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Financing Climate Solutions in Brazil

Challenges and pathways to acceleration

Thanks

This study was developed by Bain & Company in partnership with BNDES and aims to contribute to the debate on the challenges to financing the Brazilian climate transition.

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We hope you enjoy reading.

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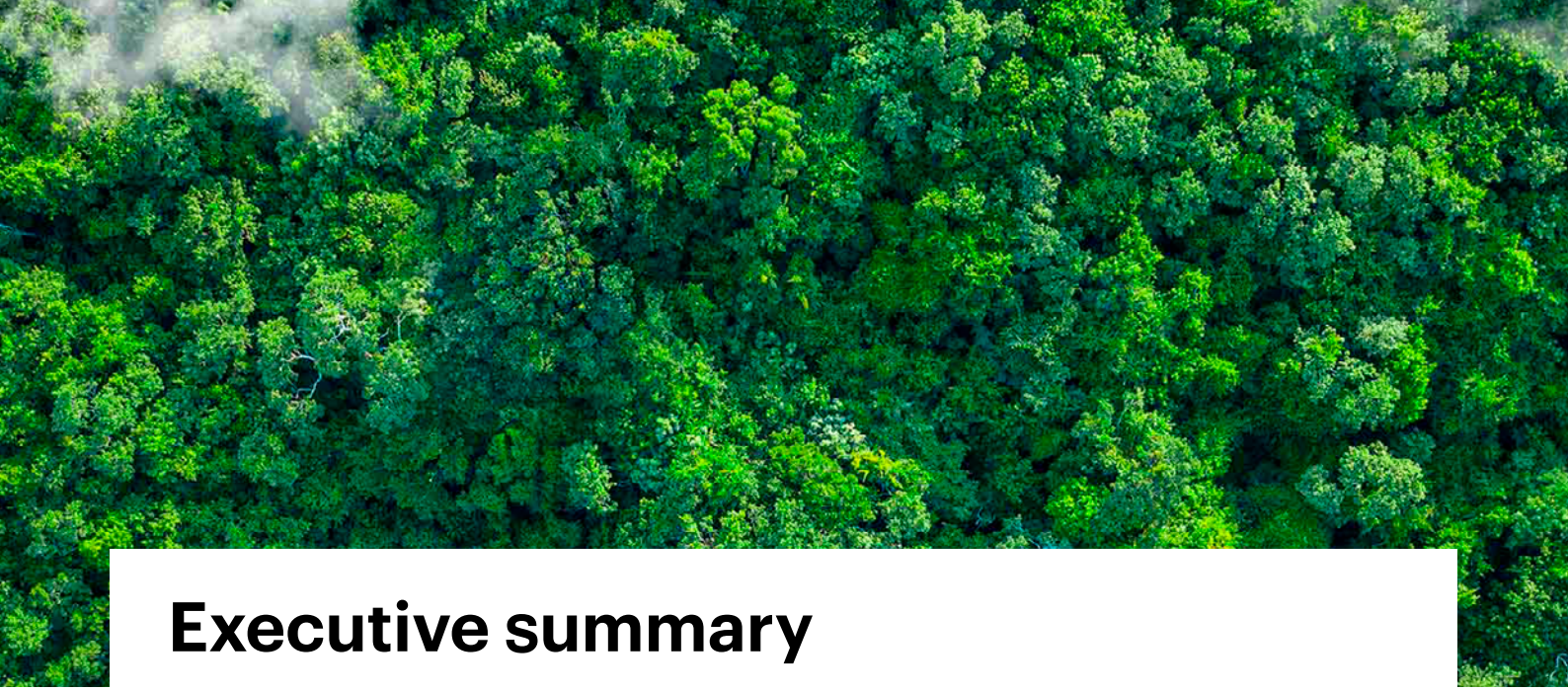


Executive summary

- **Brazil is strategically positioned in the fight against climate change. Due to its renewable and diverse energy matrix, the country can lead, globally on nature-based solutions and low-carbon technologies.**

- The Brazilian climate transition will require **massive investments, estimated at between R$ 1 trillion and R$ 1.2 trillion by 2030**, to achieve its announced commitments. This total comprises about R$ 800 billion for energy transition and R$ 400 billion for nature-based solutions.

- **The market's willingness to finance climate transition solutions is still limited**, especially in emerging sectors or those with greater technical complexity. **This reluctance reflects a risk-return equation that is still unbalanced for most climate solutions**, as a result of the low maturity of four fundamental pillars: **regulatory standardization, technology, value chain, and institutional incentives.**

- The study analyzed **15 key solutions for decarbonization**, categorized into four maturity archetypes, depending on the stage of development of the four fundamental pillars. Each archetype presents specific challenges for capital mobilization, regulatory alignment, and consolidation of value chains, requiring specific financial approaches:

  — **Undefined Technological Pathways:** focus on research and development grants; insurance and guarantees to mitigate the risk of first projects; offtake contracts and incumbents engagement to signal demand.

  — **Emerging Solutions:** catalytic equity and concessional debt for capital-intensive risk absorption and demand mandates to reduce revenue uncertainty.

  — **Nascent Chains:** concessional debt, strategic equity and long-term offtake contracts, which promote the integration of the value chain to reduce costs and increase scale.

  — **Developing Markets:** guarantees, concessional debt, and offtake contracts to mitigate demand risk and scale ecological restoration and conservation in a predominantly voluntary carbon market.

The challenge of financing the climate transition is complex and goes beyond the financial dimension, requiring a combination of technical, institutional and market actions adapted to the reality of each solution. **There is no shortage of projects—the Brazil Climate and Ecological Transformation Investment Platform (BIP) alone has already identified 15 projects seeking USD 22 billion. However, there is no single solution that fits all contexts and solutions.**

Public and development institutions support will be essential to unlock climate finance in Brazil. Several initiatives are already advancing in this direction, such as:

— Brazil Climate and Ecological Transformation Investment Platform (BIP) - which connects projects to private investors and concessional capital, in addition to developing innovative mechanisms to overcome critical barriers;

— Eco Invest Brasil, which expands the supply of concessional capital in key sectors;

— BNDES, with the potential to act as an orchestrator between development actions and the private sector, allocating strategic resources to make projects viable;

— Multilateral development banks (MDBs), climate funds, and sectoral initiatives can strengthen support and expand available sources of financing.

Directing concessional capital to climate solutions with **higher risk profiles is essential**—not only to make the first projects viable, but also to **mature emerging value chains, structure new markets and mitigate structural flaws** that today drive away private capital. This initial investment **reduces uncertainties, generates practical references**, and gradually allows solutions to achieve **economic scalability, becoming attractive to commercial capital—**as Brazil has experienced in the renewable energy sector in recent decades.

Coordinated action between the private (productive and financial), public and tertiary sectors will be essential to solve regulatory challenges, structure sectoral plans with an integrated view of value chains and implement efficient instruments to promote the market. This joint approach **aligns economic incentives, reduces institutional barriers, and consolidates low- carbon markets in an integrated way, while driving decarbonization, socio-environmental resilience, and economic development.** An action structured in this sense creates positive expectations, **fostering a virtuous circle of investments**.

The Brazilian presidency at COP30 represents a strategic opportunity to position Brazil as a global reference in climate solutions, attract additional capital to accelerate the transition to a low-carbon economy, and consolidate the country as an innovation hub and leader in mitigation, adaptation, and sustainable socioeconomic development.

Introduction

Brazil has strategic advantages in the fight against climate change, both because of its natural assets, which position it as a nature-based solutions hub, and because of its predominantly renewable energy matrix, which makes the country a potential enabler of the decarbonization of hard-to-abate chains—such as cement, steel and fertilizers—as well as a powerhouse for other demands, such as data centers. If seized, the opportunity to lead key solutions to fight climate change can establish a new pattern of socioeconomic development for Brazil.

From a natural capital perspective, the country has the potential to become the leading provider of nature-based solutions, contributing significantly to the fight against the climate change by 2030. According to the IPCC, solutions based on land use and soil management can contribute with 20% to 30% of mitigation and adaptation actions by the end of this decade[1]. Brazil has the greatest biodiversity on the planet, home to more than one-third[2] of the world's tropical forests and 62% of the territory of the Amazon[3]. With this unique composition, environmental preservation is one of the central elements of the country's contribution to mitigation and adaptation, and a possibility for new development pathways through bioeconomy.

Another sector that plays a central role in the climate mitigation agenda is **Brazilian agriculture**. This activity currently represents about 25% of the country's GDP[4], more than 25% of jobs[5] and 49% of exports[6], and more than 30% of total Brazilian emissions[7]. Brazil already has several widely applied sustainable practices in the field, such as no-till farming and crop rotation. But the increase in use of sustainable and regenerative practices in agriculture and livestock should lead the next wave of productivity growth in the field and, at the same time, sequester carbon on a large scale, making the country doubly competitive. In addition, Brazil has 28 million hectares of degraded pastures[8] that could be recovered and destined for agriculture, livestock, energy and reforestation.

[1] WG III contribution to the Sixth Assessment Report: Chapter 7 (p. 6). Available at: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter_07.pdf

[2] https://www.interfaithrainforest.org/brazil

[3] World Bank Group. Eight Amazonian Countries with the Power to Save the Planet. Available in: https://www.worldbank.org/en/news/feature/2023/07/05/ocho-paises-de-la-amazonia-con-el-poder-de-salvar-el-planeta-america-latina

[4] https://www.cepea.org.br/br/pib-do-agronegocio-brasileiro.aspx

[5] https://www.cnabrasil.org.br/noticias/populacao-ocupada-no-agronegocio-no-1o-trimestre-e-recorde

[6] https://www.gov.br/secom/pt-br/assuntos/noticias/2025/05/agro-brasileiro-exporta-us-15-bilhoes-em-abril-com-crescimento-de-produtos-menos-tradicionais

It is important to mention that Brazil's natural capital also encompasses mining. The country has relevant reserves of critical and traditional minerals, important for both climate transition and economic development. Defining Brazil's exploration outline ensuring value creation in the country and alignment with preservation and bioeconomy, will be strategic for the country to realize its competitive advantages and capture a meaningful part of the value of these value chains.

The country's traditional mineral reserves and well-established industrial base, when combined with the Brazilian electricity matrix—unique among the largest economies in the world, with up to 88% of generation coming from renewable sources[9]—position Brazil as a platform for the production of low-carbon inputs and goods, including hydrogen, steel, cement and green fertilizers. Estimates indicate that Brazil could represent at least 10% of the global green hydrogen trade by 2050[10].

Capturing these opportunities and translating them into socioeconomic development for Brazil will require great efforts, in multiple dimensions, starting with the designing of solid transition plans—which recognize inter dependencies, guide sectoral climate actions based on the goals of the Brazilian NDC, and aim to position the country as a climate solutions hub—followed by the evolution and refinement of regulatory frameworks, and the promotion of new markets.

The development of Brazil's climate transition strategy, which is ultimately part of the country's socioeconomic development plan, will not happen quickly. The sectoral complexity, combined with the coordination of multiple agents and interests, will require alignments and negotiations (e.g., green taxonomy, regulated carbon market, certification/traceability rules for different solutions). Science also does not have all the answers to some elements of this journey, such as the challenges that still exist to accurately quantifying carbon sequestration in tropical soils or emissions associated with enteric fermentation.

[7] Bain Analysis - National Inventory of Anthropogenic Emissions by Sources and Removals by Greenhouse Gas Sinks (MCTI)

[8] https://www.embrapa.br/busca-de-noticias/-/noticia/87076753/brasil-possui-28-milhoes-de-hectares-de-pastagens-degradadas-com-potencial-para-expansao-agricola

[9] https://agenciagov.ebc.com.br/noticias/202402/com-88-da-matriz-eletrica-limpa-brasil-ja-e-lider-da-transicao-energetica-no-mundo

[10] https://agro.insper.edu.br/agro-in-data/artigos/hidrogenio-verde-no-brasil-estamos-prontos-para-liderar-a-revolucao-energetica

On the financing side, we are facing one of the largest capital reallocations in recent history, estimated at around R$1.2 trillion (just over 10% of the Brazilian GDP[11]), of which about R$800 billion are related to the energy transition and R$400 billion related to nature, over the next 5 years[12].

It is important to highlight that the public funds and the development and multilateral banks will not be able to mobilize sufficient capital without the participation of the private sector. In 2023, Brazil received just over US$60 billion of all global climate capital[13]. Most (approximately 90%) of this capital was allocated to solid and profitable sectors (solar and onshore wind). Only about 10% of the total was directed to other segments of the climate transition[14].

Unlocking climate financing is a challenge in terms of not only in terms of the amount involved or financial instruments required, but also in terms of the evolution of the contours of the Brazilian climate strategy (plans, policies, regulation and development). Currently, as we will explore, a significant part of climate solutions present an unattractive risk-return equation due to structural market failures. However, the climate agenda cannot wait for all these elements to be resolved. Financing of the first large-scale projects will be simultaneously an enabler and a driver of the Brazilian transition strategy by addressing the most critical structural challenges and unlocking the escalation of solutions.

As with the renewable energy sector, this initial financing effort is critical to boost the market, allowing private capital to play a greater role in the medium term, given the substantial volume of resources required.

In this context, structuring robust climate financing models represents a strategic challenge for the country. On one hand, it is critical to recognize that the portfolio of solutions available until 2030 has different degrees of maturity and scalability. On the other hand, supply chains are not yet fully established, which reinforces the central role of concessional capital in reducing intrinsic risks and making projects more attractive to commercial capital. Otherwise, it will be impossible to make the necessary investments viable. Studies reveal that every US$ 1 of concessional capital can catalyze up to US$ 5 of commercial capital[15]; despite this, data from Climate Policy Initiative (CPI) reveals that concessional capital accounted for only 10% of the volume of climate finance between 2018 and 2023[16].

[11] https://www.ibge.gov.br/explica/pib.php

[12] Bain Analysis - Intersect CGE; WEO (2024); Literature review;

[13] It is important to highlight that climate investments are being considered in the year in which they are announced, even if disbursed later over several years.

[14] CLIMATE POLICY INITIATIVE. Global Landscape of Climate Finance 2025 (p. 47). Available at: https://www.climatepolicyinitiative.org/pt-br/publication/global-landscape-of-climate-finance-2025/

In light of this scenario, this work contributes to the advancement of the Brazilian climate finance agenda by offering a practical approach based on empirical experience of several projects that, despite the sectoral nuances, can be grouped into 4 archetypes depending on the maturity of the climate solutions they represent.

For each archetype, there is a more efficient pathway for deploying the scarce concessional capital existent, which is key to generate the catalytic effect needed to attract and make use of commercial capital.

Without adequate and timely financing, Brazil risks failing to fulfill its strategic role and missing the opportunity to position itself uniquely and distinctively within the global technological agenda. The COP30 presidency therefore represents a strategic moment for Brazil to present itself as a hub for climate solutions and to attract the necessary investments for its transition, making the most efficient use of these resources to build its competitive advantages.

[15] Enhancing Access to Concessional Climate Finance: Perspectives from the IDB's Experience with Major Climate Funds: CIF, GCF, and GEF (Page xi). Available at: https://publications.iadb.org/en/publications/english/viewer/Enhancing-Access-to-Concessional-Climate-Finance.pdf

[16] CLIMATE POLICY INITIATIVE. Global Landscape of Climate Finance 2025. (p. 52): https://www.climatepolicyinitiative.org/pt-br/publication/global-landscape-of-climate-finance-2025/

The challenge of financing the Brazilian climate transition

The climate finance agenda imposes a new scale of ambition to not only to Brazil, but the whole world. We are facing a global development paradigm shift, which will require a massive capital reallocation towards technologies and productions models within an extremely short time frame and through coordinated action among multiple stakeholders.

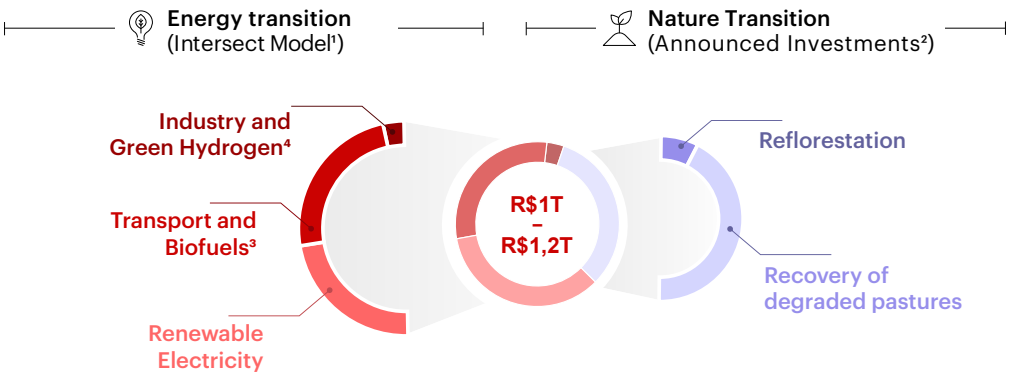
Global estimates, which continue to rise, may surpass US$3 trillion per year through at least 2030, according to the World Bank[17]. The cost of inaction also carries a high price: between US$1.7 trillion and US$3.1 trillion in annual losses by 2050[18], according to estimates from the World Economic Forum.

In Brazil's case, the challenge is also relevant—and imminent. In partnership with Copenhagen Economics, Bain & Company developed the INTERSECT Energy Transition Model: a general equilibrium model that identifies the most cost-effective pathway for decarbonizing the economy, while accounting for real-world constraints such as physical limits, costs, and the pace of technological adoption. Multiple industrial sectors are considered simultaneously, ensuring that supply and demand remain balanced and that GDP growth is sustained throughout the transition.

[17] Mobilizing Private Capital for the Sustainable Development Goals (p. 2). Available at: https://thedocs.worldbank.org/en/doc/5f794f116934331c3bb10d81397e4da6-0050022024/original/Bob-Cull-ABCDE-2024-PPT.pdf

[18] https://www.weforum.org/stories/2023/10/climate-loss-and-damage-cost-16-million-per-hour/

Figure 1: Need for climate finance by vertical to achieve NDCs (R$B between 2025 and 2030)



Notes: (1) General equilibrium model with a focus on industrial activities; (2) Considers the fulfillment of the goal of restoring 6M hectares of Forest in the Amazon (via the "Arc of Restoration in the Amazon" and Planaveg) initiative and the recovery of 20 million hectares of degraded pastures by 2030 (via the National Program for the Conversion of Degraded Pastures into Sustainable Agricultural and Forestry Production Systems – PNCDP); (3) Biofuels and biomass: grouped into Transportation, since the sector accounts for most of the fuel consumption in Brazil; (4) Grouped as an industrial solution, where its intended use is concentrated;

Source: Intersect CGE; WEO (2024); Literature review;

Based on this model, it is estimated that, to meet climate commitments by 2030, the transition of sectors such as power generation, transport and industry will require investments between R$ 610 billion and R$ 800 billion. In addition, Brazil needs another R$ 380 billion to promote the transition of activities related to land use[19], of which R$ 50 billion is needed to promote the restoration of 6 million hectares of forest[20] and R$ 330 billion to recover 20 million hectares of degraded pastures[21].

In all, R$ 1 trillion to R$ 1.2 trillion in investments will be needed by 2030 for Brazil to be in line with its climate goals.

In 2023, the world reached the equivalent of US$ 1.9 trillion in climate investments, 65% of which came from private and commercial sources. Domestic public financing and multilateral banks totaled about 30%, and the remaining came from philanthropy and other public institutions[22]. In general, private capital was associated with already well-established sectors, such as fleet electrification and renewable energies—like solar and *onshore* wind—and it was up to the concessional capital to advance more disruptive projects.

Only 3% of the world's capital invested in climate was destined for Brazil; Most of it had domestic and private origins, and also had an extremely concentrated profile, with 80% of the amount allocated to renewable energy projects[23] (a sector long present in the national economic agenda, and which has been gaining traction with the advance of distributed generation).

The market's willingness to finance climate transition solutions is still limited, especially in emerging sectors or those with greater technical complexity, as the CPI[24] study points out. This reluctance reflects a risk-return equation that is still unbalanced for most climate solutions, result of the level of maturity of four fundamental pillars that outline projects risks.

[19] Estimation of financing need according to (1) Intersect: General equilibrium model with a focus on industrial activities; (2) Considers the fulfillment of the goal of restoring 6M hectares of Forest in the Amazon (via the "Arc of Restoration in the Amazon" initiative and Planaveg) and the recovery of 20 million hectares of degraded pastures by 2030 (via the National Program for the Conversion of Degraded Pastures into Sustainable Agricultural and Forestry Production Systems – PNCDP); (3) Biofuels and biomass - Grouped into Transportation, since the sector accounts for most of the fuel consumption in Brazil; (4) Green Hydrogen: grouped as an industrial solution, where its intended use is concentrated.

[20] BRAZIL. Ministry of Environment and Climate Change. Brazil's NDC: National Determination to Contribute and Transform (p. 32). Brasília: MMA, 2024. Available at: https://www.gov.br/mma/pt-br/assuntos/noticias/brasil-entrega-a-onu-nova-ndc-alinhada-ao-acordo-de-paris/ndc-versao-em-portugues.pdf. It considers 6M hectares planted out of the planned 24M (25%), at a total cost of R$200B.

[21] The Impact of ABC Program Credit for Pasture Recovery: Evidence for the Cerrado(p. 7). Available at: https://www.climatepolicyinitiative.org/pt-br/publication/o-impacto-do-credito-do-programa-abc-para-a-recuperacao-de-pastagens-evidencias-para-o-cerrado/. Cálculo feito rateando o investimento previsto para o PNCPD (US$120B em 10 anos) em 5 anos, com taxa de câmbio em R$5,50. Calculation made by prorating the planned investment for the PNCPD (US$120B in 10 years) in 5 years, with an exchange rate of R$5.50.

[22] CLIMATE POLICY INITIATIVE. Global Landscape of Climate Finance 2025. San Francisco: CPI, 2025. (p. 4). Available at: https://www.climatepolicyinitiative.org/pt-br/publication/global-landscape-of-climate-finance-2025/. Accessed on: 19 Aug. 2025.

[23] CLIMATE POLICY INITIATIVE. Global Landscape of Climate Finance 2025. San Francisco: CPI, 2025. (p. 47). Available at: https://www.climatepolicyinitiative.org/pt-br/publication/global-landscape-of-climate-finance-2025/ Accessed on: 25 jul. 2025.

[24] CLIMATE POLICY INITIATIVE. Global Landscape of Climate Finance 2025. San Francisco: CPI, 2025. (p. 22). Available at: https://www.climatepolicyinitiative.org/pt-br/publication/global-landscape-of-climate-finance-2025/. Accessed on: 22 Aug. 2025.

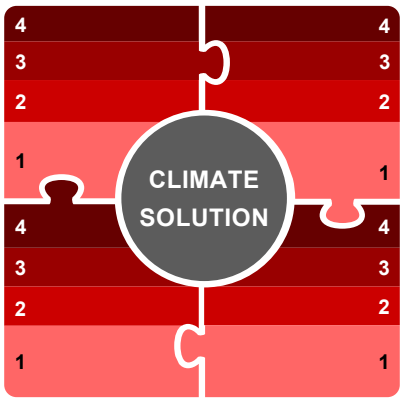
Figure 2: Climate solutions maturity pillars

STANDARDIZATION

04	**Comprehensive and established regulatory and operational guidelines**
03	Partially defined regulatory framework, with guidelines still evolving
02	Normative discussions that are still incipient or tangential
01	**Absence of applicable legal frameworks, taxonomies or standards**

TECHNOLOGY

Technology already mastered and relatively stabilized	04
Defined and scalable route, with cost curve in optimization	03
Technological route defined, but not mature enough to scale	02
No clear technology pathway; still in early-stage R&D	01



INCENTIVES

04	**Consistent, predictable incentives aligned with transition goals**
03	Direct incentive mechanisms available, but limited reach
02	Incipient or indirect development, with low predictability
01	**Absence of incentives that promote competitiveness in the "green" sector**

VALUE CHAIN

Well-established value chain with fluid and scalable integration	04
Value chain already functional, but with room for productivity and scale gains	03
Value chain in structuring, or concentrated in verticalized operations	02
Practically non-existent or entirely unstructured value chain	01

Typically, the development of solutions occurs progressively, with the new technology being optimized until it reaches parity with the conventional solution, followed by the definition of a clear regulatory framework, the construction of an adapted value chain and, finally, the market maturation with offtake and scalability.

However, for climate transition solutions—often more strategic than economic nowadays—this pathway rarely takes place linearly. In many cases, advancing a "green" solution depends on the early activation of one of these vectors, such as a mandate to use, a public auction, or a tax incentive—even before the technology is fully mature or the chain is established.

Globally, it is common for regulators to act in a purposeful way, creating demand via public policy before the private sector has more clarity on which route will be dominant or if the economics add up. This applies to technologies with high strategic potential, but which have not yet proven themselves at scale, such as green hydrogen.

In other situations, the inflection point may come from the structuring of a value chain through industrial coalitions, even without formal regulatory support—as in the case of industrial decarbonization pathways, where companies pursue green solutions even in the absence of climate mandates. In highly innovative sectors, such as regenerative agriculture or bio inputs, the initial trigger may be a technical or financial support program that enables pilot projects and encourages the entry of specialized players. Understanding this dynamic is crucial for calibrating the design of policies and instruments.

In this context, concessional capital has the role of attracting commercial capital to unlock solutions that do not yet have an attractive risk-return ratio. By making these projects viable, financing structures expose the structural challenges underlying each solution and catalyze progress around the four fundamental pillars that drive project risk.

Recognizing both the importance and the opportunity of this agenda, Brazil has advanced in developing instruments and guidelines that strengthen the institutional and operational conditions required for the effective mobilization of concessional and private capital. On the institutional side, the country has relevant sectoral climate plans—such as ABC+, the National Native Vegetation Recovery Plan (PLANAVEG), and New Industry Brazil (NIB), among other—that signal priorities and coordinate public policies. On the regulatory side, proposals such as the Future Fuel Bill (PL Combustível do Futuro) and the recent Regulated Carbon Market Bill (PL do Mercado Regulado de Carbono) are beginning to create space for low- carbon markets and business models.And in the financial sphere, emerging innovations aim specifically to bridge high-risk opportunities with commercial capital.One example is Eco Invest Brasil, an initiative led by the Brazilian government that promotes the creation of catalytic debt instruments and blended finance models with private participation, directly contributing to lowering the cost of capital and creating entry mechanisms for traditional investors in still-emerging solutions.

More recently, efforts have also been announced to attract climate-focused equity resources —an even scarcer and higher-risk type of capital. A notable example is the public call recently launched and led by BNDES, through which the development bank intends to invest in investment funds managed by private asset managers, with the potential to mobilize up to R$20 billion in partnership with domestic and international private investors.

In addition to mobilizing concessional capital, 2024 saw the launch of the Brazil Investment Platform (BIP), a country platform designed to facilitate the financing of climate projects by connecting projects with different types of capital (concessional, commercial, and risk capital) and by addressing structural barriers that hinder investment in sustainable solutions, such as lack of standardization, regulatory clarity, and technical assessment mechanisms.

[25] https://www.reuters.com/sustainability/cop/brazil-talks-with-tpg-brookfield-over-4-billion-climate-finance-push-2025-07-28/

Case Study—Brazil Investment Platform (BIP)

CASE STUDY

Country Platform to foster climate-related investments in Brazil

Concessional Debt **Concessional Equity**

Launched in 2024 by the federal government and led by BNDES, BIP connects decarbonization projects to different types of capital, facilitates access to catalytic financing, and promotes financial solutions in partnership with investors. The platform also coordinates public and private actors to align efforts and expand the impact of the Brazilian ecological transition.

The Brazil Climate and Ecological Transformation Investment Platform (BIP) is a country platform launched in 2024 by the federal government, with its secretariat led by BNDES, which gives it a strategic position alongside the country's main development bank. Its goal is to connect projects aligned with the decarbonization agenda to different types of financing—concessional and commercial—and reduce barriers that limit the viability of sustainable investments.

BIP operates in three main ways: (i) **connecting projects with financial institutions**, through the identification and integration of a project pipeline and a long list of interested investors; (ii) **addressing critical barriers**, such as the development of financial solutions in working groups and partnerships, the lack of standardization, regulatory clarity, and access to different sources of catalytic capital; and (iii) **coordination between public and private actors**, including governmental and sectoral initiatives, multilateral development banks (MDBs) and climate funds, to align efforts and expand impact.

By fostering critical discussions, developing risk mitigation mechanisms, and creating conditions for replicability, the platform seeks to expand the participation of private capital, guide the use of catalytic capital, and accelerate the implementation of transformational projects in strategic sectors of the Brazilian ecological transition.

The expectation is that, by mitigating risks and enabling the first projects with innovative climate solutions, it will be possible to create market references and thus allow subsequent projects to present more attractive and well-known risk-return profiles, finding financing in a more natural and scalable way—as has occurred with the renewable energy sector in Brazil over the last 20 years[26]. These advances create the initial conditions to unlock solutions and initiate structural change.

Relevant examples in Brazil

GOVERNMENT INITIATIVES

Two concessional capital auctions focused on sustainable sectors through private financial institutions[27]

R$ 23,3B

in concessional capital contemplated

Government's Country PLataform to facilitate climate project financing in strategic sectors of the economy[28]

USD 22,6B

in potential investments in Brazil

MULTILATERAL BANKS

Guarantee aimed at expanding financing to who implemented sustainable agricultural practices and environmental conservation[29]

USD 1,3B

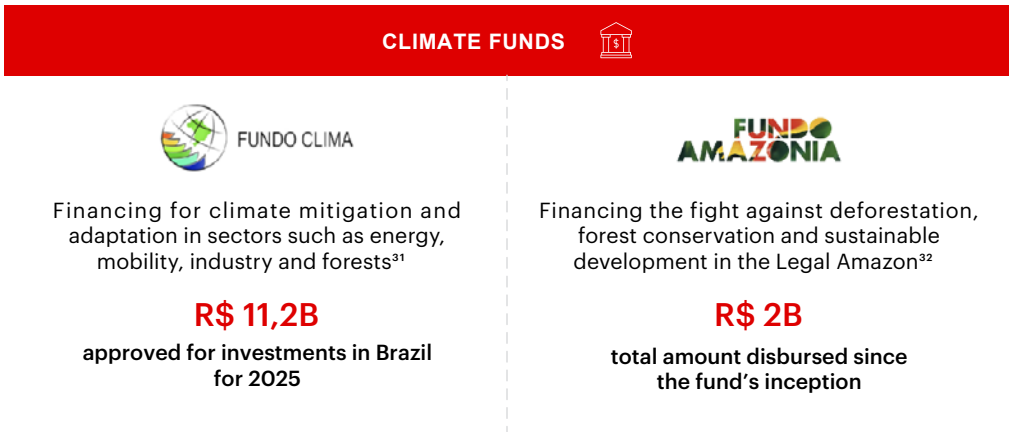
in guarantee issued to Banco do Brasil

Implementation of projects related to the climate transition in Brazil, including debt, equity and tevhnical assistance[30]

~USD 1B

in projects approved in 2024

[26] Tolmasquim, Maurício T. & de Barros Correia, Tiago & Addas Porto, Natália & Kruger, Wikus, 2021. "Electricity market design and renewable energy auctions: The case of Brazil," Energy Policy, Elsevier, vol. 158(C). Available at: https://www.sciencedirect.com/science/article/pii/S0301421521004286



But enabling the climate transition at scale will require systemic coherence between regulatory architecture, financial design, and institutional support. Only with an integrated approach, tailored to each climate solution and focused on real risk reduction, will it be possible to mobilize the capital flows necessary to transform the Brazilian economy into a low-carbon model.

[27] National Treasure of Brazil, 14 Aug. 2025. Available at: https://www.gov.br/tesouronacional/pt-br/noticias/leilao-do-eco-invest-brasil-tem-demanda-de-r-17-3-bilhoes-e-potencial-para-gerar-r-31-4-bilhoes-em-investimento-para-recuperacao-de-areas-degradadas

[28] Ministry of Finance. BIP Project Pipeline, 15 Oct. 2025. Available at: https://www.gov.br/fazenda/pt-br/acesso-a-informacao/acoes-e-programas/transformacao-ecologica/bip/projetos/projetos

[29] WORLD BANK. Annual Report 2025. Washington, D.C.: World Bank, Oct. 14, 2015. 2025. Available at: https://www.worldbank.org/en/about/annual-report

[30] INTER-AMERICAN DEVELOPMENT BANK. 14 Oct. 2025. Available at: https://www.iadb.org/en/projects/project-information;

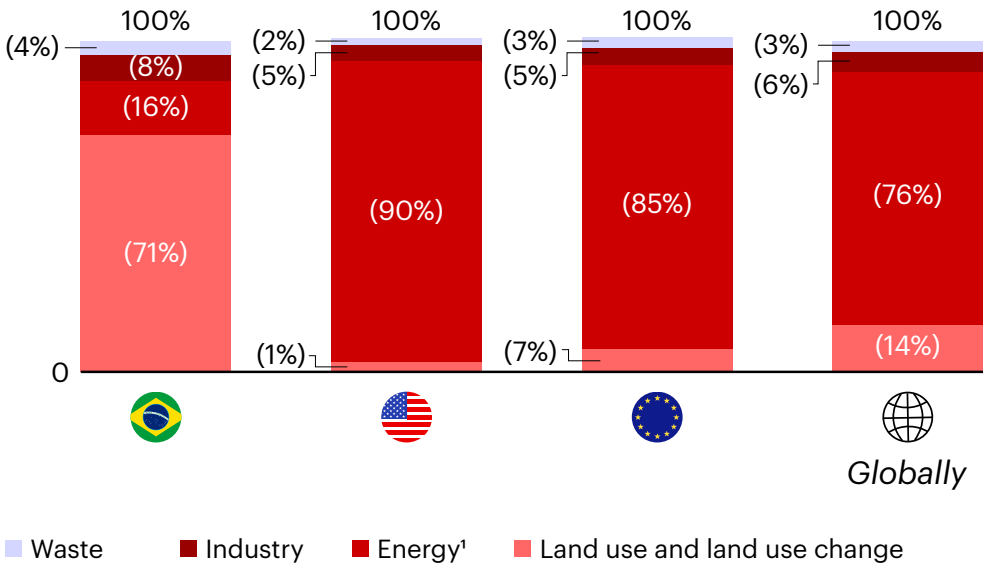
[31] Secretariat of Social Communication of the Presidency of the Republic (SECOM), 14 Oct. 2025. Available at: https://www.gov.br/secom/pt-br/assuntos/noticias/2025/04/fundo-clima-aprova-r-11-2-bilhoes-em-investimentos-para-2025

[32] BNDES, Projetos – Fundo Amazônia, Accessed on: 14 out. 2025. Available at: https://www.fundoamazonia.gov.br/pt/projetos

Sectoral solutions for the Brazilian climate transition

It is widely known that the profile of Brazilian emissions is structurally different from that of the most developed economies. Although in the US and EU, most emissions are concentrated in the energy, industry, and transportation sectors, in Brazil these sectors together account for only 24%[33], reflecting an electricity matrix among the cleanest of the world, with 88% of the energy consumed coming from renewable sources[34].

Figure 3: Distributions of emissions by category (2022)



Notes: (1) In Energy, includes transport-related emissions; Source: Brazil: National Inventory of Anthropogenic Emissions by Sources and Removals by Greenhouse Gas Sinks (MCTI); US, EU & Global: Climate Watch Data

[33] Bain Analysis – Climate Watch data (accessed on 27/06/2025): https://www.climatewatchdata.org/ghg-emissions?breakBy=sector&end_year=2022&start_year=1990

[34] https://www.gov.br/mme/pt-br/assuntos/noticias/brasil-gera-88-da-sua-energia-eletrica-a-partir-de-fontes-renovaveis

Despite the relatively minor challenge compared to other geographies, it is important to note that part of these industrial sectors are expected to make up the global climate solutions hub and, therefore, will need to carry out their transitions so that the country can capture this opportunity.

In transportation, which represents about 10% of Brazilian emissions[35], road transport mode corresponds to 92% of the total sector[36]. Emissions from this segment would be higher if it weren't for the successful biofuels program—made possible by mandatory blending mandates, which reduced the carbon intensity of liquid fuels and created competitiveness in the Brazilian industry to be a major global supplier, including for other modes such as air and sea.

Domestically, the Brazilian climate challenge is strongly associated with the exploitation of nature. About 70% of GHG emissions in Brazil originate from agriculture and land use change (LULUCF), with emphasis on deforestation, responsible for 30% of the national total. Enteric fermentation of ruminants (methane release) contributes about 20%, followed by soil management activities (7%), such as the use of nitrogen fertilizers[37].

In this context, acting to reduce nature-related emissions plays a critical role not only for national decarbonization, but also for the advancement of global climate mitigation and adaptation agendas. In fact, the IPCC points out that solutions based on land use and soil management should contribute to 20%-30% of mitigation and adaptation actions up to 2050[38]. Given Brazil's natural capital, its role is unequivocal.

In light of this scenario, and based on the analysis of the country's main emission sources and the sectoral climate transition plans established by the Brazilian government—such as PLANAVEG, ABC+, MOVER, NIB, PLANTE and PLANARES, as well as cross-cutting initiatives such as the Climate Plan and the Ecological Transformation Plan (PTE)—this study analyzed a set of solutions with high potential to contribute in a structured way to the decarbonization of the national economy.

[35] Analysis of Greenhouse Gas Emissions and their Implications for Brazil's Climate Goals: 1970 – 2023 (p. 21). Available at: https://seeg.eco.br/wp-content/uploads/2024/11/SEEG-RELATORIO-ANALITICO-12.pdf

[36] Emissions from the Energy, Industrial Processes and Product Use Sectors (p. 3). Available at: https://energiaeambiente.org.br/wp-content/uploads/2018/01/Emissoes-dos-Setores-de-Energia-e-Processos-Industrias-Documento-de-Analise-2018.pdf

[37] IMF – INTERNATIONAL MONETARY FUND. World Economic Outlook Database, April 2025: Report for selected countries and subjects (Nominal GDP). Washington, D.C., 2025. Available at: https://www.imf.org/en/Publications/WEO/weo-database/2025/April/weo-report. Accessed on: 25 jul. 2025

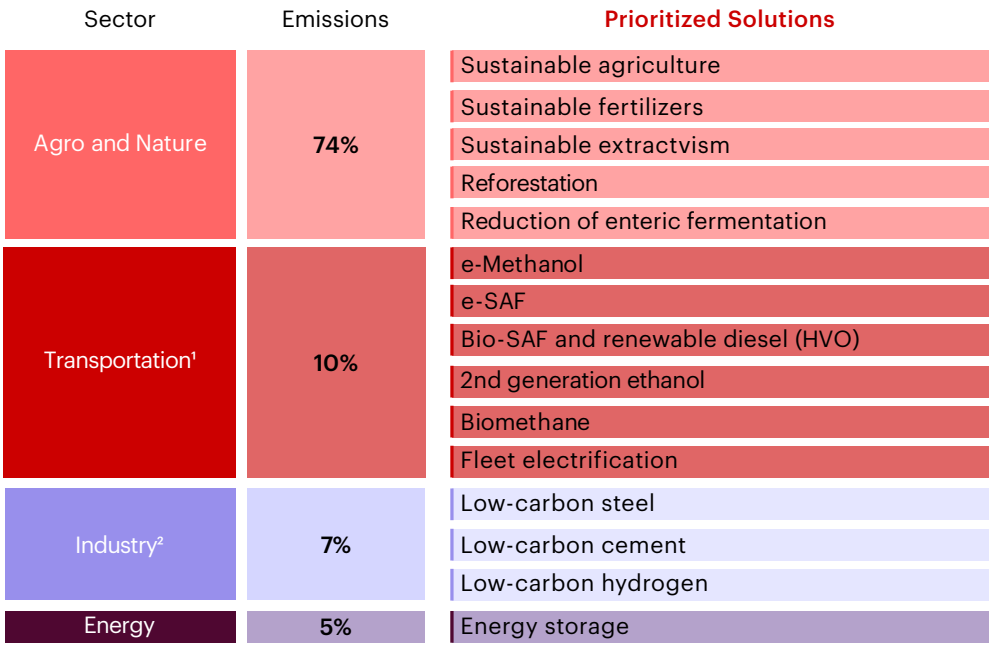
[38] WG III contribution to the Sixth Assessment Report: Chapter 7 (p. 6). Available at: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter_07.pdf

The selection was based on a multidimensional approach, which combined potential impact on emissions, degree of alignment with public policies, technological maturity, and concrete barriers to financing—whether due to the absence of market mechanisms, the perception of high risk or the lack of specific instruments.

This filter made it possible to exclude solutions that, although relevant, already have mature markets and established sources of financing, such as solar and wind energy. Likewise, the development agenda of the critical minerals chain was not contemplated in this analysis—despite its strategic importance for global chains, we chose to focus on solutions directly related to Brazil's emissions profile.

The result of this process is a portfolio of **15 solutions**, which together represent the main areas of action currently requiring coordinated efforts to enable large-scale climate transition.

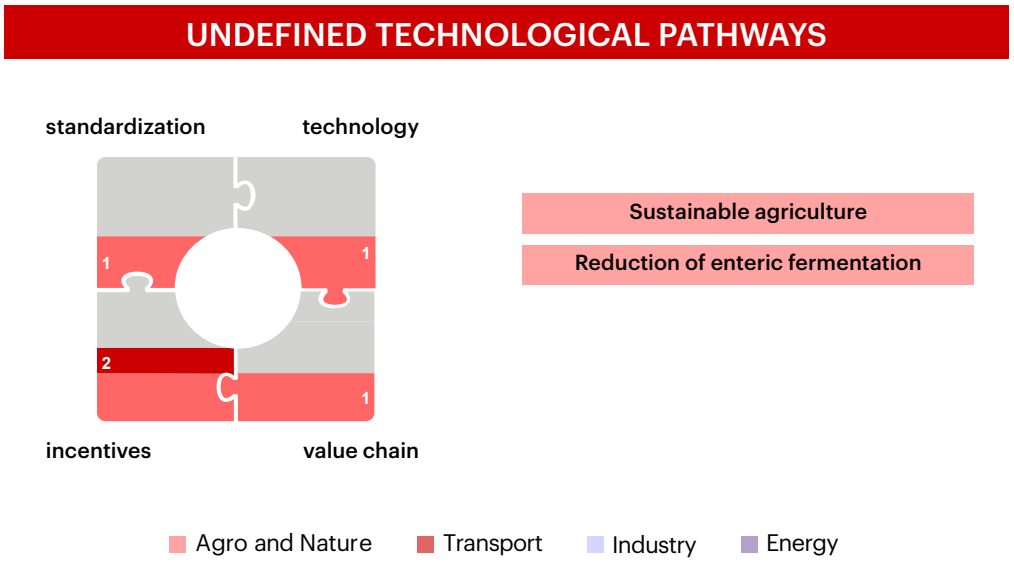
Figure 4: Portfolio of Solutions Prioritized in the Study



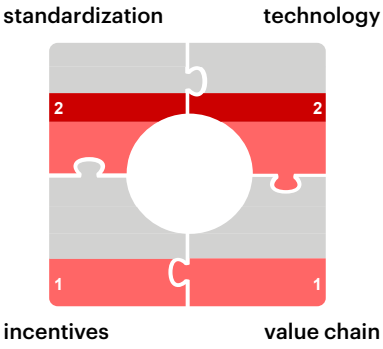
Notes: (1) Biofuels grouped into Transportation, since the sector accounts for most of the fuel consumption in Brazil; (2) Low-emission hydrogen grouped as an industrial solution, where its use will be concentrated; (3) Need for early financing for the Energy sector focuses on expanding generation capacity; Investments in storage systems are estimated to be considerably less of the amount
Sources: Intersect CGE; WEO (2024); World Economic Forum (2023); Interviews with market participants;

Solution maturity archetypes and implications for financing

Based on a maturity assessment, it was possible to group the 15 climate solutions into four archetypes that share similar challenges in mobilizing capital. Each archetype reflects a specific risk profile—resulting from the combination of different levels of maturity in regulatory standardization, technology, value chain, and institutional incentives—and demands different responses, both financial and institutional. This categorization enables a more precise alignment of the most appropriate instruments to unlock the development of each solution, addressing the right bottlenecks in each context and making more efficient use of scarce concessional capital.



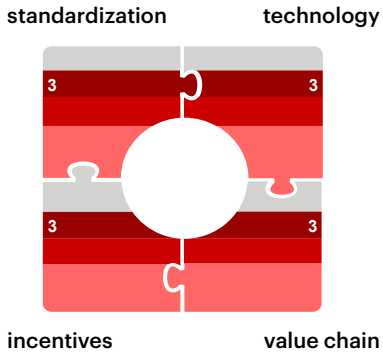
EMERGING SOLUTIONS



- Low carbon steel
- Low carbon cement
- e-Methanol
- e-SAF
- Energy Storage (BESS)

Agro and Nature | Transport | Industry | Energy

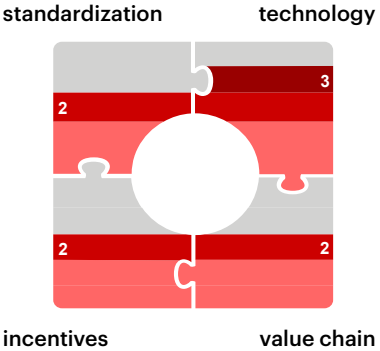
NASCENT VALUE CHAINS



- Sustainable fertilizers
- Sustainable Extractvism (NTFPs)
- Low carbon hydrogen
- Bio-SAF
- 2nd generation ethanol
- Biomethane
- Fleet electrification

Agro and Nature | Transport | Industry | Energy

DEVELOPING MARKETS



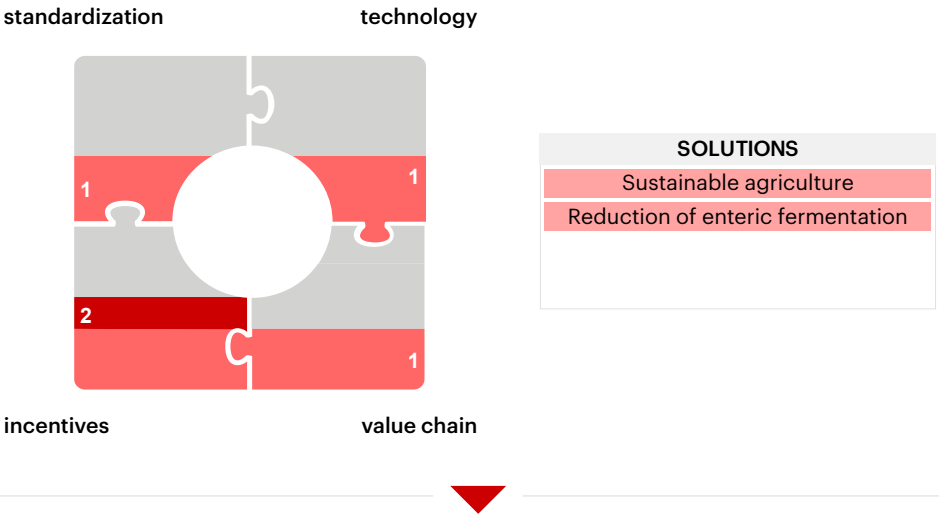
- Reforestation

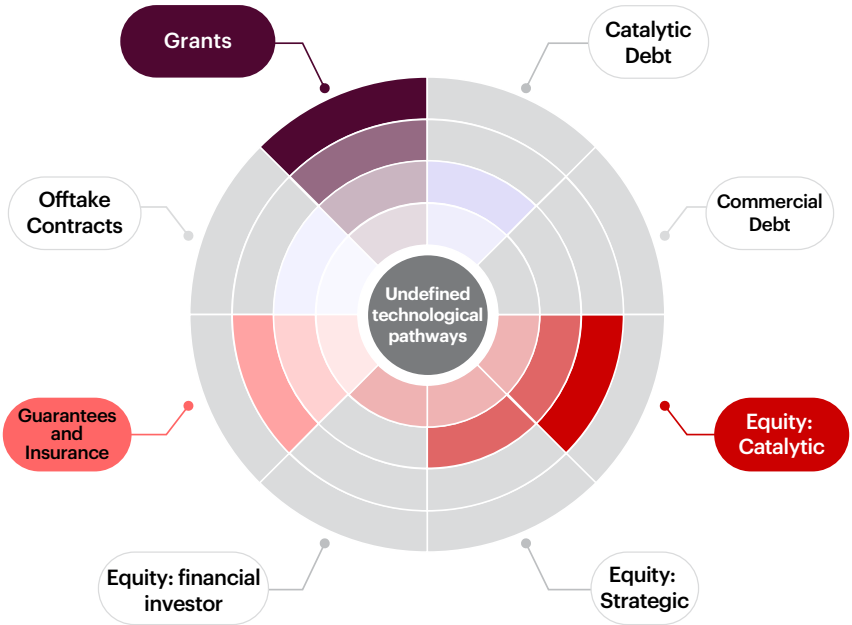
Agro and Nature | Transport | Industry | Energy

Archetype 1—Undefined Technological Pathways

Climate solutions: sustainable agriculture and enteric fermentation reduction solutions

Definition: Solutions in which the lack of definition about the most promising technological pathways generates uncertainties regarding large-scale feasibility and the real potential for demand, making it difficult to directly incentivize and structure value chains at scale.





Sustainable agriculture and livestock, as well as the reduction of emissions associated with enteric fermentation, are key solutions to directly address 30% of Brazilian emissions[39].

Currently, Brazilian agriculture and livestock play a fundamental role in the country's economy and global food security, reflected in the sector's participation in the national GDP (25%)[40] and exports (49%)[41]. The repositioning of the sector as a protagonist in the fight against climate change is a strategic pillar for Brazil.

In fact, the country already widely adopts several sustainable practices, such as no-till farming and crop rotation; However, the challenge is to scale these solutions and advance, at the same time, in regenerative practices and in the farmland digitalization for high-precision agriculture.

Understood as a set of practices that, when combined, promote soil regeneration—increasing soil resilience to extreme events and productivity through improved nutrient availability - sustainable agriculture and livestock still receive investments below what is necessary to accelerate this transformation.

First, the understanding of what sustainable agriculture and livestock are—and what results should be produced—is still under discussion, given the multiple dimensions of food production (crops, biomes, regions and land structure).

As a result, the technologies follow multiple pathways and, despite significant advances, are still in the testing phase and completing their first pilots across various parts of the food production patchwork.

In terms of incentives, in Brazil, there is only indirect institutional support, in the form of tax waivers, targeted subsidies, and institutional purchases aimed at family farming (such as PGPM-Bio, PNAE and Alimenta Brasil). Specific and structured policies (e.g., public procurement) are still incipient. As a results, there is little standardization in the eligibility criteria of available resources, and the amount available each year is unpredictable.

[39] Bain Analysis - National Inventory of Anthropogenic Emissions by Sources and Removals by Greenhouse Gas Sinks (MCTI)

[40] https://www.cepea.org.br/upload/kceditor/files/PIB-DO-AGRONEGOCIO-2022.17MAR2023%281%29.pdf

[41] https://agenciagov.ebc.com.br/noticias/202401/exportacoes-do-agronegocio-fecham-2023-com-us-166-55-bilhoes-em-vendas

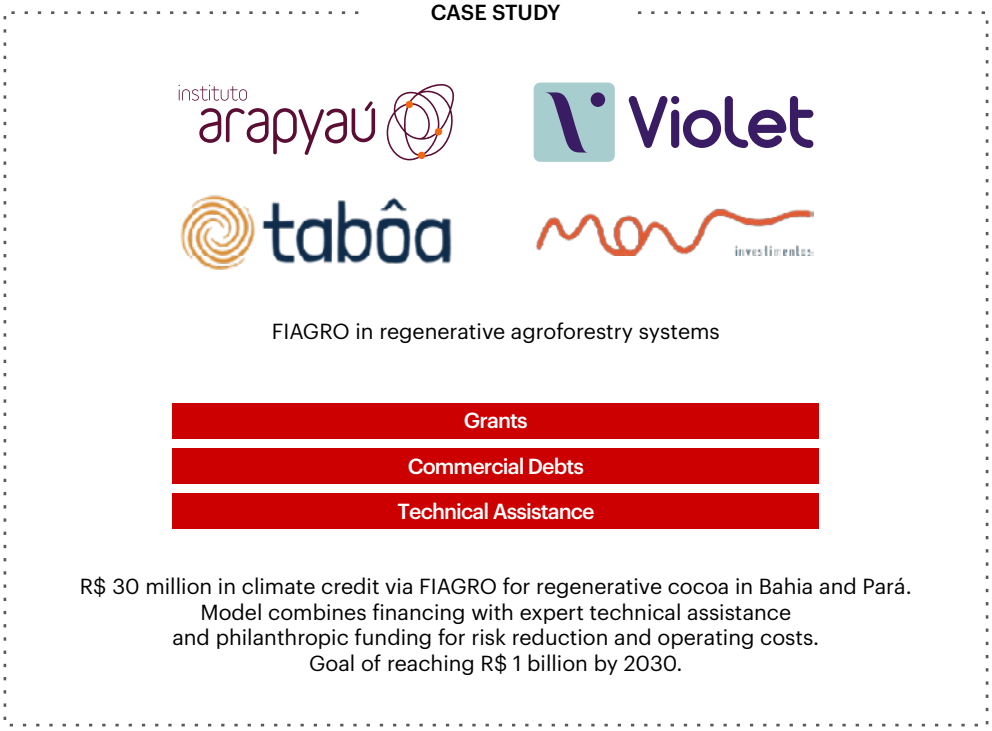
On the side of reducing emissions from enteric fermentation, the technological challenge is even more relevant. While in sustainable agriculture and livestock there are already good examples of financial and environmental results from the application of a certain set of techniques, in the case of enteric fermentation the tests are in earlier phases. Several innovations in cattle feed are promising from an environmental point of view - however, they typically fail to generate positive returns, even in larger-scale scenarios.

In solutions marked by high technological uncertainty, smaller scale of projects, and the absence of clear trade routes—as in the case of sustainable agriculture and livestock and the mitigation of enteric methane—the central challenge is to enable technical development and build a "minimum base" of the market. The still limited scale and stage of R&D require instruments that absorb risk and allow experimentation in a real environment.
In this context, R&D grants and subsidies are critical, as they enable initial technological advancement and help build technical legitimacy. In addition, guarantees and insurance will also be key to scaling the projects that prove to be successful, as these instruments can accommodate the transition risks of the first harvests together with nonfinancial support from structured technical assistance.

Also, the performance of incumbents in value chains is essential to enable the development of solutions in technological pathways that are still undefined. By making initial demand commitments—through offtakes, for example—these players help signal market traction, reduce perceived risk, and accelerate both the technological maturation and the value chains creation.

This movement also contributes to attracting new entrants and unlocking the first projects. In addition, in contexts of low standardization and high technical uncertainty, specialized technical assistance plays a critical role, offering direct support to developers and increasing the chances of successful implementation.

Case Study—Kawá Fund



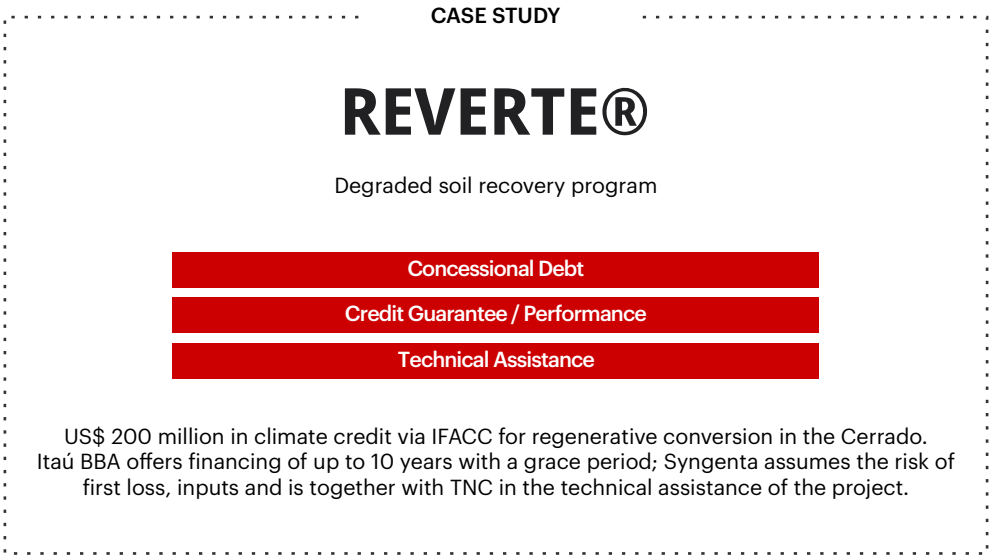
The KAWÁ Fund is a FIAGRO (Investment Fund in Agroindustrial Production Chains) idealized by Arapyaú, Tabôa, MOV and Violet, the last of these also being the manager of the structure, which supports producers of small properties and family cocoa farmers in Agroforestry Systems (AFSs) in Bahia and Pará. The model combines rural credit with specialized technical assistance, allowing for increased income and improved quality of life by increasing productivity, quality and access to differentiated markets—with a premium price.

The Fund was constituted based on theoretical models tested in practice in previous experiences, showing that the absence of structured technical support and access to adequate financing was one of the main bottlenecks for strengthening production. KAWÁ seeks to overcome these obstacles through a blended finance model, which combines private and philanthropic resources.

The fund is structured in different investment tranches (senior, mezzanine and subordinate), accommodating multiple risk-return profiles. At the same time, it has an Enabling Conditions Facility (ECF), powered by philanthropic capital, to finance essential services not covered by the credit, such as producer origination and technical assistance, and to advance in monitoring and optimization technologies.

In the first phase, with R$ 30 million, around 1,200 producers will benefit in regions of Bahia and Pará. The goal is to scale the fund to R$ 200-300 million by 2030, consolidating Brazilian cocoa as a regenerative commodity and family farming of small producers as an international reference in sustainable agriculture.

Case Study—Reverte



Reverte is an initiative of Syngenta in partnership with The Nature Conservancy (TNC) and Itaú BBA with a focus on supporting rural producers in the conversion of degraded pastures to high-productivity and deforestation-free agricultural systems, helping to reduce pressure on native vegetation, accelerate the adoption of regenerative practices and increase the production of food, fiber and energy. Its ultimate goal, therefore, is to promote global food security.

The program coordinates technical support actions in several areas, such as the adoption of sustainable practices and the socio-environmental compliance of rural property. It also offers lines with long-term incentive conditions appropriate to the needs of producers.

Each partner has a different role: Syngenta provides technical support and assumes part of the operation risk; TNC contributes to the development of the program's eligibility and monitoring criteria; and Itaú acts as the financial resource provider.

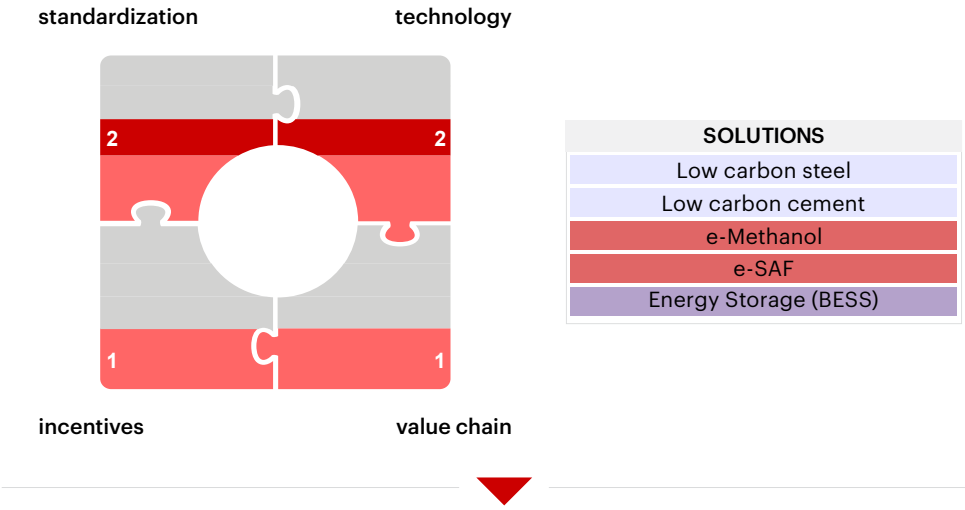
Since its creation, the program has disbursed more than R$ 1.8 billion in climate credit, and recovered more than 260 thousand hectares (2025 data).

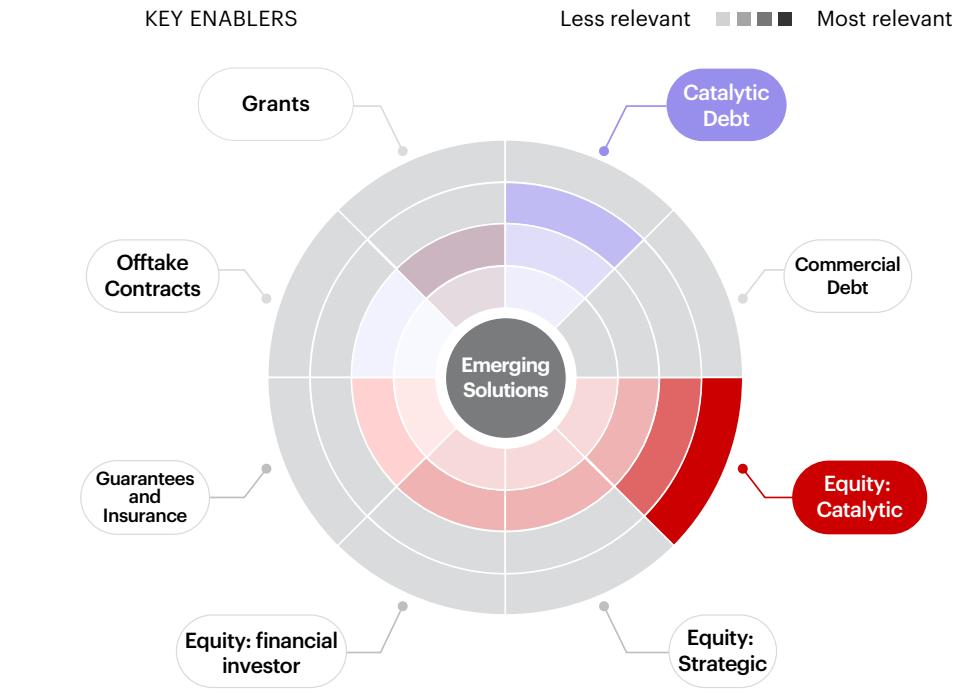
> *"The Reverte Program has been fundamental to accelerate the process of conversion of degraded pastures in the country. The partnership between Syngenta and Itáu was fundamental for it to be possible to bring benefits to the producer and scale the program. Only in this way will we be able to bring even more scale to the challenge we have in our Climate Plan to recover around 40 million hectares of degraded areas by 2030."*
>
> **Pedro Barros**
> Director of Agriculture at Itaú BBA

Archetype 2—Emerging Solutions

Climate solutions: Low-carbon steel, low-carbon cement, synthetic fuels (e-methanol, e-SAF) and energy storage systems

Definition: Solutions with defined but evolving technology pathways. They have very high costs compared to alternatives with higher emissions and limited and uncertain demand, aggravated by limitations in infrastructure, technology and the absence of clear incentives.





Green hydrogen has been recognized as a key solution for the decarbonization of hard-to-abate sectors such as cement, fertilizers, and steel, which together account for a significant portion of global greenhouse gas emissions. Brazil, with its predominantly clean energy matrix and abundance of renewable resources, has privileged conditions to lead this agenda. However, capturing this value faces common and sector-specific challenges.

The first intersecting obstacle is the cost of production, which in Brazil still hovers between US$ 4 and US$ 6 per kilogram, while hydrogen produced from natural gas costs less than half[42] of that. This differential directly makes green hydrogen-dependent solutions—such as green steel and green fertilizers—more expensive, reducing its competitiveness against high-emission international alternatives with a strong presence in the Brazilian market.

To compete internationally, it will be necessary to minimize costs through access to low-cost energy, the expansion of the productive scale, and technological advancement. The promotion of these technological pathways, such as the European Union's CBAM (Carbon Border Adjustment Mechanism), will also play a relevant role in ensuring additional and more predictable demand.

In addition to cost, green hydrogen-based solutions face structural obstacles in Brazil. Restricted access to the power grid makes it difficult for the industry to expand and requires billions of dollars in new capacity, resulting in more pressure on costs. Added to this is the lack of predictability of demand, which, due to high costs, and infrastructure not yet developed, has not been able to consolidate in Brazil so far. While the European Union has already set mandatory targets and created mechanisms to encourage the use of green hydrogen, the country lacks equivalent instruments, which compromises investor security and limits the viability of new projects.

These limitations affect chains that are essential for global decarbonization, such as steel, fertilizers, and synthetic fuels (e-SAF and e-methanol). In all these industries, the challenges are repeated: high cost, energy infrastructure constraints, and lack of clear stimuli to demand—all of which make it difficult to mobilize financing at scale.

In the case of low-carbon steel, green hydrogen can replace mineral coal in the process of reducing iron ore, enabling the production of the so-called "green steel". Alternatives such as biocarbon and scrap have lower costs, but face logistical constraints linked to biomass transportation and scrap availability, as well as international acceptance barriers, due to the low traceability of carbon intensity.

[42] Green Hydrogen for Industry: A Guide to Policy Making (p. 24). Available at: https://now.solar/wp-content/uploads/2022/09/irena_green_hydrogen_industry_2022_.pdf

Synthetic fuels, such as e-SAF (Sustainable Aviation Fuel) and e-methanol, are a strategic application aimed at sectors that are difficult to electrify, such as aviation and maritime transport. Produced from green hydrogen and captured CO_2, these fuels have the potential to significantly reduce the carbon footprint but still face much higher costs (up to 8 times higher than those of traditional alternatives)[43]. In addition, regulatory and certification barriers need to be overcome for their large-scale adoption.

In the case of low-carbon cement, despite the efficiency gains, the Brazilian cement industry still lacks specific incentives and more ambitious regulatory commitments to accelerate its decarbonization. Reducing clinker content and using alternative fuels are central but depend on public policies, standardization and financing to scale up. Sectoral initiatives exist, but their impact on the goal of climate neutrality remains limited.

In Brazil, the first steps have already been taken, but there are still gaps to be filled for these projects to scale up. The Ecological Transformation Plan, coordinated by the Ministry of Finance, seeks to consolidate the low-carbon economy with policies that encourage industries such as green steel, fertilizers, sustainable cement and synthetic fuels. In this context, both Rehidro and the Low Carbon Emission Hydrogen Development Program (PHBC)[44] foresee around R$ 18 billion in incentives and tax credits[45], while the National Hydrogen Program (PNH2), through its thematic chambers, contributes to regulatory advancement and the structuring of the domestic market.

Battery energy storage systems (BESS) also fall into this archetype. Despite technological advancement, they still face relevant obstacles to large-scale adoption in Brazil, including high costs and the absence of remuneration mechanisms for the services they can offer—such as flexibility, demand response, and support to renewables integration.

In this context, incentives and catalytic financing play a central role. In financial terms, given the magnitude of structural uncertainties, this archetype requires the significant presence of concessional capital. In its most typical configuration, it translates into catalytic equity and debt instruments aimed at pioneering projects, taking specific risks and encouraging the development of local value chains.

[43] Bain Company - **Sustainable Aviation Fuel (SAF) POV**

[44] https://www.camara.leg.br/noticias/1099227-nova-lei-institui-programa-de-incentivo-fiscal-para-producao-nacional-de-hydrogen

[45] https://www.gov.br/fazenda/pt-br/assuntos/noticias/2024/julho/pl-que-concedera-incentivos-a-empresas-produtoras-de-hidrogenio-de-baixo-carbono-e-aprovado-pela-camara

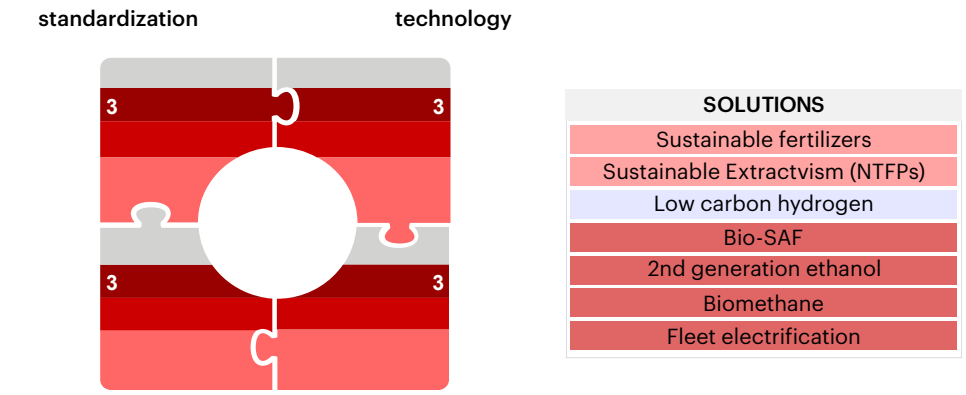
There are a few exemplary cases within this solution archetype, currently in the structuring phase and planned for implementation in the coming years. It will be essential to keep track of which of these cases manage to advance to stages of effective investment and which end up encountering new technical, regulatory, or market barriers.

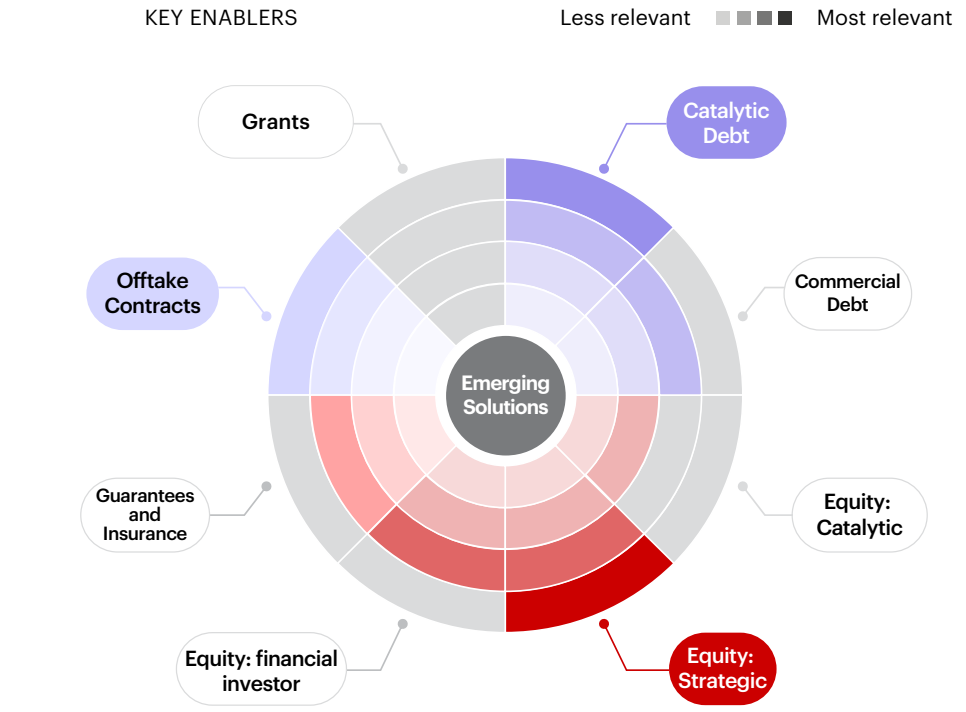
Still, in addition to financial instruments, it will be necessary to integrate all links in the value chain—from supply to demand—for the first effective investments to materialize.
This translates into a need for regulation and demand-side incentives for green solutions, as has been done in the European Union.

Archetype 3—Nascent Chains

Climate solutions: Sustainable fertilizers, Sustainable extractivism (NTFPs), Low-carbon hydrogen, Bio-SAF, Second-generation ethanol, Biomethane, and Fleet electrification

Definition: Solutions with consolidated technical maturity, but whose value chain, although functional, faces scalability obstacles and inefficiencies, which raises costs and compromises competitiveness against gray solutions.





The analyzed solutions—including sustainable fertilizers, extraction of nontimber forest products, low-emission hydrogen, Bio-SAF, second-generation ethanol, biomethane, and fleet electrification—already feature tested technology and, in many cases, industrial-scale operation, supported by relatively consolidated regulatory frameworks. Examples include the Bioinputs Law (Law No. 15,070/2024)[46] for fertilizers, the National System of Conservation Units (Law No. 9,985/2000)[47] for NTFPs, the Low-Emission Hydrogen Legal Framework (Law No. 14,948/2024)[48], the Fuel of the Future Law (Law No. 14,993/2024)[49] for Bio-SAF and biomethane, and ANEEL regulations and national plans for the electrification of fleets.

Despite this relative technological maturity and regulatory support, the costs of these solutions remain high relative to conventional alternatives. In Brazil, low-emission hydrogen costs between US$ 4 and 6/kg (vs. less than US$ 2/kg for hydrogen from natural gas)[50]; Bio-SAF is 2 to 5 times more expensive than fossil kerosene[51], and second-generation ethanol costs 1.5 to 2 times 1G ethanol[52]. The perspective of cost reduction tends to be gradual, depending mainly on the consolidation of efficient value chains, the reduction of inputs cost, the development of adequate logistics infrastructure and the implementation of public policies that ensure minimum demand and predictability for investors.

In the case of sustainable fertilizers, both biofertilizers and organominerals have the potential to reduce external dependence and increase resilience of national agriculture. However, their main challenges lie in the integration among biomass producers, processing industries and distribution channels, in addition to the need for certification and quality standardization that ensure confidence to the farmer. The sustainable extraction of NTFPs faces barriers of another nature: the absence of adequate logistics, the informality of the chains, and the lack of traceability and certification mechanisms, making it difficult to ensure fair compensation for extractive communities and to achieve scalability in more demanding markets.

[46] https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2024/lei/l15070.htm

[47] https://www.planalto.gov.br/ccivil_03/leis/l9985.htm

[48] https://www.planalto.gov.br/ccivil_03/_Ato2023-2026/2024/Lei/L14948.htm

[49] https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2024/lei/l14993.htm

[50] The Low-Carbon Hydrogen Market in Brazil: Perspectives and Challenges until 2030, IPEA (p. 29). Available at: https://repositorio.ipea.gov.br/server/api/core/bitstreams/672d0d51-ab08-4041-9b5a-b86cb83cdd9a/content

[51] Lifetime emissions from aircraft under a net-zero carbon budget (p. 5). Available at: https://theicct.org/wp-content/uploads/2024/07/ID-188-%E2%80%93-Committed-emissions_wp_final.pdf

[52] Energy in 2020: Assessing the Economic Efects of Commercialization of Cellulosic Ethanol (p. 6). Available at: https://www.trade.gov/sites/default/files/2020-12/Energy%20in%202020_Assessing%20the%20Economic%20Effects%20of%20Commercialization%20of%20Cellulosic%20Ethanol.pdf

Low-carbon hydrogen has economic and institutional bottlenecks: high production costs, difficult access to the energy grid, transport and storage limitations—the latter being mainly relevant for export focused projects—and the absence of perennial demand. For Bio-SAF and 2 G ethanol, the main obstacles are related to cost and the need for efficient integration among biomass production, industrial plants and distribution logistics. Biomethane, although more mature, faces geographical dispersion of supply, and the need for investments in purification and network connection. Fleet electrification presents different challenges for private and commercial vehicles, although they share certain obstacles, including the lack of adequate charging infrastructure, dependence on imports, and the high cost of vehicles compared to combustion-powered vehicles—a difference that has been decreasing for light vehicles, but still remains significant for commercial vehicles. In the case of commercial fleets, in addition to these factors, there is greater dependence on specific business models and public incentives, especially in public transport, such as the adoption of electric buses.

Although each chain has specificities, the common denominator is that the technology is already available or at a more advanced stage, but there is a lack of an economic-institutional framework capable of articulating supply, infrastructure, and demand in efficient value chains.

In financing, solutions in the initial phase of diffusion, such as hydrogen and Bio-SAF, still require catalytic equity, while more mature solutions—biomethane, 2G ethanol and fleet electrification —can benefit from concessional debt, as long as they are accompanied by long-term offtake contracts that reduce commercial and regulatory uncertainties. Due to the higher degree of commercial maturity, these chains also allow the use of traditional financing instruments. The focus should be on coordination between different links of the value chain to mitigate implementation risks, such as inefficiencies in the critical infrastructure needed to scale the chain (e.g., biomethane pipeline or grid connection for green hydrogen).

In parallel, the modular structuring of projects—with implementation in successive phases— can reduce execution risk and facilitate progressive access to commercial capital, allowing learnings and adjustments at each stage. In addition, demand-side policies, such as blending mandates for 2G ethanol or expanded targets for SAF, help to enable scale, although they may face resistance from incumbent sectors due to the increase in marginal costs or the need to adapt existing infrastructure.

Given this relatively more mature environment, there is also room for the entry of strategic equity capital, especially from incumbent players along the chain, such as large consumers or inputs suppliers. These actors' participation can reduce friction between the links of the value chains, facilitate access to markets, ensure demand and even support the logistical and operational structuring necessary for scalability. More than just contributing with capital, these strategic investors work as catalysts for sector integration, contributing to transforming specific initiatives into replicable solutions that are financially viable on a large scale.

In summary, the Brazilian challenge is not predominantly technological, but structural: it is about articulating actors, aligning incentives and consolidating low-carbon markets in a coordinated manner, overcoming the mismatch between technological availability and economic viability.

Case Study—Acelen

CASE STUDY

acelen

Development of advanced biofuels from Macaúba (SAF/HVO)

Concessional Debt **Technical Assistance**

R$ 258 million in BNDES concessional debt made the biofuel chain from macaúba viable. The project is also linked to the Industrial Transition Accelerator (ITA/MDIC), which promotes instruments and coordination to unlock investments in the new bioeconomy.

Acelen is a Brazilian energy company leading a pioneering initiative to develop advanced biofuels from macaúba—a native palm tree with high oilseed potential.

The company has been investing in research and innovation to build a new supply chain based on large-scale macaúba cultivation, including industrial processing and the production of SAF (Sustainable Aviation Fuel) and renewable diesel.

The main barrier to the project's progress was the lack of consolidated technological infrastructure for cultivating and processing macaúba as an energy feedstock.

To make the initiative viable, in 2024 BNDES approved R$ 258 million[53] in concessional financing for Acelen to support R&D and project implementation. The resources fund both the crop's agronomic development and the extraction and refining infrastructure, and are essential to transform macaúba into a viable alternative to fossil fuels.

BNDES's support acted as an institutional and technological de-risking mechanism, enabling the company to advance in an emerging segment of the bioenergy market.

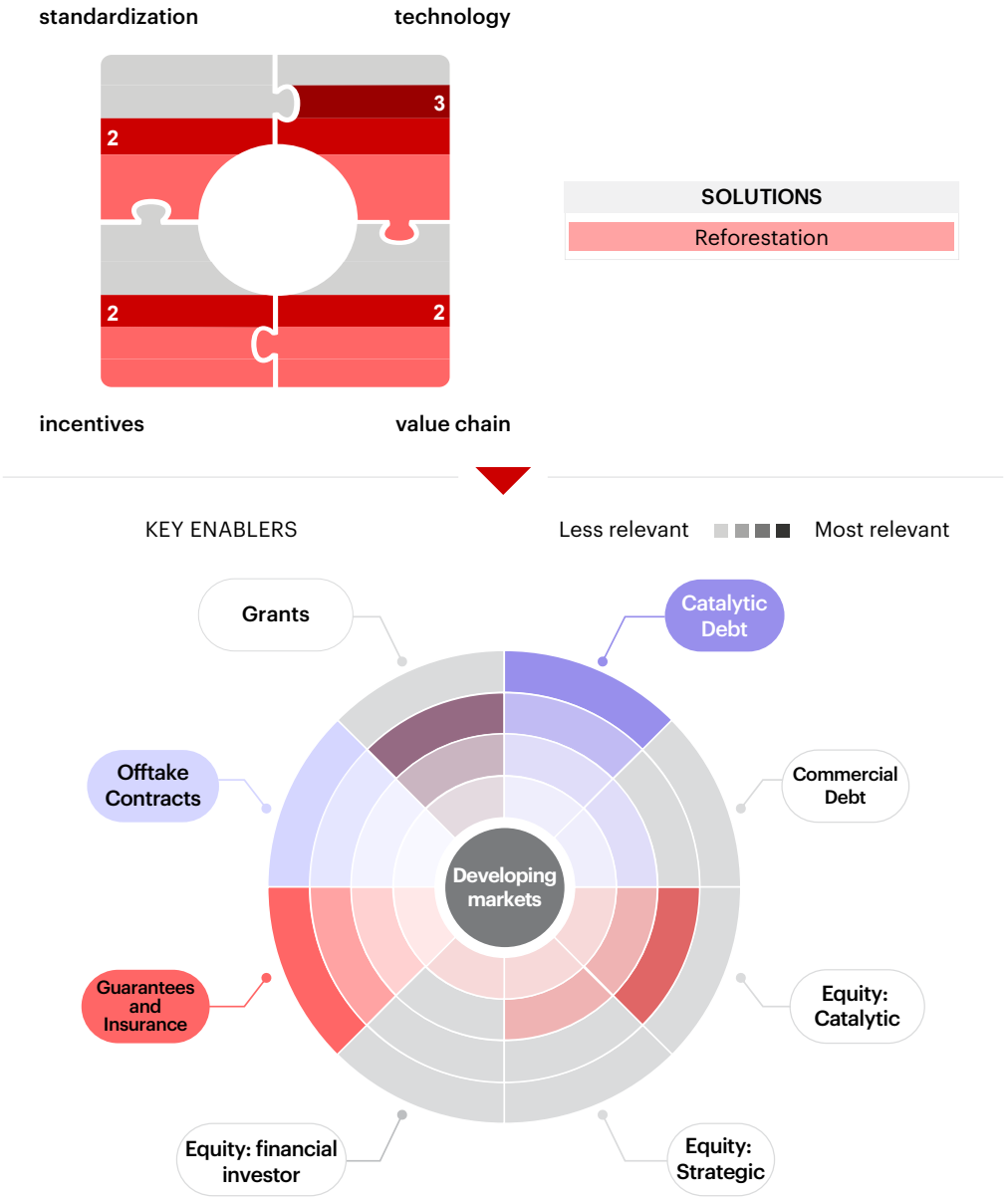
Acelen is also part of the BIP (Brazil Investment Platform), an initiative designed to accelerate investments in sustainable projects across the country. Through its inclusion in the platform, the project gains greater visibility and demonstration effect, attracting additional capital and accelerating the maturation of this new value chain.

[53] BNDES. BNDES approves R$ 258 million to Acelen for innovation and development of macaúba for fuels. BNDES News Agency. Available at: https://agenciadenoticias.bndes.gov.br/industria/BNDES-aprova-R$-258-mi-a-Acelen-para-inovacao-e-desenvolvimento-da-macauba-para-combustiveis/. Accessed on: 25 jul. 2025.

Archetype 4—Developing Markets

Climate solutions: Ecological reforestation

Definition: Markets that are operationally functional but still dependent on structural regulatory definitions that integrate these solutions into the broader economic framework, ensuring greater demand stability and price predictability.



Ecological reforestation with native species is a central climate mitigation strategy in Brazil, generating positive impacts on biodiversity, ecosystem services, and socio-environmental resilience. Unlike many emerging technological solutions, the main obstacles to scaling up this practice do not lie in technological capability or unit implementation costs, but rather in the consolidation of markets and the creation of robust, integrated production chains that enable scalability.

Recent studies by Embrapa estimate that approximately 28 million hectares of degraded pastures have potential for reforestation and ecological restoration[54], especially in the Cerrado and Legal Amazon biomes. This represents a significant opportunity to increase carbon sinks, restore ecological functions, and diversify the rural production matrix. Effective implementation depends on coordination among rural producers, native seedling suppliers, restoration enterprises, and robust mechanisms for monitoring and certifying results.

The voluntary carbon market in Brazil remains incipient: in 2023, around 3.4 million credits were issued[55], concentrated in a limited number of reforestation and forest conservation projects. In parallel, the regulated market, formalized by Law No. 15,042/2024, encompasses 4,000 to 5,000 companies, covering up to 15% of national emissions[56]. Although still modest, the global regulated market is significantly larger, estimated in the tens of billions of dollars[57], while the voluntary market accounted for approximately US$ 720 million in 2023.

In addition to land-use issues, such as land tenure, integration with local communities, and risks related to production losses from adverse weather events or environmental crimes, ecological reforestation projects face specific structural challenges. These include the need to ensure additionality and permanence of credits, standardization of carbon measurement methodologies, and validation of results, as well as the integration of socio-environmental co-benefits. The fragmentation of the carbon market, combined with difficulties in monetizing multiple ecosystem services, restricts private capital flows and limits project scalability.

[54] https://www.embrapa.br/busca-de-noticias/-/noticia/87076753/brasil-possui-28-milhoes-de-hectares-de-pastagens-degradadas-com-potencial-para-expansao-agricola

[55] https://portal.datagro.com/pt/12/agribusiness/855375/mercado-voluntario-de-carbono-no-brasil-foi-10-vezes-menor-no-ano-passado-ante-2021-segundo-observatorio-de-bioeconomia-da-fgv

[56] https://capitalreset.uol.com.br/empresas/net-zero/mercado-regulado-de-carbono-deve-abranger-5-mil-empresas-diz-fazenda/

[57] https://www.worldbank.org/en/news/press-release/2024/05/21/global-carbon-pricing-revenues-top-a-record-100-billion

Brazil has made progress in building a regulatory framework for the sector, notably through Law No. 15,042/2024[58], which establishes the regulated carbon market, along with complementary rules that govern the registration, monitoring, and validation of forest projects. These instruments aim to reduce regulatory uncertainty and provide clear market signals—essential to attract larger-scale private investment. However, as long as voluntary markets remain without clear rules or consistent pricing, revenue predictability for reforestation projects will remain low, hindering scalability and limiting private-sector interest.

Financing ecological reforestation therefore requires instruments capable of addressing the uncertainty inherent in both forest growth (supply) and the carbon market (demand). Concessional capital, in the form of guarantees or catalytic debt, plays a key role in reducing risks and attracting commercial investors.

However, concessional capital alone is not sufficient. Offtake agreements, which guarantee volumes and prices for carbon credits, are essential to unlock projects. These contracts not only stabilize the business case but can also serve as risk mitigators—alongside land tenure—enabling commercial financial institutions to develop greater appetite for project risk.

Practical cases indicate that ecological reforestation projects share similarities with infrastructure contracts: they involve known parameters (planting cost, growth rate, carbon stock) but face uncertainty in market demand. This reinforces the critical role of the offtaker in mitigating risk and enabling private capital participation.

Thus, ecological reforestation with native species holds high potential for climate mitigation and multiple socio-environmental co-benefits. Its main limitations do not stem from technology, but from the need to consolidate efficient carbon markets, manage forest growth risks, integrate production chains, and reduce economic uncertainty for investors. Regulatory progress, mechanisms that increase revenue predictability, and public policies to stimulate demand are key to transform ecological reforestation into an economically viable and scalable climate solution in Brazil.

[58] https://www2.camara.leg.br/legin/fed/lei/2024/lei-15042-11-dezembro-2024-796690-publicacaooriginal-173745-pl.html

Case Study—re.green

CASE STUDY

re.green

Large-scale ecological restoration, with priority action in the Amazon and the Atlantic Forest

Offtake Contracts **Concessional Debt** **Credit Guarantees**

re.green articulated an offtake agreement with Microsoft and a letter of guarantee from Bradesco to enable R$ 80 million in BNDES concessional debt via the Climate Fund. The structure faced the typical barriers of the restoration sector — long cycle, low collateral and low liquidity market — and became a replicable reference in financing reforestation with the generation of carbon credits.

Founded in 2021, re.green is a Brazilian company dedicated to large-scale ecological restoration, with priority operations in the Amazon and the Atlantic Forest. Its model combines science, technology, and long-term capital to regenerate degraded areas and generate high-integrity carbon credits. Since its founding, the company has restored more than 15,000 hectares.

Despite this progress, fund-raising presented significant challenges. The biological nature of the asset, long return cycles, and the limited liquidity of forest credits made the projects unattractive to traditional lenders.

The turning point came with the adoption of two complementary instruments. The first was an offtake contract signed with Microsoft in 2024, which guaranteed the early sale of carbon credits with defined term, volume, and price. This predictability not only enabled the structuring of long-term financial planning but also demonstrated market confidence in the project's integrity.

> *"Initially, we thought we would restore, produce the carbon credits, and sell them once they were issued. Later, we realized that the ideal approach at this early stage was to sign an offtake contract, because it would make all the bank financing much easier . This step was very important for that dialogue—perhaps the most important point—together with the project's execution progress."*

Thiago Picolo
CEO of re.green

The second instrument was a guarantee issued by Bradesco in 2025, enabling access to R$ 80 million in concessional financing from BNDES through the Climate Fund. The guarantee made it possible to structure a risk mitigation mechanism that, until then, had been largely inaccessible and rarely applied to reforestation projects, precisely due to its complexity and the atypical profile of these assets.

These two instruments—the offtake agreement and the private guarantee unlocking public credit–were decisive in making the project both bankable and replicable. This structure has been gaining traction in the market, with banks now developing similar operations and offering guarantee terms on increasingly favorable conditions.

Conclusions and paths to unlock climate finance in Brazil

The climate transition is not merely an environmental imperative—it represents, above all, a large-scale economic and institutional challenge. In this context, Brazil holds a unique climate profile, characterized by a predominantly renewable energy matrix and strategic natural capital that underpins climate solutions of global relevance.

Despite these advantages, the transition to a low-carbon economy faces heterogeneous financial, technological, and institutional barriers, each requiring tailored approaches depending on the maturity stage of the climate solutions involved.

The study analyzed 15 key solutions for decarbonization, grouped into four maturity archetypes —Undefined Technological Pathways, Emerging Solutions, Nascent Value Chains, and Developing Markets. Each archetype presents specific challenges related to capital mobilization, regulatory alignment, and the consolidation of value chains.

Beyond the volume of capital required, innovative risk mitigation mechanisms—such as hedging instruments, performance guarantees, and structures designed to buffer exchange rate or price volatility—can complement concessional capital, helping to rebalance the risk-return equation in strategic sectors.

This is a multifaceted challenge that extends beyond the financial dimension. It demands a coordinated combination of technical, institutional, and market-based actions, adapted to the specific context of each solution—there is no one-size-fits-all answer.

Accordingly, overcoming these challenges depends on three key elements:

1. Development of financial instruments calibrated by archetype

- **Undefined Technological Pathways:** greater emphasis on research and development grants, insurance and guarantee mechanisms to mitigate the risks associated with first projects, and purchase agreements and the engagement of incumbent players for signaling demand.
- **Emerging Solutions:** use of catalytic equity and concessional debt to absorb capital-intensive risks, combined with demand mandates to reduce revenue uncertainty.
- **Nascent Value Chains:** application of concessional debt, strategic equity, project phasing, and long-term offtake agreements that promote integration across the value chain to reduce costs and increase scale.
- **Developing Markets:** deployment of guarantees, concessional debt, project phasing, and offtake contracts to mitigate demand risk and expand ecological restoration efforts within a predominantly voluntary carbon market.

2. Deepening the Climate Hub model

Several projects currently being structured in Brazil will help the country advance its climate ambitions. It is essential to consolidate national platforms that connect climate projects and commercial capital, promoting standardization, technical validation, and the replicability of pilot projects. Beyond mobilizing financial resources, these platforms play an essentially catalytic role by building robust financing frameworks, reducing perceived investor risk, and creating comparative benchmarks for assessing environmental and economic performance, in line with international blended finance practices and sectoral decarbonization mechanisms[59] [60].

Brazil's experience with the BIP (Brazil Investment Platform) points to a promising path for mobilizing stakeholders capable of implementing many of the proposed solutions and, in doing so, unlocking private financing. The first projects will be strategic milestones in this journey, serving not only to enable decarbonization, but to structure it effectively.

[59] Country Platforms for Climate Action: MDB statement of common understanding and way forward (p. 1-5). Available at: https://documents1.worldbank.org/curated/en/099427511122436202/pdf/IDU-eb55cea2-53b2-4e2d-88cd-6a23e8b08a0a.pdf

3. Public-private coordination as a strategic pillar in accelerating Brazil's climate agenda

Fighting climate change and positioning Brazil as a protagonist in this agenda means, above all, promoting a new technological and productive paradigm—one that rebuilds the foundations of the country's growth and socioeconomic development. Therefore, joint action between the private (productive and financial) and public sectors will be essential to address regulatory challenges, design sectoral plans with a full value-chain perspective, and implement effective market incentive mechanisms. Such an approach enables the alignment of economic incentives, the reduction of institutional barriers, and the coordinated consolidation of low-carbon markets, while simultaneously fostering decarbonization, socio-environmental resilience, and economic development. Intentional action in this direction helps align expectations and trigger a virtuous cycle of financing.

In this new paradigm, the private sector is not merely an implementing agent, but an active participant in shaping the transition agenda. Its involvement from the earliest stages of strategy formulation—contributing market insight, innovation, and mobilization capacity—is crucial to ensure that proposed solutions are economically viable, technically scalable, and institutionally sustainable. The transition therefore requires structural alignment between public ambition and private capacity, supported by mechanisms that drive investment decisions aligned with climate goals, while generating returns and creating growth opportunities.

These measures—deepening the national investment platform, developing financial instruments calibrated to each archetype, and strengthening strategic coordination between public and private sectors—are key to building predictability, reducing risks, and accelerating the implementation of climate solutions in Brazil.

Brazil's presidency at COP30 represents a strategic opportunity to position the country as a global leader, showcase its climate solutions to the world, and attract additional capital to advance the agenda—consolidating Brazil as a hub of innovation and leadership in the transition to a low-carbon economy, with significant impacts on mitigation, adaptation, and socioeconomic development.

[60] Scaling Private Capital Mobilization: Call to Action to heads of state, policymakers and multilateral development bank officials (p. 3-6). Available at: https://www.unepfi.org/wordpress/wp-content/uploads/2023/11/CTA_Scaling-Private-Capital-Mobilization_final.pdf

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