministry of the Environment and Climate Change (MMA), the Comptroller General of the Union (*Controladoria-Geral da União* - CGU), the Federal Court of Accounts (*Tribunal de Contas da União* - TCU), Sudene, and state governments, ensuring integration with regional multi-sectoral councils and committees. Also participating will be universities and research centers (including UFRN, UFPE, UFBA, UFC, and *Fundação Getúlio Vargas* - FGV), as well as State Research Support Foundations, State Universities, Federal Institutes (IFs), and state technological and environmental institutes, alongside civil society organizations and transparency networks such as Transparency International Brazil. The BNB and BNDES will support the integration of funds with state sustainable investment portals, while local councils will ensure the representation of communities, indigenous peoples, family farmers, and social entrepreneurs.

PRIORITY ACTIVITIES:

➞ Strengthen existing territorial councils and multi-sectoral committees with representation from state governments, civil society, academia, and the private sector, responsible for establishing selection criteria for high socio-environmental impact investments, monitoring implementation, validating results, and ensuring that collegiate decisions are documented and published transparently.

➞ Adopt a comprehensive socio-environmental safeguards plan and contractual integrity clauses for all projects, incorporating periodic independent audits, compliance verifications, and the publication of recommendations and reports, ensuring that civil society participation effectively shapes the monitoring and course correction of investments.

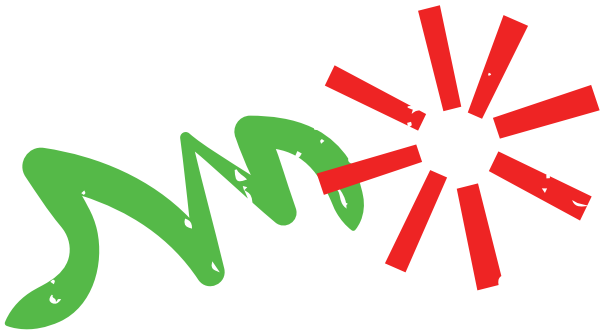
➞ Operate an independent channel for consultation, complaint, and conflict mediation, complemented by a media literacy programme and continuous capacity-building for impacted communities, ensuring that farmers, entrepreneurs, and vulnerable populations have full access to the financial instruments and public policies linked to sustainable projects.

➞ Develop mechanisms for active transparency and accountability, such as the publication of collegiate decision minutes, audit reports, corrective action plans, and performance indicators for each council or committee, ensuring that civil society and other stakeholders can monitor and challenge decisions in a structured manner.

➞ Promote continuous capacity-building for public managers, civil society representatives, and local fund operators, through workshops, technical training, and guidance materials on participatory governance, socio-environmental impact assessment, and transparency best practices.

FSI05 — Strengthen a rapid and accessible climate protection network, through subsidized insurance, for medium-sized rural producers[28], family farmers, and urban microentrepreneurs most exposed to extreme events and climate risks.

This initiative should integrate or build upon existing programmes within the **Rural Insurance Premium Subsidy Programme (*Programa de Subvenção ao Prêmio do Seguro Rural* - PSR)**, drawing on reliable climate databases and contractual modernization processes, reducing risks and accelerating indemnification through triggers parameterized by micro-region and crop type, thereby strengthening financial resilience and bankability for sustainable credit lines. The *Garantia-Safra* Programme[29] may be restructured to overcome its operational and logistical challenges in adoption and loss verification.



28. The prioritization of family and medium-sized farmers is grounded in the access gap and greater exposure to climate shocks observed among these categories. Large producers, by contrast, generally possess greater capacity for self-insurance and access to private coverage. By focusing on family and medium-sized farmers, the proposal aims to expand distributive efficiency, reduce inequalities, and direct subsidies in a more targeted manner (CPI, PUC-Rio, 2012).

29. *Garantia-Safra* (GS) is a social benefit from the Brazilian Federal Government, linked to the Ministry of Agrarian Development and Family Agriculture (MDA), which acts as insurance for family farmers. Its objective is to guarantee a minimum income for family farmers who lose their harvest (at least 50% of production) due to drought or excessive rainfall.

The innovative dimension concerns urban microinsurance designed to serve Individual Microentrepreneurs (MEIs) in community tourism, artisanal production, and local services, populations exposed to extreme rainfall and heat waves, with simplified product design and automated claims processing. The proposal draws inspiration from reference experiences such as the ***ACREDITAR* Programme[30] (Pernambuco), *CrediAmigo* (BNB)**, MEI RS *Calamidades*[31], and *Garantia-Safra* itself, to consolidate an integrated architecture of climate protection and productive inclusion for the populations most exposed to climate shocks.

➞ **Strategic initiatives and agents:** the Ministry of Agriculture and Livestock (*Ministério da Agricultura e Pecuária* - MAPA), Ministry of Agrarian Development and Family Farming (*Ministério do Desenvolvimento Agrário e Agricultura Familiar* - MDA), Ministry of Social Development and Assistance, Family, and Fight against Hunger (*Ministério do Desenvolvimento Social e Assistência Social, Família e Combate à Fome* - MDS), and the Ministry of Finance, through the Superintendency of Private Insurance (*Superintendência de Seguros Privados* - Susep), with technical support from Sudene, the *Consórcio Nordeste*, BNB, the National Bank for Economic and Social Development (BNDES), Embrapa, and the National Institute of Meteorology (*Instituto Nacional de Meteorologia* - Inmet), integrating rural insurance and climate adaptation policies. Implementation will involve public and private insurers, credit cooperatives, microfinance institutions, and digital climate data platforms for claims automation and beneficiary inclusion.

PRIORITY ACTIVITIES:

➞ Structure a cost-sharing fund among the federal government, states, municipalities, and contractors for the coverage of premiums and deductibles with complementary contributions from the FNFS, defined penetration targets by region and beneficiary profile, resource allocation monitoring mechanisms, and incentive instruments to encourage uptake among family farmers, rural producers, and urban microentrepreneurs.

➞ Modernize insurance contracts and settlement workflows, standardizing contractual clauses, automating claims verification and indemnification processes, reducing payment timelines and operational costs, and ensuring transparency and auditability across all processes.

30. The Programme aims to promote productive inclusion, entrepreneurship, and income generation for low-income families, especially those registered in the Unified Registry (CadÚnico).

31. The MEI RS Calamidades initiative was launched by the Government of the State of Rio Grande do Sul, through the Secretariat of Labour and Professional Development (*Secretaria de Trabalho e Desenvolvimento Profissional* - STDP), to provide emergency financial support, capacity-building, and structural assistance to Individual Microentrepreneurs (MEIs) affected by the floods of April and May 2024.

➡ Integrate digital systems, such as the Green Registry and beneficiary onboarding platforms, to facilitate eligibility verification, enrolment, financial literacy, and real-time policy status monitoring, creating user-friendly interfaces for rural producers, MEIs, and vulnerable communities.

➡ Restructure the *Garantia-Safra* Programme for integration with the parametric insurance network, adjusting operational and logistical processes, defining eligibility criteria, loss verification protocols, and agile payment mechanisms, ensuring compatibility with the strategic micro-regions and crops of the Semi-Arid region.

➡ Create urban microinsurance products targeted at MEIs and small entrepreneurs in community tourism, artisanal production, and local services with simplified design, automated triggering, and integration with municipal climate monitoring systems, ensuring financial protection against extreme rainfall, heat waves, and other emerging risks.

➡ Promote continuous capacity-building for public managers, brokers, cooperatives, and beneficiaries, including training on the use of digital platforms, interpretation of climate indicators, risk management, and financial literacy, ensuring the effectiveness, uptake, and sustainability of the rapid protection network.

FSI06 — Consolidate a collaborative fiscal pact among the states, within the context of the new tax reform, establishing incentives for the development of business environments oriented toward ecological transformation

This proposal aims to transform the Tax Reform (Constitutional Amendment No. 132/2023) into an **opportunity for fiscal and environmental coordination among the Northeastern states**, establishing a collaborative, legally sound fiscal architecture oriented toward the ecological transition through its transitional rules. This proposal does not seek to create tax benefits or alter the regime of the Goods and Services Tax (IBS)[32], but rather to leverage the transition period of the new regime, between 2026 and 2033, to prepare the Northeastern states for a new cooperative tax structure.

32. The IBS (Imposto sobre Bens e Serviços) is a new unified consumption tax created by Constitutional Amendment No. 132/2023, Brazil's most comprehensive tax reform in decades, to replace the current fragmented system of state-level ICMS and municipal ISS (Imposto sobre Serviços) taxes. Modelled on value-added tax (VAT) systems prevalent in other jurisdictions, it will be jointly administered by states and municipalities through a newly created National IBS Management Committee (Comitê Gestor do IBS).

The overarching aspiration is for states to increasingly cooperate rather than compete in attracting investment. To this end, it is important to establish fiscal and financial instruments harmonized with the criteria of the Brazilian Sustainable Taxonomy. The expected outcome is a **transparent, standardized, and inter-federative regional fiscal framework,** supported by technical governance from the *Consórcio Nordeste* and Sudene, integrating the local context into the transition process of the Federal Tax Regime without compromising any principles of IBS neutrality and uniformity. In other words, the region will move from the paradigm of "race to the bottom" to a logic of "sustainable fiscal cooperation" with convergent extra-tax policies, legal certainty, and the capacity to orient its economic base toward ecological transformation, capitalizing on the ongoing tax regime transition.

➞ **Strategic initiatives and agents:** coordinated by the *Consórcio Nordeste*, in articulation with State Secretariats of Finance, Planning, and the Environment *(Secretarias Estaduais de Fazenda, Planejamento e Meio Ambiente)*, Sudene, and the Ministry of Finance, with technical support from the IDB and the Federal Revenue Service *(Receita Federal)*, for alignment with the Tax Reform (Constitutional Amendment No. 132). Universities and research centers may support the development of diagnostics and socio-environmental performance metrics, while civil society organizations and the productive sector will participate in regional consultations and pacts.

PRIORITY ACTIVITIES:

➞ Consolidate, within the *Consórcio Nordeste*, a technical working group with representatives from State Secretariats of Finance, Planning, and the Environment, Sudene, and regional universities, with the objective of aligning legal interpretations of Constitutional Amendment No. 132/2023, producing technical notes, and defining regional methodologies compatible with the future National IBS Management Committee.

➞ Map current fiscal and financial incentives in force across the states, identifying overlaps, gaps, and potential synergies with the targets of the Brazilian Sustainable Taxonomy aimed at the harmonization of extra-tax instruments permitted during the transition period of the new fiscal regime, between 2026 and 2033.

➞ Identify and reorient state policies and funds, such as the Ecological ICMS and the Caatinga Fund, as "state or regional fiscal laboratories" for implementing environmental performance metrics, monitoring criteria, and transparent governance models that may be replicated within the new tax system following the final regulation of the IBS in 2033.

➞ Develop and provide guidance on models of state legislation and decrees for the regulation of funds, subsidies, and public-private partnerships, ensuring regional harmonization and the integrity of fair intra-regional fiscal competition, while observing tax neutrality and future compatibility with IBS regulation.

➞ Submit technical proposals to the IBS Management Committee, aligned with the Northeastern context, for the incorporation of sustainability and socio-environmental performance criteria into revenue sharing or the application of linked funds in compliance with federative governance and the principles of the Tax Reform.

➞ Promote continuing education in fiscal governance for state civil servants, legislators, and oversight bodies, to support the structuring of a transparent, standardized, and collaborative regional fiscal framework, articulated with the Tax Reform and ensuring legitimacy and legal certainty in the use of public resources and the establishment of funds oriented toward the region's ecological transformation.

6.2 AXIS 2
Technological Densification

The Technological Densification Axis **positions innovation and technological development as fundamental levers for an inclusive and sustainable regional project that integrates sustainability, social inclusion, and productive modernization.** Aligned with the New Industry Brazil Policy (*Política Nova Indústria Brasil* - NIB) and the National PTE, this axis seeks to **increase regional competitiveness by prioritizing strategic sectors for a low-carbon economy.**

Its starting points are the promotion of innovation within the productive base, **linked to the development of products with greater technological complexity and added value,** and the internalization of infrastructure, expanding technological reach across the entire territory.

The axis further aims to valorize human capital and the region's rich biodiversity, while promoting income redistribution through the socio-productive inclusion of citizens in high-quality, well-remunerated employment generated by the green-blue economy alongside the strengthening of sustainable, digital, and territorially embedded productive and industrial chains, and the promotion of Research, Development, and Innovation (RD&I) as the foundation for neo-industrialization.

To this end, the axis acknowledges the need to overcome historical and structural challenges, including the concentration of economic and technological infrastructure in large cities and metropolitan areas, and the fragile articulation among educational and research institutions, the productive sector, public policies, and traditional and local communities and peoples. Overcoming these barriers requires **integrated governance and the deconcentration of Science, Technology, and Innovation (ST&I) investments, so as to internalize technological development and connect scientific knowledge to territorial demands** from the coast to the *sertão*.

By **integrating traditional knowledge with technical and scientific expertise, and by prioritizing the valorization of local human capital**, the Technological Densification Axis aspires to position the Northeast as a national and global reference in the production of socio-environmental technologies,

promoting a just ecological transition and a development model that is economically dynamic, socially inclusive, and environmentally responsible.

Within this context, the axis proposals are structured around five main fronts: the improvement of regulatory frameworks to attract green-blue economy investments; the strengthening of education at all levels, with a focus on critical training and workforce development for green and blue jobs; investment in RD&I to drive sustainable neo-industrialization; the diversification and internalization of the productive base with value addition; and the promotion of regional entrepreneurship, local innovation ecosystems, and social technologies.

6.2.1 Structural Challenges for Technological Densification

The greatest challenge for technological densification in the Northeast lies in **decentralizing economic infrastructure, both technological and scientific, and in increasing technological complexity** with a view to expanding the region's competitiveness through products of greater added value. This central difficulty triggers and intensifies other significant obstacles, constraining the region's innovation potential.

Among these, particular attention is due to the **difficulty of building integrated governance**, marked by weak articulation among the public sector, educational and research institutions, and the productive sector. This fragility undermines the development of an innovation culture within the public service and limits the effective incorporation of social technologies and the stimulation of regional entrepreneurship. Another critical gap is the **scarce participation of traditional and local peoples and communities in decision-making processes,** which prevents the construction of truly inclusive innovation ecosystems connected to local realities and knowledge. This exclusion perpetuates development models disconnected from the territory and from regional potentialities.

In the domain of human capital, the challenge of **talent retention** stands out, compounded by insufficient recognition of researchers and qualified professionals. Although progress has been made in the internalization of higher education, a deficit persists in technical training oriented toward green-blue economy jobs. The **disconnection between scientific production and territorial demands**, combined with **still-limited investment** in science and technology, constrains the development of an innovative productive chain that valorizes workers and generates products and services with greater added value.

Financial barriers constitute another significant obstacle characterized by difficult access to credit, low investment in sustainable technologies, and insufficient fiscal incentives for small enterprises and family farming. Excessive bureaucracy and the scarcity of resources for projects aligned with local specificities hinder the consolidation of a dynamic and inclusive business environment essential for driving regional innovation.

Complementing these challenges are the **low level of industrialization and the disconnection between productive chains and the knowledge generated through ST&I.** Technological infrastructure presents limited reach, with coastal concentration and precarious access in rural and interior areas. The discontinuity of public calls for proposals and chronic underfinancing in research and infrastructure undermine the formation of regional innovation hubs, perpetuating territorial asymmetries and constraining the potential for knowledge-based economic transformation.

6.2.2 Pathways and Opportunities for Technological Densification

Despite the challenges, the Northeast region possesses singular potentialities that position it to lead the **growth of sustainable economic productivity through technological innovation and professional qualification.** Its human capital is composed of a resilient and creative population whose workforce represents a strategic asset for the green-blue economy, provided it is supported by consistent qualification policies. Furthermore, the expansion and internalization of Federal Universities and Institutes across the region have not only increased the number of scientists but also strengthened their connection with their territories of origin.

The existing knowledge networks in the region, integrating research and researchers from diverse fields, represent a strategic resource for directing scientific production toward innovation in the productive sector and toward a low-carbon economy. To this potential is added the **sociocultural and economic value of the knowledge, technologies, and practices of indigenous peoples, traditional communities, and inhabitants of the semi-arid region, as well as social technologies** focused on coexistence with the Caatinga. The exchange between these bodies of knowledge constitutes a distinctive advantage capable of driving inclusive and contextually grounded technological development. Moreover, the planned initiative to promote the internalization of technological densification, aligned with local productive chains and demands, from the coast to the sertão, broadens regional opportunities through investment in strategic areas of the low-carbon economy and the digital era.

The Northeast presents unique conditions to consolidate itself as a hub of sustainable innovation. The region counts on universities and federal institutes that maintain **research networks of excellence in strategic areas**, offering a solid foundation for technological advances. There is significant potential to **expand public calls for proposals, consolidate technology parks and climate-focused innovation centers, and foster startups and productive arrangements aligned with the green-blue economy.** The integration of technical training, social technologies, and biotechnology represents a singular opportunity to develop innovative and inclusive solutions to climate challenges.

In addition, the **advancement of state ST&I strategies oriented toward the ecological transition** creates new opportunities to strengthen local capacities. Adding to this

context is the **connection between scientific knowledge and sustainable productive and industrial sectors, alongside the potential of state-owned enterprises with distinguished technological expertise** which play a crucial role in sustainable territorial development. When strengthened, this synergy among academia, the productive sector, and public policies constitutes an essential foundation for regional technological densification.

6.2.3 Vision for the Future of Technological Densification

The vision for the future of the Northeast conceives of technology as the central lever for overcoming historical challenges and positioning the region as a global reference in socio-environmental technologies with the capacity to export this knowledge. This trajectory will be built through broad collaboration among government, the productive and industrial sectors, and territories, actively integrating the knowledge of indigenous peoples, traditional communities, and peoples of the fields, waters, and forests.

The future scenario envisions a **strengthened educational system** across basic, technical, and vocational levels, aligned with environmental education and forming critical citizens prepared for quality employment in the green-blue economy. In parallel, strategic investments aim to **retain and valorize local scientific talent**, combating intellectual exodus and promoting income deconcentration.

The productive transformation will be marked by the **diversification and internalization of economic activities**, with the decentralization of innovation infrastructure and the sustainable use of the region's biomes, particularly the rich biodiversity of the Caatinga. The promotion of RD&I and ST&I ecosystems will strengthen regional productive and industrial chains while improving living conditions for the population. **Completing this vision is the creation of a business environment conducive to regional entrepreneurship and green enterprises**, expanding competitiveness through products of greater technological complexity and added value.

6.2.4 Proposals for the Technological Densification Axis

The proposals for **Technological Densification** are directed toward consolidating an integrated strategy of innovation, education, and productive development oriented to the transition toward a green-blue economy in the Northeast, articulating environmental sustainability with economic dynamism. The objective is to improve regulatory and normative frameworks, strengthen technical training and critical environmental education, and stimulate research, development, and innovation to drive sustainable neo-industrialization, grounded in productive complexity, value addition, and socioeconomic inclusion. By promoting regional entrepreneurship, social technologies, and the diversification of the productive base, the axis aims to internalize development, generate highly qualified employment, and make the region more competitive, resilient, and attractive to sustainable investment.

ADT01 — Improve regulations and regulatory frameworks related to innovation and technology, so as to enable the effective realization of opportunities generated by the green-blue economy in the Northeast.

This proposal seeks to consolidate the Northeast as an attractive hub for green-blue economy investments and enterprises, grounded in regulatory modernization to drive innovation and technology with socio-environmental justice toward a low-carbon economy. To this end, it is essential to propose integrated planning and the establishment of strategic territorial and sectoral zones aligned with the region's vocations and organizational structure, and with the conservation of its natural resources. Instruments such as Export Processing Zones (EPZs)[33], which promote development, generate employment, and attract investment, and legal frameworks such as Complementary Law No. 182/2021 (*Startup Legal* Framework) and Decree No. 10.534/2020 (National Innovation Policy) are vital for fostering innovative solutions and integrating public policies to stimulate sustainable technological development in the Northeast.

In the context of the blue economy, the proposal articulates with the implementation of Marine Spatial Planning (MSP)[34] — Decree No. 12.491/2025[35] — ensuring that marine economic development occurs in synergy with the conservation of coastal and ocean ecosystems. Through the *Consórcio Nordeste*, the aim is to establish integrated governance among the states, guaranteeing the participation of traditional communities and aligning regional strategies with national sustainability objectives.

➞ **Strategic initiatives and agents:** MMA, MDIC, *Consórcio Nordeste*, Sudene, regional state governments, State Secretariats of the Environment, State Environmental Bodies, the Brazilian Navy *(Marinha do Brasil)*, the Interministerial Commission for Sea Resources (*Comissão Interministerial para os Recursos do Mar* - CIRM), State Legislative Assemblies, the Regional Development Plan for the Northeast (PRDNE) 2024–2027, and the National Policy for the Recovery of Caatinga Vegetation.

33. Export Processing Zones (EPZs) are free trade areas open to foreign commerce, designated for the establishment of enterprises oriented toward the production of goods and services for export. Available at: https://www.gov.br/mdic/pt-br/assuntos/zpe.

34. "Marine Spatial Planning is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that have been specified through a political process." Available at: https://www.ioc.unesco.org/en/manag

35. Available at: Planejamento Espacial Marinho — Ministério do Meio Ambiente e Mudança do Clima; D12491

PRIORITY ACTIVITIES:

➞ Develop and improve regulatory instruments that favor predictability, legal certainty, and impact investment for the promotion of sustainable development in the Northeast.

➞ Ensure integrated governance and technical work in the elaboration and implementation of Territorial and Sectoral Zoning frameworks, so as to achieve alignment among the federal government, the Northeastern states, and municipalities.

➞ Strengthen the regulatory framework of the Regional Development Plan for the Northeast (PRDNE) through the identification, analysis, and incorporation of pre-existing state legislation related to strategic themes with a view to constructing innovative solutions and integrating regulatory instruments already consolidated in the region.

➞ Foster regional productive integration through investment in logistics infrastructure, harmonization of norms, and regional value chain planning.

➞ Prioritize, within Territorial and Sectoral Zoning frameworks, the sitting of enterprises that use renewable energy.

➞ Establish integrated governance, through the *Consórcio Nordeste*, with all states in the region for the implementation of Marine Spatial Planning (MSP) across the entire region.

➞ Condition new Export Processing Zones (EPZs) on investment in research centers.

ADT02 — Strengthen the basic education system and technical and vocational training in the Northeast with critical and innovative environmental education, preparing conscious citizens and building local workforce capacity for high-qualification green-blue jobs.

This proposal aims to improve the quality of life and expand opportunities for the citizens of the Northeast region, through initiatives that **promote education at the basic, technical, and vocational levels, valorizing human capital**. The aim is to expand critical thinking capacity, particularly among young people, through actions oriented toward environmental education.

The strengthening of public policies, projects, and programmes[36] fostering critical and participatory environmental education is fundamental to this end. The goal is not only to develop students' critical awareness of the reality surrounding them and of new social, economic, and environmental contexts, especially in the face of the ecological transformation process in the digital era, but also to encourage research and innovation from the basic education level onwards.

In addition, the proposal will align technical and vocational training with regional demands, qualifying the local population for a labor market in constant transformation. To this end, it will ensure that technical and vocational training is aligned with existing or emerging regional demand. The planned initiatives will qualify the regional workforce, expanding access to jobs that require specialization and offer better remuneration thereby contributing to reducing labor precariousness and income, economic, and social inequalities, while promoting better living conditions.

Initiatives such as Oxe Tech[37], the Scientific Expedition of the Lower São Francisco River *(Expedição Científica do Baixo São Francisco)*[38] (AL), *Qualifica+ Ceará*[39], and the Science at School Programme *(Programa Ciência na Escola)*[40] (BA) demonstrate the viability of this approach and represent concrete examples aligned with the direction of this proposal.

➞ **Strategic initiatives and agents:** Ministry of Science, Technology and Innovation (*Ministério da Ciência, Tecnologia e Inovação* - MCTI), Ministry of Education (*Ministério da Educação* - MEC), the *Sistema S* network, and the region's governors coordinated by the *Consórcio Nordeste* for the sharing of successful practices in basic, technical, and vocational education and joint regional direction, alongside State Secretariats

36. As exemplified by Cemaden Educação. Available at: https://educacao.cemaden.gov.br/sobre-nos/#4-section

37. A programme developed in the state of Alagoas that fosters technological capacity-building with a view to insertion into an increasingly dynamic and digital labor market. Available at: https://oxetech.al.gov.br/

38. An initiative operating across multiple fronts, including the promotion of environmental education. Available at: https://ufal.br/ufal/pesquisa-e-inovacao/programas/expedicao-cientifica-do-rio-sao-francisco/quem-somos/apresentacao-da-expedicao-cientifica-do-baixo-sao-francisco.pdf/view

39. Focus on "promoting sociodigital inclusion and productive insertion with an emphasis on employment and income." Available at: https://www.ceara.gov.br/2024/08/06/16-mil-pessoas-receberao-qualificacao-profissional-por-meio-de-projeto-do-governo-do-ceara/

40. The Programme aims to drive scientific curiosity and strengthen the process of Scientific Education and the popularization of science for teachers and students in Basic Education, particularly in the final years of primary school and secondary education, across all modalities. Available at: https://www.ba.gov.br/educacao/cienciananescola

of Education, the Environment, Science and Technology, and Labor and Professional Qualification *(Secretarias Estaduais de Educação, Meio Ambiente, Ciência e Tecnologia, Trabalho e Qualificação Profissional)*; the National Centre for Monitoring and Alerts for Natural Disasters (*Centro Nacional de Monitoramento e Alertas de Desastres Naturais* - Cemaden); and the State Research Support Foundations (*Fundações Estaduais de Amparo à Pesquisa* - FAPs) of the region's states.

PRIORITY ACTIVITIES:

➡ Strengthen programmes and projects that stimulate active and participatory environmental education, as exemplified by Cemaden Educação[41].

➡ Universalize access to technical and vocational education, expanding the provision of courses oriented toward the green-blue economy[42], aimed at productive inclusion in qualified and well-remunerated employment.

➡ Establish a regional continuing education programme for basic education teachers, so that environmental education is addressed in a critical and interdisciplinary manner, stimulating collective awareness aligned with socio-environmental justice.

➡ Incorporate new technologies into the teaching and learning process in basic education, building students' capacity to use new information and communication technologies.

➡ Establish citizen science programmes that encourage young students to propose technological solutions and/or socially impactful initiatives related to their territory.

➡ Expand and ensure the internalization of public institutions offering technical courses that provide training aligned with the vocation and demand of the territory, fostering innovation and the responsible use of social and digital technologies with environmental responsibility.

41. Cemaden Educação is a program of the National Center for Monitoring and Alerts of Natural Disasters (Cemaden), linked to the MCTI (Ministry of Science, Technology and Innovation), created in 2014 to promote a culture of disaster prevention. It works with schools and communities, educating about environmental risks, climate change, and building community resilience.

42. "Sectors that align economic growth and innovation with social and environmental justice, a low-carbon economy, grounded in collaboration and inclusion, that respects terrestrial and marine ecosystems and ocean health" (UNESCO, 2017; UN, 2019). Available at: https://unesdoc.unesco.org/ark:/48223/pf0000374788_por and https://news.un.org/pt/story/2019/06/1676321

➥ Ensure the use of new PAC[43] resources to guarantee infrastructure such as Computing, Science, and Robotics Laboratories with full connectivity.

➥ Encourage the sharing of good teaching practices at the primary and secondary levels through the exchange of successful experiences in environmental education and the use of new innovation and communication technologies.

ADT03 — Invest in research, development, and innovation to drive the sustainable neo-industrialization of the Northeast, with a focus on productive complexity, competitiveness, and value addition.

The transition toward **sustainable neo-industrialization** requires the combination of Science, Technology, and Innovation (ST&I) with the strengthening of local productive capacities. The Brazilian Northeast, with its diversity of natural resources, human capital, and cultural assets, has the potential to lead this agenda provided that investments in applied research, **technological innovation, and the development of new products and processes** are planned in an articulated, continuous, and territorially balanced manner.

The **valorization of the regional scientific and technological** base is essential for transforming knowledge into innovation, reducing external dependencies, and generating qualified employment. This involves investing in the infrastructure of the Technology Innovation Centers (*Núcleos de Inovação Tecnológica* - NITs) of universities and public institutes; creating innovation environments in scientific and technology parks; and articulating regional and national RD&I calls for proposals oriented toward strategic themes of the ecological and digital transitions.

Experiences such as the Porto Digital Technology Park (*Parque Tecnológico Porto Digital* - PE), SergipeTec (SE), the Bahia Technology Park (BA), and the Scientific and Technological Park of Rio Grande do Norte (*Parque Científico e Tecnológico do Rio Grande do Norte* - PotyPark) demonstrate the potential of territorial innovation when academia, government, and the productive sector are integrated. Expanding this ecosystem and connecting it to international research networks and technical cooperation is fundamental for positioning the Northeast as a driving force in bioeconomy, economic decarbonization, and new clean technologies.

43. The PAC (Growth Acceleration Program) is an investment program coordinated by the federal government, in partnership with the private sector, states, municipalities, and social movements. The combined effort aims to accelerate economic growth and social inclusion, generating employment and income, and reducing social and regional inequalities.

The proposal aims to **retain talent, stimulate applied research**, and add value to regional resources through the convergence of biotechnology; Information and Communication Technologies (ICTs); renewable energies; circular and solidarity economy; sustainable agroindustry; bio-inputs; and innovative agri-food systems. The formation of knowledge networks, advanced capacity-building programmes, and international scientific cooperation calls for proposals to complement this effort, expanding the Northeast's technological autonomy and competitive insertion into high value-added productive chains.

➞ **Strategic initiatives and agents:** MCTI; MEC; the National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* - CNPq); the Coordination for the Improvement of Higher Education Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* - Capes); BNDES; Studies and Projects Financing Agency (*Financiadora de Estudos e Projetos* - Finep); state development banks (BNB, *Desenbahia, AgeRio, Desenvolve*-PE, among others); State Research Support Foundations (FAPs); *Consórcio Nordeste*; Federal Universities and Institutes; Technology Parks and Hubs; Embrapa; ICTs; and international institutions of scientific and technological cooperation.

PRIORITY ACTIVITIES:

➞ Institutionally strengthen NITs and Scientific and Technology Parks in the Northeast, modernizing laboratories, accelerators, and prototyping centers and expanding applied research capacity in areas such as biotechnology, ICTs, sustainable materials, and renewable energies.

➞ Implement the Northeast Programme for Neo-industrialization and Sustainable Innovation (*Programa Nordeste de Neoindustrialização e Inovação Sustentável* - Pronis), articulated with the *Consórcio Nordeste*, to finance RD&I projects in bioeconomy, decarbonization, industrial digitalization, bio-inputs, sustainable agroindustry, and clean energies, connecting enterprises, universities, and ST&I institutions.

➞ Create a Regional Scientific Talent Fund, oriented toward the retention of researchers and young scientists, offering grants, industrial internships, and career support in science with a focus on applying knowledge to regional demands and on the creation of technology-based startups.

➞ Foster Advanced Research Centers in universities and federal institutes, stimulating thematic networks oriented toward innovation in intelligent agri-food systems, biorefineries, biotechnology, ICTs, and the circular economy, integrated with national and international cooperation programmes.

➞ Promote technical cooperation programmes and international exchanges with reference institutions in sustainable innovation, such as Fraunhofer, Wageningen, MIT, Fiocruz, and the Brazilian Enterprise for Industrial Research and Innovation (*Empresa Brasileira de Pesquisa e Inovação Industrial* - Embrapii), for technology transfer and the co-development of solutions in bioeconomy, energy efficiency, and productive digitalization.

➞ Develop regional digital platforms for the management and integration of data on Research, Development, and Innovation (RD&I), startups, patents, and innovation projects, strengthening the connection among academia, the productive sector, and government, based on digital technologies and the Internet of Things (IoT).

➞ Launch integrated applied innovation calls for proposals, oriented toward projects that transform scientific knowledge into high value-added productive solutions, such as biofertilizers, bio-inputs, new materials, biofuels, waste recovery technologies, and ICTs applied to Industry 4.0.

➞ Expand and internalize Graduate Programmes (*Programas de Pós-graduação* - PPGs) with an emphasis on strategic themes of neo-industrialization, promoting interinstitutional cooperation, the formation of networks, and the sharing of infrastructure between consolidated and emerging institutions.

➞ Encourage integration among universities, cooperatives, and solidarity economy enterprises, so as to diffuse social technologies, low-cost solutions, and inclusive innovation oriented toward sustainability and local income generation.

➞ Establish Regional Centers for Technical and Entrepreneurial Training in Sustainable Innovation, connected to technology parks and universities, to build the capacity of young people and professionals in areas such as bioeconomy, circular economy, productive digitalization, and renewable energies.

ADT04 — Diversify and internalize the productive base of the Northeast to promote socioeconomic inclusion, increase added value through technologies, and make the region more attractive for green-blue economy investments.

Inserting the Northeast region into the global production of the low-carbon economy, biotechnology, Industry 4.0, and the energy transition is imperative given the structural changes currently underway. To this end, it is essential to **diversify the regional productive base**, foster productive, industrial, and agroindustrial enterprises, and promote the **internalization of development**.

This transformation requires a **qualified workforce** to meet the demands of neo-industrialization, **adequate infrastructure, credit incentives**, especially for micro, small, and medium-sized enterprises, and public policies that stimulate **innovation in production**, such as public procurement for innovation, as exemplified by Technological Orders (*Encomendas Tecnológicas* - ETCs)[44].

The initiative aims to strengthen the Northeastern economy by stimulating the production of goods and products with **greater added value and technological complexity** while simultaneously ensuring income deconcentration through the capacity-building of people to occupy highly qualified positions in the green-blue economy. Programs such as *Brasil Mais Produtivo* and *Mais Inovação Brasil*[45], alongside the credit instruments of the NIB Action Plan, are aligned in this direction.

➞ **Strategic initiatives and agents:** MCTI, MDA, MDIC, public banks, State Secretariats of Labor and Professional Qualification, Economic Development Agencies and State Secretariats of Economic Development of the Northeastern states, public universities, the *Sistema S* network, startups, state governments, and the *Consórcio Nordeste*.

Priority Activities:

➞ Stimulate diversification in the productive sector by encouraging the development of products with greater technological complexity and added value, as well as innovative services and/or processes, through public procurement.

44. Available at: https://www.gov.br/aeb/pt-br/programa-espacial-brasileiro/encomenda-tecnologica-etec

45. The *Brasil Mais Produtivo* program is a Brazilian Federal Government initiative (coordinated by the Ministry of Development, Industry and Foreign Trade) aimed at increasing the productivity and digitalization of Brazilian micro, small, and medium-sized enterprises, offering consulting services, training, and financial support for the adoption of technologies. The *Mais Inovação Brasil* initiative is a complementary program focused on providing credit and financing (via BNDES/Finep) for innovation, technology, and sustainability projects.

➞ Establish integrated management that prioritizes communication and directs periodic monitoring and alignment actions as a means of avoiding operational bottlenecks and streamlining the public procurement for innovation process.

➞ Foster the productive capacity of the region through projects and programmes of financial, technical, and capacity-building incentives oriented toward micro, small, and medium-sized enterprises operating in strategic sectors of the PTE-NE, with special attention to traditional communities, indigenous peoples, and peoples of the fields, waters, and forests through the improvement of management processes and digital transformation, as exemplified by the *Brasil Mais Produtivo* project of the national government.

➞ Foster productive chains for the beneficiation of priority minerals for decarbonization and the energy transition process, as well as agroindustrial chains, stimulating the aggregation of value to bioeconomy products, particularly those produced by family farming, indigenous peoples, traditional communities, and peoples of the fields, waters, and forests.

➞ Promote sustainable industrial spaces with adequate technological infrastructure, including investments in data traffic and submarine cables, alongside technical support and innovation incentives, as a means of attracting green-blue economy enterprises. Establish and attract investment for green data centers in the Northeast, with priority given to the use of renewable energy sources and intelligent water management systems for cooling.

➞ Strengthen the agricultural innovation ecosystem by bringing together and promoting existing initiatives, as exemplified by the Agro Hub portal defined within the NIB, as a means of reinforcing agroindustrial chains.

➞ Invest in applied knowledge in Biotechnology and expand infrastructure oriented toward Research, Development, and Innovation (RD&I), with the aim of promoting the decentralization of scientific and technological activities and reducing intra-regional disparities in research and technological development while also stimulating the connection between Research and Innovation Centers and the productive base.

ADT05 — Foster Regional Entrepreneurship and Social Technologies as a means of strengthening the green-blue economy of the Northeast and reinforcing Local Innovation Ecosystems across the region.

Innovation Ecosystems emerge as strategic instruments for promoting just and sustainable territorial development, aligning the region with global trends in Industry 4.0 and the low-carbon economy. This type of initiative contributes to the assertive insertion of the Northeast into the green-blue economy at both national and international levels. To this end, it is fundamental to **strengthen innovation** through public institutions with robust national technology, such as Embrapa, developing solutions adapted to territorial demands.

In parallel, there is an urgent need to foster **innovative entrepreneurship** that valorizes local knowledge, regional cultures, and social technologies, particularly those oriented toward sustainable coexistence with the semi-arid environment. These joint initiatives accelerate the Northeast's competitive insertion into the green-blue economy. A successful example is the *EtnoCaatinga*[46] project, a partnership between Embrapa and MDA, which integrates traditional knowledge, Caatinga restoration *(recaatingamento)*[47], and social technologies to promote the socio-productive inclusion of traditional peoples and communities.

➞ **Strategic initiatives and agents:** MCTI; MDA; Ministry of Entrepreneurship, Microenterprise, and Small Business *(Ministério do Empreendedorismo, da Microempresa e da Empresa de Pequeno Porte)*; UFS; Federal Institutes (IFs); public and private sectors; *Sistema S* network; State Secretariats of Science, Technology, and Innovation *(Secretarias Estaduais de Ciência, Tecnologia e Inovação)*; cooperatives; public banks; and organized civil society organizations.

46. The *EtnoCaatinga* project aims to recover degraded areas of the Caatinga biome and promote ethno-development in the territories of traditional peoples and communities. Coordinated by Embrapa Semiárido and MDA, the project benefits 400 families, using the "*recaatingamento*" methodology and social technologies such as cisterns and underground dams.

47. *Recaatingamento* designates the active process of ecological restoration specific to the Caatinga biome, encompassing the reintroduction of native species, assisted natural regeneration, and the recovery of the biome's characteristic vegetation cover through practices adapted to the semi-arid ecology. The term is a neologism derived from caatinga, a Tupi word meaning "white forest" or "sparse forest," referring to the biome's leafless appearance during the dry season, combined with the prefix re-, signaling restoration and return. It differs from generic "reforestation" in two key respects: it is biome-specific, referring exclusively to Caatinga vegetation recovery; and it carries a cultural and political dimension, having been developed primarily by traditional communities and social movements within the *convivência com o semiárido* paradigm, for whom the recovery of the Caatinga is also an act of territorial sovereignty and cultural affirmation. No single English term fully captures this convergence of ecological, cultural, and political meaning, which is why the original has been retained throughout this document.

PRIORITY ACTIVITIES:

➞ Strengthen local innovation ecosystems across the region, expanding support for incubators, accelerators, and technology parks that develop sustainable businesses and startups oriented toward the green-blue economy, prioritizing solutions for the semi-arid environment, Caatinga restoration (*recaatingamento*), and the efficient use of natural resources.

➞ Establish entrepreneurial and technological capacity-building programmes, with a focus on cooperatives, family farmers, indigenous peoples, and traditional communities, aimed at training green entrepreneurs and disseminating productive practices aligned with the circular and solidarity economy and low-carbon development.

➞ Foster partnerships among universities, institutes, and public enterprises with local populations, for the development and improvement of diverse technologies with emphasis on Social Technologies oriented toward adaptation to the Semi-Arid environment, Caatinga restoration (*recaatingamento*), and the socio-productive inclusion of traditional communities, indigenous peoples, family farmers, and peoples of the fields, waters, and forests.

➞ Strengthen enterprises and other public institutions as drivers of innovation, offering fiscal, financial, and managerial modernization incentives for public enterprises and entities with a vocation for innovation,as exemplified by Embrapa, with a focus on projects and programmes that leverage the low-carbon economy and neo-industrialization in the region.

➞ Invest in ST&I and expand the connection among public universities and institutes, research centers, the productive sector, and public authorities, with a view to promoting innovation in the region with a focus on the demands of the local productive base, in the context of the low-carbon economy and the digital era, through the implementation and use of funds dedicated to this purpose, such as the National Fund for Scientific and Technological Development (*Fundo Nacional de Desenvolvimento Científico e Tecnológico* - FNDCT) and Sectoral Funds, including those for Biotechnology, Energy, and Information Technology.

➞ Create research and artificial intelligence application hubs, integrated with universities, innovation centers, and enterprises in data centers with a focus on practical solutions for precision agriculture, water management, sustainable logistics, and the solidarity economy.

6.3 AXIS 3 Bioeconomy and Adapted Agri-food Systems

The Bioeconomy and Adapted Agri-food Systems axis is oriented toward consolidating and stimulating the generation of products, processes, and services based on the sustainable use of land and natural resources, grounded in science and innovation. Aligned with the National PTE, the central objective of this axis is to articulate the production of healthy food, the conservation of the socio-biodiversity of the Caatinga and other biomes, and the aggregation of value to the productive chains of agroecology, agroindustry, and non-agricultural services (such as community-based sustainable tourism), aligning **economic viability with social justice and environmental health.** Of particular note, the Northeast carries a historic experience of adaptation and the development of technologies for coexistence with the semi-arid environment.

The proposed strategic vision thus consists of consolidating an integrated agenda among the Northeastern states that strengthens the conservation and sustainable management of biomes, especially the Caatinga and marine ecosystems, and the valorization of socio-biodiversity; the promotion of income and food security through resilient, regenerative, and adapted agriculture and livestock farming, with the valorization of traditional knowledge; as well as the development of sustainable productive chains from bioeconomy products and community tourism.

The materialization of this vision demands, above all, coordinated and cooperative action to mobilize investments, integrate traditional knowledge with technological innovation, and monitor and evaluate social and environmental indicators, facilitating the exchange of good practices and collective learning. Among the strategic agents for this axis, particular prominence belongs to the *Consórcio Nordeste* itself, the Bank of the Northeast, state governments, agroextractivist cooperatives, development banks, social organizations, MDA, the Confederation of Rural Workers *(Confederação de Trabalhadores Rurais)*, universities, and research and technology institutions. The strengthening of public policies and support for local initiatives may thus drive the consolidation of an economy with ecological, solidarity-based, and inclusive foundations.

6.3.1 Structural Challenges for Bioeconomy and Agri-food Systems in the Northeast

The Northeast stands out nationally as a region deeply marked by socio-environmental conflicts, the result of a colonization process that perpetuated inequality and exploitation through the contestation of land and natural resources such as water and minerals. Treating land as common heritage, rather than as an object of speculation, is fundamental to strengthening the environmental legislation governing the protection and sustainable use of the Northeastern biomes.

Among the structural challenges related to sustainable land use that must be overcome are **food insecurity, deforestation** caused by monoculture practices and extensive livestock farming, and climate vulnerability, faced particularly by the Northeastern semi-arid region, whose susceptibility to prolonged droughts and desertification requires sustainable adaptive solutions that promote the productivity of rural families. Agri-food systems **dependent on external inputs persist**, making it necessary to strengthen sustainable agriculture that incorporates, in its production methods, the reduction of agrochemicals and synthetic fertilizers, implying investment in bio-inputs and biologically based technologies adapted to the semi-arid climate.

In the dimension of labor and social justice, one of the central obstacles is the undervaluing of local labor and knowledge. The ecological transition must therefore fully include rural workers, families settled through agrarian reform, and *quilombola* and indigenous communities. The **absence of robust mechanisms for access to credit** and Technical Assistance and Rural Extension (*Assistência Técnica e Extensão Rural* - ATER) specific to ecology-based agriculture limits the adoption of sustainable practices and prevents value aggregation in short production chains. Furthermore, the lack of **legal and land tenure security** across many traditional territories discourages long-term investment and conservation.

Despite its extraordinary biodiversity, the Northeast's bioeconomy faces the fragility of local production chains. The challenge lies not only in production, but in structuring logistics, processing, and commercialization in an efficient and just manner within adequate infrastructure (such as refrigerated warehouses and transport) for channelling perishable bioproducts. Without this, competitiveness and the valorization of final prices at origin may be constrained, perpetuating the cycle of raw material sales.

6.3.2 Pathways and Opportunities for Strengthening Bioeconomy and Adapted Agri-food Systems

The Northeast possesses unique conditions for driving Bioeconomy and Adapted Agri-food Systems as central axes of its socioeconomic transformation. The opportunities lie primarily in the strategic valorization of its rich socio-biodiversity through oriented research and innovation. The core must be the transition from a low value-added extractive economy toward the production of bioactives, bio-inputs, and high-quality functional foods, ensuring that technological development advances in step with social justice.

By investing in short production chains, supported by a robust system of Technical Assistance and Rural Extension (ATER) and green credit policies, the region can not only mitigate the effects of the climate crisis and desertification, but also generate endogenous economic growth that valorizes the knowledge of indigenous peoples, traditional, rural, fishing, and peripheral communities, strengthening the food security and food sovereignty of local families.

To achieve this objective, various pathways and opportunities may be traced, including: the expansion of partnerships, such as those with Sudene and local teaching and research institutions, for the production of bioactives and bio-inputs, such as medicines, cosmetics, and foods, adding value and driving the economy; the promotion of commercialization models that valorize biomes and communities; the valorization of traditional productive solutions through support for community-based production, ensuring the fair distribution of profits and investments that underpin food sovereignty and security; the encouragement of sustainable and solidarity-based production among small farmers, aimed at expanding productivity and reaching new markets, with the support of public policies and investment; and the integration of productive chains and markets through the promotion of events and platforms that connect small producers to industry and the population at large.

A further opportunity lies in the strengthening of legal frameworks that guarantee the protection and sustainable use of the Northeastern biomes, respecting the rights of indigenous peoples and traditional, rural, and peripheral communities. The union between traditional knowledge, scientific innovation, and a just regulatory framework will allow the Northeast to draw on its rich biodiversity to build a more prosperous, just, and sustainable future.

6.3.3 Vision for the Future of Bioeconomy and Agri-food Systems in the Brazilian Northeast

The PTE-NE celebrates the region's rich biodiversity as the engine of a new development model. The Caatinga, the Atlantic Forest, the Amazon, and the Cerrado are not merely biomes that compose the Northeast to be preserved, they are strategic assets for inclusive and participatory sustainable development that associates the strengthening of local productive capacities with social and environmental justice.

As a vision for the future, the Northeastern bioeconomy will rest on the following fundamental pillars: social inclusion and the combating of inequalities, valorizing the traditional knowledge of local communities and ensuring that benefits reach historically vulnerable groups; environmental preservation and climate solutions, integrating the environmental and economic agendas and strengthening sustainable solutions for addressing climate change and desertification, particularly in the semi-arid region; and the development of bioproducts and value aggregation to socio-biodiversity as vectors of more just and participatory chains.

Another important achievement is the consolidation of the network of cooperatives and social movements organized around agroecology and the solidarity popular economy. These measures are indispensable for promoting sustainable family farming and uniting tradition with innovation, mobilizing scientific and technological communities to enter into dialogue with **traditional ecological knowledge.**

Finally, this axis projects a vision for the future in which the Northeast is globally recognized as a reference in inclusive, resilient, and just bioeconomy. A region in which Agri-food Systems are integrally sustainable; the semi-arid region emerges with adapted agroecological practices; food insecurity is replaced by **food sovereignty, guaranteed by a strong family farming sector; and desertification indices are reversed through the regenerative management of biomes.**

In this future, **protected traditional ecological knowledge** merges with cutting-edge technology, generating innovative and high value-added bioproducts that supply national and global markets, generating income growth with redistribution toward communities of origin. The result is the expanded generation of dignified work and income, the end of the polluting matrix in food production, and the consolidation of a development model that balances environmental justice with social justice, demonstrating the harmony between economic growth and the preservation of the planet.

6.3.4 Proposals for the Bioeconomy and Adapted Agri-food Systems Axis

The proposals for the Bioeconomy and Adapted Agri-food Systems Axis aim at the conversion of the Northeast's productive model into a vector of sustainable and inclusive development. Their central objective is to articulate the production of healthy food, the conservation of the Socio-biodiversity of the Caatinga and other biomes, and the aggregation of value to the productive chains of agroecology, agroindustry, and non-agricultural services. The implementation of the proposals is grounded in collaborative governance, the debureaucratization of access to credit, and innovation. The success of the Axis depends on the inclusion of family farming, women, rural and coastal youth, and the formalization of commitments with commercial agriculture and agroindustry to ensure scale, market access, and sustainability across the entire region.

BIO01 — Strengthen legal instruments that regulate environmental protection and define guidelines for the conservation, sustainable management, and use of the Northeastern biomes.

The valorization and conservation of the Caatinga and other biomes requires the strengthening of specific legal instruments that protect the environment and orient sustainable economic activities. Decisive examples include the improvement of the legislation on Access to Genetic Resources and Benefit Sharing (Biodiversity Law)[48] to protect traditional ecological knowledge against biopiracy, and the Legal Framework for Science, Technology, and Innovation. Rigorous enforcement is indispensable to ensure that governments and agroindustry firmly comply with established laws and agreements.

Additionally, it is fundamental to expand the allocation of resources to funds and programmes for conservation compensation and incentives, such as Payment for Environmental Services (PES), the Rural Environmental Registry (*Cadastro Ambiental Rural* - CAR), and the Green Grant Programme (*Programa Bolsa Verde* - PBV).

As a regional implementation strategy, the proposal should strengthen the articulation and implementation of the Action Plan for the Prevention and Control of Deforestation and Burning in the Caatinga (*Plano de Ação para a Prevenção e o Controle do Desmatamento e das Queimadas da Caatinga* - PPCaatinga), in pursuit of the reduction of native vegetation loss and zero deforestation by 2030. This articulation will be achieved through the Federative Articulation Hub (*Núcleo de Articulação Federativa* - NAF) and the Monitoring and Evaluation Hub (*Núcleo de Monitoramento e Avaliação* - NMA) provided for in the Plan, to ensure that environmental protection is integrated into the Bioeconomy.

In the domain of legal protection, the Degraded Area Recovery Plans (*Planos de Recuperação de Áreas Degradadas* - PRADs), developed from the Technical Cooperation Agreement in Sergipe, involving the state government, *Desenvolve*-SE, the Sergipe Public Prosecutor's Office (*Ministério Público do Estado de Sergipe* - MPSE), Ibama, and Chico Mendes Institute for Biodiversity Conservation (*Instituto Chico Mendes de Conservação da Biodiversidade* - ICMBio), serve as models of joint action for environmental protection. In monitoring, the partnership between MapBiomas[49] and the

48. Available at: https://www.gov.br/mma/pt-br/noticias/lei-brasileira-de-biodiversidade-para-acesso-e-reparticao--de-beneficio-e-destaque-nacop15#:~:text=Em%2020%20de%20maio%20de,e%20uso%20sustent%C3%A1vel%20da%20biodiversidade

49. MapBiomas is a multi-institutional collaborative network (NGOs, universities, and technology companies) that has been mapping land use and land cover in Brazil annually since 1985. Using satellite imagery and artificial intelligence, the platform monitors deforestation, regeneration, agriculture, and fire with high resolution, offering free public data to understand the transformations of the territory.

CNE to combat illegal deforestation reinforces surveillance. Finally, the promotion of community-based programmes, such as the Green Enterprise Seal *(Selo Empresa Verde)* and reforestation through the *Plantar Juntos*[50] project, complements the strategy, uniting the oversight of major players with community action.

➞ **Strategic initiatives and agents:** Embrapa, Agronomic Institute of Pernambuco (*Instituto Agronômico de Pernambuco* - IPA), National Institute for Colonization and Agrarian Reform (*Instituto Nacional de Colonização e Reforma Agrária* - Incra), Sudene, National Indigenous Peoples Foundation (*Fundação Nacional dos Povos Indígenas* - Funai), ICMBio, state governments, State Environmental Bodies (*Órgãos Estaduais de Meio Ambiente* - Oemas), public banks, BNDES, BNB, IDB, the Development Bank of Latin America and the Caribbean (*Banco de Desenvolvimento da América Latina e Caribe*), and the Brazilian Biodiversity Fund (*Fundo Brasileiro para a Biodiversidade* - Funbio). At the federal level, the Ministries of the Environment and Climate Change and of Science, Technology, and Innovation participate, alongside CNPq and the National Council of the Northeast *(Conselho Nacional do Nordeste)*. Also involved are universities and federal and state institutes, as well as organizations, entities, and social movements, such as Centro Sabiá de Agroecologia, the *Quilombola* Women's Movement *(Movimento das Mulheres Quilombolas)*, Instituto Arapuá, the School of *Quilombos* in Pernambuco *(Escola de Quilombos em Pernambuco)*, and the *Casa da Mulher do Nordeste*. Also included are collaborative initiatives such as the Degraded Area Recovery Plans (PRADs), resulting from an agreement among the Government of Sergipe, *Desenvolve*-SE, and the Sergipe Public Prosecutor's Office (MPSE) and the *Caatinga Viva* Project, supported by BNDES and BNB, alongside environmental mapping and monitoring platforms such as MapBiomas.

PRIORITY ACTIVITIES:

➞ Establish direct dialogues with enforcement bodies for environmental protection laws, such as social oversight councils, territorial collegiate bodies, regional parity forums, and committees.

➞ Establish a permanent forum composed of representatives from public authorities, industries, communities, social movements, universities, and scientific institutions to implement strategies that promote and strengthen agroecology.

50. The *"Plantar Juntos"* program is a government initiative from Pernambuco, launched in June 2024 by Semas-PE, which aims to plant 4 million native trees in the Atlantic Forest and Caatinga biomes by 2026. The initiative focuses on the recovery of degraded areas, environmental education, and the engagement of civil society, businesses, and municipalities to combat climate change.

➞ Encourage the expansion of fiscal incentives, programmes, and financial funds that stimulate environmental protection and sustainable production among agroindustries, small and medium-sized producers, and family farming households.

➞ Conduct community workshops and interactive dialogues with diverse segments, including rural producers, social organizations, universities, and environmental bodies, on existing legislation, to collectively build solutions for the protection of productive buffer zones.

➞ Collectively build, with groups and agents related to agri-food systems, an aerial map of the region, identifying productive areas and riparian forests, legal reserves, marine environmental protection areas (artisanal fishing, coral coast), agroforests, irrigation systems, sustainable extractivist areas, and other productive buffer zones, for dissemination purposes.

➞ Conduct integrated georeferencing across the Northeastern states, with a focus on traditional and rural communities, fishing communities, and indigenous peoples affected by industrial agriculture, informing sustainable territorial planning, rational land use, the valorization of socio-biodiversity, and the mitigation of socio-environmental conflicts.

➞ Act as a facilitating link in the oversight of governmental bodies (Ibama, ICMBio, Funai, Incra, Oemas) regarding the financing of major players in embargoed areas, indigenous lands, national parks, coastal environmental conservation areas, and illegal deforestation zones.

➞ Create a centralized regional platform, managed by the *Consórcio Nordeste*, that uses Artificial Intelligence (AI) to cross-reference climate data with Rural Environmental Registry (CAR) data and deforestation alerts to predict and indicate zones at risk of desertification or environmental irregularity for the immediate action of enforcement bodies.

➞ Integrate data from the National Family Farming Registry (*Cadastro Nacional de Agricultura Familiar* - CAF), the Nursery Network, and ATER to indicate to farmers the best practices, adapted cultivars, and ideal planting and harvesting periods, increasing productivity and resilience.

BIO02 — Promote shared management and cooperation among the nine Northeastern states, using the *Consórcio Nordeste* as a central platform, to harmonize and accelerate the implementation of socio-environmental and economic solutions that benefit family farming, agroecology, and climate resilience across the Northeastern biomes.

This proposal advocates an integrated and cooperative approach among the Northeastern states, involving different segments of public authority, organized civil society, and the productive sector, in a shared management process for the development and implementation of sustainable solutions in agriculture and agroecology. The objective is to overcome bureaucratic barriers and the fragmentation of actions, promoting the integration of state public policies supporting agroecology, technical assistance (ATER), and market access.

The institutionalization of this cooperation will take place through the creation of a Working Group of Integrated Chambers dedicated to Bioeconomy, with the mission of facilitating the replication of sustainable solutions tested in the Semi-Arid region. This unified approach mirrors the coordination already present in market integration instruments, such as the joint use of the National School Feeding Programme (*Programa Nacional de Alimentação Escolar* - Pnae) and other Government Procurement Programmes (*Programas de Compras Governamentais* - PCG), which harmonize the demand of the nine states for family farming production. Furthermore, the proposal aligns with the spirit of long-term regional planning, as advocated in the Regional Sustainable Development Plans (*Planos de Desenvolvimento Regional Sustentável* - PDRSs), ensuring that sustainable development becomes a unified and well-managed state policy.

➞ **Strategic initiatives and agents:** universities; Federal Institutes; the Institute for Applied Economic Research (*Instituto de Pesquisa Econômica Aplicada* - Ipea); the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* - IBGE); National Institutes of Science and Technology (*Institutos Nacionais de Ciência e Tecnologia* - INCT); National Food and Nutrition Security Council *(Conselho Nacional de Segurança Alimentar)*; Sudene; Ministry of Education; BNB; *Consórcio Nordeste*; initiatives such as the National Programme for Education in Agrarian Reform (*Programa Nacional de Educação na Reforma Agrária* - Pronera), implemented by Incra, MEC, and MDA; the *Sertão Vivo* Programme (launched in 2023 by the Federal Government); Payment for Environmental Services Programmes (BA, PE,

CE, and PI); *Ecoforte* (a public policy implemented through the partnership between *Fundação Banco do Brasil*, BNDES, and the federal government); the Training and Social Mobilization Programme for Coexistence with the Semi-Arid: Management of Agrobiodiversity - Seeds of the Semi-Arid *(Sementes do Semiárido)*; and the One Land and Two Waters Programme *(Programa Uma Terra e Duas Águas - P1+2)*.

PRIORITY ACTIVITIES:

➞ Create a formal mechanism, coordinated by the Integrated Chamber, to identify, systematize, and promote the replication of best state practices, such as sustainable Caatinga management, social technologies for water security, and simplified sanitary inspection systems, across all Northeastern states.

➞ Work toward the integration of state regulations on credit, Technical Assistance and Rural Extension (ATER), and certification, particularly for agroecological and organic products, to reduce bureaucracy and facilitate family farmers' access to markets and financing instruments such as the FNE.

➞ Use the Consortium to pursue regional certification with international climate funds (such as the GCF and GEF), enabling access to non-reimbursable capital.

➞ Act jointly to drive the creation and use of the *Caatinga* Fund for degraded area recovery projects managed by family farming communities.

➞ Establish a collaborative network involving universities, Ipea, IBGE, and INCT to provide scientific data and predictive analyses, on climate change, carbon stocks, and markets, to support the strategic decisions of state managers and family farmers.

➞ Financially strengthen structural programmes such as *Viva o Semiárido* and the *Água Doce* Programme, improving resource allocation criteria and prioritizing territories with the greatest water and socioeconomic vulnerabilities.

➞ Invest in the qualification of ATER professionals through the creation of regional dialogue centers and decentralized hubs for agroecology studies and continuous technical assistance adapted to local realities.

➞ Strengthen the Northeast Healthy Eating Programme (*Programa de Alimentação Saudável* - PAS Nordeste) with sufficient and continuous budgetary provision so that it consolidates as a state policy, as the strategy guarantees predictability and security for farming families.

➞ Financially support the installation and modernization of small biofactories within associations and cooperatives, using the national family farming registry for seedling production, ensuring local income and the autonomy of traditional communities, rural communities, and indigenous peoples.

BIO03 - Consolidate a low-carbon regional economy based on the sustainable use of the Caatinga's biodiversity, through productive innovation, the development of the agroindustrial sector, the protection of genetic heritage, and the rigorous implementation of the zero deforestation target.

This proposal aims to establish a low-carbon bioeconomy development model focused on the use and value aggregation of the Caatinga's socio-biodiversity. The objective is to consolidate a sustainable regional agroindustry, structuring the entire productive chain from family farming through to final processing. This will be achieved through the financing and establishment of agroindustrial units and biofactories that will ensure the transformation of raw materials with traceability and certification of origin.

The sustainability of the productive base is secured by a rigorous commitment to zero deforestation, reforestation, and the promotion of Agroforestry Systems *(Sistemas Agroflorestais* - SAFs), which are capable of sequestering carbon. The protection axis is reinforced by the need to combat biopiracy and ensure Benefit Sharing, reflecting the success of governmental research programmes conducted by institutions such as Embrapa, particularly Embrapa Tropical Agroindustry (*Embrapa Agroindústria Tropical*, based in Fortaleza, CE) and Embrapa Semi-Arid (*Embrapa Semiárido*, based in Petrolina, PE), in the identification, improvement, and certification of adapted cultivars such as cashew and wild passion fruit (*maracujá-do-mato*)[51], which paves the way for the sustainable and legal use of regional bioactives.

51. The *maracujá-do-mato (Passiflora cincinnata Mast.)* is a native Caatinga species distinct from the commercially dominant yellow passion fruit *(Passiflora edulis)*. Naturally adapted to drought, poor soils, and high temperatures, it has documented applications in food production, traditional medicine, and the pharmaceutical and cosmetics industries, with bioactive compounds of growing scientific and commercial interest. *Embrapa Semiárido* has conducted genetic improvement research on the species, working toward cultivars that can be sustainably managed by family farmers and traditional communities. Its retention in Portuguese reflects both the absence of a consolidated English common name and the importance of preserving the cultural and territorial identity of a native plant whose valorization is central to the Northeastern bioeconomy agenda.

As examples of successful initiatives in the promotion of low-impact agriculture, it is worth citing the Terra Plantar Programme, which promotes the rural distribution of seeds and essential machinery, and the *Sertão Vivo* Programme, a climate resilience initiative that encourages agroforestry systems, social technologies, technical assistance for family farmers, and water harvesting through cisterns, operating primarily in the state of Ceará and other Northeastern states.

Furthermore, the inclusion of agroindustry and commercial agriculture and livestock farming is vital to the implementation of the proposed model, and must be governed by a sustainability pact. To this end, the proposal establishes governance mechanisms and technological tools that allow the monitoring of the alignment of large enterprises with conservation and social inclusion objectives, requiring vigorous oversight in the adoption of low-impact technologies.

➞ **Strategic initiatives and agents:** teaching and research institutions; the Constitutional Fund for Financing the Northeast (FNE); the Brazilian Bar Association (*Ordem dos Advogados do Brasil* - OAB); Embrapa; ASA; MMA; MDA; *Consórcio Nordeste*; Ibama; and Incra.

PRIORITY ACTIVITIES:

➞ Encourage the commercialization of seeds through Creole Seed Houses *(Casas de Sementes Crioulas)* and the continuation of the *Redeser* Programme (MMA), one of whose objectives is to reverse desertification processes in the Caatinga.

➞ Establish a regional certification system for native seeds and seedlings, ensuring quality and the use of material of proven and legal origin, combating the predatory extractivism of seeds.

➞ Financial support, through instruments such as the FNE and green funds, the establishment and modernization of small biofactories and processing units managed by cooperatives and family farmer associations for the processing of bioactives to add value across food, cosmetics, and pharmaceutical chains.

➞ Structure and maintain a regional network of nurseries and seed banks with advanced technology for the propagation of native seedlings of priority Caatinga species. This network will serve as the basis for state and community reforestation and degraded area recovery programmes.

➞ Create and implement a Regional Programme for Traceability and Intellectual Property, in partnership with universities and legal sectors, to curb biopiracy and ensure that research and the commercial use of bioactives generate the fair sharing of benefits with communities holding associated traditional knowledge in compliance with the Biodiversity Law.

➞ Commit states to the zero deforestation target across the region's biomes, supported by satellite monitoring systems such as the *Caatinga* Vegetation Cover Monitoring and Alert System (*Sistema de Monitoramento e Alerta para a Cobertura Vegetal da Caatinga* - SIMACaatinga). Integrate this effort with large-scale reforestation and the promotion of the conversion of degraded areas into productive Agroforestry Systems (SAFs), uniting conservation with water and food security.

➞ Formalize, with commercial agriculture and livestock farming enterprises and agroindustries, the signing of Sectoral Commitment Terms with verifiable Zero Deforestation targets in the Caatinga, water efficiency commitments, and guaranteed inclusive procurement targets for inputs and products from family farming cooperatives registered in the National Family Farming Registry (CAF-PJ).

BIO04 — Enter into technical cooperation agreements with development banks, state governments, social organizations, and municipalities to strengthen agroecological initiatives, agri-food systems, and non-agricultural activities such as community-based tourism and artisanal crafts.

This proposal establishes structured technical cooperation among development banks, state governments, and social organizations to strengthen and expand agroecological and non-agricultural initiatives in the Northeast. The objective is to articulate the efforts and competencies of each agent, ensuring resources, capacity-building, and qualified advisory services aimed at expanding the effectiveness of these actions across territories.

In this regard, development banks and the Federal Government may act as providers of financial resources and credit lines directed toward the implementation of projects. State governments, in turn, will act as guarantors and institutional intermediaries, promoting alignment with public policies and ensuring the sustainability of initiatives. Social organizations, meanwhile, will be responsible for community mobilization, capacity-building, and technical advisory support, assisting communities in the elaboration and implementation of local projects.

Furthermore, to improve technical assistance and rural extension, state bodies will develop training programmes and participatory methodologies oriented toward territorial realities, while social organizations may again support the identification of local demands, ensuring that technical and financial support reaches the beneficiary communities in an adequate and effective manner.

The proposed technical cooperation arrangement already finds support in other Northeastern experiences. Successful examples include *Conecta Caatinga*[52], implemented by the Brazilian Biodiversity Fund (Funbio), and the Caatinga Protected Areas Project (*Projeto Áreas Protegidas da Caatinga* - Arca), financed by the Global Environment Facility (GEF). The project focuses on the sustainable use of biodiversity in Conservation Units and their buffer zones; guarantees the autonomy of family farmers by strengthening grassroots agroecological initiatives; and promotes network organization. This integration drives the value chain of Caatinga bioactives, from sustainable management to small-scale processing, while also diversifying community income through non-agricultural activities such as community-based tourism.

Initiatives may also draw on the Plano Safra and National Programme for Strengthening Family Farming (Programa Nacional de Fortalecimento da Agricultura Familiar - Pronaf), which strengthen family and sustainable agriculture, encourage organic and sustainable production through lower interest rates and credit lines for low-impact technologies, and address the effects of climate change by prioritizing product diversification and, thus, efficient agri-food systems.

➞ **Strategic initiatives and agents:** Ministry of Tourism *(Ministério do Turismo)*; federal and state universities; Embrapa; state governments in partnership with the World Bank; BNDES; federal institutes, development banks, and private institutions, including the Plano Safra through the Federal Government, the National Programme for Strengthening Family Farming (Pronaf), and the National Support Programme for Medium Rural Producers (*Programa Nacional de Apoio ao Médio Produtor Rural* - Pronamp); *Piauí Sustentável e Inclusivo* (PSI); Funbio and the implementation of *Conecta Caatinga*, a strategy aligned with the *Caatinga* Protected Areas Project (Arca), financed by the Global Environment Facility (GEF), with the collaboration of partners such as the Institute for Socio-environmental Development of Bahia (*Instituto de Desenvolvimento Socioambiental da Bahia* - IDS).

52. *Conecta Caatinga* is an environmental conservation project focused on integrated management, ecosystem recovery, and strengthening biodiversity in the Caatinga biome. Coordinated by the Ministry of the Environment (MMA) and managed by FUNBIO, the project aims to create ecological corridors connecting protected areas within the biome.

Priority Activities:

➞ Use georeferencing and data from the National Family Farming Registry (CAF) to map areas with potential for **Community-Based Tourism** and Sociobiodiversity Artisanal Crafts hubs, directing investments strategically.

➞ Expand credit lines and working capital for non-agricultural rural projects, such as **Pronaf Bioeconomy; sustainable rural tourism** (financing for accommodation infrastructure and experiential itineraries in territories that use the Caatinga landscape as an asset); and **artisanal crafts and processing** (resources for equipment purchases and raw materials for artisan cooperatives and small agroindustries processing biodiversity products such as liqueurs, oils, candles, and preserves).

➞ Guarantee market access by articulating credit with institutional procurement programmes, such as Pnae and PAA, with a view to reaching new markets and increasing confidence for larger investments.

➞ Strengthen existing public policies such as the National School Feeding Programme (*Programa Nacional de Alimentação Escolar* - Pnae), Payment for Environmental Services (PES), the Food Acquisition Programme (*Programa de Aquisição de Alimento* - PAA), and Green Credits through the accompaniment of monitoring programmes.

➞ Create specific and simplified credit lines in development banks, with low interest rates, long repayment terms, and straightforward requirements, for ecological transition projects, agroindustry, and the commercialization of community-based products such as sustainable tourism and artisanal crafts.

➞ Strengthen pedagogical initiatives and technological research, while broadening access to available funds such as Funbio and the implementation of *Conecta Caatinga*.

➞ Form partnerships for the implementation of technological innovation projects with institutes, federal universities, and consultancies specialized in rural credit and capacity-building in agroecology and the solidarity popular economy.

➞ Promote training for small and medium-sized family farmers on the use of waste management technologies that contribute to reducing greenhouse gas emissions, such as composting.

BIO05 — Promote fairs, congresses, and gatherings to foster the exchange of local knowledge among networks of cooperatives, organizations, and social movements that practice bioeconomy and agri-food systems in the Northeast.

This proposal is essential for promoting the exchange of knowledge and the strengthening of local networks among cooperatives and social movements. By enabling direct connection between producers and specialists, the proposal not only valorizes traditional ecological knowledge but stimulates the local economy in a sustainable manner, generating employment and income and, above all, guaranteeing food security and sovereignty for people.

With commercialization and the expansion of local markets in mind, the *Consórcio Nordeste* may draw on the structure of the National Solidarity Economy Policy (PNES), forming partnerships between cooperatives and the public sector to supply products at fairs financed with resources from the Paul Singer Law (Law No. 15,068/2024, which establishes the National Solidarity Economy Policy - *Política Nacional de Economia Solidária*). Universities, research institutions, and social organizations may strengthen commercialization channels, connecting conscious consumption networks with fair trade.

By promoting integration among workers in agroecology and the solidarity popular economy with agroindustrial sectors and specialists, these gathering spaces **will facilitate the sharing of good productive practices**, support the fair commercialization of products, and advance the search for strategic solutions to overcome difficulties. The result is a bioeconomy that is just, inclusive, sustainable, solidarity-based, politically strong, autonomous, and potent.

➞ **Strategic initiatives and agents:** National Conference on Solidarity Economy (*Conferência Nacional de Economia Solidária* - Conaes); the National Solidarity Economy Council (*Conselho Nacional de Economia Solidária* - CNES); Ministry of Labor and Employment; *Centro Sabiá* (PE); CNE Thematic Chamber on Solidarity Economy; the National Institute of Metrology, Quality and Technology (*Instituto Nacional de Metrologia, Qualidade e Tecnologia* - Inmetro); Landless Workers' Movement (*Movimento dos Trabalhadores Rurais Sem Terra* - MST); the Interstate Movement of Babaçu Coconut Breakers (*Movimento Interestadual das Quebradeiras de Coco Babaçu* - MIQCB), an example of agroextractivism and struggle for territorial regularization in MA, PI, and BA; *Central da Caatinga* in Ceará, as an initiative that respects socio-biodiversity and

practices sustainable agroextractivism; the National Solidarity Economy System (*Sistema Nacional de Economia Solidária* - Senaes); *Armazém do Campo* (already established in PE, CE, BA, and RN); and *Armazém da Caatinga* in Ceará[53].

PRIORITY ACTIVITIES:

➡ Promote exchanges for the sharing of knowledge, ancestral technologies, and methods of water, soil, and production management among those who adopt agroecology as a field of biopsychosocial transformation.

➡ Carry out collective efforts (*mutirões*) to complete and update the National Registry of Solidarity Economic Enterprises (*Cadastro Nacional de Empreendimentos Econômicos Solidários* - Cadsol). Formalization will allow solidarity enterprises in communities to access financing lines, participation in public procurement, calls for proposals, and specific programmes such as the Paul Singer Programme.

➡ Strengthen self-management through socio-political training, encouraging democratic and collective participation in organizational decisions and in mechanisms of social oversight and popular participation.

➡ Continue and expand the Northeast Circuit of Family Farming Fairs *(Circuito Nordestino de Feiras da Agricultura Familiar)*, whose central pillar is the Northeast Family Farming and Solidarity Economy Fair (*Feira Nordestina da Agricultura Familiar e Economia Solidária* - Fenafes).

➡ Encourage citizen participation in the oversight and regulation of Local Productive Arrangements (*Arranjos Produtivos Locais* - APLs) through informational and educational campaigns, supervising the generation of dignified work, employment, and income aligned with sustainable practices.

53. *Armazém do Campo* is a chain of stores belonging to the Landless Rural Workers Movement (MST) that sells products from agrarian reform, focusing on organic, agroecological, and family farm products. *Armazém da Caatinga* is a space for marketing and promoting family farming in the Brazilian Semi-Arid region.

BIO06 — Enter into partnerships with governmental bodies, universities, social organizations, and private institutions for capacity-building and technical advisory services for youth and women in rural and coastal areas, with a focus on agroecology, the blue economy, and local bioeconomy — ensuring age and gender equity.

This proposal seeks to create a network of strategic partnerships with governmental bodies, universities, social organizations, and private institutions, guaranteeing specialized training and technical advisory services for youth and women in rural and coastal areas. The central focus is agroecology, which valorizes the production of healthy and **sustainable food, and local bioeconomy**, which promotes the responsible use of natural resources. The initiative ensures that capacity-building programmes and market opportunities incorporate age and gender equity, enabling women and youth to be the driving force of economic and environmental development in their communities.

By encompassing coastal youth and women, the proposal broadens its scope and impact, addressing the specificities of the blue economy in a sustainable manner. Through this collaboration, training modules will be developed that unite the traditional knowledge of female fishers, shellfish gatherers, and extractivists with new technologies and management practices. This will enable income generation from activities such as sustainable aquaculture and the processing of marine products. Technical advisory support will ensure that enterprises managed by these groups are viable and competitive, promoting economic autonomy and the preservation of marine ecosystems.

The building of these partnerships will enable the development of innovative projects that encourage a just and solidarity-based economy. By integrating the academic knowledge of universities with the **practical experience of communities** and the support of public and private institutions, the proposal creates a cycle of innovation sustainability. This collaborative model not only builds technical qualifications but also strengthens women and youth socially, encouraging leadership, collective organization, and participation in decision-making. The initiative thus consolidates itself as a tool for social transformation that promotes sustainability, equity, and the autonomy of local communities.

The Marine Spatial Planning (MSP) process currently underway may serve as an instrument guiding diverse governmental sectors — MMA, Ministry of Fisheries and Aquaculture (*Ministério da Pesca e Aquicultura* - MPA), MDS, the Ministry of Women (*Ministério das Mulheres* - MMulheres), and State Secretariats of the Environment, Social Development, Women, and Science and Technology — as well as public and development banks that may offer specific credit lines and promotion programmes for the popular, solidarity-based,

and sustainable economy. This may be complemented by the support of enterprises already working with social and environmental responsibility that may become partners in commercialization and innovation.

➞ **Strategic initiatives and agents:** Ministry of Agrarian Development and Family Farming (MDA); Ministry of Defense (Navy); Ministry of the Environment and Climate Change (MMA); Pastoral Land Commission (*Comissão Pastoral da Terra* - CPT); Agronomic Institute of Pernambuco (IPA); Landless Workers' Movement (MST); Homeless Workers' Movement (MTST); Educational Programme for Support to Sustainable Development (*Programa Educacional de Apoio ao Desenvolvimento Sustentável* - Peads) of the Service of Alternative Technologies (*Serviço de Tecnologias Alternativas* - Serta/PE); National Conference on Popular and Solidarity Economy (Conaes); *Consórcio Nordeste*; Sudene; BNDES (*Caatinga* Fund); Bank of the Northeast (Pronaf, Ecoforte); Brazilian Semi-arid Articulation (ASA); *Central da Caatinga*; *Centro de Desenvolvimento Agroecológico Sabiá* (PE); Embrapa (Semi-Arid); *Instituto Arapuá*; Northeast Black Women's Network *(Rede de Mulheres Negras do Nordeste)*; *Casa da Mulher do Nordeste*; National Rural Learning Service (SENAR); Parliamentary Agriculture Front (*Frente Parlamentar da Agropecuária* - FPA); National Agency for Technical Assistance and Rural Extension (*Agência Nacional de Assistência Técnica e Extensão Rural* - Anater); *Piauí Sustentável e Inclusivo* (PSI), co-financed by the IDB and the International Fund for Agricultural Development (IFAD).

PRIORITY ACTIVITIES:

➞ Expand the financing of inclusive and transformative environmental education policies, such as the National Programme for Education in Agrarian Reform (*Programa Nacional de Educação na Reforma Agrária* - Pronera).

➞ Promote the provision of financial incentives for continued networked capacity-building, courses, and workshops on the solidarity popular economy and the creative economy through private institutions, government bodies, research institutions, universities, and social organizations.

➞ Establish partnerships with institutions and social organizations for capacity-building on access to credit and financing programmes for family farmers, prioritizing youth and women.

➞ Develop an action plan that will accompany and establish direct dialogues with the management of the National Policy for Technical Assistance and Rural Extension (*Política*

Nacional de Assistência Técnica e Extensão Rural - Pnater) (Law No. 12,188/2010)[54] through the *Consórcio Nordeste*'s thematic chambers on youth and economic development.

➡ Foster and facilitate access to rural credit specifically targeted at youth and women.

➡ Conduct training in management and commercialization to develop self-management skills for cooperatives, business plans, and access to fairer markets, using solidarity economy platforms such as Cadsol.

➡ In partnership with development banks, create financing mechanisms for research support foundations engaged in projects for capacity-building and technical advisory services, including rural youth with a focus on agroecology and bioeconomy in the region.

➡ Create Marine Innovation and Bioeconomy Laboratories to establish physical and virtual spaces for exchange and experimentation in coastal communities, enabling youth and women to develop new products and services from marine resources in a sustainable manner.

➡ Develop projects and initiatives in partnership with *Petróleo Brasileiro* (Petrobras) and the National Industrial Learning Service (*Serviço Nacional da Indústria* - SENAI), with a focus on training and capacity-building for activities related to the blue economy (off-shore) for youth and women in the Northeastern coastal region.

➡ Provide qualification in new technologies through courses on sustainable aquaculture, the processing of algae for bio-inputs and cosmetics, and the maintenance of less polluting fishing equipment.

➡ Build the capacity of women and youth through flexible modular courses, grounded in their own practices, such as shellfish gathering *(mariscagem)*[55] and fish processing, adding value and ensuring the sustainability of resources.

54. Available at: https://www.planalto.gov.br/ccivil_03/Projetos/PL/2009/msg572-090722.htm#:~:text=A%20PNATER%20ter%C3%A1%20como%20benefici%C3%A1rios,%2C%20silvicultores%2C%20aquicultores%2C%20extrativistas%20e

55. *Mariscagem* designates the manual harvesting of shellfish, including molluscs such as oysters, mussels, and clams, and crustaceans such as crabs and shrimp, in coastal areas, estuaries, and mangroves of the Brazilian Northeast. It is a predominantly female activity, historically practiced by women known as *marisqueiras*, whose work constitutes a fundamental pillar of food security, cultural identity, and income generation in coastal and riverside communities. Despite its economic and social significance, *mariscagem* has historically been undervalued and excluded from formal fishing categories in Brazilian labour and production statistics, a gap progressively addressed by legal advances including the Maria da Penha Fisherwomen Law (Law No. 11,959/2009), which extended social protections to *marisqueiras*. In the context of the PTE-NE, *mariscagem* is recognized as a form of traditional ecological knowledge encoding generations of understanding of coastal ecosystems and sustainable harvesting, whose valorization is central to the blue economy and community-based development agenda of the Northeastern coast.

BIO07 — Promote the sustainable commercialization of Northeastern bioeconomy products and the provision of community-based sustainable tourism services, strengthening local agri-food systems and valorizing traditional knowledge.

This proposal presents the establishment of an integrated programme to strengthen the commercialization of products from the Northeastern socio-biodiversity to be implemented through the structuring of short supply chains, value aggregation based on socio-environmental innovation, and a commercialization model focused on overcoming inequalities, generating dignified work, and conserving the environment.

The objective is to directly connect family farming, agroextractivists, and traditional peoples and communities to institutional, private, and e-commerce consumer markets, ensuring fair prices, traceability, and the conservation of biomes, particularly the Caatinga. **This approach is strengthened by the incorporation of ethnotourism,** a modality that promotes immersion in the traditions and culture of traditional peoples and communities, such as indigenous peoples, *quilombola* communities, and artisanal fishers. In the Northeast, ethnotourism not only generates fair income for communities but also acts as a tool for cultural and environmental preservation.

Furthermore, considering the potential of Northeastern food landscapes, the sustainable commercialization programme proposes to create a **strategic bridge between the production of the Northeastern bioeconomy and the provision of community** tourism services, reinforcing local agri-food systems and the central role of communities in the management of their territories. An example that may be implemented with greater robustness is the Route of Semi-Arid Knowledge and Flavours *(Rota de Saberes e Sabores do Semiárido)*, which encompasses the states of Alagoas, Pernambuco, and Sergipe and was developed by Embrapa in partnership with local communities. This model deepens the valorization of food landscapes, which reflect the dynamics between the natural environment, ways of life, and the food culture of a people.

➞ **Strategic initiatives and agents:** MDA; MMA; National Conference on Popular and Solidarity Economy (Conaes); *Consórcio Nordeste*; Sudene; BNDES (Caatinga Fund); Bank of the Northeast (Pronaf, Ecoforte); Brazilian Semi-arid Articulation (ASA); *Central da Caatinga*; *Centro de Desenvolvimento Agroecológico Sabiá*; Embrapa (Semi-Arid); Agronomic Institute of Pernambuco (IPA); *Instituto Arapuá*; Northeast Black Women's Network; *Casa da Mulher do Nordeste*.

Priority Activities:

➞ Continue the Northeast Circuit of Family Farming and Solidarity Economy Fairs as a proposal for the circulation of farmers' products and the valorization of North-eastern culture.

➞ Structure an integrated socioeconomic and productive registry for the design of a bio-solidarity commercialization network in the Northeast.

➞ Implement a community-based tourism and ethnotourism circuit in strategic semi-arid territories, integrating new thematic routes that valorize food landscapes, promote the direct commercialization of local bioeconomy products such as native fruits and their derivatives, and increase the income of family farming households and traditional communities involved, ensuring gender equity and the central role of youth.

➞ Conduct capacity-building and continuous accompaniment of extension agents to act in bio-solidarity transformation, integrating agroecology, commercialization, sustainable resource management, and the valorization of traditional knowledge, promoting food sovereignty and security.

➞ Structure and strengthen direct and solidarity-based commercialization channels for agroecology and sustainable extractivism products from the Northeast, including facilitating the participation of enterprises in the PAA, Pnae, and PES programmes.

➞ Create a unified Brand and Seal — Bio-Solidarity Northeast *(Nordeste Biossolidário)* — that simultaneously attests to the sustainable origin (bioeconomy criteria) and the collective and fair management (solidarity economy criteria) of products, adding value to socio-biodiversity products through innovative processes, design, and participatory certifications.

➞ Foster community units or cooperatives for the processing of native fruits, production of native bee honey, processing of vegetable oils, biomass, smart cosmetics, pharmaceutical bio-inputs and medicines, and the manufacturing of bioproducts, using social and low environmental impact technologies.

➞ Support commercialization and market access to strengthen channels for agro-ecological and organic production, such as fairs, short commercialization circuits, and institutional procurement programmes, as exemplified by the Food Acquisition Programme (PAA).

➞ Structure a green and solidarity-based logistics network for bioeconomy products and community tourism services, reducing the carbon footprint of the value chain by 30% through route optimization and the implementation of distribution centers and strategic collection points at production hubs and tourist routes in the Northeast.

6.4 AXIS 4
Energy Transition

Brazil already holds one of the most sustainable electricity matrices in the world, with a broad contribution from hydroelectric, solar, and wind sources. The country is also a global reference in biofuel production, a central element in the decarbonization of the transport sector. Against this backdrop, Brazil stands out for its potential to expand renewable energy technologies such as Sustainable Aviation Fuel (SAF), biomethane, bio-bunker fuel, and low-carbon hydrogen, while attracting new energy-intensive industries and broadening local productive chains.

The PTE-NE deepens this agenda by recognizing the strategic role of the Northeast, which accounts for more than 80% of national wind and solar energy production, according to data from the Energy Research Company (*Empresa de Pesquisa Energética* - EPE), which serves the Ministry of Mines and Energy (*Ministério de Minas e Energia* - MME), and the National Electric System Operator (*Operador Nacional do Sistema Elétrico* - ONS). In this sense, the Energy Transition axis proposes to transform the region's natural and technological potential into a vector of sustainable development through the expansion and modernization of electrical infrastructure, the integration of smart grids, green industrialization, and the creation of local productive chains tied to renewable energy.

Furthermore, the proposals contained in the plan must ensure that the benefits of the energy transition are distributed in a fair and territorially balanced manner, promoting productive inclusion, income generation, and the strengthening of regional capacities with the adoption of social and environmental safeguards, impact mitigation mechanisms, and ongoing processes of listening to and participation by the communities involved.

In this context, the Brazilian Northeast emerges as the most promising territory for powershoring in the Southern Hemisphere, bringing together an abundance of high-quality solar and wind resources; competitive and renewable energy supply; and growing technological capacity. These factors position the region strategically to attract and

relocate energy-intensive industries; drive green reindustrialization; strengthen local productive chains; and expand its presence in global markets for renewable energy and sustainable products.

The proposals within this axis structure a new integrated energy model encompassing sustainable generation, storage, distribution, and consumption. This transformation aims to diversify renewable sources; advance the digitalization and storage of energy; strengthen productive chains for biofuels, biomass, and green hydrogen; qualify the workforce; and promote the responsible use of strategic minerals.

In this way, the Northeast consolidates its position as a central vector of Brazil's **energy transition, uniting fair territorial development, green reindustrialization, and the attraction** of renewable energy-intensive investment.

6.4.1 Structural Challenges for the Energy Transition in the Northeast

The energy transition in the Brazilian Northeast faces a complex set of structural, socioeconomic, and environmental challenges that demand integrated and coordinated responses. The region remains significantly dependent on fossil fuels to guarantee energy security, making it urgent to pursue a gradual substitution toward renewable sources,

such as solar, wind, biofuels, low-carbon hydrogen, biomethane, and SAF, in a planned manner and in alignment with the balance between supply and demand. This transition, however, runs up against infrastructure and logistics constraints: obsolete transmission networks, insufficient storage capacity, and low integration between generation hubs, industrial centres, and consumer markets, all of which undermine the efficient expansion of renewable energies and the integration of productive chains.

Economic sustainability also constitutes a significant obstacle: the scarcity of financial resources and the absence of continuous credit lines hinder the implementation of clean projects and technologies, particularly for small producers, cooperatives, and traditional communities. Low industrialization and limited economic diversification reduce the region's energy autonomy and constrain the attraction of long-term investment. In parallel, the lack of technical training and structured education programmes oriented toward the energy sector reveals gaps in the formation of a qualified workforce and in the articulation between science, technology, and innovation, especially for solutions adapted to the semi-arid context and the Caatinga biome.

Moreover, the expansion of renewable energy enterprises can generate significant social and environmental impacts, including deforestation, desertification, habitat disruption, stress on wildlife, and risks to human health, often without adequate compensation or legal regulation. These effects are compounded by the absence of specific protective instruments and appropriate reparation mechanisms.

Finally, governance and planning issues represent a cross-cutting challenge: the fragmentation of public policies, the low integration among governments, the productive sector, universities, and communities, and insufficient social participation, particularly from traditional peoples and smallholder farmers, undermine both the effectiveness and the legitimacy of the process. Overcoming these obstacles demands articulated public policies, long-term planning, technological innovation, and an inclusive and participatory governance capable of steering an energy transition that is just, sustainable, and aligned with the Northeast's inherent potential.

6.4.2 Pathways and Opportunities for the Energy Transition in the Northeast

The Northeast brings together a singular combination of natural, technological, and institutional assets that position it as a strategic protagonist in both the national and global energy transition. The convergence of steady winds, high solar irradiance, water availability, and mineral resources essential to the production of renewable equipment creates ideal conditions for expanding renewable energy generation and decarbonizing the economy.

The region stands out for the diversification of its energy matrix — solar, wind, hydroelectric, biomass, biofuels, ethanol, and green hydrogen — and for landmark initiatives that already demonstrate its capacity for innovation and investment attraction. The expansion of renewable generation, with particular emphasis on hybrid systems (solar-wind-hydrogen) and the consolidation of green hydrogen production hubs, such as the *Pecém Hub*[56] (CE) and the Green Energy Park (PI), makes it possible to reduce dependence on fossil fuels, advance energy security, and drive green reindustrialization, strengthening productive chains and generating skilled employment.

This energy vocation is intimately connected to the sustainable use of natural resources and the strengthening of the regional bioeconomy. The integration of agriculture, forests, and industry opens space for productive chains grounded in bioenergy

56. *Pecém Hub* (CE) is a large Industrial and Port Complex (CIPP) in Ceará, operating as a world-class logistics, industrial, and energy hub. In partnership with the Port of Rotterdam, it integrates a port, export zone (ZPE), and industries, with a current focus on green hydrogen, data centers, and fruit/steel exports.

and biofuels, making use of agro-industrial residues and biomass to generate energy and green inputs. State-level bioeconomy policies, such as those of Maranhão and Bahia, illustrate how the **valorization of socio-biodiversity** can bring together environmental conservation, productive innovation, and social inclusion.

At the same time, the strengthening of **human capital** is essential: the articulation between universities, research institutes, and technology centres must drive innovation and the development of emerging technologies, such as electrolysers, storage systems, and remote monitoring, alongside capacity-building programmes oriented toward the green economy, connecting scientific knowledge and traditional knowledge systems to the productive and social demands of the semi-arid region.

The energy transition also represents an opportunity to promote social inclusion and reduce inequalities. Decentralized and community-based models of renewable generation, such as the Sun for All *(Sol para Todos)* programme in Piauí and Solar Rooftop *(Teto Solar)* in Bahia, demonstrate that it is possible to broaden access to energy while generating income and reinforcing the autonomy of rural communities and vulnerable populations. The expansion of microgrids, energy cooperatives, and distributed systems strengthens both climate and productive justice. In parallel, infrastructure modernization, through the expansion of transmission lines, smart grids, and strategic works such as the *Canal do Sertão*[57] (AL), alongside the adaptation of ports like Pecém and Suape for hydrogen exports, enhances regional competitiveness and connects the Northeast to global energy value chains.

This process of technological and productive qualification reinforces regional competitiveness and strengthens the Northeast's powershoring potential, attracting sustainable and renewable energy-intensive industries and green infrastructure, boosting local value chains, blue-green jobs, and ecologically grounded reindustrialization.

The replication and scaling of successful experiences, such as the Ceará Green Hydrogen Hub, the One Million Solar Rooftops Programme *(Programa 1 Milhão de Tetos Solares)*, and the *Eco Piauí* project, consolidate the Northeast's role as a centre of innovation, sustainability, and climate leadership. To this end, it is essential to harmonize state, inter-municipal, and public-private policies within an integrated governance framework. Plans such as Pernambuco's PerMeie and Bahia's *Plano ABC+* exemplify participatory methodologies and institutional cooperation that can be replicated across the region. Coordinated engagement in national and international forums, meanwhile, can attract green finance for technological innovation, social inclusion, and environmental conservation.

57. The *Canal do Sertão* is one of the largest water infrastructure projects in Brazil, built to bring water from the São Francisco River to the *Sertão* and *Agreste* regions of Alagoas, benefiting more than 1 million people. With a projected length of approximately 250 km, it combats drought, provides water for human consumption, and boosts family farming.

6.4.3 Vision for the Future: The Northeast as a protagonist of the energy transition

The Brazilian Northeast holds exceptional conditions to **lead the country's energy transition,** combining an abundance of renewable resources — solar, wind, biomass, and biofuels — with the advancement of emerging technologies such as green hydrogen, biomethane, and sustainable fuels. This foundation makes it possible to consolidate the region as a national and international protagonist in the generation and export of renewable energy, while simultaneously strengthening productive chains, attracting industries, and driving green reindustrialization. The expansion of the energy matrix through hybrid systems, distributed microgeneration, and new energy models reinforces regional autonomy, while the integration between universities, technology centres, and the productive sector accelerates the development of innovative solutions adapted to the semi-arid context.

This energy transformation is directly connected to the promotion of social and territorial justice, ensuring tangible benefits for local communities, valorizing traditional knowledge, and generating green jobs linked to family farming and the circular economy. By consolidating strategic hubs and attracting national and international investment, the Northeast projects itself as a global hub of innovation and sustainability, converting its natural and social potential into a model of development that is competitive, inclusive, and resilient. In this scenario, the energy transition ceases to be merely a technological shift and becomes a structuring project capable of repositioning the region at the centre of Brazil's — and the world's — green economy.

Furthermore, this process opens the way for a new industrial and geopolitical development strategy, anchored in the concept of powershoring. In this context, the Northeast emerges as the ideal territory to host blue-green production hubs, connecting onshore and offshore energy, aggregating local value, and strengthening national competitiveness in global low-carbon markets. The advancement of green industries and the strengthening of regional productive chains, articulated with policies for innovation, infrastructure, and professional qualification, has the potential to transform the Northeast into an international reference for sustainable reindustrialization, energy integration, and shared prosperity.

6.4.4 Proposals for the Energy Transition Axis

The energy transition in the Northeast represents a significant opportunity for the country's productive and social transformation, grounded in the abundance of renewable resources, the region's geostrategic position, and its growing technological capacity. The proposals within this axis convert that potential into a vector of competitiveness and innovation, promoting investment attraction, the consolidation of green industries, and the strengthening of local productive chains. The aim is to expand and integrate energy infrastructure, generate green jobs, and ensure energy security and inclusion, transforming the Northeast's natural vocation into a solid foundation for a new low-carbon economy.

The proposals are presented below:

TE01 – Establish a territorialized regulatory framework for the energy transition in the Northeast, ensuring local generation, storage, commercialization, and the inclusion of vulnerable areas.

The Brazilian Northeast stands out as a leader in renewable energy generation, concentrating the largest share of the country's installed wind and solar capacity, yet it continues to coexist with deep territorial inequalities. Many rural and peri-urban areas, as well as traditional communities, remain on the margins of energy supply, storage, and consumption systems, limiting their productive participation in the energy transition and in sustainable regional development.

The Regional Development Plan for the Northeast (PRDNE) identifies as priority axes the "Harnessing of the Northeast's Energy Potential," "Sustainable Territorial Integration," and the "Development of the Renewable Energy Chain," highlighting the need to transform energy potential into economic value and social inclusion. To achieve these objectives, the proposal is to create a Territorialized Regulatory Framework for the Energy Transition, structured around three pillars: decentralized and equitable local generation; efficient energy storage and use; and simplified commercialization of surplus energy through local and cooperative markets.

This framework aims to guarantee legal certainty, economic predictability, and equitable access to the opportunities arising from the energy transition, valorizing the territories covered by the PRDNE and creating the conditions for renewable energy to become a vector of productive inclusion and climate justice in the Northeast.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); National Electric Energy Agency (ANEEL); National Agency for Petroleum, Natural Gas and Biofuels (*Agência Nacional do Petróleo, Gás Natural e Biocombustíveis* - ANP); Energy Research Company (EPE); National Electric System Operator (ONS); Electric Energy Trading Chamber (*Câmara de Comercialização de Energia Elétrica* - CCEE); Superintendency for the Development of the Northeast (Sudene); Ministry of the Environment and Climate Change (MMA); Bank of the Northeast (BNB); National Development Bank (BNDES); state and municipal governments; state secretariats for Energy and the Environment; universities and federal institutes; renewable energy cooperatives and associations; and international organizations (UNDP, IEA, UNEP, IDB).

PRIORITY ACTIVITIES:

➞ Develop and implement a regional regulatory framework for distributed generation, storage, and energy commercialization, aligned with Law No. 14.300/2022 (the Legal Framework for Micro and Mini Distributed Generation) and ANEEL resolutions, adapting them to the territorial realities of the PRDNE.

➞ Establish regional mechanisms for the commercialization of energy surpluses, including local and cooperative energy markets based on simplified contracts and registrations with the Electric Energy Trading Chamber (CCEE), enabling small producers, cooperatives, and rural enterprises to sell surplus energy to regional consumers.

➞ Regulate the use and remuneration of energy storage systems, including batteries, green hydrogen, and other emerging technologies, recognizing their role in grid stability and the reduction of energy losses.

➞ Structure dedicated credit lines within the FDNE, the Northeast Development Fund (*Fundo de Desenvolvimento do Nordeste* - FNE), BNB, and BNDES frameworks, directed at the installation of distributed generation systems, storage, and smart grids in small and medium-sized properties, cooperatives, and local enterprises, with emphasis on the energy-vulnerable areas identified by the PRDNE.

➞ Develop technical, environmental, and recycling standards for energy equipment — encompassing solar panels, turbines, inverters, and batteries — aligned with the National Solid Waste Policy *(Política Nacional de Resíduos Sólidos)* and the circular economy targets of the Ecological Transformation Plan.

➞ Institute renewable energy procurement programmes through which regional distributors and consumer cooperatives purchase energy from small and medium-sized producers, with clauses ensuring fair pricing, contractual stability, and regional priority, integrated within the Energy Compensation System (*Sistema de Compensação de Energia Elétrica* - SCEE).

➞ Establish social and environmental safeguard guidelines and community participation mechanisms, ensuring that energy generation, storage, and commercialization projects respect the territories and rights of local communities and advance climate justice, articulating the implementation of strategic investments by national and international companies (powershoring) so as to generate blue-green jobs and strengthen local renewable energy productive chains.

TE02 – Establish a State policy for multiple forms of energy integration in the Northeast, articulated through Regional Energy Innovation and Transition Centres (Citener), under the coordination of the *Consórcio Nordeste*.

The energy transition in the Brazilian Northeast requires a structural, regional, and permanent approach capable of articulating science, technology, economics, and social inclusion. Although the region concentrates approximately 80% of the country's installed solar and wind energy capacity, the harnessing of this potential still occurs in a fragmented manner, with low integration between sources, sectors, and territories.

Multiple forms of energy integration propose the coordinated connection between diverse energy matrices (solar, wind, biomass, biogas, and low-carbon hydrogen), complementary technologies (storage, digitalization, and smart grids), and different territorial scales (urban, rural, and industrial), ensuring greater efficiency, stability, and energy justice.

To consolidate this transition in a sustainable and lasting manner, the proposal is to create a **regional State policy — the Integrated Northeast Energy Transition Programme (*Programa Nordeste Integrado de Transição Energética* - Pronite-NE)** — under the coordination of the *Consórcio Nordeste*, in cooperation with state governments, universities, technology institutes, the productive sector, and civil society.

This policy will be implemented through the **Regional Energy Innovation and Transition Centres (*Centros de Inovação e Transição Energética Regional* - Citener)**: dedicated structures for applied research, technological development, professional training, project incubation, and territorial energy management. SENAI CIMATEC (BA) serves as a practical reference for this approach, integrating industrial innovation, scientific research, and technical qualification in green hydrogen, offshore wind, and advanced storage projects, functioning as a model for the creation of an interconnected regional network of Citeners.

➞ **Strategic initiatives and actors**: *Consórcio Nordeste*; Ministry of Mines and Energy (MME); National Electric Energy Agency (ANEEL); Energy Research Company (EPE); National Electric System Operator (ONS); Bank of the Northeast (BNB); BNDES; Brazilian Development Association (*Associação Brasileira de Desenvolvimento* - ABDE); state secretariats for Energy, Science and Technology, and the Environment; SENAI CIMATEC (BA); Federal Institutes; public universities; state development agencies; energy cooperatives; the private sector; and international organizations (IDB, UNDP, IEA, UNEP).

PRIORITY ACTIVITIES:

➡ Formalize the Integrated Northeast Energy Transition Programme (Pronite-NE) as a regional State policy, through a Letter of Intent within the framework of the *Consórcio Nordeste*, pursuant to Law No. 11,107/2005 (the Public Consortia Act - *Lei de Consórcios Públicos*).

➡ Establish the Pronite-NE Fund, in partnership with BNB, BNDES, and ABDE, dedicated to financing energy integration projects, the implementation of Regional Energy Innovation and Transition Centres (Citener), and the development of technological innovation.

➡ Deploy the first Citeners in strategic states, such as Bahia (methodological reference), Rio Grande do Norte (wind energy and green hydrogen), and Pernambuco (storage and smart grids), to create regional hubs for applied research, innovation, and technical capacity-building, articulating research, industry, and territory around a just and integrated energy transition.

➡ Establish experimental regulatory environments (energy sandboxes) in partnership with ANEEL and state agencies, testing models for microgrids, community generation, and local energy markets, with a view to promoting regulatory innovation and stimulating the creation of new sustainable productive arrangements in the energy sector.

➡ Develop the Northeast Green Hydrogen Plan *(Plano Nordeste de Hidrogênio Verde - H_2V)*, mapping industrial and port hubs and integrating solar and wind energy with electrolysers in regional pilot projects, contributing to industrial decarbonization and the Northeast's competitive insertion into the global green economy.

➡ Institute regional mechanisms for renewable energy public procurement (integrated procurement), coordinated by the *Consórcio Nordeste*, aggregating state demand for joint renewable energy contracting in order to reduce costs and increase predictability for investors.

➡ Implement technical and professional training programmes in partnership with SENAI, Federal Institutes, and universities, focused on the operation and maintenance of hybrid systems and community microgrids.

➡ Create the Northeast Energy Transition Observatory (*Observatório Nordeste da Transição Energética* - Onte), linked to Pronite-NE, for the continuous evaluation and monitoring of regional indicators on installed capacity, jobs generated, green hydrogen production, investment flows, and the mitigation of environmental impacts.

TE03 – Expand and integrate the Northeast's energy infrastructure to guarantee security, access, competitiveness, and regional leadership in the energy transition.

The Northeast faces structural and regulatory bottlenecks that limit the harnessing of its renewable energy potential. Specific studies, including the Strategic Infrastructure Study: Strategy 2050 (*Estudo Estratégico de Infraestrutura* – Estratégia 2050 - EB2050), the Northeast Power Plan *(Plano Nordeste Potência)*, and the Infrastructure Overview: Northeast Region *(Panorama da Infraestrutura – Região Nordeste)*, point to the urgent need to expand and modernize the Northeast's electrical, logistics, and natural gas infrastructure. These analyses underscore the importance of integrating renewable sources — solar, wind, biomass, and green hydrogen — with a view to guaranteeing energy security, universal access, economic competitiveness, and regional leadership in the energy transition.

The insufficiency of transmission lines, the fragmentation of legal frameworks, and the absence of local reinvestment mechanisms reduce the attractiveness of new projects and undermine the region's competitiveness. At the same time, the strengthening of territorial governance through territorial and sectoral zoning is essential to reconcile energy expansion, environmental protection, and social inclusion. Moreover, the integration of generation, transmission, distribution, storage, and efficient consumption must be accompanied by territorially balanced planning and investment policies, ensuring that the expansion of energy infrastructure occurs in a sustainable and inclusive manner, guided by regional development objectives.

To this end, it is essential to understand energy flows, where energy is produced, consumed, and wasted, and to align investment decisions with territorial, social, and environmental demands. In this sense, **the creation of regional renewable energy auctions, integrated planning in collaboration with the Energy Research Company (EPE), the expansion and interiorization of gas pipelines, and the implementation of smart grids** are key measures for advancing the Northeast's competitiveness in the energy sector.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); National Electric Energy Agency (ANEEL); National Electric System Operator (ONS); Energy Research Company (EPE); BNDES; state governments; transmission and distribution concessionaires; regional energy consortia; Ministry of the Environment and Climate Change (MMA); Ministry of Science, Technology and Innovation (MCTI); Studies and

Projects Financing Agency (Finep); universities and research centres; the private sector; and international investors.

PRIORITY ACTIVITIES:

➞ Conduct a Regional Diagnostic Study of Energy Infrastructure and Efficiency in the Northeast, coordinated by EPE in conjunction with state governments, universities, and concessionaires, mapping generation, transmission, distribution, losses, and bottlenecks; identifying regions subject to curtailments and constraints; proposing optimizations prior to new auctions; and incorporating social and environmental safeguards as well as the sustainable use of water, including for the low-emission hydrogen supply chain.

➞ Develop a Regional Energy Investment Prioritization Matrix, based on technical, social, environmental, and efficiency criteria, enabling the identification of critical areas, the optimization of existing capacity, and the territorially balanced direction of investment, prioritizing regions with the greatest energy deficits and avoiding infrastructure overlap.

➞ Establish regional renewable energy auctions targeted at the Northeast, with prioritization targets for renewable sources (solar, wind, biomass, and green hydrogen) and contractual clauses conditioning a portion of revenues on the expansion and modernization of regional transmission and distribution networks.

➞ Create a Regional Energy Reinvestment Fund, designed to ensure that a share of generation and transmission revenues is channelled back into infrastructure works, technological innovation, and local development, strengthening regional productive chains. The fund will also support the interiorization of gas pipelines and the expansion of digital infrastructure (such as submarine cables and fibre-optic networks), essential to the region's logistical and technological integration.

➞ Plan and execute the Integrated Northeast Energy Infrastructure Programme, expanding and modernizing transmission networks, integrating strategic gas pipelines and connectivity and data systems, incorporating water sustainability, environmental, and territorial criteria with the use of recycled water, low-impact technologies, and social responsibility standards.

➞ Incorporate powershoring guidelines into the energy infrastructure expansion policy, prioritizing the use of renewable energy and low-carbon hydrogen as vectors of regional reindustrialization and the attraction of green industries, particularly in the green steel, fertilizers, and cement sectors, and of value addition and economic income generation.

➞ Promote regulatory standardization and harmonization across states, municipalities, and the federal government, reducing administrative barriers, streamlining licensing processes without compromising environmental protection, aligning incentive policies, and strengthening integrated transmission studies to increase predictability and attractiveness for national and international investors.

➞ Integrate regional energy planning with territorial development policies, so that the expansion of energy infrastructure also contributes to improvements in mobility, sanitation, telecommunications, and digital connectivity in the areas of influence of energy projects.

TE04 – Promote participatory governance and just territorial development in the Northeast's energy transition, integrating Territorial and Sectoral Zoning instruments and the redistribution of socioeconomic and environmental benefits.

The energy transition in the Northeast represents a historic opportunity to promote economic development, social inclusion, and environmental sustainability in an integrated manner. Yet challenges persist in relation to governance, the equitable distribution of benefits generated by renewable energy projects, particularly regarding local job creation, professional training, the effective participation of local communities in decision-making processes, and the guarantee of fair social and environmental compensation.

Consolidating a model of just and inclusive energy transition requires the strengthening of regulatory, fiscal, and institutional frameworks that ensure the economic, social, and environmental gains remain within the region. Instruments such as the Ecological Green IBS *(IBS-Verde Ecológico)*; local content requirements; social clauses in contracts; mandatory social and environmental safeguards; and financial compensation mechanisms must be institutionalized across the Northeastern states to ensure that a portion of investments and royalties is channelled back into job creation, income generation, and the strengthening of local economies.

Territorial and Sectoral Zoning instruments are central elements of this process, guiding energy expansion in a territorially balanced manner and reconciling projects with **environmental protection, water security, and local productive dynamics.** The integration of energy, family farming, and semi-arid coexistence[58] policies is essential to promote socioeconomic resilience, reduce inequalities, and generate income sustainably. Initiatives such as the Cisterns Programme *(Programa Cisternas)*, Living *Sertão* - Sowing Climate Resilience *(Sertão Vivo - Semeando Resiliência Climática)*, the National Biodigesters and Biogas Programme *(Programa Nacional de Biodigestores e Biogás)*, and the Sustainable Irrigated Agriculture Programme *(Programa de Agricultura Irrigada Sustentável)* can be further leveraged by decentralized and integrated energy systems, strengthening local capacities and the linkages between energy, water, production, and territory across the region.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); Ministry of the Environment and Climate Change (MMA); Ministry of Agrarian Development and Family Farming (MDA); Ministry of Integration and Regional Development MIDR); Ministry of Social Development and Assistance, Family, and Fight against Hunger (MDS); National Development Bank (BNDES); Bank of the Northeast (BNB); Constitutional Fund for Financing the Northeast — Green *(FNE Verde)*; National Climate Fund (Fundo Clima); state development banks; *Consórcio Nordeste*; state and municipal governments; National Electric Energy Agency (ANEEL); National Water and Sanitation Agency (*Agência Nacional de Águas e Saneamento Básico* - ANA); National Electric System Operator (ONS); regional energy concessionaires and distributors; universities, federal institutes, and Regional Energy Innovation and Transition Centres (Citeners); CNPq; community organizations, agro-industrial cooperatives, and social movements; companies in the energy and agro-industrial sectors; civil society organizations and inter-institutional governance forums; International Bank for Reconstruction and Development (IBRD/ World Bank); Inter-American Development Bank (IDB); Development Bank of Latin America and the Caribbean (CAF); United Nations Development Programme (UNDP); German Development Cooperation Agency (*Deutsche Gesellschaft für Internationale*

58. The concept of semi-arid coexistence *(convivência com o semiárido)* represents a paradigm of territorial development that reframes the relationship between communities and the semi-arid environment of the Brazilian Northeast. Developed from the 1990s onward by civil society organizations and social movements, most notably the *Articulação no Semiárido Brasileiro* (ASA), a network of over three thousand organizations, it represents a deliberate departure from the historic "combat drought" *(combate à seca)* approach, which treated the semi-arid climate as an obstacle to be overcome through large-scale engineering interventions. In its place, convivência proposes the adaptation of productive systems, technologies, and public policies to the ecological logic of the semi-arid environment, working with its rhythms and resources rather than against them. In practical terms, the paradigm encompasses technologies such as rainwater harvesting cisterns, adapted seed banks, Caatinga-suited agroforestry systems, and decentralized renewable energy, many of which are referenced throughout the PTE-NE. It also recognizes traditional and local knowledge as an irreplaceable asset for sustainable development, and communities as the protagonists of solutions designed for their own territories.

Zusammenarbeit - GIZ); French Development Agency (*Agence Française de Développement* - AFD); United Nations Environment Programme (UNEP); European Investment Bank (EIB); International Fund for Agricultural Development (IFAD).

PRIORITY ACTIVITIES:

➞ Approve and implement regulatory frameworks and fiscal instruments that ensure the redistribution and retention of the benefits of the energy transition within the Northeastern territory, including mechanisms such as local content requirements, social clauses, contractual safeguards in auctions and authorizations, and financial compensation arrangements that strengthen regional development[59].

➞ Develop economic and regulatory policies and instruments directed at the installation of renewable energy projects in degraded areas, with incentives for the recovery of natural vegetation and territorial sustainability, including tax benefits, targeted credit, and environmental certifications, while avoiding new deforestation and preventing desertification in vulnerable zones of the Caatinga.

➞ Establish mechanisms for social participation, community oversight, and fair compensation, comprising structured community consultation processes, mandatory social and environmental conditionalities in the licensing of energy projects, and participatory monitoring of project implementation, in conformity with ILO Convention No. 169[60].

➞ Institute and implement Territorial and Sectoral Zoning (*Zoneamentos Territoriais e Setoriais* - ZTS) across all Northeastern states as a territorial governance tool and basis for strategic decisions, ensuring compatibility between energy projects, sustainable land use, and environmental protection, with broad social participation and legal certainty.

➞ Integrate energy, water, and family farming policies in the Northeast, promoting coordinated territorial planning that aligns the expansion of energy projects with productive and community demands, strengthening local economies and reducing inequalities.

59. With the 2023 Tax Reform, consideration must be given to the transition from the Ecological ICMS *(Imposto sobre Circulação de Mercadorias e Serviços)* to the Ecological IBS *(Imposto sobre Bens e Serviços)*, which allocates 5% of tax revenues to municipalities on the basis of environmental criteria, ensuring continuity in the promotion of just and sustainable territorial development practices.

60. Available at: https://tinyurl.com/bdfhm45k

➡ Promote terminological and conceptual standardization across regulatory instruments and projects, ensuring technical clarity, transparency, and accessible communication among developers, public managers, and local communities, guaranteeing that sustainability, taxation, and governance criteria are aligned with the new Ecological IBS model and the guidelines of the 2023 Tax Reform.

TE05 – Implement professional training and qualification programmes for the energy transition and the generation of green jobs in the Northeast.

The qualification of the regional workforce is an essential factor in ensuring that the benefits of green industrialization translate into quality employment, social inclusion, the strengthening of local productive chains, the Northeast's technological autonomy, regional competitiveness, and the stimulation of local innovation and productive arrangements. **The expansion of solar, wind, low-carbon hydrogen, and storage projects demands large-scale technical and scientific training, aligning educational policies, capacity-building programmes, and partnerships with the productive sector.**

Several initiatives illustrate this agenda, among them the One Million Solar Rooftops Programme (P1MTS), focused on the training and inclusion of young people and community electricians[61]. Lab SOLar+ integrates research, innovation, and training in photovoltaic technologies; and Local Productive Arrangements (APLs) in wind energy and low-carbon hydrogen, promoted by universities, federal institutes, and regional research centres, further demonstrate the breadth of this capacity-building ecosystem.

Professional qualification must integrate social and environmental safeguards, promoting safe and environmentally responsible operations, mitigating impacts, and strengthening the circular economy. It must prepare professionals for powershoring, equipping them to attract and operate international green industries such as batteries, steel, fertilizers, and low-carbon cement. It also encompasses training in

61. Community electricians *(eletricistas comunitários)* are local technicians, typically recruited from within the communities where solar energy systems are being installed, trained to carry out the installation, operation, and basic maintenance of photovoltaic solar panels and associated electrical infrastructure. The concept is central to the decentralized and inclusive model of energy transition proposed in the PTE-NE: rather than relying exclusively on specialized external technicians, the community electrician model invests in the technical qualification of local residents, prioritizing youth, women, and members of traditional and peripheral communities, ensuring that the skills and economic opportunities generated by the expansion of distributed solar energy remain within the territory. This approach draws on a longer tradition of community-based technical training in the Brazilian Northeast, including programmes developed by ASA and other civil society organizations in the context of the *convivência com o semiárido* paradigm.

technology and digitalization, covering smart grids, remote monitoring, intelligent network operation, and digital processes. Finally, it supports territorial planning, prioritizing regions with the greatest demand for green jobs, taking into account innovation hubs, existing projects, and socioeconomic development opportunities.

➞ **Strategic initiatives and actors:** Ministry of Education (MEC); Ministry of Mines and Energy (MME); Ministry of Labour and Employment (*Ministério do Trabalho e Emprego* - MTE); SENAI; the National Service for Commercial Apprenticeship (*Serviço Nacional de Aprendizagem Comercial* - SENAC); federal institutes; public universities; BNDES; Finep; state governments; and companies in the energy and industrial sectors.

PRIORITY ACTIVITIES:

➞ Create qualification and technical training programmes for the operation, assembly, and maintenance of renewable energy plants and equipment, covering solar, wind, hydrogen, battery energy storage systems (BESS), biomass, and biomethane, with a focus on green job creation, productive inclusion, and responsible social and environmental practices.

➞ Implement regional capacity-building programmes in renewable energy and low-carbon hydrogen, articulating universities, federal institutes, and the private sector, with incentives for the training of technicians and engineers specialized in technological innovation and powershoring.

➞ Scale up factory-schools for the production and maintenance of solar panels in the Northeast, drawing on the model of the One Million Solar Rooftops Programme (P1MTS), with priority given to young people and workers from rural and urban communities, ensuring local development and inclusion.

➞ Foster partnerships between universities, technology centres, and companies for applied research and innovation (R&D&I) in technologies such as green hydrogen, battery energy storage (BESS), tidal energy, and bioenergy, integrating local capacities with international demands.

➞ Develop capacity-building programmes in offshore wind energy, port infrastructure, and process digitalization, in cooperation with the *Sistema S* network, universities, and state governments, preparing professionals for new productive chains, green energy exports, and sustainable industrial hubs.

TE06 – Diversify renewable energy sources and drive technological innovation in electricity system storage and digitalization.

The diversification of the energy matrix and the strengthening of technological innovation are strategic elements for consolidating the Northeast's leadership in Brazil's energy transition. Assessments indicate that the advancement of renewable energies must be accompanied by the incorporation of new sources, storage technologies, digitalization, and industrial integration, ensuring competitiveness, energy security, and local value addition.

The region presents strong potential for green hydrogen, biofuels, biomass, offshore energy, and ethanol, as well as favourable conditions for the implementation of battery energy storage plants (BESS) and intelligent digital management platforms. In this context, smart grids play an essential role by enabling the automated and decentralized management of energy, promoting distribution efficiency, the integration of multiple renewable sources, and the active participation of consumers. The adoption of these technologies, combined with digitalization, energy storage, and a locally grounded bioeconomy, strengthens the resilience, sustainability, and competitiveness of the Northeastern electricity system.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); Energy Research Company (EPE); Ministry of Development, Industry, Commerce and Services (MDIC); Ministry of Science, Technology and Innovation (MCTI); BNDES; Finep; Bank of the Northeast (BNB); state governments; universities; SENAI; technology institutes (including CIMATEC and Citeners); energy concessionaires and distributors; National Electric Energy Agency (ANEEL); National Electric System Operator (ONS); companies in the electricity, oil and gas sectors; agro-industrial cooperatives; and international R&D&I and digital innovation partners (including GIZ, IDB, and the International Energy Agency - IEA).

PRIORITY ACTIVITIES:

➞ Incentivize and consolidate productive chains for biofuels, sustainable ethanol, biomass, biogas, and bamboo ethanol with dedicated financing lines, sustainability certification, and integration with family farming and the regional agro-industry, making use of degraded areas and promoting carbon sequestration.

➞ Deploy battery energy storage plants (BESS) and intelligent digital management platforms (SCADA, AGC, SEM) integrated with smart grids, providing greater flexibility, reliability, and efficiency to the regional electricity system and promoting the integrated and decentralized use of multiple renewable sources.

➞ Launch the Northeast Distributed Storage Programme (*Programa Nordeste de Armazenamento Distribuído* - PNAD/BESS), aimed at the installation of community batteries and hybrid systems in small municipalities and isolated communities, ensuring reliable access to renewable energy.

➞ Create an Energy Storage and Digitalization Innovation Laboratory, articulated with universities, SENAI, and technology centres, for applied research, with the purpose of developing prototypes, professional capacity-building, and the integration of new technological solutions.

➞ Conduct technical, economic, and environmental feasibility studies for onshore wind, offshore wind, and tidal energy generation projects, including port logistics, industrial integration, and infrastructure, taking into account social and environmental impacts and mitigation strategies.

➞ Implement professional training and capacity-building programmes for the operation, maintenance, and management of hybrid systems, BESS, smart grids, and renewable technologies, integrating family farming and the local bioeconomy (including bamboo ethanol).

➞ Stimulate the local production of modules, turbines, and components, integrating tariff policies, incentives for regional industry, and the strengthening of the low-carbon hydrogen productive chain.

➞ Implement continuous monitoring of new renewable energy sources and electricity system storage and digitalization technologies, assessing technical, environmental, and socioeconomic impacts with community participation, ensuring that energy expansion is efficient, sustainable, and inclusive.

TE07 – Promote energy-industrial powershoring in the Northeast to attract green industries and renewable energy-intensive technologies.

The Brazilian Northeast holds enormous potential to consolidate itself as a strategic destination for energy-intensive industries, capitalizing on its abundance of renewable sources — solar, wind, biomass, and green hydrogen — alongside port logistics infrastructure, data centres, and technological innovation hubs. The concept of energy-industrial powershoring seeks to relocate global productive chains to regions with a renewable, secure, and competitive electricity matrix, stimulating local development, the generation of green jobs, the valorization of regional content, and the addition of value to exports. International experiences, such as the integration of green industrial hubs in coastal regions with renewable generation in Germany and Japan, demonstrate that attracting sustainability-aligned industries increases competitiveness, reduces emissions, and strengthens the local economy.

In this sense, the expansion of powershoring in the Northeast must articulate development policies, professional qualification, innovation incentives, integrated logistics, and social and environmental sustainability, ensuring that investments promote inclusive and resilient economic development. Powershoring in the Northeast must generate green jobs, strengthen local productive chains, and increase exports, while simultaneously guaranteeing social and environmental sustainability, impact mitigation, and the inclusion of local communities.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); Ministry of Development, Industry, Commerce and Services (MDIC); *Consórcio Nordeste*; BNDES; Bank of the Northeast; ApexBrasil; state and municipal governments; universities and technology institutes; SENAI/SENAC; companies in the energy, industrial, and logistics sectors; regional research centres; and international development organizations (IDB, UNDP, IEA).

PRIORITY ACTIVITIES:

➞ Map strategic regions of the Northeast considering renewable generation, port logistics, and digital connectivity and, on the basis of this mapping, conduct technical, environmental, and social feasibility studies for the attraction of green industries via powershoring, incorporating safeguards, continuous monitoring, and the participation of local communities to ensure mitigated and context-adapted social and environmental impacts.

➞ Incentivize the creation of green powershoring zones, attracting renewable and low-carbon energy-intensive industries, supported by credit programmes, financing lines, and regional insurance instruments to strengthen sustainable and competitive investment.

➞ Modernize existing industrial infrastructure (retrofit) and integrate logistical, port, and digital systems, ensuring efficiency, competitiveness, and the optimization of renewable energy generation and use in the region, including low-carbon hydrogen, biomass cogeneration, and mitigated natural gas.

➞ Establish public-private partnerships, public policies, and international cooperation frameworks for green industrialization, creating synergies with the regional energy matrix.

➞ Implement innovation laboratories and technology hubs, in partnership with universities and SENAI, to integrate and qualify local workers in the operation of advanced energy technologies and green industrialization processes.

➞ Develop low-carbon products and fuels, including ammonia, methanol, synthetic hydrocarbons, fertilizers, and green steel, and implement innovation laboratories and technology hubs connecting renewable energy solutions to productive chains, while promoting capacity-building in green industrialization.

➞ Develop incentive programmes for attracting renewable energy-intensive industries, covering fertilizers, green cement, biofuels, data centres, and sustainable petrochemicals, integrating credit, taxation, and local content policies.

TE08 – Consolidate regional low-carbon hydrogen hubs in the Northeast.

Low-carbon hydrogen is a strategic vector for decarbonizing hard-to-abate industrial sectors, promoting energy exports, and consolidating the Northeast as a sustainable technological and industrial hub. Brazil, through the National Hydrogen Programme (*Programa Nacional de Hidrogênio* - PNH2), already develops pilot projects in Pecém (CE) and other locations, demonstrating both technical and economic viability. Projects such as the electrolysers currently operating in Ceará illustrate how local green hydrogen production can drive exports and technological innovation.

The consolidation of regional low-carbon hydrogen hubs must articulate local production through electrolysers, port logistics, integration with renewable energy networks, and innovation policies, ensuring the generation of skilled employment, the development of local productive chains, and the reduction of dependence on imported inputs. International experiences, such as the hydrogen hubs in Portugal and Germany, show that coordinated investments in infrastructure, regulation, and R&D&I are decisive for global competitiveness.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); National Hydrogen Programme (PNH2); PNH2 Steering Committee; MDIC; BNDES; Finep; Bank of the Northeast; *Consórcio Nordeste*; universities and technology centres; SENAI/SENAC; companies in the hydrogen, renewable energy, and port logistics sectors; strategic ports (Pecém, Suape, Açu[62], Luís Correia); and international research and development organizations (IEA, IDB, GIZ).

PRIORITY ACTIVITIES:

➞ Structure regional hydrogen hubs with infrastructure for production, storage, transportation, and export, integrating ports, renewable energy networks, and intelligent systems for energy optimization.

➞ Foster industrial integration and powershoring, attracting green and renewable energy-intensive industries (fertilizers, cement, petrochemicals, and SAF), strengthening circular and regional productive chains, and promoting the installation of electrolyser manufacturing facilities for local and national supply.

➞ Develop R&D&I and capacity-building in low-carbon hydrogen, storage, and digitalization, in partnership with universities, technology institutes, SENAI, and the private sector, training a qualified and innovative workforce.

➞ Ensure technical, environmental, and social viability and territorial sustainability through technical, environmental, and social studies; the definition of safeguards; continuous monitoring; and the participation of local communities.

62. The Port of Açu *(Porto do Açu)* referenced in this document is located in the municipality of São João da Barra, in the northern region of the state of Rio de Janeiro, approximately 320 kilometres from the city of Rio de Janeiro. It is one of the largest deep-water port and industrial complexes in Latin America, operated by *Prumo Logística*, and strategically positioned for the export of oil, iron ore, and other commodities, as well as for the development of green hydrogen and offshore energy infrastructure. Its inclusion alongside the Northeastern ports of Pecém (Ceará), Suape (Pernambuco), and Luís Correia (Piauí) reflects its role as a regional logistics hub with direct relevance to the energy transition agenda, particularly in the context of green hydrogen export chains and offshore wind energy development along the Brazilian Atlantic coast. The name "Açu" is shared by other geographic features in the Northeast, most notably the Açu River *(Rio Açu)* in Rio Grande do Norte and the municipality of Assú in the same state, and should not be confused with port infrastructure in that region.

TE09 – Optimize reverse logistics associated with production and distribution in renewable energy chains to mitigate social and environmental impacts, reduce energy waste, and strengthen environmental management.

The Northeast's energy transition faces significant challenges related to energy waste, the inadequate disposal of equipment, and the absence of material recovery infrastructure within renewable energy productive chains. Studies by the Energy Research Company (EPE, 2023) indicate that, despite the region's generation potential, it suffers from transmission curtailment losses, reaching up to 10% of energy generated during certain periods, alongside deficiencies in collection and recycling policies for photovoltaic panels, turbines, and batteries.

This scenario results in economic and environmental inefficiencies, undermining the full harnessing of renewable sources and generating environmental liabilities associated with the disposal of technological waste. The implementation of reverse logistics policies, energy storage, and integrated management can transform this challenge into an opportunity, reducing losses, creating green jobs, and strengthening local recycling and reindustrialization chains.

The sustainability of the energy transition also requires articulation with water security and sustainable rural development policies, ensuring that technological advancement is accompanied by social and territorial benefits. Programmes such as Água Doce, Cisternas, National Programme for Strengthening Family Farming (*Programa Nacional de Fortalecimento da Agricultura Familiar* - PRONAF), *Dom Hélder Câmara*, and *Sertão Vivo* are examples of initiatives that can be integrated into regional energy policy, promoting synergies between water access, renewable energy, and agroecological production[63]. This convergence strengthens the climate and productive resilience of rural communities, broadens the efficient use of natural resources, and ensures alignment between energy, water, and territorial development policies.

63. The programmes referenced are federal and state-level public policies oriented toward climate resilience, water security, and sustainable rural development in the Brazilian Northeast. The *Programa Água Doce* (Sweet Water Programme) promotes sustainable desalination for rural semi-arid communities through decentralized, low-cost systems. The *Programa Cisternas* (Cisterns Programme) finances the construction of rainwater harvesting cisterns for family farming households, one of the flagship technologies of the *convivência com o semiárido* paradigm. PRONAF *(Programa Nacional de Fortalecimento da Agricultura Familiar)* is Brazil's primary federal credit programme for family farming, offering subsidized financing lines for production, infrastructure, and agro-industrial activities. The *Projeto Dom Hélder Câmara* is a federal programme for sustainable territorial development in the semi-arid Northeast, targeting the most vulnerable rural communities through productive inclusion, environmental management, and access to water and income. *Sertão Vivo* — Semeando Resiliência Climática is a climate resilience initiative of the Federal Government that promotes agroforestry systems, social technologies, technical assistance, and water harvesting in priority semi-arid territories, operating primarily across the Northeastern states.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); Ministry of the Environment and Climate Change (MMA); National Electric Energy Agency (ANEEL); Energy Research Company (EPE); Bank of the Northeast (BNB); BNDES; state governments; State Secretariats for the Environment and Energy; universities; technology institutes; cooperatives and companies in the recycling and reverse logistics sector; and international organizations (UNDP, IEA, UNEP).

PRIORITY ACTIVITIES:

➞ Strengthen the regulatory framework to curb forced curtailment — the interruption or reduction of energy generation, particularly in wind and solar plants, due to insufficient demand or grid limitations — articulating investments in battery energy storage systems (BESS) and the expansion of transmission infrastructure.

➞ Broaden the efficiency and use of renewable generation through the deployment of battery energy storage systems (BESS) and smart grids, which enable the balancing of supply and demand, the reduction of losses during low-load periods, the guarantee of grid stability, and the integration of multiple energy sources, including solar, wind, and biomass.

➞ Institute reverse logistics and circular economy policies in the energy sector, with a focus on the recycling and recovery of photovoltaic panels, wind turbine blades, and batteries, establishing regional collection and reconditioning centres in the Northeast.

➞ Establish economic and fiscal incentives, such as differentiated recycling fees, green credits, and financing lines, for companies that adopt material recovery and reuse practices in their energy equipment production and maintenance processes.

➞ Promote technical capacity-building programmes in reverse logistics, focused on material recovery and the maintenance of sustainable energy systems, integrating universities, SENAI, and local cooperatives with a view to training a workforce specialized in low-impact productive chains.

➞ Integrate the energy transition with water security policies and sustainable rural development, connecting energy projects to initiatives such as *Água Doce, Cisternas, Pronaf Renovável, Dom Hélder Câmara*, and *Sertão Vivo*, promoting synergies between water access, renewable energy, and agroecological production.

➡ Conduct technical assessments and territorial consultations prior to the implementation of large-scale projects, ensuring social and environmental safeguards and the mitigation of negative impacts. These actions must be aligned with the National Climate Change Adaptation Plan (*Plano Nacional de Adaptação à Mudança do Clima* - PNA) and the guidelines of the UN 2030 Agenda.

TE10 – Strengthen biofuel, bioenergy, and biomass chains with integration into family farming and technological innovation.

The diversification of the Northeast's energy matrix requires the strengthening of biofuel chains (ethanol, biodiesel, and biomethane), bioenergy, and biomass, with emphasis on environmental sustainability, productive inclusion, and the generation of local added value. Despite advances in the sector, the region still faces structural bottlenecks: low integration between rural producers and industries; insufficient logistical infrastructure for the transportation and storage of biofuels; the absence of stable certification and financing mechanisms; and limited technological capacity for the valorization of agro-industrial residues.

The Northeast holds privileged conditions for expanding the production of sustainable bioenergy and biofuels, integrating agro-industrial and rural waste productive chains into energy generation. Family farming plays an essential role in this process, particularly through the cultivation of oilseeds adapted to the semi-arid context, the valorization of agricultural, livestock, and forestry residues, and the production of biogas and energy biomass. Experiences such as the use of cellulosic ethanol derived from bamboo and lignocellulosic residues, biogas and biomethane technologies, and cogeneration systems using agro-industrial waste point toward viable pathways for a regional, circular, and inclusive bioeconomy.

This bioenergy agenda reinforces regional energy sovereignty, promotes the decarbonization of productive sectors, and drives sustainable industrial and rural development, positioning the Northeast as a national reference in energy innovation and just transition.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); National Energy Policy Council (*Conselho Nacional de Política Energética* - CNPE); Energy Research Company (EPE); Ministry of Agriculture and Livestock (MAPA); Ministry of Science, Technology and Innovation (MCTI); Ministry of Development, Industry, Commerce and Services (MDIC); BNDES; Finep; Bank of the Northeast (BNB); state governments; universities and federal institutes; SENAI; Embrapa Agroenergy (*Embrapa Agroenergia*); agro-industrial cooperatives; Brazilian Bamboo Producers Association (*Associação Brasileira de Produtores de Bambu* - Aprobambu); biofuel and bioenergy companies (including Raízen and FS Bioenergia); startups and R&D&I centres; and international development organizations (GIZ, IDB, FAO).

PRIORITY ACTIVITIES:

➞ Consolidate productive chains for biofuels, bioenergy, biomass, and biogas, integrating dedicated financing lines, sustainability certification (RenovaBio, ISCC, CBIO[64]), and technical assistance directed at family farming and the regional agro-industry.

➞ Create a Northeast Network of Innovation Laboratories in Bioenergy and Biomass, articulated with universities, SENAI, and federal institutes, to develop technologies adapted to the semi-arid context, including second-generation ethanol (bamboo ethanol) and energy cogeneration using agro-industrial residues.

➞ Introduce hybrid energy generation systems integrating biomass, biogas, solar, and wind energy, promoting the decentralized and efficient use of renewable sources, with a focus on rural communities and agro-industrial hubs.

➞ Support green innovation and industrialization programmes, stimulating second-generation biofuels, low-carbon technologies, and integration into sustainable export chains.

64. RenovaBio, ISCC, and CBIO are certification and market instruments for sustainable biofuels and bioenergy. RenovaBio *(Política Nacional de Biocombustíveis)* is Brazil's National Biofuels Policy, established by Law No. 13,576/2017, which sets decarbonization targets for the fuel sector and creates a market for Decarbonization Credits (CBIOs), tradeable securities issued by biofuel producers certified for their carbon efficiency, purchased by fuel distributors to meet their mandatory emissions reduction targets. The CBIO *(Crédito de Descarbonização)* is therefore the financial instrument generated within the RenovaBio framework, representing one tonne of CO_2 equivalent avoided or removed through certified biofuel production. The ISCC (International Sustainability and Carbon Certification) is a globally recognized voluntary certification scheme, governed by a German-based non-profit organization, that attests to the sustainability and greenhouse gas reduction performance of biomass, biofuels, and bioenergy across the entire supply chain, and is widely required for access to European and international renewable energy markets. Together, these instruments provide the regulatory, financial, and market architecture within which the PTE-NE's bioenergy productive chain proposals are designed to operate.

➞ Integrate bioenergy projects with socioeconomic inclusion and just transition policies, linking direct benefits to local job creation, professional qualification, and sustainable rural development.

➞ Institute fiscal and financial incentives aligned with the new tax system (IBS and Selective Tax - *Imposto Coletivo* - IS[65]), ensuring favourable tax treatment for biofuels and bioenergy, as provided for in the Tax Reform and decarbonization policies.

➞ Conduct technical, economic, and social and environmental feasibility studies for impact mitigation and the definition of territorial safeguards, ensuring the sustainability of the expansion of biomass and biofuel chains.

TE11 – Create the Northeast Community Generation and Energy Cooperatives Programme (PNGC), aimed at the deployment of solar and hybrid plants operated by local cooperatives, to decarbonize isolated systems and expand access to renewable energy.

The progressive substitution of diesel fuel by renewable sources, such as solar, biomass, biogas, and hybrid systems with storage, is a fundamental strategy for reducing greenhouse gas emissions, broadening access to renewable energy, and strengthening local economies. The creation of the **Northeast Community Generation and Energy Cooperatives Programme (***Programa Nordeste de Geração Comunitária e Cooperativas Energéticas* **- PNGC)** aims to promote the energy self-sufficiency and autonomy of rural communities and isolated systems, ensuring reliable, inclusive, and sustainable access to electricity, particularly in semi-arid territories and remote areas.

65. Selective Tax (*Imposto Seletivo* — IS) is a new federal tax created by Constitutional Amendment No. 132/2023 as part of Brazil's comprehensive Tax Reform, designed to discourage the consumption of goods and services considered harmful to health or the environment, a mechanism broadly analogous to sin taxes or Pigouvian taxes in international fiscal theory. Unlike the IBS, which is a broad-based consumption tax replacing the ICMS and ISS, the IS is a targeted instrument levied on specific products whose production or consumption generates negative externalities, including tobacco, alcoholic beverages, polluting vehicles, and fossil fuels. In the context of the energy transition, the IS has particular relevance as a fiscal instrument for accelerating the decarbonization of the Brazilian economy: by increasing the relative cost of fossil fuel consumption, it creates market incentives for the adoption of renewable energy sources and biofuels, while the revenue generated may be directed toward environmental and social programmes. The PTE-NE identifies the IS as a complementary instrument to the IBS within the cooperative fiscal architecture proposed for the Northeastern states, particularly in the structuring of incentives for bioenergy and biofuel productive chains. It should be noted that the English rendering "Selective Tax" is a descriptive translation; no official English denomination has been consolidated by the Brazilian government for international use.

These actions must be accompanied by the formation of **energy cooperatives**, the expansion of smart microgrids, and the retrofit of thermal power plants for operation with natural gas or biomass, ensuring energy security during the transition and preparing for the gradual substitution toward 100% renewable sources. The decentralized generation model, when allied with the solidarity economy, makes it possible to generate additional income through the sale of energy surpluses, strengthen family farming, and promote socioeconomic inclusion and sustainable territorial development.

Across different territories of the Northeast, regional experiences demonstrate the viability and social impact of community energy generation, models that can be adapted and scaled. Among the most notable are the Revenue from the Sun Programme *(Renda do Sol)* in Ceará, which promotes the installation of photovoltaic systems in low-income communities, converting energy into electricity bill reductions and additional household income; and the Solar Roots Project *(Raízes Solares)* in Maranhão, developed in partnership between the Sousândrade Foundation (FSADU), the Pernambuco Secretariat for Professional Development and Entrepreneurship (*Secretaria do Desenvolvimento Profissional e Empreendedorismo de Pernambuco* - Sedepe), and the *quilombola* communities of Piqui da Rampa, strengthening local productive and financial autonomy.

In the context of the energy transition, the Northeast can also consolidate itself as a powershoring platform, attracting investments and renewable-based industries that capitalize on the region's abundant and competitive renewable energy. This strategy enables the internalization of productive value, the generation of skilled employment, and the diversification of the local economic base, connecting energy cooperatives, microgrids, and green industrial hubs. In this way, the PNGC operates not only as an instrument of energy inclusion, but as a driver of energy autonomy, grid stability, and regional productive integration.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); Ministry of Development, Industry, Commerce and Services (MDIC); Ministry of the Environment and Climate Change (MMA); Ministry of Agrarian Development and Family Farming (MDA); Ministry of Agriculture (MAPA); BNDES; Bank of the Northeast (BNB); ANEEL; Finep; SENAI; Citeners; universities and federal institutes; local cooperatives; the Brazilian Micro and Small Business Support Service (*Serviço Brasileiro de Apoio às Micro e Pequenas Empresas* - SEBRAE); solidarity economy networks; solar energy, biomass, and biogas companies; startups and R&D&I centres; international organizations (CAF, IDB, GIZ); ASA; *Instituto Ideal*.

PRIORITY ACTIVITIES:

➞ Deploy the Northeast Community Generation and Energy Cooperatives Programme (PNGC), articulating state governments, municipalities, concessionaires, and local cooperatives with a focus on the installation of small-scale solar and hybrid plants (solar-biomass, solar-biogas, and solar-battery), operated under a cooperative model and directed at rural communities, agrarian settlements, irrigated perimeters, and isolated areas.

➞ Foster the creation and strengthening of energy cooperatives and community associations, with technical and financial support from BNDES, BNB, and ANEEL, including capacity-building in management, maintenance, participatory governance, and the productive use of energy, ensuring energy autonomy and the generation of additional income through the commercialization of energy surpluses.

➞ Finance the installation of photovoltaic systems in small rural properties, with dedicated credit lines from Pronaf and the Climate Fund, for community generation and energy cooperatives, prioritizing small and medium-scale projects in municipalities with low Human Development Index (HDI) ratings and in areas of energy vulnerability.

➞ Conduct retrofit operations and transition thermal power plants currently running on diesel and coal to lower-carbon operation (through the mitigated use of natural gas or biomass), gradually integrating them into hybrid generation and local storage systems.

➞ Deploy hybrid and smart microgrids (solar, biomass, biogas, and battery storage systems — BESS) in traditional, indigenous, *quilombola*, and isolated rural communities, connecting local renewable generation to productive consumption (agro-industries, desalination, irrigation, and refrigeration), while contributing digital solutions, community management models, and integration with green production hubs.

➞ Support the creation of regional networks of community solar plants in the semi-arid region, drawing on programmes such as One Million Solar Rooftops (P1MTS) and Lab SOLar+, articulated with sustainable industrial and logistics hubs.

➞ Raise public awareness of the advantages of deploying energy microgrids on rural properties, ensuring that the processes for implementing cooperative plants are understood as a secure economic asset, preventing conflicts and increasing uptake, particularly among indigenous peoples, *quilombola* communities, and isolated rural landowners.

➞ Integrate the PNGC with public policies for productive inclusion, family farming, regional development, and green powershoring, articulating programmes such as *Pronaf Verde*[66], *Sertão Vivo*, *Água Doce*, the National Biodigesters and Biogas Programme, and agroecology and industrial decarbonization initiatives — so as to promote the productive use of renewable energy, increase rural income, and reduce territorial inequalities.

TE12 – Conduct the sustainable management of strategic mineral reserves and stimulate the full regional value chain for renewable energy components.

The strengthening of the regional chain for **strategic minerals** (lithium, nickel, and cobalt) and **essential components** (conductors, towers, semiconductors, and battery cells) will be decisive in securing the Northeast's energy and industrial autonomy. Harnessing the region's significant potential in these raw materials, in conjunction with the expansion of solar and wind energy and low-carbon hydrogen, generates local added value, technological development, skilled employment, and global competitiveness. Furthermore, the interiorization of the productive chain for minerals and energy components can drive industrial hubs in semi-arid areas, stimulating balanced territorial development and the decentralization of economic opportunities associated with the energy transition.

66. Pronaf (*Programa Nacional de Fortalecimento da Agricultura Familiar)* is Brazil's primary federal credit programme for family farming, offering subsidized financing lines administered by the Bank of the Northeast (BNB) and other public financial institutions. Within Pronaf's portfolio, specialized lines have been developed to incentivize the ecological transition of family farming, including *Pronaf Agroecologia* (for the conversion to organic and agroecological production systems), *Pronaf Floresta* (for agroforestry, extractivism, and native forest management), and *Pronaf Semiárido* (for investments in water infrastructure and sustainable production adapted to drought conditions). *Pronaf Verde* is the most recent of these specialized lines, created to finance low-carbon agricultural practices, such as the adoption of bio-inputs, organic fertilization, integrated crop-livestock-forest systems, and the recovery of degraded areas, offering reduced interest rates and extended repayment terms as additional incentives for the ecological transition of family farming enterprises.

Recent federal policies, such as the General Environmental Licensing Act (*Lei Geral do Licenciamento Ambiental*, Law No. 15,190/2025), aimed at modernizing licensing processes, particularly for mining activities, and Provisional Measure No. 1,308/2025, which establishes the Special Environmental Licence (*Licença Ambiental Especial* - LAE) for strategic projects, alongside state-level industrial development programmes and local content incentives, indicate that a favourable legal and institutional landscape exists for advancing this axis. However, the application of these norms must be accompanied by rigorous safeguards. Ensuring transparency, social oversight, and participatory monitoring is essential, seeking to protect ecosystems and respect local communities in mining territories.

Another critical challenge is technological mastery: the chemical processing involved in the separation and purification of strategic minerals, particularly rare earth elements (REE), is technologically complex and currently concentrated in countries such as China (IEA, USGS). To reduce this dependence, Brazil can conclude bilateral and multilateral technology transfer agreements with countries already diversifying this chain. Such agreements, aligned with international practices of green economy and energy security, are fundamental to consolidating a Brazilian hub for the sustainable processing of critical minerals, strengthening national technological sovereignty and the Northeast's leadership role in the global energy transition.

Coordinated action in research, regulation, and financing can transform the Northeast into a high-technology hub for renewable energies and electric mobility, ensuring sustainable extraction, ecosystem protection, predictable licensing, and the minimization of social and environmental harm in mining regions.

➞ **Strategic initiatives and actors:** Ministry of Mines and Energy (MME); National Mining Agency (*Agência Nacional de Mineração* - ANM); Geological Survey of Brazil (*Serviço Geológico do Brasil* - SGB); Ministry of Science, Technology and Innovation (MCTI); BNDES; Finep; state governments (Ceará, Bahia, Piauí, Rio Grande do Norte); State Secretariats for Economic Development and Energy; universities and technical institutes; mining companies; manufacturers of electrical components and batteries; and international cooperation and innovation entities (including IEA, UNDP, GIZ).

PRIORITY ACTIVITIES:

➞ Create a state and federal programme for the sustainable mining of strategic minerals (lithium, nickel, cobalt, and rare earth elements), including social and environmental certifications, requirements for mitigated impacts, and extraction conducted with territorial responsibility and public transparency.

➞ Incorporate regulatory mechanisms that prioritize national companies using strategic minerals from the region, promoting local value addition, the strengthening of productive chains, industrial interiorization, and the generation of skilled employment.

➞ Create a regional programme for the mapping of strategic minerals and sustainable extraction guidelines, with support from the SGB, universities, and research centres, prioritizing low environmental impact, clean technologies, and the participation of local communities.

➞ Conclude bilateral and multilateral technology transfer agreements on the sustainable management of strategic minerals with reference countries (Australia, Canada, Japan, and the European Union), promoting joint ventures, local capacity-building, collaborative R&D, and the development of clean technologies, while strengthening technological sovereignty and the Northeast's leadership role.

➞ Support and articulate integrated research, development, and innovation programmes in materials and processes for batteries, photovoltaic cells, wind turbines, semiconductors, and strategic minerals, involving universities, technology centres, and companies, with federal, state, and international financing, aiming to develop low-carbon solutions, sustainable vertical integration, and local value addition.

➞ Implement social and environmental impact assessment programmes and participatory consultations in mining regions, with territorial consultations, continuous monitoring, and impact mitigation plans, ensuring transparency, respect for communities, and alignment with federal and state environmental standards.

6.5 AXIS 5 Circular and Solidarity Economy

The **circular economy** constitutes one of the strategic pillars of the Brasil Nordeste Ecological Transformation Plan (PTE-NE), in consonance with the National PTE and Brazil's new **Nationally Determined Contribution (NDC)**, submitted in 2024, which establishes as an objective of the National Mitigation Strategy to "promote circularity through the sustainable and efficient use of natural resources across productive chains" (Brazil, 2024, Art. 1, Decree No. 12,082, of 27 June 2024).

The PTE-NE proposes to rethink the linear economic model, based on extraction, production, consumption, and disposal, and to drive a **restorative and regenerative system of low-carbon development and productive inclusion**, guided by the preservation and extension of the lifecycle of products and materials through strategies of maintenance, repair, remanufacturing, and reuse, and by the valorization of waste as a resource. This approach includes the **recovery of organic** waste for composting and bioenergy generation through the deployment of biodigesters and innovative technological solutions for the production of biogas and natural fertilizers, alongside the stimulation of innovation in bioplastics and the recycling of conventional plastics, fostering local chains of work and income associated with sorting, transportation, and reprocessing.

In recent years, the Federal Government has made significant advances in consolidating the circular economy. Among the main actions are the increase in import tariffs on plastic, paper, and cardboard waste, stimulating domestic recycling and valorizing the work of waste pickers; the Recycling Incentive Act (*Lei de Incentivo à Reciclagem* - Law No. 14,260/2021), which grants tax benefits to investments in recovery and reuse; the

inclusion of circularity in the guidelines of business incentive programmes; and the recognition, by the Brazilian Sustainable Taxonomy, of the transition from the linear to the circular model as an activity that promotes sustainability and the green economy. By articulating these directives with the specific regional characteristics of the Northeast, the PTE-NE aims to align circularity, climate resilience, environmental conservation, and inclusive territorial development, consolidating the circular economy as a vector of sustainable and just neo-industrialization in the region.

To complement the strategic dimension of the circular economy, the PTE-NE axis also incorporates the solidarity economy, grounded in cooperative networks, self-managed labour, social currencies, and community banks. This integration seeks to strengthen local value chains, promoting social justice, income generation, and territorial agency. By integrating this perspective, the PTE-NE aims to transform productive flows and democratize the economic and ecological benefits of the circular transition, making them instruments of sustainable and equitable development for the populations of the Northeast.

6.5.1 Structural Challenges for the Circular and Solidarity Economy in the Northeast

Despite its transformative potential, the consolidation of the circular and solidarity economy in the Northeast still faces a series of complex and interconnected challenges. Environmental and water degradation, marked by advancing desertification, the intensive use of natural resources, and pressure on ecosystems, demands integrated solutions oriented toward conservation, the rational use of water, and the recovery of degraded areas. Insufficient environmental education is another significant obstacle: low awareness of sustainable practices hinders social uptake and community engagement, making the implementation of continuous and transformative strategies in this field essential. Compounding this are the low formalization of waste picker cooperatives and restricted access to appropriate technologies, factors that undermine the valorization of waste and the productive inclusion of these workers.

In the institutional sphere, governance and legislative fragilities persist, with difficulties in the enforcement of environmental laws, the absence of specific policies for urban rivers, and limited articulation between different levels of government and civil society. Socio-economic vulnerability, expressed through structural inequalities, low industrialization, and the predominance of traditional linear economic models, also constrains the transition toward more inclusive circular models. In addition, market pressures, such as the decline in virgin raw material prices, reduce the competitiveness of recyclables and threaten both the income of waste pickers and the economic viability of the recycling sector. Finally, outdated infrastructure, associated with deficits in sanitation, logistics, and regulation, as well as water scarcity and climate vulnerability, remains one of the principal obstacles to the effective advancement of circular economy policies in the region.

Beyond these aspects related to circularity, the consolidation of the solidarity dimension faces structural barriers connected to the organization of labour and the valorization of collective forms of production. The absence of consistent support policies for solidarity enterprises, the predominance of informality, difficulties in accessing credit and technical assistance, and limited management capacity all constrain their expansion and sustainability.

Incorporating solidarity foundations is essential so that the circular economy in the Northeast does not remain confined to waste management, but becomes an effective instrument of decent **work, citizenship, and social transformation.**

6.5.2 Pathways and Opportunities for the Circular Transition

Despite the challenges, the Northeast presents numerous opportunities for transformation. The region already holds an important base of local initiatives, community networks, and social technologies oriented toward circularity with potential for integration into federal, state, and municipal programmes. There is also strong synergy between the circular economy and other PTE-NE axes, including the bioeconomy, the energy transition, innovation through Nature-based Solutions, workforce capacity-building for recycling, and climate mitigation.

Among the principal strategies and proposals are: improving financial, economic, and regulatory incentives for the circular and solidarity economy; expanding market instruments, innovation mechanisms, and public procurement to drive recovery technologies; stimulating startups; and fostering new industrial solutions. It is equally essential to broaden technical support and

capacity-building for waste picker cooperatives, valorizing the socioeconomic role of these workers and recognizing waste as a productive input through redesign, recycling, and reprocessing. The formation of shared governance across the circular productive chain emerges, in this context, as a central element for consolidating the circularity ecosystem in the Northeast.

Another priority factor is the strengthening of research, development, and innovation (R&D&I) promotion mechanisms, which are fundamental to scaling the circular economy broadly. The transformation of waste into energy and productive inputs through biorefineries and biodigesters, capable of generating biogas, biofertilizers, and biofuels such as SAF, reduces environmental impacts, increases productive efficiency, and opens new economic opportunities. Finally, the elimination of open waste dumps remains an indispensable condition for both public health and environmental preservation. This requires the deployment of modern sanitary landfills equipped with leachate and biogas containment systems, and the creation of inter-municipal consortia to strengthen regional governance and ensure the integrated management of waste.

6.5.3 Vision for the Future of the Northeast as a Reference in Circular and Solidarity Economy

The PTE-NE proposes a transformative vision for the future: the Northeast as a reference territory in circular and solidarity practices capable of reducing waste, regenerating ecosystems, reusing finite natural resources, promoting decent work, and advancing social inclusion. The region has the potential to become a national hub of innovation in circularity and sustainability,

leading a new development model that combines economic prosperity, social justice, and environmental balance. This vision is structured around strategic pillars that guide the ecological and productive transition needed to achieve this objective.

The first is environmental resilience focused on the development of communities adapted to climate change, on access to and rational use of water, on combating desertification, and on the valorization of regional biomes. This is followed by education and inclusion: integrating conscious production and consumption with incentives for ESG practices across all business processes, generating sustainable employment, and guaranteeing the active participation of community networks, such as waste picker cooperatives, in the decision-making processes of the circular and solidarity economy. Another central axis is the construction of a robust circular economy through the closure of open waste dumps, the creation of integrated waste productive chains, professional capacity-building, and the installation of modern infrastructure for recycling and reverse logistics.

The solidarity economy, in synergy with the circular economy, constitutes a strategic pathway for adding value to regional production and expanding income generation in the Northeast. By stimulating short value chains for reusable, reconditioned, and recycled products, it strengthens grassroots cooperatives and solidarity enterprises, creating new economic opportunities grounded in the sustainable use of resources. This integration drives more inclusive and innovative value chains, capable of transforming waste into productive assets and promoting regional development that combines economic dynamism, social justice, and environmental sustainability.

The consolidation of this vision also demands strengthened governance and cooperation, promoting articulation among governments, businesses, civil society, and teaching and research institutions for the joint and transparent monitoring of public policies. Finally, Nature-Based Solutions (NbS) and the energy transition stand as structuring axes of a new regional development model capable of driving innovation, environmental regeneration, and productive inclusion.

6.5.4 Proposals for the Circular and Solidarity Economy Axis

The following proposals for the Circular and Solidarity Economy of the Brasil Nordeste Ecological Transformation Plan are designed to accelerate the transition toward a low-carbon productive model, characterized by efficient resource use, the valorization of waste, and the strengthening of solidarity initiatives. The proposals listed prioritize, above all, regulatory updating, the promotion of innovation and sustainable public procurement, the socio-productive inclusion of waste pickers and cooperatives, the decommissioning of open waste dumps, the stimulation of circular industrial hubs, and the promotion of a business and community culture oriented toward circularity, integrating sustainability, social justice, and regional competitiveness.

EC01 – Update and improve the regulatory framework and economic and financial incentive instruments to foster investment in the circular and solidarity economy.

The Northeast still faces regulatory fragilities and a lack of legal predictability for structuring robust circular economy policies. Updating and harmonizing legal frameworks — aligning them with the **National Solid Waste Policy (*Política Nacional de Resíduos Sólidos* - PNRS) and the National Circular Economy Strategy (*Estratégia Nacional de Economia Circular* - Enec)** — is essential to driving investment, innovation, and competitiveness. This process must encompass the establishment of quantifiable targets, standards, and indicators to monitor circularity; the development of markets for reusable, reconditioned, and recycled products; and the articulation with other public policies and international commitments, in an integrated and systemic manner.

The circular economy is collaborative, that is, it requires working with all parties involved along the supply chain, within organizations, and with the public sector, in order to increase transparency and create shared value. For this reason, the strengthening of economic instruments, such as tax incentives, income tax deductions (Law No. 14,260/2021), presumed credits[67], and **Climate Fund** credit lines combined with recognition programmes such as the **Green Seal Municipality (*Município Selo Verde* - PSMV)** and the Ceará Sustainable School Seal, can broaden the financing capacity and participation of companies, municipalities, states, and communities.

67. Presumed credits *(créditos presumidos)* are a fiscal instrument within the Brazilian tax system whereby governments, at federal, state, or municipal level grant taxpayers the right to offset a notional credit amount against their tax liability, effectively reducing the tax burden on specific activities or transactions deemed worthy of public policy incentivization. Unlike tax exemptions (which eliminate the tax obligation entirely) or tax reductions (which lower the applicable rate), presumed credits operate within the normal tax collection framework while generating a financial benefit equivalent to a partial subsidy. In the context of the circular economy and ecological transition, presumed credits may be structured to reward enterprises that adopt sustainable production practices, use recycled inputs, reduce waste generation, or invest in clean technologies, making them a flexible instrument for embedding environmental performance criteria into existing tax frameworks without requiring structural legislative reform. Their application in Brazil varies significantly across federal, state, and municipal levels, and their design within the IBS transition framework is one of the fiscal governance challenges directly addressed by the PTE-NE.

This normative and institutional environment favourable to the circular economy in the Northeast must also be supported by Law No. 15.068/2024[68], which, in addition to establishing the National Solidarity Economy Policy, structures solidarity economy enterprises and creates the National Solidarity Economy System (Senaes). As an example of state-level regulation, Law No. 12,368/2011 of Bahia, which institutes the State Policy for the Promotion of the Solidarity Economy (*Política Estadual de Fomento à Economia Solidária* - Pefes/BA), may be cited as a development strategy.

➞ **Strategic initiatives and actors:** Federal Government; state and municipal governments; BNDES; Caixa Econômica Federal[69]; State Secretariats of Environment; Federal Revenue Service; Banco do Brasil Foundation *(Fundação Banco do Brasil)*; the productive sector; National Congress; State Public Prosecutor's Offices; State Assemblies; and Municipal Chambers.

PRIORITY ACTIVITIES:

➞ Update and harmonize state and municipal legal frameworks with the National Solid Waste Policy (PNRS), the National Circular Economy Strategy (Enec), and the Global Circularity Protocol[70] (GCP), ensuring regulatory coherence and investment predictability, avoiding the overlap of functions, optimizing resources, and guaranteeing full coverage of all stages of the cycle.

➞ Create and operationalize a regional fund for the promotion of circular projects, with public calls directed at companies, cooperatives, and startups developing technologies for recycling, reverse logistics, and waste reduction.

68. Law No. 15,068/2024, known as the Paul Singer Law *(Lei Paul Singer)* in honour of the Brazilian economist and public intellectual (1933–2018) who founded and led the National Secretariat for the Solidarity Economy (Senaes) from 2003 to 2016, establishes Brazil's National Solidarity Economy Policy *(Política Nacional de Economia Solidária)*, creating the legal and institutional framework for the recognition, support, and promotion of solidarity economy enterprises across the country. The law defines solidarity economy enterprises as collective, self-managed productive organizations, including cooperatives, associations, and community enterprises, governed by democratic participation, equitable distribution of results, and the primacy of labor over capital. It also formally reconstitutes Senaes within the Ministry of Labor and Employment, restoring an institutional structure that had been dismantled in 2019, and establishes the National Solidarity Economy System as the coordination mechanism articulating federal, state, and municipal policies with civil society networks. The law's popular denomination honors Paul Singer's foundational role in consolidating the solidarity economy as a field of public policy in Brazil and in connecting it internationally to cooperative and social economy movements.

69. Caixa Econômica Federal (CEF) is a Brazilian public company and the main agent of federal government public policies, focused on urban development, housing (*Minha Casa, Minha Vida* program), sanitation, and social projects

70. The Global Circularity Protocol is an international initiative aimed at standardizing indicators and metrics to determine the degree of circularity of economies, sectors, and products, developed by the Ellen MacArthur Foundation in partnership with the World Business Council for Sustainable Development (WBCSD) (Ellen MacArthur Foundation; WBCSD, 2021).

➞ Establish an integrated system of tax benefits, credits, subsidies, and financing lines, directly linked to the fulfilment of circularity targets, waste reduction, and sustainable innovation, ensuring clear rules with legal predictability and monitoring through environmental and socioeconomic indicators.

➞ Expand certification initiatives, such as the Green Seal Municipality Programme (Sema-CE), to all Northeastern states, integrating circularity and environmental performance criteria into certification and resource transfer processes.

➞ Structure and regulate the market for recycling certificates and circularity credits, connecting cooperatives, startups, companies, and governments through digital platforms for commercialization, traceability, and transparency.

➞ Develop regulatory frameworks and promotion instruments that incorporate the environmental assets market, Public-Private Partnerships (PPPs), and the carbon market as financing and incentive mechanisms for solidarity enterprises operating in recycling, reverse logistics, and efficient resource use.

➞ Ensure that new regulatory frameworks and incentive instruments take into account the ecological and socioeconomic specificities of the Semi-Arid region, the Caatinga, and the Cerrado, stimulating circular economy models adapted to the environmental potentials and constraints of each biome.

➞ Draft and approve specific legislation for large waste generators, restricting their use of public collection systems and requiring them to structure their own waste disposal and recovery systems, integrated with cooperative networks and solidarity economy enterprises.

EC02 – Stimulate financing, innovation, and public procurement instruments to drive new circular and solidarity economy business models and the commercialization of their products.

The lack of market scale and structured demand for circular solutions still limits technological advancement, productive competitiveness, and the consolidation of sustainable chains in the Northeast. To overcome this challenge, it is essential to mobilize the **State's purchasing power** as a driver of **green and inclusive neo-indus-**

trialization, creating stable markets for recycled materials, recovery technologies, and low environmental impact products.

The **articulation between financing instruments and public procurement** with programmes directed at startups, cooperatives, and innovative companies can drive the transition toward new business models that integrate social justice, community participation, and Nature-Based Solutions (NbS), fostering reverse logistics and value generation in circular and solidarity chains. Programmes such as *Startup Maranhão* (SEBRAE) and Rio Grande do Norte Law No. 11.363/2023, which institutes the State Programme for Government Procurement from Family Farming and the Solidarity Economy (*Programa Estadual de Compras Governamentais da Agricultura Familiar e Economia Solidária* - Peces/Pecafes), and the Cred Programme in Bahia, demonstrate the potential of credit initiatives for fostering circular and solidarity entrepreneurship in the construction of innovative and competitive productive ecosystems.

Initiatives such as those developed by the Federal University of Campina Grande (UFCG), the Federation of Industries of the State of Paraíba (FIEPB), and Institute of Education and Citizenship (Instituto de Educação e Cidadania - IEC Brasil) combined with models of **community financing and social currencies** demonstrate the potential of the solidarity economy in the circular transition. The example of Palmas Bank *(Banco Palmas)*, in Fortaleza (CE), a pioneer in the creation of its own social currency *(Palma*) and in the provision of solidarity productive microcredit, illustrates how local financial instruments can strengthen sustainable economic circuits, support community enterprises, and stimulate the generation of green income, connecting social innovation, financial inclusion, and productive circularity in a continuous manner.

➞ **Strategic initiatives and actors:** Ministries of the Environment and Industry; SEBRAE; industrial federations; universities; BNDES; Solidarity Enterprise Incubators of the Federal Institutes (*Incubadoras de Empreendimentos Solidários dos Institutos Federais* - Ifsol).

PRIORITY ACTIVITIES:

➞ Create state programmes for sustainable public procurement with mandatory quotas for recycled, reused, remanufactured, or certified circular chain products, prioritizing solutions that integrate technological innovation, Nature-Based Solutions (NbS), and positive social impact.

➞ Create regional incubation and acceleration programmes that connect startups, cooperatives, universities, and industries to the concrete demands of municipalities and productive sectors, promoting green neo-industrialization, social innovation, value generation in circular chains, and the strengthening of sustainable local productive arrangements.

➞ Develop credit lines, financing funds, and specific fiscal incentives for enterprises and projects directed at recycling, reuse, recovery, and technological innovation, prioritizing sectors with high circularity potential (electronics, batteries, plastics, textiles, construction, and food) and integrating waste management policies with solidarity and circular economy strategies.

➞ Institute public procurement mechanisms that prioritize goods and services with circularity attributes and positive social impact, stimulating demand for recycled, reusable, or sustainable products, and strengthening cooperatives, startups, and solidarity enterprises operating in green productive chains.

➞ Foster regional markets and short commercialization circuits for reusable, reconditioned, and recycled products, connecting solidarity and popular economy cooperatives, industries, and consumers within value chains that broaden commercialization, traceability, and sustainable income generation in the Northeast.

➞ Deploy a programme to promote impact businesses and innovation ecosystems that use community banks, social currencies, and revolving funds as structuring instruments of circular economy and income generation across territories.

EC03 – Strengthen waste picker cooperatives and associations with infrastructure, capacity-building, advisory services, and access to contracts, integrating them into the formal economy and recognizing their social and environmental role.

Informality and social vulnerability still characterize the reality of thousands of waste pickers in the Northeast. Strengthening cooperatives with **infrastructure, technical capacity-building, access to equipment, legal advisory services, and public and private** contracts is fundamental to integrating them into the formal economy, recognizing and valorizing their environmental and social role. The creation of programmes such as Solidarity Selective Collection *(Coleta Seletiva Solidária)*, which remunerates

waste pickers for the environmental services they provide, serves as a reference for the expansion of this policy across the region.

Law No. 14.260/2021 — known as the Recycling Incentive Act — represents an important milestone for the strengthening of the recycling chain in Brazil, by creating fiscal incentive mechanisms to stimulate investment in recycling and reverse logistics projects, recognizing the work of waste pickers as an essential part of this economy. A practical example of this directive is the Ceará Credi Cooperativas Programme, of the Ceará State Development Agency (*Agência de Desenvolvimento do Estado do Ceará* - Adece), which offers specific and accessible credit lines for cooperatives and solidarity economy enterprises. The initiative enables access to working capital and investment in infrastructure, equipment, and process modernization, contributing to the formalization, valorization, and income generation of waste pickers.

In addition, various programmes may be cited, such as Pró-Catadores[71], the Collection for Good (*Coleta do Bem* Project), and other cooperatives and government programmes including the *Alagoas Catador* Programme, *Cooperativa dos Catadores da Vila Emater* - Coopvila, *Cooperativa das Produtoras e Produtores Rurais da APA do Pratigi* (Cooprap), and the *Auxílio Catador*[72] (CE), all of which stand out for generating income and support. The institutionalization of regional forums — such as the Northeast Circular Economy Forum *(Fórum Nordeste de Economia Circular)* — and Good Practice Networks, such as project repositories, guarantee the permanent participation and exchange of experience among these actors.

➞ **Strategic initiatives and actors:** Diogo Sant'Ana *Pró-Catadores* Programme; *Rede Recicla Bahia*; National Union of Recyclable Materials Waste Pickers of Brazil *(União Nacional dos Catadores e Catadoras de Materiais Recicláveis do Brasil)*; state and municipal governments.

71. *Pró-Catadores* is a federal programme established by Decree No. 7,405/2010 within the framework of Brazil's National Solid Waste Policy (Law No. 12,305/2010), designed to support the social and economic inclusion of waste pickers *(catadores de materiais recicláveis),* informal workers who collect, sort, and sell recyclable materials, playing a critical role in Brazil's solid waste management system while historically operating outside formal labour protections and social security. The programme coordinates federal actions across multiple ministries to strengthen waste-picker cooperatives and associations, improve their working conditions and equipment, expand access to selective waste collection contracts with municipalities, and promote the formalization and scaling of their enterprises. Brazil is internationally recognized for its waste-picker inclusion model, with an estimated 400,000 to 800,000 catadores active across the country, organized in networks such as the National Movement of Waste Pickers (MNCR), and *Pró-Catadores* represents the primary federal instrument for translating this recognition into structured public policy support.

72. The *Auxílio Catador* Program (CE) is a public policy of the Government of Ceará that pays a monthly financial benefit to associated or cooperative waste pickers. The objective is to value the work of selective collection, increase the income of these professionals, and promote social inclusion and sustainability.

PRIORITY ACTIVITIES:

➡ Structure regional programmes for technical capacity-building and continuing education in management, logistics, safety, and waste operations for selective collection, reverse logistics, and material recovery cooperatives, incorporating nature-based solution technologies and innovative sorting and recovery practices.

➡ Guarantee access by selective collection, reverse logistics, and material recovery cooperatives to adequate infrastructure, such as modern warehouses, automated sorting equipment, sustainable transportation, and personal and collective protective equipment (PPE/CPE), and create specific and accessible credit lines for expanding cooperatives, promoting their insertion into value chains and integration with solidarity economy initiatives.

➡ Structure collaborative spaces with the active participation of cooperatives, associations, waste picker movements, and solidarity economy networks, oriented toward the exchange of experiences and the dissemination of innovative solutions, including the creation of a replicable project repository that strengthens qualified social participation and the collective construction of circular policies and initiatives across territories.

➡ Expand and institutionalize selective collection programmes with payment for services rendered, linking them to public contracts and municipal recycling targets that incentivize social innovation and the socioeconomic inclusion of waste pickers.

➡ Implement training and formalization programmes for collective circular economy enterprises, integrated with the solidarity economy, valorizing female community leadership, traditional knowledge and local knowledge systems, with a view to enabling a more inclusive regional governance of the circular and solidarity economy.

➡ Deploy and consolidate regional public centres for solidarity economy support, ensuring continuous and universal technical assistance to cooperatives, associations, and solidarity enterprises — formal and informal — to promote practices of recovery, recycling, social innovation, and sustainable productive inclusion.

➡ Promote commercial articulation between companies and waste picker cooperatives, with a view to strengthening the recycling productive chain through the creation of a regional system that integrates reverse logistics flows and the supply of recyclable materials with clear purchasing and selling rules, traceability, and the valorization of waste.

EC04 – Decommission open waste dumps and deploy integrated waste management systems — with technical and financial support — in order to reduce environmental impacts, broaden management efficiency, and promote circular and sustainable solutions.

The Northeast region concentrates 883 active open waste dumps[73], which compromises public health and the environment. The definitive elimination of these sites and their replacement by **sanitary landfills** is fundamental to complying with the Legal Framework for Sanitation (*Marco Legal do Saneamento* — Law No. 14.026/2020). The structuring of inter-municipal consortia, combined with the deployment of regional treatment and recycling units, reduces costs and broadens efficiency. Experiences such as the Ceará Solid Waste Management Strategies Project (*Projeto Estratégias de Gestão e Manejo dos Resíduos Sólidos para o Estado do Ceará* - Egemares), the *Lixo Mais Não* Plan (SE), the Landfill Regionalization Plan (*Plano de Regionalização dos Aterros* - Sema/Iemsc), the eradication of open dumps in Alagoas, and initiatives in Arez/RN and the Seridó Geopark *(Geoparque Seridó)* illustrate viable pathways.

It is also important to highlight the **Municipal Solid Waste Consortia Policy** *(Política de Consórcios Municipais de Resíduos Sólidos)* of Ceará as a state government strategy encouraging municipalities to join inter-municipal consortia for the joint implementation of integrated solid waste management. This policy seeks to optimize resources, enable shared infrastructure, such as sanitary landfills, sorting centres, and transportation, and strengthen selective collection and the inclusion of waste pickers, guaranteeing technical efficiency, financial sustainability, and compliance with the National Solid Waste Policy.

➞ **Strategic initiatives and actors:** BNDES; Caixa Econômica Federal; Ministry of the Environment and Climate Change; Ministry of Cities *(Ministério das Cidades)*; state governments; municipal consortia; and State Public Prosecutor's Offices.

73. The figure of 883 active open waste dumps in the Northeast is drawn from the National Sanitation Information System (*Sistema Nacional de Informações sobre Saneamento* - SNIS), the primary federal database for monitoring sanitation infrastructure and services across Brazilian municipalities, maintained by the Ministry of Cities *(Ministério das Cidades)*. The SNIS compiles annual data submitted by municipalities and state governments on water supply, sewage, solid waste management, and urban drainage, serving as the official reference for policy planning, regulatory oversight, and investment allocation in the sanitation sector. Open waste dumps *(lixões)* are uncontrolled disposal sites with no engineered lining, leachate treatment, or gas management systems, posing severe risks to soil, groundwater, and public health. Their elimination is mandated by the Legal Framework for Sanitation (Law No. 14,026/2020), which established revised deadlines for the closure of all open dumps and their replacement by sanitary landfills, with priority given to municipalities in the Amazon region and those with populations above 100,000 inhabitants.

PRIORITY ACTIVITIES:

➞ Develop and execute integrated plans for the closure of open waste dumps with regional timetables and actions for environmental remediation, ecological recovery of degraded areas, and the socioeconomic reintegration of affected workers, through capacity-building, cooperativism, and new sustainable enterprises.

➞ Strengthen the implementation of industrial transformation and solid waste processing projects at former dump sites through the creation of industrial hubs or parks oriented toward recovery and recycling, promoting technological innovation, green job creation, and the strengthening of the circular economy.

➞ Integrate the generations and commercialization of carbon credits into recovery projects for areas degraded by open dumps, so as to finance environmental restoration actions, reduce greenhouse gas emissions, and include waste picker cooperatives in the economic benefits.

➞ Implement inter-municipal consortia for the shared management of sanitary landfills, sorting units, and regional composting centres, incorporating Nature-based Solutions for drainage, revegetation, and pollution control, with technical and financial support from the federal government and states.

➞ Create permanent environmental monitoring and evaluation programmes, with social participation, public indicators, and open digital platforms, to track the final disposal of waste, progress in the closure of open dumps, and the social and environmental results of the sustainable management systems deployed.

EC05 – Promote productive innovation and strengthen the scientific and technological foundations for valorizing waste in its economic and energy potential.

The low incorporation of technology and applied research in waste treatment and valorization limits the harnessing of its economic and energy potential, reducing opportunities for innovation and sustainable development. Experiences such as the **bamboo ethanol production programme in Maranhão,** which uses bamboo cellulose fibres to generate biofuel and other products without producing waste, exemplify the potential of a natural circular economy and sustainable productive chains grounded in innovation. Biorefineries and biodigesters represent strategic solutions in this context, as they convert organic waste into biogas, biofertilizers, and biofuels, reducing greenhouse gas emissions, closing productive cycles, and broadening the efficiency of agricultural, agro-industrial, and urban chains.

Strengthening the **scientific and technological base** is essential for these solutions to be developed and scaled regionally. This requires equipping universities, federal and state institutes, and Research Support Foundations (FAPs) with technical and scientific infrastructure oriented toward research, development, and innovation (R&D&I) in the processing, transformation, and circular use of solid waste. Interdisciplinary research lines can connect process engineering, biotechnology, green chemistry, and environmental management, stimulating the creation of social technologies that are low-cost and applicable to different territorial realities.

The strengthening of the knowledge base, **through applied research, scientific dissemination, and the formation of innovation networks,** must be accompanied by incentives for sustainable industrial, artisanal, mineral, extractivist, agricultural, and agroforestry production, including associated distribution, trade, and service processes. In this way, waste comes to be seen as a strategic resource driving the bioeconomy and the just energy transition.

➞ **Strategic initiatives and actors:** Federal and state universities; Embrapa and Federal Institutes; productive sectors; Science and Technology Institutions *(Instituições de Ciência e Tecnologia* - ICTs); Research Support Foundations (FAPs); State Institutes and Technology Parks.

PRIORITY ACTIVITIES:

➞ Map regional flows of solid and organic waste, identifying opportunities for the deployment of biorefineries, biodigesters, and waste processing and transformation units producing value-added products.

➞ Strengthen the scientific and laboratory infrastructure of universities, institutes, and FAPs, creating research and innovation lines oriented toward the energy and material valorization of waste, with a focus on low-carbon technologies and the circular economy.

➞ Deploy regional R&D&I centres and living labs to test, validate, and scale technological solutions related to bioenergy, biogas, biofertilizers, recycling, and industrial recovery.

➞ Launch R&D&I and technological innovation calls directed at waste recovery, regenerative design, the bioeconomy, and reverse logistics, with strong participation from universities, research centres, and companies, incentivizing the development of Nature-based Solutions and social technologies in the field.

➞ Foster sustainable productive hubs — industrial, agricultural, extractivist, mineral, and artisanal — that use waste as a productive input, promoting technological innovation and green job creation.

➞ Promote technical and scientific training and capacity-building programmes, connecting academia, the public sector, and the productive sector to develop competencies in biotechnology, bioenergy, waste engineering, and circular management[74].

➞ Incentivize pilot projects and technological demonstration programmes for biorefineries and biodigesters in strategic municipalities, connecting them to innovation networks, green investment, and local productive arrangements.

➞ Promote PPPs for the construction and operation of technically advanced sanitary landfills, integrating biogas capture and recovery systems, sustainable leachate treatment, and circular technologies that reduce environmental impacts and promote efficiency in the waste cycle.

74. Federal Institutes (IFs) can offer Initial and Continuing Training (*Formação Inicial e Continuada* — FIC) courses oriented toward the circular economy, providing rapid and free-of-charge capacity-building for workers, waste pickers, and entrepreneurs, strengthening technical qualification, productive inclusion, and the dissemination of sustainable practices across territories.

➞ Disseminate results and strengthen knowledge networks with incentives for research publication, inter-institutional exchange, scientific events, hackathons, and open innovation digital platforms.

EC06 – Deploy economic recovery and recycling hubs integrated with efficient logistics networks and partnerships to guarantee socio-productive inclusion and sustainable recyclable waste management practices.

The lack of productive and logistics infrastructure is one of the greatest bottlenecks for the circular economy in the Northeast. The **creation of industrial hubs dedicated to recovery and recycling**, strategically distributed according to the vocation and availability of waste in each territory, can generate skilled employment, attract private investment, and reduce operational costs. Drawing on the Egemares project (CE), which collects data and proposes strategies for the efficient management of solid waste, the deployment of an integrated sustainable management system allied with continuous monitoring is recommended.

To guarantee efficient logistics, it is fundamental to **incorporate digital technologies and the Internet of Things (IoT)** to optimize the monitoring and control of waste flows, support data-driven decision-making, and strengthen connections among supply chain participants, accelerating the transition toward a circular and intelligent system.

It is also important to foster the **solidarity economy,** incentivize **innovation**, and amplify socio-productive inclusion with emphasis on **female leadership** and the integration of traditional knowledge to improve management at the interface between people and ecosystems. Practical examples inspiring the model include initiatives such as Solos (circular fashion and logistics), *Rede Recicla Bahia* (cooperative network), and recycling plant projects in Piripiri.

Furthermore, connection with cooperatives, technology parks, port zones, and Export Processing Zones (EPZs) is imperative to potentiate the insertion of recycled products into national and international productive chains. The *Receita Cidadã* Programme, which enables seized goods to be redirected toward social and productive purposes, transforming assets and equipment into inputs, capacity-building tools, and raw materials for cooperatives and solidarity enterprises, may serve as a reference for incentive design.

➞ **Strategic initiatives and actors:** *Rede Recicla Bahia*; Piauí Industries Centre (*Centro das Indústrias do Piauí* - Ciepi); Grupo Mudá; Recycling Plant in the Piripiri region; Egemares Project; among others.

PRIORITY ACTIVITIES:

➞ Map the principal waste flows and identify strategic regions for the deployment of economic hubs, prioritizing areas with high waste generation, existing logistics infrastructure, and potential for articulation with cooperatives and solidarity economy networks.

➞ Install ecological-industrial zoning in the Northeastern territories identified as most suitable through prior study, creating regional hubs oriented toward recycling, reindustrialization, and waste recovery. These hubs should stimulate circular industrial parks capable of transforming environmental liabilities into productive inputs, strengthening the regional solidarity economy, and promoting a new dynamic of sustainable development.

➞ Structure PPPs and concession models and green funds to finance hubs and innovation incubators, with emphasis on clean technologies, NbS, and social startups, with credit lines prioritizing collective enterprises and female leadership.

➞ Integrate the hubs into the National Solid Waste Management Information System (*Sistema Nacional de Informações sobre a Gestão dos Resíduos Sólidos* - Sinir), connecting them to sorting centres, cooperatives, and companies demanding recycled inputs; and establish formal cooperation protocols with the Receita Cidadã Programme to receive, adapt, or redistribute seized goods as inputs, capacity-building equipment, or products for the solidarity economy.

➞ Integrate digital technologies and IoT systems into waste management and industrial processes, implementing regional traceability and certification systems for recyclable material flows using tools such as blockchain, QR codes, and public platforms, connecting cooperatives, municipalities, and industries to guarantee efficiency, transparency, and socio-productive inclusion, with real-time data-driven decision-making and the elimination of intermediaries.

➞ Create sorting centres and collection points in rural and semi-arid regions, connected to logistics networks and recovery and recycling hubs, stimulating new local productive opportunities and integrating waste picker cooperatives, solidarity economy associations, and small producers.

EC07 – Foster a culture of circular economy and the transformation of social and business practices, incorporating ESG criteria and stimulating circular and sustainable economic models.

Low social and environmental awareness and the absence of structured awareness-raising policies hinder the transition toward circular practices in the Northeast. It is fundamental to promote a deep cultural shift — both within civil society and among businesses — that transforms habits of consumption, disposal, and production, strengthening a new relationship between society and the environment. This involves creating spaces for collective learning, social mobilization campaigns, and corporate engagement programmes that integrate ESG principles, innovation, and the solidarity economy, stimulating r**esponsible purchasing, reverse logistics, and local recovery networks.**

In this sense, it is essential to **foster innovation, culture, education, and the development of competencies** oriented toward circularity through the creation of capacity-building programmes for companies and workers that incentivize the adoption of circular productive practices; support for research, development, and technological innovation; and the promotion of environmental culture and education, stimulating critical and innovative thinking about the sustainable use of resources.

➞ **Strategic initiatives and actors:** Federal Institutes (IFs); SEBRAE; State and Municipal Secretariats of Education and the Environment; Civil Society Organizations (CSOs); waste picker movements; and companies adopting ESG practices.

PRIORITY ACTIVITIES:

➞ Incentivize continuing awareness-raising and capacity-building programmes directed at behavioural change in communities with emphasis on consumption reduction, material recovery, and the valorization of waste as economic assets.

➞ Establish collaboration networks among governments, universities, CSOs, and the private sector to finance and scale circular culture projects with a focus on the creation and expansion of community financial infrastructures that support cooperatives, waste pickers, and circular businesses.

➞ Develop corporate training and ESG certification programmes, linking organizational culture change to the adoption of waste reduction targets, product redesign, and investment in circular productive chains.

➞ Guide citizens toward responsible, healthy, and safe consumption, stimulating sustainable choices, waste reduction, and preference for reusable or recyclable products, integrating educational campaigns and public policies for sustainable consumption.

➞ Monitor and evaluate companies with regard to the adoption of circular economy and reverse logistics practices, creating transparency and certification systems linked to fiscal and financial incentives, and penalties for non-compliance with environmental and social targets.

➞ Improve and expand the application of Extended Producer Responsibility (EPR) laws, ensuring that manufacturers and distributors assume responsibility for the collection, disposal, and reintegration of products and packaging into the productive cycle.

➞ Create financial and regulatory incentive instruments for companies that demonstrably adopt ESG and circularity practices, linking tax benefits to social and environmental performance and promoting a sustainable and competitive business environment[75].

75. B Corporation Certification and the Brazilian Sustainable Taxonomy, from the Ministry of Finance, can serve as references for demonstrating social and environmental performance and for classifying sustainable economic activities, ensuring standardization, transparency, and integrity in the fiscal and financial incentives granted.

6.6 AXIS 6
New Green-Blue Infrastructure and Climate Adaptation

The new green-blue infrastructure and climate adaptation axis **constitutes a strategic and urgent response of the Brasil Nordeste Ecological Transformation Plan (PTE-NE)** to the challenges posed by climate change.

Aligned with the National PTE, this axis proposes a paradigm shift, integrating traditional ("grey") infrastructure with Nature-Based Solutions (NbS), with a focus on creating an effective social, environmental, and economic management system that combines physical, natural, and social infrastructure to protect communities, ecosystems, and the regional economy from climate impacts already underway.

The conceptual and operational integration between the Caatinga and the Blue Amazon represents a fundamental strategic vision for a new low-carbon economy with competitive potential, higher value-added production, improved quality of life, and adaptation to climate change. This innovative perspective recognizes that climate challenges in the Brazilian Northeast demand integrated solutions connecting actions for the Caatinga biome and the marine-coastal ecosystem, both of which hold potential for carbon capture and storage and ecosystem protection essential to climate resilience.

Brazil's ratification of the Global Ocean Treaty, which will enter into force in 2026, creates an urgent international legal framework for the protection of marine areas, reinforcing the need to explicitly include the oceanic dimension in national and regional climate policies. Furthermore, the United Nations Convention to Combat Desertification and Mitigate the Effects of Drought, in which Brazil is one of the State Parties with greatest global leadership in building bi- and multilateral partnerships, points to the potentialities for an effective, just, and comprehensive ecological transition, particularly directed at the Caatinga biome.

To materialize an integrated vision, the effectiveness of this agenda depends on the construction of a broad coalition of strategic actors: the federal government, states, municipalities, financial institutions, academia, civil society (local, traditional, and indigenous communities), and international organizations. This **multilevel and collaborative governance** is indispensable for implementing public policies that valorize and protect, in a synergistic manner, the Caatinga and the vast Northeastern coastal zone, transforming their environmental, social, and economic interdependencies and potentialities into the foundation for climate adaptation and sustainable development in the Northeast and in Brazil.

6.6.1 Structural Challenges for the New Green-Blue Infrastructure and Climate Adaptation in the Northeast

The implementation of green-blue and adaptive infrastructure in the Northeast Region faces a series of interconnected structural and systemic challenges. **Institutional and governance fragmentation,** characterized by the lack of effective articulation between federal, state, and municipal levels and by the absence of specific regulatory frameworks for climate adaptation, for both terrestrial and marine ecosystems, results in dispersed efforts, overlapping actions, and reduced impact.

Compounding this is **insufficient and unstable financing:** a scarcity of resources at scale directed both at social technologies for semi-arid coexistence, particularly for rural communities and family farming, and at structuring projects that integrate coastal and marine management, fishing and urban communities, encompassing climate resilience and justice within green-blue infrastructure. Another significant challenge is the **lack of integration of traditional knowledge:** the articulation between traditional communities, both from the semi-arid region and from coastal areas, who hold valuable ancestral knowledge for adaptation, and public policies, remains uneven, limiting the effectiveness and local appropriation of interventions.

The **socio-environmental and climatic** vulnerability of the Northeast region, marked by droughts, desertification processes, flooding, and pressures on coastal zones, presents socioeconomic characteristics that amplify climate risks, requiring integrated multi-sectoral solutions. The difficulty in scaling social technologies and green-blue infrastructure models, combined with **limitations in technical capacity** for the integrated management of terrestrial and marine ecosystems, represents a significant obstacle to the necessary scalability of these initiatives, particularly given the complexity of governing the Blue Amazon and semi-arid ecosystems.

6.6.2 Pathways and Opportunities for the New Green-Blue Infrastructure and Climate Adaptation in the Northeast

Despite the challenges, the Northeast presents singular potential and robust opportunities for the consolidation of green-blue and adaptive infrastructure anchored in its social, environmental, intellectual, and **cultural capital, and in emerging strategic synergies**. The region benefits from important global frameworks, such as the United Nations Decade on Ecosystem Restoration and the Decade of Ocean Science for Sustainable Development, which create unique opportunities to attract international resources and technical cooperation. In addition, national programmes such as *BNDES Azul*[76] and initiatives such as ***Caatinga Viva*** offer concrete foundations for integrated and systemic projects.

Territorially embedded teaching and research institutions, combined with the outreach of civil society networks, provide a solid

76. The *BNDES Azul* initiative, launched in January 2024, is a strategy of the Brazilian National Bank for Economic and Social Development (BNDES) to promote the sustainable use and economic development of the Brazilian "Blue Amazon." It finances projects in naval decarbonization, port infrastructure, maritime research, and environmental preservation.

base for developing, validating, and scaling contextualized adaptive solutions, generating fundamental technical and scientific knowledge for ecological-economic zoning, the development of resilient cultivars, and the validation of social technologies, forming a robust ecosystem for the replication of low-cost, high-impact adaptive solutions. The institutionalization of governance mechanisms that guarantee the **active participation of women, youth, local and traditional communities, and indigenous peoples,** in dialogue with academia and public authorities, ensures that solutions are culturally appropriate and socially validated.

Integration with national instruments, such as the New PAC, the National Climate Change Fund, the Climate Plan, and the National Adaptation Plan, creates a channel for attracting transformative investments, directing them toward resilient infrastructure projects with a technical foundation and territorial anchoring.

6.6.3 Vision for the Future: New Green-Blue Infrastructure and Climate Adaptation in the Northeast

The future envisioned for the Brazilian Northeast is that of a pioneering region in the implementation of resilient green-blue infrastructure, capable of harmonizing socioeconomic development with the protection of terrestrial and marine ecosystems, demonstrating in practice how the international conventions on **combating desertification and protecting the oceans** can converge to create a model of territorial development that is sustainable, just, and resilient. This model would be capable of simultaneously protecting the singular biodiversity of the Northeast's biomes, particularly the Caatinga, and the strategic wealth of the Blue Amazon, for present and future generations.

The materialization of this vision involves the expansion of low-carbon, reduced environmental **footprint infrastructure that combines disaster** prevention actions with Nature-Based Solutions and harnesses the carbon capture potential of semi-arid and marine ecosystems. This transformation requires integrated climate monitoring, ecological-economic zoning and spatial planning of the Caatinga–Blue Amazon binomial with territories adapted to climate change, equipped with efficient water security systems, sustainable and adaptive sanitation, restored ecosystems, and a diversified and robust regional economy aligned with the conservation of terrestrial and marine biodiversity and the generation of employment and income.

6.6.4 Proposals for the New Green-Blue Infrastructure and Climate Adaptation Axis

Axis 6 proposes an integrated set of actions to promote water resilience, ecosystem recovery, sustainable and adaptive sanitation, accessible monitoring, and climate adaptation and justice in the Northeast. The initiatives seek to combine innovation, NbS, and participatory governance, aiming at sustainable territorial development, water and food security, and the reduction of vulnerability to extreme climate events, whose implementation approaches engage directly with sustainable and inclusive finance, the bioeconomy, and sustainable agriculture.

The proposals are presented below:

NIVA01 – Deploy urban and rural resilient water infrastructure and sustainable and adaptive basic sanitation systems, with Nature-Based Solutions (NbS), including innovative technologies for water capture, reuse, drainage, and treatment.

This proposal aims to consolidate **sustainable and adaptive water management and basic sanitation,** unifying the expansion of resilient physical infrastructure with the integration of natural and technological approaches as drivers of neo-industrialization and sustainable agro-industry. The objective is to guarantee water security, broaden basic sanitation, and mitigate the impacts of extreme climate events for urban areas (with a focus on peripheral communities and coastal zones) and for arid, semi-arid, and desertification-prone rural areas, promoting the conservation of water resources through efficient capture, storage, reuse, and urban drainage systems. The viability of this approach is demonstrated by successful initiatives in the semi-arid region and coastal areas, including the *Água Doce* Programme in Alagoas, the Saara Project in Paraíba, the *Água e Vida* Operation in Piauí, *Floresta Viva* in Maranhão[77], the Water Security Plan *(Plano de Segurança Hídrica)* of the State of Bahia, the Contingency Plan (cliffs, erosion, and oil spills) and reservoir policies in Ceará, and the Coastal Management Programme *(Programa de Gerenciamento Costeiro)* of Sergipe.

➞ **Strategic initiatives and actors:** National Development Bank (BNDES); World Bank; Green Climate Fund (GCF); Ministry of Cities; Ministry of Integration and Regional Development; Ministry of Agrarian Development and Family Farming; Embrapa; Regional Institute for Appropriate Small-Scale Farming (*Instituto Regional da Pequena Agropecuária Apropriada* - IRPAA); National Semi-Arid Institute (INSA); National River Basin Revitalization Programme *(Programa Nacional de Revitalização de Bacias Hidrográficas)* of the Ministry of Integration and Regional Development; universities; federal institutes; municipalities; state governments; state sanitation companies; and river basin committees.

77. The programmes referenced are public initiatives oriented toward water security, environmental restoration, and sustainable development in the Northeastern semi-arid region. The Água Doce Programme in Alagoas is a state-level implementation of the federal *Programa Água Doce*, promoting decentralized desalination systems for rural communities without access to potable water. The Saara Project *(Projeto Saara)* in Paraíba, an acronym for *Semiárido Sustentável, Agroecológico, Resiliente e Amoroso* (Sustainable, Agroecological, Resilient and Caring Semi-Arid), is a territorial development initiative integrating water access, agroecology, and community organization in semi-arid municipalities. The *Água e Vida* Operation *(Operação Água e Vida)* in Piauí is a state programme combining emergency water supply interventions with long-term infrastructure investments for communities in situations of severe water scarcity. *Floresta Viva* in Maranhão is a state environmental programme combining native forest restoration, the prevention of vegetation fires, and the promotion of sustainable land use practices, one of two complementary initiatives through which the Government of Maranhão advances its ecological transition agenda, alongside *Maranhão Sem Queimadas*, as noted earlier in this document.

PRIORITY ACTIVITIES:

➞ Conduct an integrated territorial diagnostic of water challenges, mapping, on the basis of data from the National Water and Sanitation Agency (ANA), the Geological Survey of Brazil (SGB), IBGE, the Satellite Image Analysis and Processing Laboratory *(Laboratório de Análise e Processamento de Imagens de Satélites* - Lapis/Ufal), and state and municipal bodies, the most vulnerable territories: peripheral communities and coastal zones subject to waterlogging and flooding; and, in arid, semi-arid, and desertification-prone regions, those with critical water deficits.

➞ Deploy sustainable drainage systems in urban areas (draining roadways, permeable pavements, rain gardens) to reduce waterlogging; and build micro-systems for the capture and reuse of rainwater in public facilities (such as schools and health posts) and community associations, ensuring water supply for non-potable uses.

➞ Deploy social and innovative technologies in rural areas for water capture and storage (higher-capacity cisterns, dams, solar desalinators) and promote safe water reuse practices for family farming, including sustainable river basin management.

➞ Implement rural and urban sanitation programmes to eliminate sources of groundwater contamination, including the environmentally adequate disposal of solid waste and effluents, and foster the installation of decentralized sewage treatment systems (such as the constructed wetlands model and ecological septic tanks) in communities not served by the sewage network.

➞ Identify river basins with high seasonality and implement revitalization projects with a focus on spring recovery, the restoration of riparian forests, and the deployment of natural flow control mechanisms (such as retention ponds[78] and terraces).

➞ Incentivize the adoption of municipal climate adaptation plans, articulated with State Forums and the *Consórcio Nordeste*, with specific targets and medium- and long-term timetables.

78. Retention ponds are water storage structures designed to capture and temporarily hold surface runoff, reducing peak flow velocity, controlling erosion, and gradually releasing water into the soil or downstream watercourses. In the semi-arid Northeast, they are a central technology within the *convivência com o semiárido* paradigm: by capturing rainfall that would otherwise rapidly drain from the *Caatinga*'s highly seasonal river basins, they extend water availability for human consumption, livestock, and small-scale agriculture during dry periods. Small-scale variants, including *barraginhas* (micro-retention ponds), *barreiros* (earthen ponds), and paved catchment cisterns, have been widely deployed by family farming communities across the region, often combined with terracing and contour bunding to maximize soil infiltration. Their integration with riparian forest restoration and spring recovery initiatives reflects a systemic approach to watershed management that combines engineered and nature-based solutions with traditional landscape knowledge.

➞ Establish promotion programmes through public calls for the adoption of innovative technologies in basic sanitation and rainwater capture and reuse systems in residences, industries, and rural establishments.

➞ Implement demonstration units in each context (urban and rural) with academic and participatory monitoring of socioeconomic and environmental impacts (such as the reduction of waterlogging and the increase in water availability), creating a public database, managed by the *Consórcio Nordeste*, to support the scaling of solutions to other regions with similar characteristics.

➞ Promote the review and updating of master plans *(planos diretores)* for municipalities located in the semi-arid region and in coastal zones, incorporating specific guidelines for stormwater management, establishing mandatory standards for NbS and for urban micro-watershed areas, river floodplains, and natural channels, restricting urban occupation, and defining land use and occupation rules that prioritize infiltration, flood control, and the protection of water bodies.

NIVA02 – Implement territorial zoning and spatial planning instruments to plan and manage resilient green-blue infrastructure in the Northeast.

This proposal aims to structure complementary disaster prevention actions articulated with risk matrices and emergency action protocols, through territorial planning instruments that incorporate green-blue infrastructure to increase the Northeast's resilience. The objective is to reduce vulnerability to extreme events such as flash floods, droughts, and the loss of marine and terrestrial biodiversity, through the integration of territorial zoning instruments, including sanitation, drainage, and river basin recovery grounded in natural solutions, while ensuring financing and technical capacity-building for local entities. A pioneering example of this approach is the Ecological-Economic Zoning of the Coastal Zone in Ceará and Maranhão, which demonstrates in practice the viability of integrating green-blue infrastructure into strategic planning. The proposal also engages with the National Coastal Management Plan (*Plano Nacional de Gerenciamento Costeiro* - PNGC).

➞ **Strategic initiatives and actors:** BNDES and climate funds; Ministry of Cities and Ministry of the Environment and Climate Change; Ministry of Indigenous Peoples and

Traditional Communities *(Ministério dos Povos Indígenas e Comunidades Tradicionais)*; Secretariat of Federal Assets (*Secretaria do Patrimônio da União* - SPU); Ministry of Justice and Public Security (*Ministério da Justiça e Segurança Pública* - MJSP); Brazilian Navy ; and *Consórcio Nordeste*.

PRIORITY ACTIVITIES:

➡ Develop territorial zoning instruments based on detailed risk matrices, identifying critical areas for preservation, recovery, and the deployment of green-blue infrastructure, prioritizing Permanent Preservation Areas (*Áreas de Preservação Permanente* - APPs), riparian forests, and disaster-vulnerable zones, as well as zoning for the natural dynamics of the *Caatinga*'s cyclical droughts and for desertification and soil degradation processes.

➡ Integrate, within territorial planning instruments (master plans and land use legislation), a portfolio of innovative green-blue infrastructure technical solutions, including bioretention gardens, reforestation, agroforestry systems, and other practices adapted to the region's biomes with clear protocols for the maintenance of these infrastructures and rapid response in emergency situations.

➡ Establish a continuing technical capacity-building programme for public managers and municipal technical teams, ensuring the knowledge required to implement zoning instruments, carry out sustainable urban drainage works, recover burnt and degraded areas, and manage resilient sanitation systems.

➡ Develop innovative green-blue infrastructure solutions through living labs in partnership with higher education institutions, research centres, and local communities, testing and validating techniques adapted to the different realities of the Northeast.

NIVA03 – Integrate green-blue infrastructure and sustainable public mobility for resilient cities in the Northeast.

This proposal aims to increase climate resilience and quality of life in Northeastern cities. The objective is to **requalify urban space**, integrating low-carbon sustainable mobility with a green-blue infrastructure network. The transition toward sustainable mobility will be planned synergistically with the expansion of green-blue infrastructure. The strategy integrates transport electrification, energy efficiency, sustainable stormwater management, and the creation of green corridors, complemented by energy optimization in urban lighting, public buildings, and transport systems, transforming grey infrastructure into multifunctional systems that reduce costs and offer replicable solutions for the entire region. The proposal articulates with the Energy Efficiency Programme (*Programa de Eficiência Energética* - PEE) of the National Electric Energy Agency (ANEEL), with a focus on cost reduction and the replicability of good practices.

➞ **Strategic initiatives and actors:** Ministry of Regional Development (MDR); Ministry of Cities; Ministry of Mines and Energy (MME); BNDES; ANEEL; Brazilian Nuclear and Binational Energy Participations Company (*Empresa Brasileira de Participações em Energia Nuclear e Binacional S.A.* - ENBPar); Ministry of Transport; National Land Transport Agency (*Agência Nacional de Transportes Terrestres* - ANTT); National Electric Energy Conservation Programme (P*rograma Nacional de Conservação de Energia Elétrica* - Procel); state and municipal governments; transport companies and vehicle manufacturers; universities and research institutes (for the development of Nature-based Solutions); and water and sanitation concessionaires.

PRIORITY ACTIVITIES:

➞ Create a regional resilient urban mobility programme, incentivizing the gradual replacement of fleets with electric and hybrid vehicles (with financing through BNDES and fiscal incentives) with provision for mandatory investments in green-blue infrastructure along transport corridors. This includes the installation of permeable pavements, rain gardens for stormwater management, and tree planting with native species.

➞ Deploy energy efficiency and thermal comfort programmes in public buildings and urban systems, integrating green roofs and living walls, efficient lighting, and transport, to reduce energy consumption, increase thermal comfort, retain rainwater, and promote urban biodiversity.

➞ Expand energy efficiency programmes with the integration of green roofs and living walls in public buildings, including the development of pilot green-blue corridor projects that demonstrate the connection between electric mobility, stormwater management, urban tree planting, and the creation of community spaces, serving as a replicable model.

➞ Integrate sustainable solid waste management into the green-blue cycle, promoting the generation of renewable energy (such as biomethane) and the protection of water resources.

NIVA04 – Promote the implementation of integrated soil and degraded area recovery systems in the biomes of the Northeast Region, particularly the Caatinga, aiming to increase efficiency in carbon capture and storage in Brazil.

This proposal aims to position the Northeast as a national reference in sustainable territorial development, aligning income generation, food and nutritional security, and climate adaptation with the **preservation, recovery, and reduction of deforestation across the region's three strategic biomes: Caatinga, Cerrado, and Atlantic Forest.** The central objective is to build a robust regional economy adapted to climate change that protects natural capital, strengthens water and energy security, stimulates ecological and sustainable tourism, and promotes climate justice. This proposal is grounded in initiatives already underway: the State Programme for Payment for Environmental Services (AL); the *Floresta Viva* Programme; the State Carbon Credit Policy and the REDD+ Jurisdictional System (MA); the APA Litoral Sul and the Sergipe Green Economy Plan (SE); RN + Verde and the Vale Sustentável degraded area recovery project; and the ethno-tourism initiatives of the Amarelão Indigenous Community (RN).

➞ **Strategic initiatives and actors:** Regional Institute for Appropriate Small-Scale Farming (IRPAA); National Semi-Arid Institute (INSA); Embrapa; Brazilian Semi-Arid Articulation (ASA); Caatinga Association (Associação Caatinga - CE and PI); federal universities; Green Climate Fund (GCF); National Development Bank (BNDES); Bank of the Northeast; Ministry of the Environment and Climate Change (MMA); Ministry of Agriculture and Livestock (MAPA); Ministry of Women (MMulheres); and Re.green, a Brazilian company specializing in large-scale forest restoration.

PRIORITY ACTIVITIES:

➞ Identify and map priority degraded areas using satellite imagery and data from IBGE, the Satellite Image Analysis and Processing Laboratory (Lapis/Ufal), and the Caatinga Vegetation Cover Monitoring and Alert System (*Sistema de Monitoramento e Alerta para Cobertura Vegetal da Caatinga* - Sima Caatinga), in conjunction with technical extension teams and community leaders, to create a territorial registry of properties eligible to join a recovery and reforestation programme.

➞ Implement Technological Reference Units (*Unidades de Referência Tecnológica* - URTs) on the properties of semi-arid smallholder farmers, to demonstrate in practice the benefits of integrating Agroforestry Systems (SAFs) adapted to the semi-arid context with energy-water integration, fostering applied research to continuously assess vegetation recovery, soil health, carbon stocks, and the socioeconomic impacts of interventions, to enhance evidence-based adaptation.

➞ Conduct continuing capacity-building sessions for technical teams, producers, and farmers on regenerative practices, water and soil management, the implementation of agroforestry systems, and the development of ecological tourism itineraries with a focus on the leadership of women and youth.

➞ Foster value chains associated with Caatinga and coastal zone products, creating identification seals and commercialization channels for food and other products originating from recovered systems.

➞ Incentivize a regional programme for the recovery of soils and degraded areas in the Northeast Region's biomes with payments for environmental services to farmers and communities that maintain preserved or recovering areas.

➞ Execute integrated recovery and conservation projects for river micro-watersheds, integrating sustainable soil and water management techniques (such as retention ponds, terracing, and agroforestry systems) to reduce erosion, broaden infiltration, and guarantee water security in rural communities.

➞ Institute inter-municipal consortia for the energy recovery of solid waste, transforming open dumps into regenerated areas through biogas capture for biomethane production, integrated with the deployment of green-blue infrastructure (such as parks, woodlands, or agroforestry systems), mitigating emissions and generating sustainable revenue.

➡ Foster a regional network of bio-factories and community nurseries of native seedlings, training female and male smallholder farmers and cooperatives to produce genetic material adapted to the semi-arid context, guaranteeing supply for restoration projects and generating local income.

➡ Implement an ecological restoration programme for hilltops and hillsides, structuring a portfolio of successful cases to disseminate the concrete and investment-attractive results of public and private reforestation initiatives, with a view to scaling the adoption of these practices.

NIVA05 – Implement a Northeast Ecological Corridors Network that integrates biodiversity conservation with the economic, social, and cultural life of local communities, to transform the natural landscape into a foundation for sustainable territorial development.

This proposal is designed to protect the biomes, mitigate the negative impacts of ecosystem fragmentation, and simultaneously promote the protection and recovery of the biodiversity of the Caatinga and other Northeastern biomes, including indigenous and traditional territories, and income generation for communities and peoples. The objective is to make **environmental conservation** a structuring axis for climate resilience, creating economic opportunities grounded in the sustainable use of biodiversity, **sustainable community tourism**, and agroecology with special attention to traditional knowledge and cultures. Implementation will occur through the convergence of knowledge systems, articulating the technical expertise of institutions such as Embrapa Semi-arid, IRPAA, and local Federal Institutes with the traditional knowledge of communities for adaptive management. The proposal engages with the following references: the Northern Atlantic Forest Ecological Corridor (*Corredor Ecológico do Norte da Floresta Atlântica* - Cenfa), the Central Atlantic Forest Corridor (*Corredor Central da Mata Atlântica* - CCMA), the *Pau Brasil Ecological Corridor (Monte Pascoal)*, and the National Action Plan for the Conservation of Threatened Herpetofauna of the Northeast (*Plano de Ação Nacional para a Conservação da Herpetofauna Ameaçada do Nordeste* — PAN Herpetofauna do Nordeste)[79].

79. Available at: https://www.gov.br/icmbio/pt-br/assuntos/biodiversidade/pan/pan-herpetofauna-do-nordeste

➞ **Strategic initiatives and actors:** Ministry of Tourism; Ministry of the Environment and Climate Change (Ecological Corridors Programme); Ministry of Planning and Budget (External Financing Commission - *Comissão de Financiamentos Externos* - Cofiex); *Conecta Caatinga* Project; and Global Environment Facility (GEF).

PRIORITY ACTIVITIES:

➞ Identify and map priority routes for ecological corridors connecting forest fragments, considering both ecological viability and the presence of traditional communities and family farmers who can act as guardians of these areas.

➞ Deploy sustainable use demonstration units along the corridors, combining agro-forestry systems, management of socio-biodiversity products, and infrastructure for community-based ecological and cultural tourism with shared governance between environmental bodies, municipalities, and community representatives.

➞ Deploy, alongside each Ecological Corridor, a community seedling nursery and bioeconomy hub, structuring productive chains associated with restoration, for the production of native seedlings, seeds of socio-biodiversity species, and phytoproducts, guaranteeing inputs for the reforestation of corridor areas and creating sustainable sources of income.

➞ Establish and strengthen local and regional management committees for the ecological corridors, ensuring participatory, decentralized, and comprehensive governance. These committees will be responsible for monitoring implementation, mediating conflicts, validating management plans, and approving resource allocation, ensuring that decisions reflect local knowledge and territorial needs.

➞ Constitute a Northeastern alliance for socio-ecological connectivity, creating partnerships at multiple levels for the long-term sustainability of the corridors, articulating strategic actors from the federal, state, and municipal spheres, the private sector, organized civil society, and the population living in the vicinity of protected areas, to mobilize resources, knowledge, and political support for the Corridors Network.

NIVA06 – Implement actions for climate adaptation and productive sustainability in the Northeast's agricultural sector, to neutralize biome degradation and reduce Greenhouse Gas (GHG) emissions.

This proposal suggests the structuring of a climate security and resilience programme for the Northeast's agricultural sector, using **Technical Cooperation**, between rural producers, teaching and research institutions, and the public and private sectors, as the **central coordinating axis**. The objective is to foster and develop contextualized solutions to increase the region's productive resilience through the gradual transition toward bio-inputs, the reduction of greenhouse gas emissions, and the implementation of regenerative agricultural practices, knowledge transfer, institutional strengthening, and the articulation of **specific public policies for the semi-arid region and other Northeastern bioclimatic zones.** The initiative is related to the Plano ABC+CE 2020–2030 and the *Paraíba Produtiva* Programme, leveraging synergies and complementarities with initiatives in the other Northeastern states[80].

➞ **Strategic initiatives and actors:** Inter-American Institute for Cooperation on Agriculture (*Instituto Interamericano de Cooperação para a Agricultura* - IICA); Embrapa; National Supply Company (*Companhia Nacional de Abastecimento* - Conab); Ceará Agricultural Defense Agency (*Agência de Defesa Agropecuária do Estado do Ceará* - Adagri); MAPA; MPA; MDA; universities and Federal Institutes; agricultural federations; and Northeastern cooperatives.

PRIORITY ACTIVITIES:

➞ Conduct participatory territorial diagnostics to identify specific climate vulnerabilities in strategic productive chains, such as grain production, fruit farming, goat and sheep farming, and family farming, defining action priorities based on risk matrices.

80. The *Plano ABC+CE 2020–2030* is the Ceará state implementation of Brazil's federal ABC+ Plan *(Plano Setorial para Adaptação à Mudança do Clima e Baixa Emissão de Carbono na Agropecuária)*, the Sectoral Plan for Climate Change Adaptation and Low-Carbon Emissions in Agriculture and Livestock Farming, adapted to the specific bioclimatic conditions, productive vocations, and institutional landscape of Ceará. It establishes targets and actions for the adoption of low-carbon agricultural practices, including integrated crop-livestock-forest systems, biological nitrogen fixation, treated animal waste management, and the recovery of degraded pastures, within a ten-year planning horizon aligned with Brazil's nationally determined contributions under the Paris Agreement. The *Paraíba Produtiva* Programme is a state rural development initiative of the Government of Paraíba oriented toward the productive inclusion of family farmers and rural communities through investments in water infrastructure, technical assistance, agroecological practices, and market access, with particular focus on territories of high social vulnerability in the semi-arid interior. Both programmes are referenced in the PTE-NE as existing state-level frameworks whose objectives, instruments, and territorial reach can be leveraged and expanded within the regional climate security and resilience agenda proposed in this axis.

➞ Create and implement multi-institutional pilot projects in the Northeast to demonstrate the viability of regenerative productive systems in critical areas of the semi-arid region and the Northeastern Cerrado, integrating adaptation and resilience metrics into business models.

➞ Foster regional productive integration through investments in logistics infrastructure, harmonization of standards, and regional value chain planning.

➞ Develop and manage projects to attract resources that finance the transition toward regenerative agricultural practices with continuous evaluation metrics for impacts on productivity, sustainability, and income in the agricultural sector.

➞ Implement a zoning, monitoring, and impact assessment system for the transition toward sustainable practices with indicators for GHG emission reduction, increased productive resilience, and improved quality of life in rural communities.

➞ Foster crop-livestock integration (*integração lavoura-pecuária* — ILP) with emphasis on soybean and maize cultivation, implementing circularity systems that use Dried Distillers Grains (DDGs), a co-product of ethanol production, as a low-cost protein supplement in cattle farming, optimizing land use and reducing dependence on external inputs.

➞ Incentivize Agroforestry Systems (SAFs) adapted to the different Northeastern biomes, combining native and agricultural species for the recovery of degraded areas, increased productive resilience, diversified income generation, and carbon capture with technical assistance and access to inputs.

NIVA07 – Implement an integrated regional platform for disaster monitoring, early warning, and rapid response with accessible communication systems that account for digital exclusion in the country.

This proposal aims to create a unified and robust system for the **prevention and response to natural disasters** affecting the Northeast Region, articulating state and municipal governments, civil defence bodies, and communities, with a focus on events aggravated by climate change: extreme rainfall and coastal erosion along the coastline, and prolonged droughts, wildfires, and desertification in the semi-arid interior, all of which intensify human, material, and immaterial losses. The objective

is to **overcome the fragmentation of data and actions and the country's digital exclusion,** increasing territorial resilience through high-precision environmental monitoring, the interoperability of existing databases, and the emission of precise and comprehensible regional alerts.

A fundamental pillar for the sustainability and autonomy of this platform, particularly in remote areas, will be the integration and installation of photovoltaic solar energy systems (given the region's solar irradiance potential) to power hydrometeorological monitoring stations, communication points, and community support centres. The proposal takes as its reference the Integrated Disaster Information System (*Sistema Integrado de Informações sobre Desastres* - S2ID) and the Public Alert Dissemination Interface (*Interface de Divulgação de Alertas Públicos* - Idap).

➞ **Strategic initiatives and actors:** National Centre for Natural Disaster Monitoring and Alerts (Cemaden); Lapis/Ufal; National Consortium for Climate Management and Disaster Prevention (*Consórcio Nacional para Gestão Climática e Prevenção de Desastres* - Conclima); National Disaster Risk and Emergency Management Centre (*Centro Nacional de Gerenciamento de Riscos e Desastres* - Cenad); Inmet; public and private technology companies; MDR; Ministry of Communications *(Ministério das Comunicações)*; National Telecommunications Agency (*Agência Nacional de Telecomunicações* - Anatel); Secretariat for Institutional Relations (*Secretaria de Relações Institucionais* - SRI); *Casa Civil*[81]; and universities and federal teaching and research institutes in the region for technological development and data analysis.

PRIORITY ACTIVITIES:

➞ Integrate the environmental data networks and databases already available in the Northeast from the private sector and research institutions, creating a single integrated digital platform for data visualization and analysis, including indicators for arid, semi-arid, and desertification-prone territories.

81. The *Casa Civil* has been retained in Portuguese as an institutional proper name without direct equivalent in other governmental systems. It designates the Chief of Staff Office of the Brazilian Presidency, a ministry-level body responsible for coordinating government action across all ministries, supervising the implementation of presidential priorities, reviewing and drafting legislation and executive acts, and ensuring the political and administrative coherence of the federal executive. At the state level, each Brazilian state government maintains its own *Casa Civil* with an analogous coordinating function within the state executive. The *Casa Civil* occupies a position broadly comparable to the Cabinet Office in the United Kingdom, the Executive Office of the President in the United States, or the Secrétariat général du gouvernement in France, though its specific powers, structure, and political role differ across these systems. Its retention in Portuguese throughout this document reflects both the absence of a precise English equivalent and the importance of preserving the institutional identity of an organ whose coordinating function is central to the governance mechanisms proposed in the PTE-NE.

➞ Conclude technical cooperation agreements with universities and research institutions for personnel capacity-building, scientific validation of protocols, and the development of extreme event forecasting models adapted to the realities of the Northeast.

➞ Develop and implement specific monitoring and early warning models for droughts, heat waves, and desertification risk, including the analysis of vegetation indices, soil temperature, seasonal climate forecasts, and public health indicators related to excessive heat.

➞ Implement a multimodal alert communication system, combining digital technologies with accessible social technologies (community radio, sirens, SMS) to guarantee universal reach, accounting for the country's digital exclusion, particularly in remote, rural, and peripheral areas, with capacity-building actions and continuous monitoring.

➞ Implement a monitoring and impact assessment system for the transition toward sustainable practices, using technologies such as the Internet of Things (IoT), satellites, artificial intelligence, and blockchain, with indicators for emission reductions and carbon sequestration, increased productive resilience, and improved quality of life in rural communities, broadening precision, transparency, and efficiency in environmental management and the fight against climate change.

➞ Institutionalize citizen and community participation in the platform's governance, including the capacity-building of local leaders, with emphasis on youth, in the in-situ collection of data, the interpretation of alerts, and the mobilization of rapid responses, strengthening grassroots resilience.

NIVA08 – Institute permanent state forums for territorial governance and climate change in the Northeast, with equal representation from government, teaching and research institutions, the private sector, traditional and local communities, and indigenous peoples, to guide public policies on green-blue infrastructure and climate adaptation.

This proposal aims to institutionalize a **collaborative social and technical space for territorial planning,** ensuring that environmental management and infrastructure expansion are carried out with transparency, avoiding environmental racism and guaranteeing the fair distribution of benefits. The objective is to align public policy

guidelines, scientific knowledge, and community demands in long-term planning, incorporating **traditional ecological knowledge (TEK)** and sustainable practices that preserve ecosystems and promote environmental and social resilience and justice.

➞ **Strategic initiatives and actors:** Public Prosecutor's Office; Public Defender's Office *(Defensoria Pública)*; *Consórcio Nordeste* (to create a common agenda); cooperation with universities (to provide technical inputs); and with local and traditional communities and indigenous peoples.

Priority activities:

➞ Formalize the creation of the Forums through state decrees, establishing their composition, responsibilities, and meeting frequency, guaranteeing the effective participation of vulnerable peoples and communities.

➞ Structure an integrated territorial and environmental management system for each state, aggregating mapping of Permanent Preservation Areas (APPs), climate data, existing zoning instruments, and information on projects, to serve as a transparent basis for discussions.

➞ Conduct public hearings and technical consultations to develop guidelines orienting the expansion of sectors such as renewable energy, guaranteeing rigorous social and environmental criteria, benefit-sharing, and the consent of affected communities.

➞ Produce periodic reports and binding recommendations for state and municipal planning with a focus on the integration of climate, land use, ecosystem recovery, sanitation, and infrastructure policies, ensuring sources of resources and technical capacity-building for their implementation.

➞ Institute a thematic body on Green-Blue Infrastructure and Climate Adaptation within the *Consórcio Nordeste*, formally linked to the State Forums, to harmonize regional policies, articulate inter-municipal and interstate financing for strategic projects, and represent the Northeast Region in a cohesive manner in national and international forums on climate and sustainable development.

NIVA09 – Establish protection and resilience mechanisms for the food cultural heritage of traditional, rural, and fishing peoples and communities of the Northeast in relation to climate change.

This proposal aims to create an integrated **monitoring, prevention, and response system** to safeguard the food cultural heritage of **traditional communities, rural communities, and indigenous peoples of the Northeast** threatened by extreme climate events and climate change processes. The objective is to ensure the continuity of knowledge systems, practices, adapted technologies, traditional agricultural systems, and ways of life intimately connected to food, recognizing them as material and immaterial assets indispensable to cultural and food sovereignty. The proposal articulates with the recommendations of the Brazilian Charter on Cultural Heritage and Climate Change *(Carta Brasileira do Patrimônio Cultural e Mudanças Climáticas)* and with the National Climate Change Adaptation Plan.

➞ **Strategic initiatives and actors:** Ministry of the Environment and Climate Change; Ministry of Culture *(Ministério da Cultura)*; Funai; National Historical and Artistic Heritage Institute (*Instituto do Patrimônio Histórico e Artístico Nacional* - Iphan); Embrapa; National Agroecology Articulation (*Articulação Nacional de Agroecologia* - ANA); National Commission for Traditional Peoples and Communities *(Comissão Nacional de Povos e Comunidades Tradicionais)*; Climate Fund; Brazilian Committee of the International Council on Monuments and Sites (*Comitê Brasileiro do Conselho Internacional de Monumentos e Sítios* - Icomos Brasil); Brazilian Committee of the International Council of Museums (*Comitê Brasileiro do Conselho Internacional de Museus* - Icom Brasil); Brazilian Museum Institute (*Instituto Brasileiro de Museus* - Ibram).

PRIORITY ACTIVITIES:

➞ Map and document threatened food cultural heritage, identifying communities, cultivated species, culinary practices, and associated traditional calendars, using participatory methodologies and georeferencing of climate risk areas, to record threats to food heritage.

➞ Implement creole seed banks and resilient community nurseries (urban and rural) with adapted infrastructure and protocols for the transfer and multiplication of traditional species, guaranteeing genetic diversity and food security.

➞ Develop metrics, indicators, and technologies, in partnership with research institutes, that account for the losses and damages to the food cultural heritage of traditional and local communities and indigenous peoples.

➞ Include food heritage as a specific category in calls for access to post-disaster recovery resources (Funcap[82], Climate Fund), guaranteeing reparation that is not only material but also cultural and symbolic.

NIVA10 – Implement a programme to promote female leadership and intersectional approaches in climate adaptation.

This proposal aims to incorporate, in a structured manner, the gender and climate justice perspective across all policies and projects of the New Green-Blue Infrastructure and Adaptation axis, recognizing the **fundamental and strategic role of women**, particularly those belonging to traditional, rural, fishing, and peripheral communities, in the construction and maintenance of territories adapted to climate change. Aligned with the international priority of redistribution of resources, reparation, recognition, and representation, the proposal promotes the integration of social, environmental, and economic dimensions. The objective is to foster agroecological practices, **sustainable environmental management systems**, biome restoration, including the Caatinga, and infrastructure that contributes to the resilience of ecosystems and communities, simultaneously strengthening female agency. The proposal articulates with the climate justice actions of UN Women and the National Climate Change Adaptation Plan.

➞ **Strategic initiatives and actors:** National Climate Fund; Caixa Socio-Environmental Fund *(Fundo Socioambiental Caixa);* GCF; UN Women; Ministry of Women (MMulheres); Secretariat for Racial Equality Promotion Policies *(Secretaria de Políticas de Promoção da Igualdade Racial)*; State and Municipal Secretariats for Women's Policies; Northeast Women's Articulation *(Articulação de Mulheres do Nordeste)*; *Marcha das Margaridas*[83]; and reference community organizations.

82. Funcap (National Fund for Public Calamities, Protection and Civil Defense) is an accounting instrument linked to the Ministry of National Integration, created to finance actions for the prevention of and response to disasters (floods, droughts, etc.).

83. The *Marcha das Margaridas* (Margaridas' March) is one of the largest women's mobilizations in Latin America, a mass political demonstration organized every four years in Brasília by rural women's movements and feminist organizations, led by CONTAG (National Confederation of Agricultural Workers - *Confederação Nacional dos Trabalhadores Rurais Agricultores e Agricultoras Familiares)*. First held in 2000 in homage to Margarida Maria Alves, a rural union leader assassinated in Paraíba in 1983 who became a symbol of the struggle for land rights, labor justice, and women's dignity in the Brazilian countryside, the March brings together hundreds of thousands of rural and forest women, *quilombola* and indigenous women, and fishing and extractivist communities around a unified agenda of demands addressed to the federal government, encompassing agrarian reform, food sovereignty, water access, climate justice, and the rights of traditional peoples.

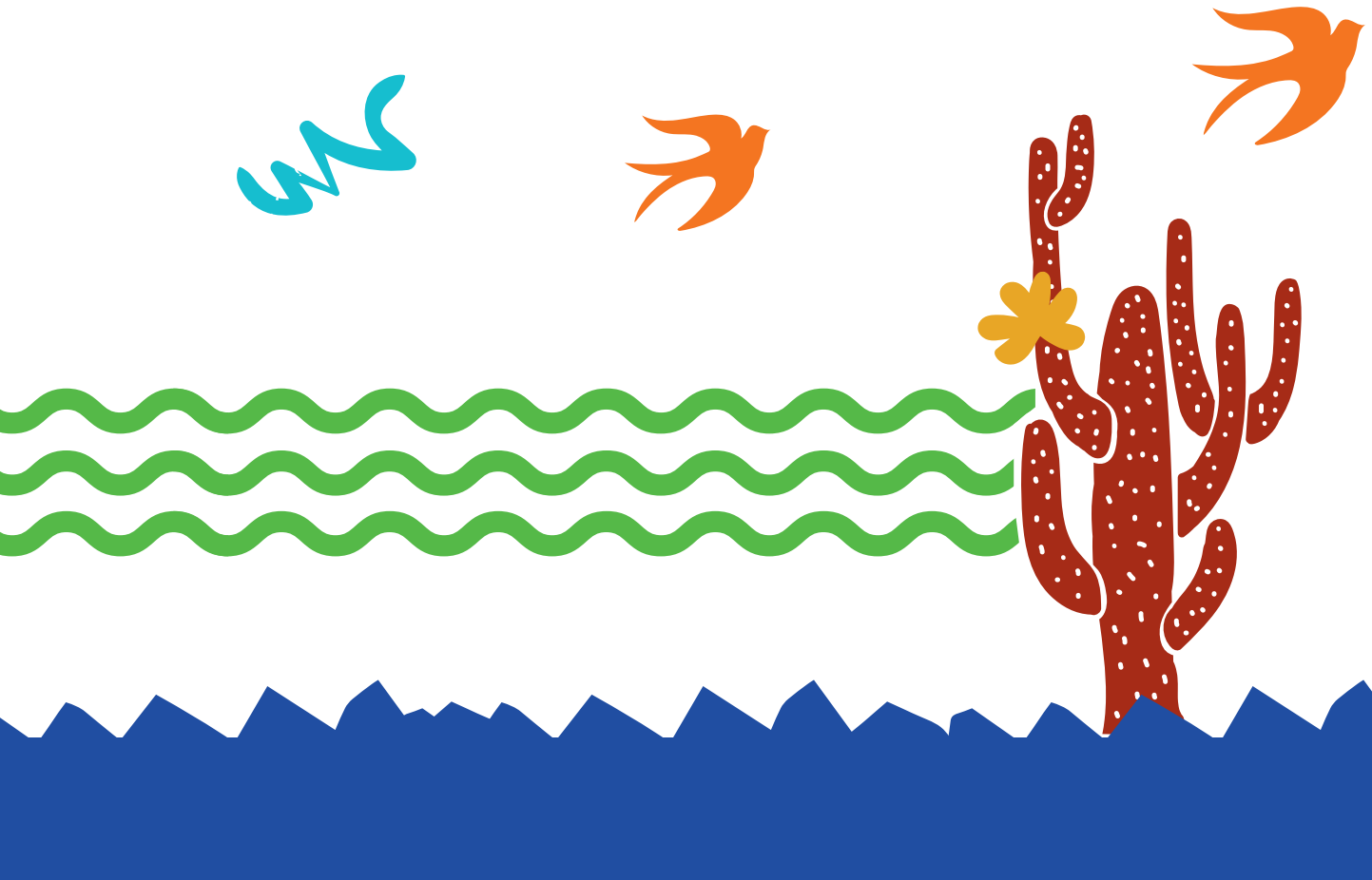
Priority activities:

➞ Stimulate participatory diagnostics with equity and climate justice metrics in vulnerability and adaptive capacity monitoring systems with an intersectional lens of gender, race, and territory, identifying the differentiated impacts of the climate crisis on rural and urban women, while valorizing existing local knowledge and practices.

➞ Constitute and strengthen women's committees for climate resilience at municipal, territorial, and state levels, endowed with deliberative power over planning, resource allocation, and the monitoring of public policies for climate mitigation, adaptation, and resilience, guaranteeing plural representativeness.

➞ Implement a capacity-building and mentorship programme in climate adaptation and resilience and project management, integrating traditional and scientific knowledge, with a focus on agroecology, sustainable water management, ecological restoration, and access to public calls and funds dedicated to climate change mitigation and adaptation.

➞ Institute community climate adaptation programmes directed at early childhood, creating green educational and environmental protection spaces (educational vegetable gardens, sensory gardens, small water management areas, community parks, and shaded areas), coordinated by women leaders, promoting learning, child well-being, and climate resilience.



FINAL CONSIDERATIONS

FINAL CONSIDERATIONS:

IMPLEMENTATION MECHANISMS OF THE *BRASIL NORDESTE* ECOLOGICAL TRANSFORMATION PLAN

The Brasil Nordeste Ecological Transformation Plan (PTE-NE) is the result of a collective construction process, anchored in technical diagnostics, territorial consultations, and political commitments. The Plan represents a convergence between technical knowledge, social participation, and political will, consolidating a regional development vision that integrates economic growth, social justice, and environmental sustainability. In the Northeastern context, it reinterprets the guidelines of the National Ecological Transformation Plan launched by the Federal Government in 2023, guiding public policies and strategic actions toward a just and sustainable transition, aligned with national and international climate commitments.

The PTE-NE departs from the recognition that the Northeast is simultaneously a territory of historical vulnerabilities and singular potentialities. Throughout its elaboration, the Plan translated this paradox into a propositional agenda, guided by six structuring axes that seek to transform structural and structuring challenges into opportunities for innovation and prosperity. In this sense, the axes synthesize some priorities for the next step of sustainable development:

➞ **Sustainable and Inclusive Finance:** the plan proposes a new regional financial architecture, grounded in innovative instruments such as green funds, sustainable bonds, collective guarantees, and climate investment platforms, capable of democratizing access to credit and directing resources toward high social and environmental impact activities. The axis emphasizes the role of the Corsórcio Nordeste as a vector of financial coordination, driving a low-carbon economy articulated with the objectives of the Brazilian Sustainable Taxonomy.

➞ **Technological Densification:** the plan recognizes that regional development requires the decentralization of scientific and technological infrastructure and the strengthening of local productive capacity. The axis emphasizes the interiorization of knowledge, technical and environmental education, the valorization of traditional knowledge systems, and the promotion of innovation hubs linked to the green and blue economy, connecting science, technology, and social justice.

➞ **Bioeconomy and Adapted Agri-food Systems:** PTE-NE is structured around the valorization of the Caatinga and the other productive landscapes of the Northeast, proposing policies to strengthen family farming, sustainable agro-extractivism, agroecology, and socio-biodiversity chains. The axis articulates productive inclusion, food security and sovereignty, and environmental conservation with a focus on restoration and sustainable management strategies.

➞ **Energy Transition:** the PTE-NE reaffirms the Northeast's role as Brazil's energy heartland, highlighting its installed capacity in wind, solar, and green hydrogen energy. The Plan proposes accelerating the just transition, guaranteeing accessible tariffs, the generation of green jobs, and the equitable redistribution of energy benefits, while simultaneously driving green neo-industrialization in strategic sectors such as sustainable fertilizers and semiconductors.

➞ **Circular and Solidarity Economy:** the plan is oriented by the substitution of the linear model of production and consumption with circular and collaborative practices. The axis proposes the creation of regional recycling hubs, the integration of waste picker cooperatives, and the strengthening of reverse logistics with a focus on social inclusion and emission reductions. It also valorizes the solidarity economy as a vector of inclusive and identity-based development.

➞ **New Green-Blue Infrastructure and Climate Adaptation:** it establishes guidelines for strengthening water and coastal resi-

lience, promoting Nature-based Solutions, and integrating sustainable urban and rural planning. It includes measures to combat desertification and valorize the Caatinga's potential, broaden access to water, and valorize the Blue Amazon, recognizing the strategic role of the Northeastern coast in the ocean economy and environmental protection.

In a cross-cutting manner, the PTE-NE affirms a model of collaborative and territorialized governance that valorizes social participation, integration among states, and cooperation with the Federal Government. This structure reflects a central principle of the Plan: the ecological transformation is also an institutional transformation, in the way governments plan, execute, and account to society.

In this sense, the implementation of the PTE-NE requires clear mechanisms for adherence, coordination, and monitoring, ensuring coherence between vision, targets, and results.

7.1 Environmental and Economic Governance of the Northeast

Over the past decade, the Northeastern states have developed and consolidated their own climate and environmental governance mechanisms, many of which already constitute a solid foundation for the implementation of the PTE-NE. Each state has specific policies and action plans oriented toward sustainability and climate change mitigation. These experiences reveal different stages of institutionalization, but all share the same trajectory: the consolidation of the ecological agenda as a vector of regional development.

This institutional diversity is a strength, demonstrating that the Northeast already operates with planning, monitoring, and financing mechanisms that can be harmonized under the same strategic umbrella. There are state secretariats for the environment and for science and technology with climate innovation units, state sustainable development funds, climate change councils, and bioeconomy technical chambers. Many states already possess geographic information systems, emissions inventories, and green taxonomy instruments at an initial stage.

The *Consórcio Nordeste* emerges in this context as an instance of political and technical coordination, endowed with the legitimacy needed to articulate state-level capacities and connect them to national and multilateral bodies. Since its creation, the Consortium has been consolidating itself as the region's principal instrument of interfederative cooperation, acting as a policy mediator and driver of territorial integration. The CNE's leadership in the elaboration of the PTE-NE reinforces its vocation as an articulator of public policies and a catalyst for institutional innovation.

The role of the *Consórcio Nordeste* is that of a regional convergence platform, capable of aligning priorities, harmonizing regulatory frameworks, coordinating fiscal and financial agreements, and establishing shared governance mechanisms among

states. This structure confers a strategic advantage on the PTE-NE: the proposal is born with political and technical implementation capacity, anchored in already existing institutions, and designed to operate under a logic of integration, complementarity, and shared responsibility.

7.2 Implementation Mechanisms

The implementation of the PTE-NE marks the beginning of a new phase of regional cooperation: the passage from formulation to coordinated action. The task is to structure a living governance system capable of ensuring that the plan translates into concrete, measurable, and sustainable results over time. The robustness of this phase will depend on the capacity to articulate three fundamental dimensions — institutional, technical, and social — around a shared horizon of transformation.

7.2.1 Formal Adherence and Federative Co-responsibility

The first step of implementation is the formal commitment of the states to the PTE-NE. This adherence, expressed through decrees, joint resolutions, or letters of commitment — is the political gesture that consolidates the plan as a regional State policy. By integrating its targets and indicators into Multi-Year Plans (*Planos Plurianuais* - PPAs), Budget Guidelines Acts (*Leis de Diretrizes Orçamentárias* - LDOs), and Annual Budget Acts (*Orçamentos Anuais* - LOAs), state governments recognize the ecological transformation agenda as cross-cutting and priority, guaranteeing its continuity beyond electoral cycles.

Adherence also makes it possible to align existing state planning and financing instruments, such as innovation funds, development agencies, public banks, and sectoral programmes, with a common strategy of just transition and sustainable development. The formalization of this commitment not only confers stability to the agenda but also opens the way for the normative and financial harmonization of the region, enabling the mobilization of national and international resources under a single action framework.

7.2.2 Cooperative and Multi-scalar Governance

To sustain the execution of the plan, a cooperative governance structure is required, one that unites political coordination, technical expertise, and social oversight. The proposed structure operates at multiple levels, connecting state leaderships, technical teams, and social actors in a system of continuous and responsive deliberation.

Within the PTE-NE framework, the *Consórcio Nordeste* maintains its role of coordinating the Plan's implementation efforts. Its governance bodies bring together accumulated experience, political legitimacy, and technical capacity to coordinate regional actions. The plan is thus grounded on a solid organizational foundation, capable of articulating political decisions, technical monitoring, and social participation in an integrated and continuous manner.

The Assembly of Northeastern Governors *(Assembleia das Governadoras e Governadores do Nordeste)* — the Consortium's

highest deliberative body — is the legitimate space for the Plan's strategic deliberation and political agreement. It is responsible for validating general guidelines, approving progress reports, and periodically reaffirming the interfederative commitments undertaken by the states. This political dimension ensures that the PTE-NE remains at the centre of the regional agenda, preserving its character as a shared and long-term public policy.

The Executive Secretariat of the *Consórcio Nordeste* serves as the technical and operational nucleus of implementation, responsible for coordinating planning, monitoring indicators, and consolidating information submitted by the states. The Secretariat also plays an articulating role with the Federal Government, international organizations, and financial institutions, ensuring methodological coherence, data transparency, and the continuity of decision-making processes. Its function is to translate political deliberations into concrete actions, mediating flows between state governments, technical partnerships, and civil society.

The Thematic Chambers of the *Consórcio Nordeste*, already instituted and operational across various areas, are the natural spaces for technical monitoring and the convergence between sectoral policies and the PTE-NE. Each Chamber, within its respective field (environment, energy, agriculture, science and technology, planning, finance, among others), contributes to the alignment of state agendas with the Plan's regional targets, promoting the exchange of experiences, the harmonization of regulatory frameworks, and the standardization of monitoring methodologies. Together, these Chambers form the backbone of the PTE-NE's technical governance, ensuring coherence across the six strategic axes and preventing the fragmentation of actions.

The listening processes and participation of diverse social segments in the elaboration of the PTE-NE must be extended through all its subsequent phases. Accordingly, the monitoring of the PTE-NE will be conducted with the active presence of society through dialogue processes, public consultations, regional workshops, and interactions with teaching and research institutions, productive sectors, social movements, third-sector organizations, and community actors. This permanent openness to social listening will allow the plan's implementation to remain transparent, inclusive, and sensitive to territorial dynamics, reinforcing the principle that ecological transformation is also a collective and democratic process.

In this way, the Brasil Nordeste Ecological Transformation Plan is anchored in a cooperative and multi-scalar governance structure that articulates political, technical, and social levels within a single institutional framework.

7.2.3 Targets, Indicators, and Results Monitoring

The consolidation of a Regional Indicator Framework (*Quadro Regional de Indicadores* — QRI) is the instrument for transforming commitments into evidence. Each axis of the plan must have its targets translated

into operational indicators with clearly identified methodological definitions, baselines, data sources, measurement frequency, and responsible technical parties.

These indicators will function at three interdependent levels:

➞ **Impact indicators,** which measure structural transformations, such as the expansion of the renewable energy matrix, the generation of green jobs, or the restoration of ecosystems;

➞ **Process indicators,** which monitor execution efficiency, such as the number of structured projects, the volume of financing mobilized, or the integration between sectoral policies;

➞ **Governance and integrity indicators,** which track the functioning of deliberative bodies, compliance with social and environmental safeguards, and the level of information transparency.

The standardization of these indicators will enable comparability among states and strengthen public confidence in results.

The monitoring of the plan must combine technical routine with moments of political decision-making. The Thematic Technical Chambers will hold regular meetings to examine the progress of targets and identify risks or bottlenecks.

This monitoring and deliberation cycle creates a system of institutional learning, in which decisions are evidence-based and continuously fed back by the data and assessments generated at each stage.

7.2.4 Planning in Cycles and Territorial Scope

The implementation of the PTE-NE will be organized in planning cycles that reconcile rhythm and predictability. The first cycle should focus on the consolidation of governance bodies, the agreement on targets, and the definition of priority indicators. From there, the plan will evolve in biennial implementation cycles of 24 months, each with intermediate targets, performance reviews, and reprogramming plans.

This methodology allows the plan to operate under an iterative and continuous learning logic, adjusting to changes in context and to observed results. Each cycle must be accompanied by evaluation reports and improvement recommendations, ensuring that implementation remains dynamic and realistic.

Furthermore, execution must preserve the territorialized character of the PTE-NE, recognizing the social, environmental, and economic specificities of each sub-region. The organization of integrated project portfolios by territory is proposed — for example, river basins, coastal zones, marine zones, bioeconomy corridors, or energy axes — so that policies and investments can converge toward concrete and verifiable results at local scale. In this sense, the proposals and priority activities will serve as cross-cutting guidelines for the implementation of projects across territories.

7.2.5 Project Portfolio Structuring

The structuring of the PTE-NE's project portfolio constitutes the most important operational axis of the implementation phase. It is through this portfolio that the plan's targets and guidelines are converted into concrete initiatives — subject to execution, financing, and joint monitoring between the states and the *Consórcio Nordeste*.

This portfolio will be the dynamic instrument for regional prioritization and coordination, organized so as to reflect both the plan's thematic axes and the territorial and socioeconomic specificities of the region.

The structuring process will follow three complementary movements. First, the Executive Secretariat of the *Consórcio Nordeste* will coordinate a common methodology for selection and prioritization, ensuring that all projects comply with the sustainability, viability, and regional impact criteria defined by the plan. Subsequently, the Thematic Chambers of the Consortium must identify, in each area, the strategic initiatives already underway in the states and propose their integration into joint regional actions, avoiding overlaps and maximizing synergies. Finally, the portfolio will be submitted to the Assembly of Governors, which will approve the set of priority projects for each implementation cycle, conferring political legitimacy and predictability to their execution.

The project portfolio is a living mechanism for managing the ecological transformation and must be periodically reviewed and updated, tracking regional indicator results and changes in economic and climate contexts. This continuous updating will make it possible to reorient investments, incorporate technological innovations, and broaden the territorial reach of the highest-impact actions.

Furthermore, the portfolio will function as a bridge between planning and financing, serving as a basis for the mobilization of resources from public banks, multilateral organizations, and international climate funds. Its structured and technically qualified existence will enhance the negotiating capacity of the *Consórcio Nordeste* and state governments, consolidating the region as a cohesive governance bloc for sustainable development.

By organizing, prioritizing, and monitoring projects in a coordinated manner, the portfolio will become the principal vector for the materialization of the PTE-NE, the link

between the strategic vision and tangible results in people's lives, local economies, and Northeastern ecosystems.

7.2.6 Financing and Economic Sustainability of the Plan

No regional transformation plan sustains itself on the ambition of its targets alone, it depends on the capacity to mobilize financial resources commensurate with the scale and cross-cutting nature of its actions. The implementation of the Brasil Nordeste Ecological Transformation Plan therefore requires a coordinated multilateral, public, and private financing strategy, capable of guaranteeing both the ongoing management of the plan and the execution of the project portfolio.

This strategy departs from the recognition that the Northeast already possesses relevant financial and institutional instruments — Eco Invest; the Bank of the Northeast (BNB); BNDES; Finep; the Climate Fund; Constitutional and State Environmental Funds; Science and Technology Funds; international funds such as the Global Environment Facility (GEF) and the Green Climate Fund (GCF); and international cooperation programmes — all of which can be articulated under a single logic of support for the ecological transition.

The role of the *Consórcio Nordeste*, in this context, is to act as an integrating structure, responsible for articulating these mechanisms, designing blended financing models, and representing the region in negotiations with international organizations and private partners.

Beyond the mobilization of new resources, the PTE-NE proposes to rationalize and align existing instruments, reducing dispersion and strengthening synergies between federal and state policies. This involves the integration of sustainability criteria into credit concession, the adoption of common green taxonomies, and the harmonization of social and environmental impact measurement methodologies.

Finally, the *Consórcio Nordeste* must act as a regional technical-financial interlocutor, supporting states in the elaboration of proposals, the management of mobilized resources, and accountability reporting. This support function is essential for strengthening the institutional capacity of governments and consolidating the Northeast as a national reference in financial governance of the ecological transition.

The implementation of the Brasil Nordeste Ecological Transformation Plan represents a milestone of political and technical cooperation in the region's recent history. It translates the maturity of a federative arrangement that has learned to work in networks, sharing responsibilities and innovating in the way public policies are produced.

With the formal adherence of the states, the integrated functioning of governance bodies, the consolidation of clear indicators, and a permanent commitment to transparency, the PTE-NE will become a pact for the future, guided by values of justice, equity, sustainability, and regional solidarity.

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