BRAZIL'S INSIGHTS ON CLIMATE ACTION TEN YEARS AFTER THE PARIS CLIMATE AGREEMENT

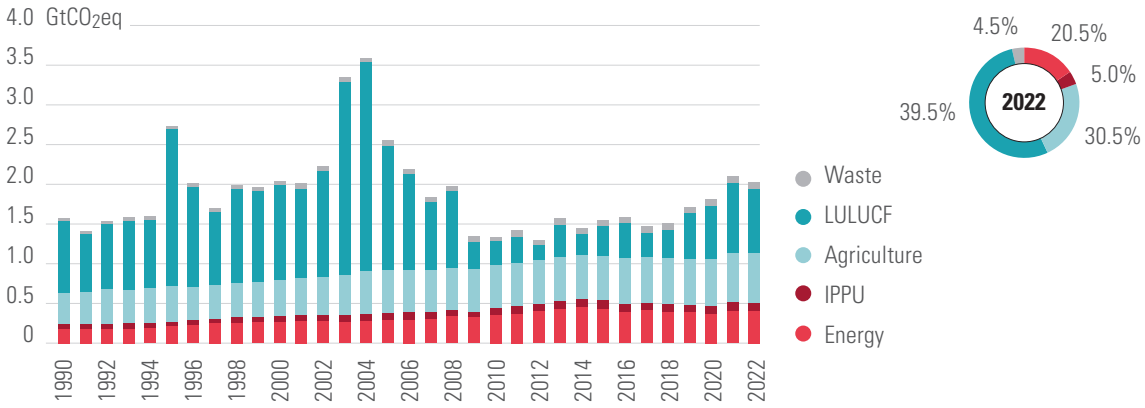
Emilio Lèbre La Rovere (UFRJ - COPPE)

KEY NUMBERS

Brazilian total GHG emissions were stagnant around 1.5 $GtCO_2e/y$ in the period from 2015 to 2018, due to the economic recession hitting the country in the 2015-2020 period (GDP average annual change rate of – 1.0%). From 2019 to 2022, economy-wide GHG emissions have increased to reach a level of over 2 $GtCO_2e/y$, due to the sharp increase in annual deforestation rates promoted by the policies adopted during the Bolsonaro's Federal Government term. Since 2023, a new term under President Lula has managed to reduce deforestation again and therefore total GHG emissions in 2025 are estimated to be around 1.7 $GtCO_2e$. This level will thus be roughly 0.4 $GtCO_2e$ above the NDC target of 1.32 $GtCO_2e$ in 2025, with a 33% reduction of the 2005 level achieved against a 48% target.

The profile of GHG emissions per source and per sector is quite different from the prevailing pattern across the world, where CO_2 emissions from Energy account for the bulk of total GHG emissions. Instead, in Brazil, as of the latest official data available for 2022, AFOLU accounts for 70% of the total 2.0 $GtCO_2e$ emissions: 39.5% from LULUCF and 30.5% from Agriculture, including methane from the enteric fermentation of livestock, which accounts for the bulk of

Figure 1. Net emissions by sector with LULUCF



Source: Brasil (MCTI), 2024.

agricultural GHG emissions. Energy-related emissions are 20.5% only, with the balance coming from IPPU with 5% and from Waste with 4.5% (see **Figure 1** below).

As a result of these national circumstances, nearly 40% of Brazilian total GHG emissions are released under the form of non-CO_2 gases. Another key country specificity is its clean electricity (88% of power generation from renewables) and the worldwide record high share (50%) of renewables in its overall energy mix (fossil fuels are limited to half of the domestic energy supply) (EPE/MME, 2025).

ROLE OF LONG-TERM

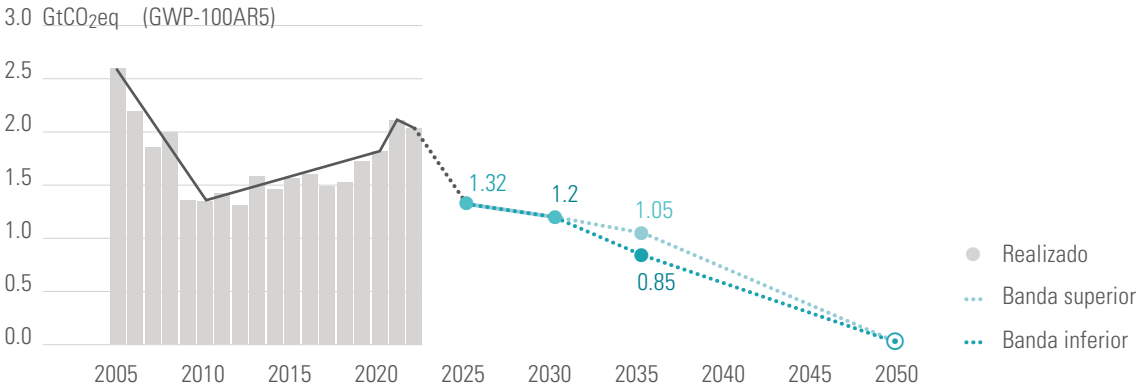
The Brazilian government submitted its first NDC to the UNFCCC in 2016. In its first update in 2020, an indicative target of achieving climate neutrality by 2060 was added. In the second update of March 2022, the target of achieving net-zero GHG emissions was anticipated to 2050. This target was confirmed in the third update of the first NDC in 2023 and in the 2nd NDC submitted to the UNFCCC during COP 29 in November 2024. These announcements were primarily political statements, as they were not based on a Long-term Low Emissions Development Strategy (LT-LEDS) designed through a stakeholder engagement process. The Government plans to submit its LT-LEDS to the UNFCCC by 2026, before the end of its term.

The NDCs were based on forward-looking scenarios, leading to GHG emissions targets of 1.2 $GtCO_2e/y$ in 2030 and of 0.85-1.05 $GtCO_2e/y$ in 2035 (announced at COP29). The recently completed preliminary version of seven Sectoral Mitigation Plans of the "Plano Clima Mitigação" (Brasil, 2025), presented to public consultation in July-August 2025, includes a list of sectorial policies and measures to achieve the targets up to 2035, but after that they simply connect the 2035 emissions endpoint to zero in 2050 by a linear pathway (see **Figure 2** below).

However, the Ministry of Finance made a remarkable effort of launching an Ecological Transformation Plan at COP 29 in November 2024, presenting a long-term vision for Brazilian development based on a green economy. It is axed in six priority dimensions: sustainable finance; enhanced technological innovation and productivity; bioeconomy and food production systems; energy transition; circular economy; and green infrastructure and adaptation. Besides, it has launched some key initiatives to mobilize long-term private domestic and international capital at lower cost to foster the transformation:

- the Brazilian Investment Platform (a portfolio of investment opportunities with a list of key information about low-carbon projects to attract the interest of potential private investors).

Figure 2. GHG Emissions Pathway and Current Brazilian NDC economy-wide Targets



Source: Brasil (2025).

- Eco Invest (a hedge fund to supply guarantees to foreign investors against future exchange rate devaluations affecting their revenues and profits in hard currency).
- the Brazilian Sustainable Taxonomy (to define criteria for green investments labelling).
- emission of sovereign green bonds (to attract investors and channel private capital to fund the transition in partnership with the government).
- and the Green Tax Reform (still underway), aiming at a tax increase on products harmful to the environment while supplying fiscal incentives to biofuels, low-carbon hydrogen, materials recycling and reuse.

A recent study has also pointed to the opportunities for Brazil tapping its competitive advantages in some promising industrial sectors within the context of a global energy transition: critical minerals; batteries and its components; hybrid and electrical vehicles; sustainable aviation fuels (SAF); wind power aerogenerators; low-carbon steel; and green fertilizers (Guerra et al, 2025).

Long-term analyses of GHG emission pathways are available from the studies developed by Centro Clima within the DDP initiative in the last ten years. From its main findings, a long-term decarbonization strategy emerges, including: a key role of stopping deforestation and increasing forest sinks; and progressively moderating the use of fossil fuels and increasing renewables in the energy mix, through enhanced use of solar and wind energy, biofuels, electrical transportation, transmission lines and storage in batteries. Centro Clima results were quoted by the Ministry of Finance in the ETP - Ecological Transformation Plan[1] concerning its economic and social implications and helping to justify its targets: a GDP per capita growth of 10% by 2026 and of 100% up to 2050, and reduction of income inequalities leading to a Gini coefficient below 0.5 in 2026 and at most 0.4 in 2050.

A long-term perspective can point to a roadmap to enlighten the required short and medium-term policies, helping to make them more effective and consistent with the long-term vision of Brazilian society and economy. The ETP can be further detailed and periodically updated, guiding the adoption of a similar approach in sectorial planning (for example, the 2055 Plan under preparation by the Energy Planning Agency – EPE of the Ministry of Mines and Energy to update the previous 2050 Strategic Energy Plan). The LT-LEDS that the Government plans to submit to UNFCCC before the end of its term in 2026 can help catalyze these planning efforts and support the revision of future NDCs every five years.

1 Brasil, Ministry of Finance (2024); Centro Clima's DDS = Deep Decarbonization Scenario results (La Rovere et al, 2021) are quoted in page 96: "by 2050, compared to 2020, a GDP growth over 90%, and real income of the 20% lower household income class 130% higher".

EXAMPLES OF CONCRETE PROGRESS

Since the signature of the Paris Agreement in 2015, the major progress in the implementation of a net-zero transition in Brazil was observed in the Energy sector. Thanks to the sharp cost decrease of solar PV and wind power, 75% of the annual power generation growth now comes from these two sources combined. Biofuels (ethanol and biodiesel) production and use has also significantly increased in this period. Surplus from two annual harvests of corn is now being used for producing billions of Liters of ethanol, complementing a continuous increase of ethanol production from sugarcane. Biodiesel production and use has nearly tripled from 3.2 to 8.8 billion Liters/year between 2014 and 2024. Brazil is also pioneering the production of advanced biofuels potentially leading to a substantial production of sustainable aviation and maritime fuels from sugar cane and corn in the medium term. In the last two years it is also worthwhile mentioning the increase of electrical vehicles sales and the launching of several green hydrogen production hubs (primarily directed to exports).

This progress was made possible in first place by international technological progress allowing for solar PV and wind power becoming competitive sources of power generation in Brazil, where low-cost large-scale hydropower is facing increasing difficulties to get environmental permits for greenfield projects. In the country's total power generation of 751 TWh in 2024, after hydropower contribution (56%), wind power (14%) was ranked second, and solar PV (9.5%) was third ranked. At the end of April 2025, 3.5 million rooftop PV systems (80% in the residential sector) with a total installed capacity of 39 GW were connected to the Brazilian grid.

Governmental policies have also contributed to some breakthroughs, including, among others: subsidies to rooftop PV cells, dedicated tendering of PV power plants, increasing mandates for ethanol and biodiesel blends in gasoline and diesel oil, caps to carbon intensity of fuels distributed for consumption (Renovabio program). The National Development Bank – BNDES has supplied long-term funding to the wind industry conditional to an initial national content level of 60% (later adjusted) of the total investment, allowing to ensure domestic manufacturing of most wind power equipment and to reach an 85%-95% level today.

In the last three years there was also a confirmation of the effectiveness of a mix of command-and-control and economic instruments to reduce by 40% the annual deforestation rate in the Amazon, along the same lines of the strategy implemented in the period 2005-2012 that had achieved a remarkably sharp decline of Brazilian GHG emissions. The creation of the Amazon Fund, soon after COP15 in Copenhagen (in 2009) was also important to channel international cooperation funds to the protection of Amazon ecosystems.

There are around 50 million hectares[2] of public forests in the Amazon with no use defined yet. They were not transformed in Conservation Units and not regularly transferred to private operators yet. They are vulnerable to illegal occupation by farmers who occupy and claim them as private properties. Farmers clear the forest and have a few heads of cattle sparsely occupying the land (at low density and cost). This enables them to claim the ownership of the land at local land ownership registry offices[3]. This illegal occupation is one of the main emission drivers in the Amazon. The main challenge to reduce it is the enforcement of environmental laws and regulations in faraway remote access territories, especially in the Amazon. It is very hard for the Federal Government to control all these vast territories and in many case states' governors and local land ownership registry offices tolerate illegal practices by powerful vested interests of big producers. Command-and-control instruments to reduce deforestation of public land include joint

2 49.5 million hectares of continuous forests of 10 thousand hectares or more; adding smaller areas on the top of it, total forest surface reaches 56.5 million hectares (IPAM, 2024).

3 The Observatory of Public Forests has found that around 60% of non-destinated public forests in the Amazon were claimed as private property, totaling more than 30 million hectares, according to the Rural Environmental Registry established by the Forest Code (IPAM, 2024).

operations of the Federal Environmental Agency (IBAMA) with the Federal Policy and the Federal Road Police. The collaboration with the States' authorities and with the Justice institutions is key to ensure its effectiveness, seizing cattle and equipment in the illegally occupied land. New norms created by the new Federal Government in 2023 and 2024 are an effort to accelerate the destination of public forests, including partnerships with private capital to restore the original forest cover (see section 3 below).

Economic policy tools were successfully used to reduce illegal deforestation in private properties. Most farmers and ranchers depend on public credit lines to get soft loans to fund agricultural activities before they can sell the production. The governmental Harvest Plan (Plano Safra) for 2025/2026 allocates around USD 90 billion to large properties and around 16 billion to small farmers (Talanoa Institute, 2025). The approval of these soft loans by public banks were made conditional to compliance with environmental laws and regulations, including the Forest Code (that defines the cap for clearing original vegetal cover in the private property according to the biome of location: 20% in the Amazon and 80% elsewhere). Many private agricultural properties have cleared more than allowed by law to increase the crop or ranching area. As access to the public credit privileged conditions is key to agricultural producers, this is a powerful incentive for compliance with the conservation of forest cover. There is scope to go much further: from 2025/26, a share of these credits will require compliance with the Climate Risk Agricultural Zoning established by the government, aiming to reduce losses caused by climate extreme events; and as of today, only 1.6% of the total credit allocated to large properties by the Harvest Plan will be used to promote low-carbon agricultural practices (Instituto Talanoa, 2025). Progressively increasing these shares in the future may represent a substantial economic incentive to the adoption of low-carbon and resilient agriculture practices.

The New Industry Brazil - NIB Plan, launched by the government in January 2024 (Brasil, MDIC, 2024), covering a period up to 2033, includes a decarbonization mission and a complementary infrastructure mission. It is an attempt to reverse the deindustrialization of the country in the last 40 years: the share of industry in its GDP has declined from 36% in 1985 to 13% in 2022. Besides launching public investments, soft loans, fiscal incentives and public/private partnerships, the NIB Plan has established targets for increasing the use of biofuels, incentives for the manufacturing of more sustainable cars and the development and production of low-carbon hydrogen. The target of increasing fertilizer production to meet 55% of domestic demand for reducing the dependency on fertilizer imports opens a good opportunity for a decentralized production of green fertilizers using solar and wind power. It has also created an Interministerial Commission of Public Procurement for Sustainable Development.

Finally, the approval at the end of 2024 of a cap-and-trade system applicable to companies emitting more than 25 $ktCO_2e/y$ (excepted in the agricultural sector) is also a major achievement to put the economy on track to a net-zero transition. Its full implementation is expected after 2030 only, but it will provide a carbon pricing tool indispensable for the net-zero transition. Moreover, it will also create a strong incentive to forest offsets that were included in the design of the domestic emissions trading system. The major enabler of the approval by the Congress of the bill creating the regulated carbon market in Brazil was the political support of the agricultural sector, looking for a scaling-up of the gains already obtained in the voluntary carbon market: farmers were strongly supportive of the bill expecting short-term additional revenues from forest restoration and REDD+ projects. Its powerful representation in both legislative houses has secured a double dividend from the creation of the domestic carbon market, as its GHG emissions were excluded from the scope of the caps but they will be able to sell GHG emissions offsets.

EXAMPLES OF CONCRETE BLOCKAGES

The Lula's government is committed to reach zero net annual deforestation in the country by 2030. However, in spite of the recent success in reducing it by 40% in the three years in the Amazon region, this target looks particularly challenging in view of the uprise in illegal small-scale gold mining and drug dealing activities. Therefore, the task is considerably more complex than in the period 2005-2012 and the enforcement of laws and regulations is even more pressing.

Brazilian new Forest Code approved by a federal law in 2012 requires the restoration of natural vegetal cover in medium and large-size private rural properties (80% of the original cover in the Amazon and 20% elsewhere). Around 20 million hectares of private land should be restored by farmers, allowing for a substantial increase of carbon removals. The initial deadline for compliance across the country was 2032. However, there were delays in the registry of rural properties and the deadline was suspended (cancelled) by the Bolsonaro government in 2019. Still today the enforcement of this law is very slow. This hampers a key feature of a net-zero transition in Brazil: the increase of carbon sinks by forestry. The main explanation for this blockage is once again the power of the agricultural lobby, particularly strong in the Northern region where state governors are generally supportive of farmers' interests. Farmers and ranchers simply don't want to pay for the restoration of the missing share of forest cover required to ensure compliance with the Forest Code in their properties.

Deforestation of non-destinated public land was also important (see section 2 above). Only in 2025 the National Development Bank has started a program targeting the reforestation and afforestation of public land in the borders of the Amazon region (the "deforestation arch"), through tenders to private operators. This is a promising initiative, as it is estimated that the amount of public degraded land in the Amazon exceeds 60 million hectares, but still at a very incipient stage. Its main challenge is the difficult logistics and the lack of infrastructure for planting and forestry activities in general, under amazonian conditions.

The lack of progress in the decarbonization of the beef production chain is another key blockage. It prevents the reduction of methane emissions from the enteric fermentation of cattle and of indirect CO_2 emissions from land use change (induced illegal deforestation) in the supply chain of meat production. Currently, there is no federal policies to moderate these emissions, but only voluntary and limited private commitments. The three main beef producers (JBS, Minerva and Marfrig) have GHG emissions reduction targets limited to their direct GHG emissions only. Except for Marfrig, they are committed to net-zero before 2040 or 2050, which may seem very ambitious. However, these targets include scope 1 emissions only. Most of GHG emissions induced by beef production are located along the supply chain. Indeed, their direct emissions occur in the final stage of the production (a few days before slaughtering) and are very low because the cattle spend most of its whole lifetime (around three years) in several different ranches of primary, secondary, and other suppliers. Tracking and reducing GHG emissions (both methane from enteric fermentation and CO_2 from induced illegal deforestation) is needed along the whole supply chain through the adoption of good practices: more intensive ranching with increased the current very low average number of heads of cattle per hectare (from 1.3 in 2020 to 2.0 by 2050); ensuring that pastureland is not result of illegal deforestation; and supplying appropriate feeding to reduce cattle lifetime from 37 months in 2020 to 27 months by 2050) (La Rovere et al, 2023). This would require the engagement of all suppliers, which is costly and difficult under amazonian conditions of lack of infrastructure and tolerance of informal activities (e.g. cattle raising in pastureland obtained by illegal clearing of forest areas). The enforcement of a certification procedure to ensure the compliance with the European Union Deforestation Regulation – EUDR can represent a key transparency rule

if properly applied, which will remain a difficult challenge if local governments, farmers and largest beef producers remain opposed to it.

In the power sector, a near-zero carbon electricity is hindered by a lack of sufficient storage capacity in the national grid. The solution to get there may come from the use of a combination of batteries and hydropower plants reservoirs', allowing to avoid the use of natural gas-fired thermopower plants.

However, the right decisions and investments have not been taken on time, and for short-term requirements, solar and mainly wind energy are victims of new rules enforced by the National Grid Operator (ONS) solar and mainly wind energy are victims of new rules enforced by the National Grid Operator (ONS) imposing a curtailment of wind and solar power dispatching, since a blackout in 2023. It was due to similar reasons as in the 2025 Iberian Peninsula blackout (high share of mini/micro decentralized PV systems preventing the stabilization of electrical grid fluctuations). The curtailments are mainly hitting wind farms in the Northeastern region (with the highest concentration of wind farms and PV power generation with large surplus transported to the Southeast region). Average curtailment last year was of 18 TWh from wind and solar power, representing 11% of the total potential generation from these sources, a considerable waste of energy and economic loss for the renewable power generators.

The situation will be aggravated in the future as solar and wind power show a fast-growing pathway: from 60 GW at the time of the 2023 blackout, the combined installed capacity of these two sources has grown to reach 90 GW in 2025, a 50% increase in less than two years. The Power Regulatory Agency (ANEEL) has thus to urgently implement measures to face this challenge: strengthen and enhance the transmission grid; compensate for the economic losses of solar and wind energy generators; adjust the regulations to control the power injection of decentralized PV systems in the grid; gradually reduce the subsidies to rooftop PV systems as they are already competitive; relax the constraints to increase the flexibility of hydropower plants in contributing to meet peak load; negotiate a shift of thermopower generation out of the periods with highest availability of solar and wind energy; and accelerate the tender of power storage capacity (battery systems) scheduled for 2025 but delayed in favour of natural-gas fired thermopower reserve capacity.

Finally, there is a political pressure to increase the production of oil and gas, given its high potential to supply short-term revenues through the royalties distributed to neighbour areas (states and municipalities) in producing regions. It pushes for the opening of new fields in Brazilian Northern shore, with some fields dangerously close to fragile ecosystems in the Amazon River delta (see the next section 4).

COMPETING INTERESTS AROUND THE ROLE OF OIL & GAS PRODUCTION

Brazilian economy has become strongly dependent of the production and exports of commodities (iron ore, oil, meat and agricultural produce such as soybeans, meat, orange juice, sugar, coffee, cocoa, etc.) for ensuring public revenues and the hard currency required by the equilibrium of its balance of payments. Brazil has discovered huge oil resources in deep fields offshore (the so-called pre-salt layer) and plans to continue oil production growth up to 2050, with an increasingly important share directed to exports. Exports of oil products are key to Brazilian trade balance as they have already become the single highest item of Brazilian exports (overcoming the hard currency earnings from soybeans). The government's hope is that Brazilian oil will remain competitive even when global oil demand peak and decline, thanks to its low extraction cost and low CO_2 content. Technically, this does not prevent Brazilian economy to follow a decarbonization pathway, as GHG emissions from oil exploration and production can be kept at a relatively small level.

On the other hand, the considerable natural gas resources associated to oil production lead to a strong political pressure from the Congress, state governors and economic interests to push for its use, allowing for short-term development benefits. They want the Federal Government to mandate the building of greenfield gas-fired thermopower plants (combined-cycle plants operating all year round to supply baseload power) in regions far away from the oil&gas fields. This would require huge investments in the building of infrastructure for natural gas storage and transport to these regions, making these projects far from cost-effective compared to other available power generation options in Brazil. Such natural gas projects would create a lock-in effect slowing the phase-down of fossil fuels required in the transition to a net-zero economy. Moreover, solar and wind power are not only cheaper but also obviously capable of generating electricity with a much lower carbon footprint.

Looking at the full picture in a broader view, climate change and a global transition towards net-zero will demand the building of a new Brazilian economy, based on new activities such as bioeconomy, a natural vocation of the country. The Ecological Transformation Plan recently launched by the Ministry of Finance supports this long-term vision (see section 1). The oil&gas sector might be a facilitator of this transformation, providing resources to progressively transition from oil to renewable economic activities. In 2024, only 0.16% of the oil rent is targeted to the environmental and climate-related activities (INESC, 2025). Technically, an initial step towards this goal would be the reduction of subsidies to fossil fuels (mostly to oil&gas, with less than 1% to coal) that have reached an amount of USD 16.4 billion in 2023 (51% to production and 49% to consumption) and shift them towards technologies required for the transition (subsidies to renewable energy were of 3.6 USD billion in 2023, 4.5 times less than for fossil fuels) (INESC, 2024). However, the Congress has approved in 2017 a law extending the duration of the subsidies to oil&gas production up to 2040.

Another key step would be the transformation of Petrobras in an Energy company. Up to 2022 Petrobras was lagging other oil majors in its diversification efforts. The new Federal Government started in 2023 has led to the nomination of a new Board of Directors of Petrobras, including an Energy Transition and Sustainability Director. However, by mid-2024 the President of Petrobras was changed and in May 2025 this Directorate (formerly occupied by an academic) was occupied by a natural gas expert. Brazilian President has been aligned to the official position of the Brazilian Minister of Energy that oil resources are necessary to fund the energy transition of the country. However, in practice Petrobras is focusing on oil&gas only, planning to accelerate the extraction of Brazilian oil resources until the last drop.

GOVERNANCE

An Interministerial Commission on Climate Change was created in 1999, mainly to serve as the DNA – Designated National Authority, required by UNFCCC to approve CDM – Clean Development Mechanism projects in Brazil. It was enlarged with new members and a wider scope of action in 2007, when it became a committee. In 2023, the new Federal Government restructured again the Committee, now formed by 20 ministries, 2 secretaries of the Presidency of the country and the Attorney General's Office (AGU), besides representatives from the Social Participation Chamber (including the National Forum on Climate Change – FBMC), a Chamber gathering subnational level entities and the Congress, and a Scientific Advisory Chamber. The general coordination of the elaboration of the National Mitigation Strategy was jointly ensured by the Civil House of the Presidency, the Ministry of Environment and the Ministry of Science and Technology. The seven Sectoral Mitigation Plans were elaborated and are to be implemented by the corresponding ministries: Energy, Industry, Transport, Agriculture, Nature Conservation (Land Use Change and Forestry, by the Ministry of

Environment), Cities and Waste (including urban transport, by the Ministry of Cities).

A Management Body must be created before the end of 2026 to handle the Brazilian System of Emissions Trading (SBCE), according to the law approved in 2024 establishing the cap-and-trade system and its implementation phases in the next five years. A Secretary within the Ministry of Finance will serve as a temporary management body, from August 2025, as it is difficult to create new bodies under severe federal budget deficit constraints. The scope of its activities is very broad, according to the law, and its decision power regarding the approval of eligibility of credits to be traded internationally under Article 6 of the Paris Agreement, as well regarding REDD+ credits, will be shared with other existing governmental bodies.

The position of the country in international fora is established by the Ministry of Foreign Affairs, under the political guidance of the Presidency and the technical support of the ministries of Environment and Science and Technology.

The main challenges concern the coordination of the domestic governance split by many plans and policy tools across different ministries. There is a need for improving mainly three features of Brazilian climate change policy governance:

- the need for consistency with other public policies, such as the Pluriannual Plan (PPA), a four-year government investment plan, spelled by budget lines; the Growth Acceleration Plan (PAC), a selection of priority governmental programs with an implementation schedule closely monitored
- monitoring, reporting and verification (MRV), based on the establishment and follow-up of milestones, helping to ensure continuity in the implementation of climate change plans (and avoid the bad experience of some Mitigation Plans elaborated in 2010, such as Industry and Transport, that have not been translated into concrete actions)
- a stakeholder engagement process to ensure real public participation, beyond the formal processes of calls for on-line comments and suggestions to preliminary drafts of already finalized plans and programs; the Climate Plan (Plano Clima) elaboration has included an effort to organize hearings with selected stakeholders about its sectoral mitigation and adaptation plans, but still lacking transparency about assumptions used in the analyses and the engagement of stakeholders at earlier stages of designing the plans.

Another proposal put forward by the Ministry of Environment would be to create a Federal Climate Change Agency, with the exact scope of its activities to be defined, but the idea has raised negative reactions, partly due to budget constraints but also to the political difficulties in having the required approval by Congress to create new governmental bodies. Anyway, there is a pressing need of defining at least the governing institution of the Brazilian emissions trading system, and initially it will be hosted by a special Secretariat at the Ministry of Finance.

INTERNATIONAL COOPERATION

International cooperation has been helpful to strengthen the capacity of the Brazilian public sector, sometimes facing difficulties to have sufficient staff due to budget constraints, through the supply of punctual services of consultants and temporary personnel.

Another dimension of international cooperation with Brazil is through direct investment of foreign companies in local manufacturing of green technology. A good example is the case of wind energy equipment manufacturers who installed production plants in Brazil, mainly after the financial crisis of 2008-2009 that caused the reduction of subsidies to renewables in developed countries. This has allowed wind park investments to be eligible to soft loans from the National Development Bank (BNDES) with at least 60% of the investment in each project being manufactured in Brazil, leading to a level of 85%-95% today. More recently, Chinese companies have contributed new business plans to the electrification of urban buses in Brazilian cities and this could offer avenues for future manufacturing of electric

trucks. Additionally, in 2025 two Chinese manufacturers are starting electric cars production in Brazil.

International capital flows to fund low-carbon projects in Brazil have supported the transition to net-zero GHG emissions. One good example is the Amazon Fund, to avoid deforestation in the region with substantial grants reaching around 0.7 - 0.8 billion of dollars, mainly from Norway (90%) and Germany (8%). Going beyond grants, Brazil has launched in COP 28 the proposal of a Tropical Forests Fund Forever – TFFF to reward good performance of forest countries in reducing annual deforestation rates below a baseline related to the historical average. The funding would be raised through blended finance mechanisms, with benefits distributed to investors, countries, and communities in proportion to the protected forest area.

However, the amount of international capital flows is insufficient to complement domestic sources and fund the huge potential of economically viable investment opportunities in low-carbon and resilient projects in Brazil. The main gap to be filled to support the country's transition is to de-risk these projects to increase the mobilization of private capital and to reduce the cost of capital in Brazil, still higher today than in other emergent economies. Brazilian Ministry of Finance has already made an effort in this direction through the creation of the Brazilian investment platform (BIP) and of the hedging fund Eco Invest (see section 1). International cooperation can contribute to its success by mobilizing institutional investors and other sources of private capital to tap opportunities not only of mitigation projects but also for "powershoring"[4] based on the genuine competitive advantage of Brazil thanks to its natural resource's basis and clean energy mix.

Another win-win international cooperation option would be the creation of Multi Sovereign Guarantee Mechanisms[5], with contributions from triple A rated countries to de-risk investments in low-carbon projects in Brazil. These contributions would respect public finance constraints as they would be spent in the case of project failures only (default rates are typically around 5-10%), while allowing a leverage of private capital of up to 10-20 times their amount.

Finally, there are two main fields of specific cooperation opportunities with the European Union:

- certification programs compatible with EUDR (see section 3): a variety of deforestation-free certification programmes exist internationally (e.g. RSPO, PNCCS and CBS/FSC in Brazil), and it is important to ensure consistency among programmes, certification methodologies and the underlying technology.
- how to make the design of the upcoming Brazilian emissions trading system compatible with the European Carbon-Based Adjustment Mechanism - CBAM? What mechanisms would be required to adjust the level of border taxes in Brazil and in the EU, at what disaggregation level, and what methodologies to use?

CONCLUSION

After a spectacular decrease of roughly 3.5 to 1.5 $GtCO_2e/y$ between 2004 and 2014, Brazilian GHG emissions have been stable from 2015 to 2018, increased again to over 2 $GtCO_2e/y$ from 2019 to 2022 and were brought back to 1.7 $GtCO_2e/y$ in 2025. Command-and-control (enforcing environmental laws and regulations) and economic policy tools (public credit conditional to environmental constraints) have been crucial to cut down annual deforestation rates and resulting emissions from 2004 to 2012 and from 2023 to 2025. The energy policy adopted since the oil crisis in the early seventies (when Brazil was relying on imports for 83% of its domestic oil consumption) has allowed to build up renewable energy production (first hydro-

4 The concept of powershoring refers to the decentralization of production from developed countries to third countries near to consumption centers and supplying clean, safe, cheap and abundant energy, besides other advantages to attract industrial investments (see Arbache, J. and La Rovere, E. L., 2024).

5 As proposed by Hourcade et al, 2025.

power, bioethanol from sugarcane and wood/charcoal; and more recently, biodiesel, wind and solar energy). As of today, 50% of the overall energy mix is supplied by renewables and 88% of power generation is green. Therefore, Brazil is already halfway in its energy transition and able to embark in a GHG emissions declining pathway to reach climate neutrality by 2050. The Paris Agreement in Brazil was not the driver to reach this privileged situation but it has helped not only the government but mainly the private sector to believe that sooner or later the transition to climate neutrality is really going to happen. In the last ten years, many governmental regulations and corporate decarbonization targets have been announced not only by multinational but also by Brazilian companies.

However, Brazilian economy has become strongly dependent of the production and exports of commodities with the deindustrialisation trend of the last 40 years. The huge oil resources found in deep fields offshore have started to increase production from 1975 and today Brazil is a large oil exporter (exports of oil products have become essential to the equilibrium of Brazilian trade balance as the single largest provider of hard currency) who has recently joined OPEC+. The fast track to short-term prosperity is therefore to accelerate the production and exports of oil products, together with agricultural and mineral commodities. It is understandable that this development strategy receives strong political support from less developed regions (including the Amazon states) and powerful vested interests in all the country.

Looking at the full picture in a broader view, the main challenge to reach a net-zero GHG emissions in Brazil is to overcome the conflict between short-term quick gains from exploiting non-renewable resources and the short, medium and long-term benefits of building a green economy based upon the vast potential of renewable resources of the country. The transition towards net-zero will demand the building of a new Brazilian economy, based on new activities such as bioeconomy, a natural vocation of the country. The Ministry of Finance made an important step to this end, launching an Ecological Transformation Plan at COP 29 in November 2024, presenting a long-term vision for Brazilian development based on a green economy.

It is essential to build not long a vision of this long-term sustainable economy but also elaborate its roadmap to enlighten the required short and medium-term policies and the benefits of following this pathway from today. The ETP can be further detailed and periodically updated, guiding the adoption of a similar approach in sectorial planning. The LT-LEDS that the Government plans to submit to UNFCCC before the end of its term in 2026 can help catalyze these planning efforts and support the revision of future NDCs every five years. These processes can help to give concreteness to the benefits provided by the Brazilian competitiveness within a global transition to net-zero and progressively increase the political support to a low emissions development strategy.

REFERENCES

- Arbache, J. and La Rovere, E. L., 2024; "Transição Energética e Powershoring na América Latina e Caribe: Oportunidades, Desafios e Políticas Públicas", CAF – Development Bank of Latin America and the Caribbean, 43 pages, March 2024.
- Brasil, 2024. Ministry of Science and Technology (MCTI); Biannual Transparency Report to the UNFCCC.
- Brasil, Ministry of Finance, 2024. New Brazil. Ecological Transformation Plan (Novo Brasil. Plano de Transformação Ecológica), 106 pages, in Portuguese. Brasília, November 2024.
- Brasil, Ministry of Development, Industry, Trade and Services – MDIC, 2024. Nova Indústria Brasil: missões, metas e ações da política industrial. Brasília, January 2024.
- Brasil, 2025. Climate Plan: National Mitigation Strategy (Plano Clima Mitigação). National Mitigation Strategy (Estratégia Nacional de Mitigação). 113 pages, preliminary version in Portuguese, Brasília, July 2025.
- EPE/MME – Empresa de Pesquisa Energéticas (Agency for Energy Planning), Ministério de Minas e Energia (Ministry of Mines and Energy); National Energy Balance, 2025.
- Guerra, A. M. et al, 2025. "New industrial policy for a new world: Seizing Brazil's opportunities in the energy transition", NZIPL - Net Zero Industrial Policy Laboratory, Johns Hopkins University, in Carta IEDI nº 1324, 15 August 2025.

- Hourcade et al, 2025; "A Climate Finance Initiative for COP 30: A Multi-sovereign Guarantee Mechanism for Accelerated Climate Investments in Developing Countries", Submission to the UNFCCC Baku to Belém Roadmap to 1.3 trillion.
- INESC – Instituto de Estudos Sócio-econômicos, 2024. "Subsídios às Fontes Fósseis e Renováveis (2022-2023)", 34 pages study, Brasília, September 2024.
- INESC – Instituto de Estudos Sócio-econômicos, 2025. "Renda do petróleo no Brasil", 35 pages technical note, Brasília, April 2025.
- Instituto Talanoa, 2025. "Safra Bilionária, desafio climático. Plano Safra 2025/2026", Política por Inteiro, Tá lá no gráfico, nº 41.
- IPAM – Instituto de Pesquisa Ambiental na Amazônia, 2024. Observatório de Florestas Públicas (Observatory of Public Forests). https://deolhonasflorestaspublicas.org.br/
- La Rovere, E. L.; Dubeux, C. B. S.; Wills, W. et al, 2021. Policy Lessons on Deep Decarbonization in large emerging economies, Brazil. 28 pages, Deep Decarbonization Pathways (DDP) Initiative – Centro Clima/COPPE/UFRJ and IDDRI. Paris.
- La Rovere, E. L.; Dubeux, C. B. S.; Wills, W. et al, 2023. A Decarbonization Strategy for a 2050 Net-zero Carbon Brazilian Economy: Enablers and Sectoral Mitigation Plans. DECARBOOST Project: Enabling conditions for investment in the transition to a low-carbon society in Latin-american countries. 269 pages. International Climate Initiative – IKI of the German Federal Government - Centro Clima/COPPE/UFRJ. Rio de Janeiro, February 2023.