



# Brazil Transition Factbook

September 2024

**Bloomberg  
Philanthropies**

**BloombergNEF**

# Introduction

The spotlight of the energy transition is on Brazil. As this year's G-20 President and the host of COP30 in 2025, Brazil is embracing a historic opportunity to lead the global transition to a low-carbon economy.

From renewable energy to clean fuels to nature, Brazil's excellent resources and capabilities mean that it plays a leading role on the global stage. This first Brazil Transition Factbook, produced by BNEF and commissioned by Bloomberg Philanthropies, aims to support policy, business and investment professionals by making key data and insights available on the country's energy transition and climate themes, trends and opportunities.








Abundant, affordable clean electricity and a booming renewables market underpin Brazil's energy mix, which is already the cleanest among members of the Group of 20. They could also pave the way to Brazil being the first G-20 member to reach net zero.

Brazil's clean electricity system makes the production of goods less carbon-intensive than in other major economies, opening opportunities for decarbonizing entire sectors. In addition, Brazil's natural capital is truly unique. With more than half of the Amazon rainforest and the planet's greatest concentration of biodiversity within its borders, Brazil has an outsized role to play in global carbon and environmental markets.

The country has laid out an ambitious climate agenda, the successful implementation of which could help reshape strategies for fighting climate change worldwide. It could also transform the Brazilian economy, creating new opportunities in growth industries that are already molding global markets.

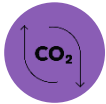
To make the most of these opportunities, Brazil will need to design, approve and implement effective policies and regulations – and address potential market barriers – in the near future. The next few years will be pivotal as the world looks to tackle climate change, and Brazil faces a unique opportunity to take a leading role in this fight.

# Content

	BloombergNEF's energy scenarios for Brazil	3
	Renewable energy	9
	Decarbonizing transport	21
	Decarbonizing industry	26
	Energy transition metals	34
	Sustainable finance	38
	Agriculture, land use and biodiversity	43
	Carbon markets	48



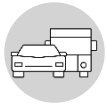
# BloombergNEF's energy scenarios for Brazil



**Energy  
scenarios**



**Renewable  
energy**



**Decarbonizing  
transport**



**Decarbonizing  
industry**



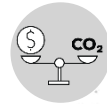
**Energy  
transition metals**



**Sustainable  
finance**



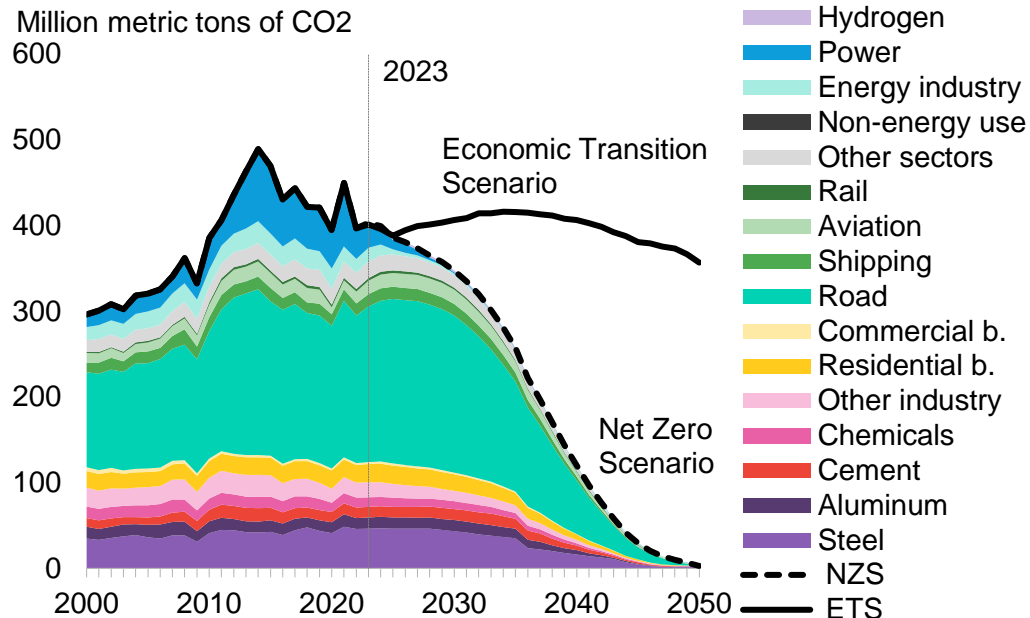
**Biodiversity**



**Carbon  
markets**

# Brazil's energy-related emissions need to drop steeply to reach net zero

## Brazil energy-related emissions and net-zero carbon budget



Brazil's energy-related emissions need to fall 14% by 2030 from the 2023 level and drop 70% by 2040 to be aligned with BloombergNEF's Net Zero Scenario (NZS). Globally, this transition path would reach zero emissions in 2050 and achieve the Paris Agreement objective, with temperature rise of 1.75C by 2050 without overshoot or the need for net-negative emissions post-2050.

In contrast, emissions in BNEF's Economic Transition Scenario (ETS) for Brazil continue to rise until the mid-2030s. Globally, this scenario results in emissions consistent with 2.6C warming trajectory by mid-century.

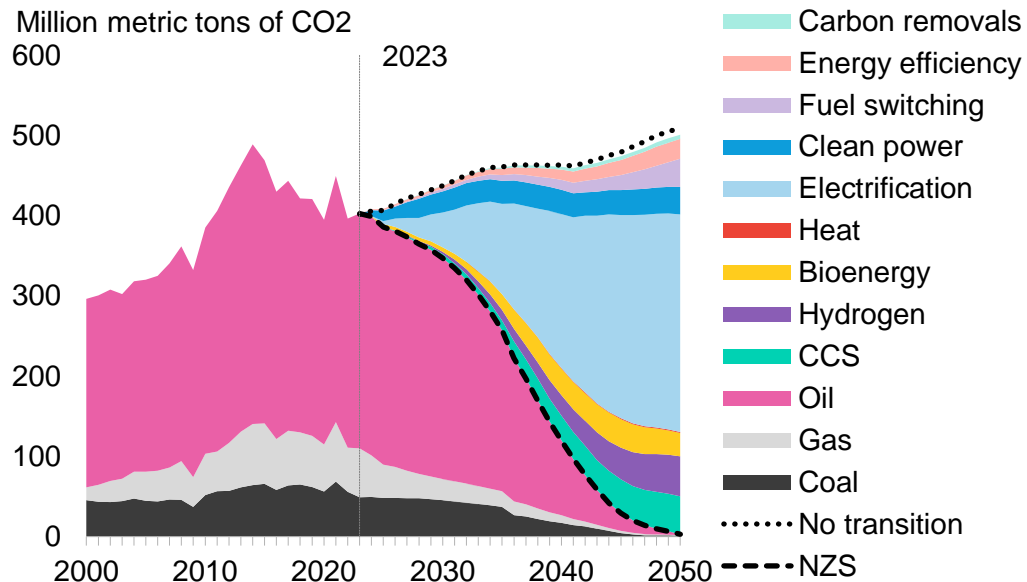


Scan the QR code for more details on BNEF's New Energy Outlook 2024

Source: BloombergNEF. Note: 'Commercial b.' and 'Residential b.' refer to buildings sector; 'non-energy use' is not-combusted fuel consumption consumed mostly in petrochemicals.

# Brazil requires multiple technology pathways to reach net zero

## Brazil CO2 emissions abatement from fuel combustion by type/technology



There is no silver bullet to decarbonize Brazil's energy-related emissions. However, one of the most important areas is the electrification of end-use sectors, including road transport, buildings and industry. Electrification alone accounts for 53% of emissions avoided between today and 2050, compared with a no-transition scenario where there is no further action on decarbonization.

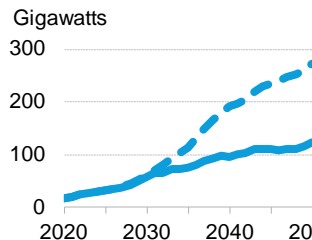
Carbon capture and storage (CCS), hydrogen and bioenergy together account for 25% of emissions reductions, while clean power represents only 7%. This picture is very different from most countries, where power accounts for about half of abatement.

Source: BloombergNEF. Note: The 'no transition' scenario is a hypothetical counterfactual that models no further improvement in decarbonization and energy efficiency. In power and transport, it assumes that the future fuel mix does not evolve from 2023 (2027 in shipping). For all other sectors, the counterfactual to the Net Zero Scenario (N/ZS) is the Economic Transition Scenario (ETS). 'Clean power' includes renewables and nuclear. 'Energy efficiency' includes demand-side efficiency gains and more recycling in industry. CCS refers to carbon capture and storage.

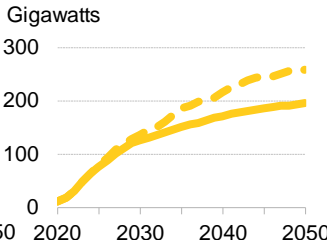
# Net Zero in Brazil requires both mature and new technologies to succeed

## Select technology drivers in BNEF's Brazil scenario modeling

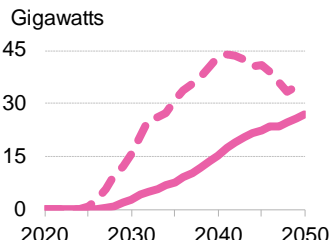
### Wind capacity



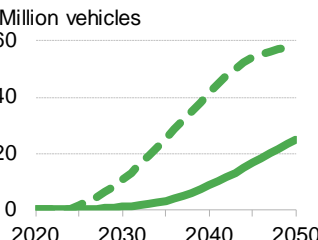
### Solar capacity



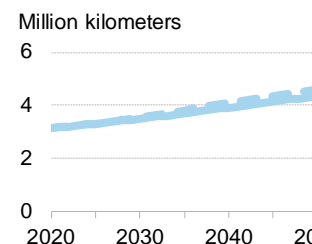
### Battery storage capacity



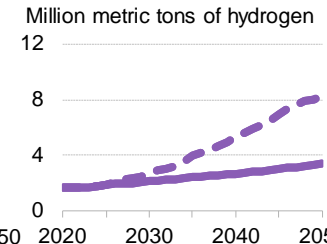
### Passenger EV fleet



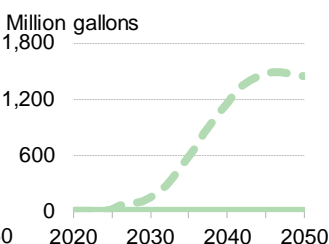
### Power grid length



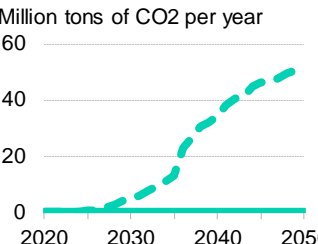
### Hydrogen demand



### SAF demand



### CCS capacity



— Economic Transition Scenario (ETS)    - - - Net Zero Scenario (NZS)

Renewable power, energy storage, grids and EVs are already mature and scalable technologies with proven business models. While significant growth is needed to get on track for net zero, we already see strong uptake in the ETS.

In contrast, hydrogen, sustainable aviation fuel (SAF), and CCS are not currently cost-competitive, resulting in little uptake in our base case. Each of these pillars must scale rapidly to achieve the trajectories laid out in the NZS.

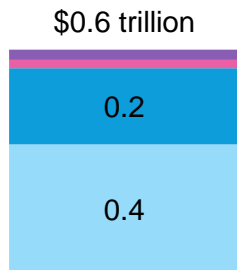
Source: BloombergNEF. Note: Wind includes offshore and onshore. Solar includes small-scale and utility-scale solar PV. Battery storage includes stationary storage. SAF is sustainable aviation fuels, while CCS is carbon capture and storage. The ETS shows the current project pipeline. Nuclear capacity and heat pumps were disregarded for their scale in Brazil.

# Brazil has a \$1.3 trillion opportunity in low-carbon energy supply investments

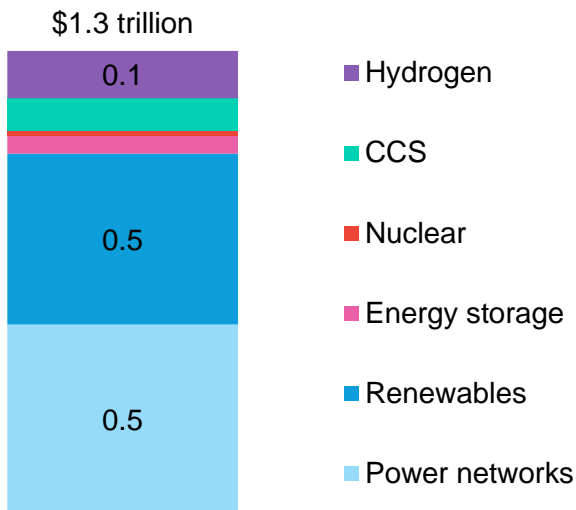
## Brazil low-carbon energy supply investment, 2024-2050

\$ trillion (real 2023)

### Economic Transition Scenario



### Net Zero Scenario



To keep on track for net zero, Brazil will need to scale its low-carbon energy supply investments to over \$1.3 trillion across 2024-2050 to accommodate growing electrification in transport, industry and buildings. In this scenario, the demand-side energy investment and spending reaches \$4.3 trillion, mainly led by the electrification of the passenger-vehicle fleet.

In both scenarios, power networks and renewable energy snatch the larger portions of the supply investment pie. Hydrogen and CCS are significantly higher in the Net Zero Scenario as both solutions mainly target hard-to-abate sectors.

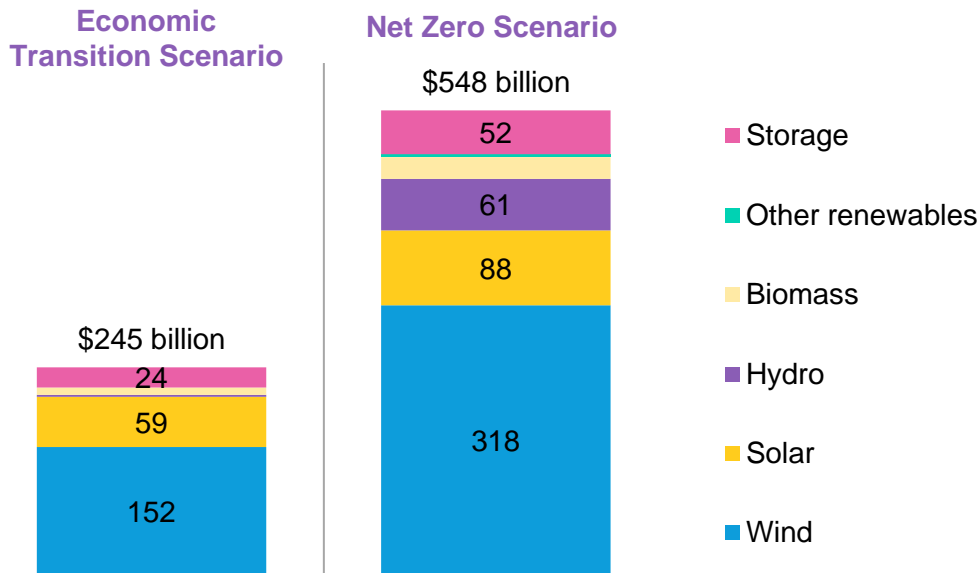
Source: BloombergNEF. Note: The numbers above the bars indicate cumulative investment and spending figures from 2024 to 2050. CCS refers to carbon capture and storage.



# Brazil's Net Zero Scenario sees half a trillion dollars flow into renewables

## Brazil renewable energy and storage investment, 2024-2050

\$ billion (real 2023)



Despite Brazil's already decarbonized power sector, increased electrification and economic growth continue to drive investment in clean power.

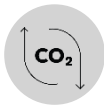
Under the Economic Transition Scenario, renewable investment reaches \$245 billion, with onshore wind accounting for over half of the total figure. The Net Zero Scenario sees twice this investment figure, reaching \$548 billion by 2050.

The massive adoption of wind and solar in the NZS also boosts storage investments, which reach \$52 billion.

Source: BloombergNEF. Note: The numbers above the bars indicate cumulative investment and spending figures from 2024 to 2050. Wind includes offshore and onshore. Solar includes small-scale and utility-scale solar PV.



# Renewable energy



Energy scenarios



**Renewable energy**



Decarbonizing transport



Decarbonizing industry



Energy transition metals



Sustainable finance



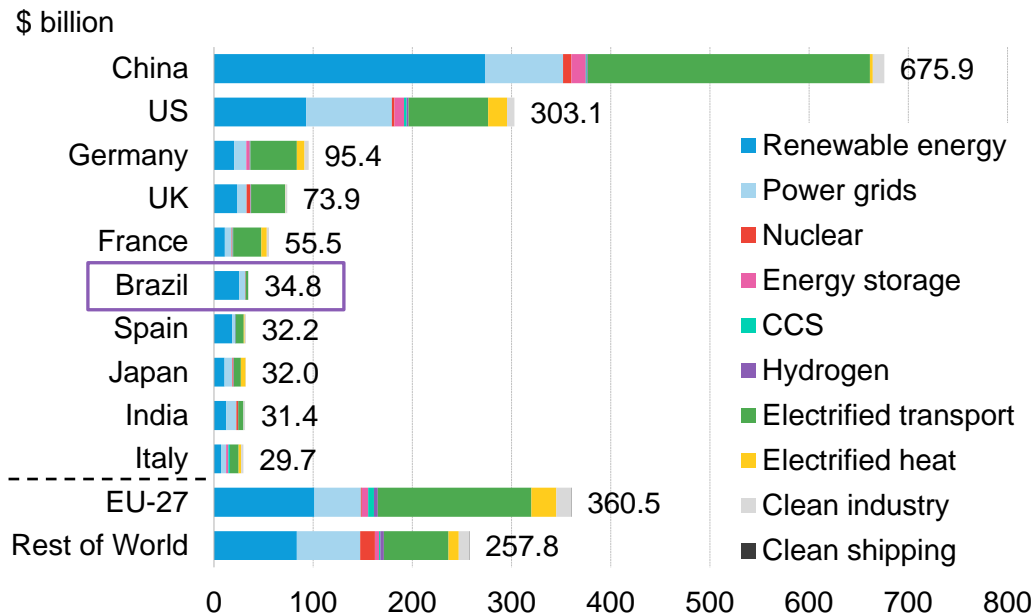
Biodiversity



Carbon markets

# Brazil is a top global destination for renewable energy investment

## Top 10 economies for energy transition investment, 2023



Brazil is consistently one of the world's largest markets for energy transition investment.

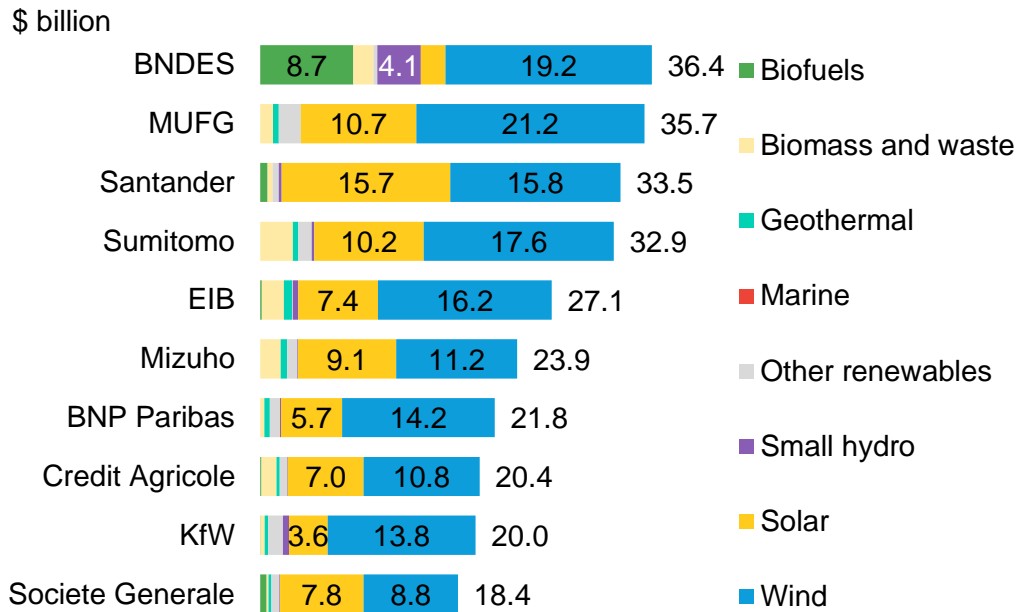
Brazil attracted nearly \$35 billion in energy-transition investment in 2023, the sixth-highest figure globally and the highest among emerging markets outside of China.

Currently, its investment mix is heavily dominated by renewable energy and power grids. Other sectors hold vast growth potential.

Source: BloombergNEF's Energy Transition Investment Trends 2024. Note: EU-27 bar also includes the EU member states shown. 'Rest of world' is global investment excluding the EU and individual economies in the chart. A small amount of estimated spend for EU countries may be included in 'rest of world'. CCS refers to carbon capture and storage.

# BNDES leads on renewable energy finance

## Top lead renewables finance arrangers globally from 2004 to 2023



Brazil's national development bank, BNDES, is the world's largest supporter of renewables projects. It arranged \$36.4 billion in investment over the last two decades, nurturing the country's renewables industry and pushing the market to the top of the league table.

BNDES and its peer Banco do Nordeste (BNB) have facilitated a lower cost of debt for energy projects through concessional finance and by assuming higher lending risks.

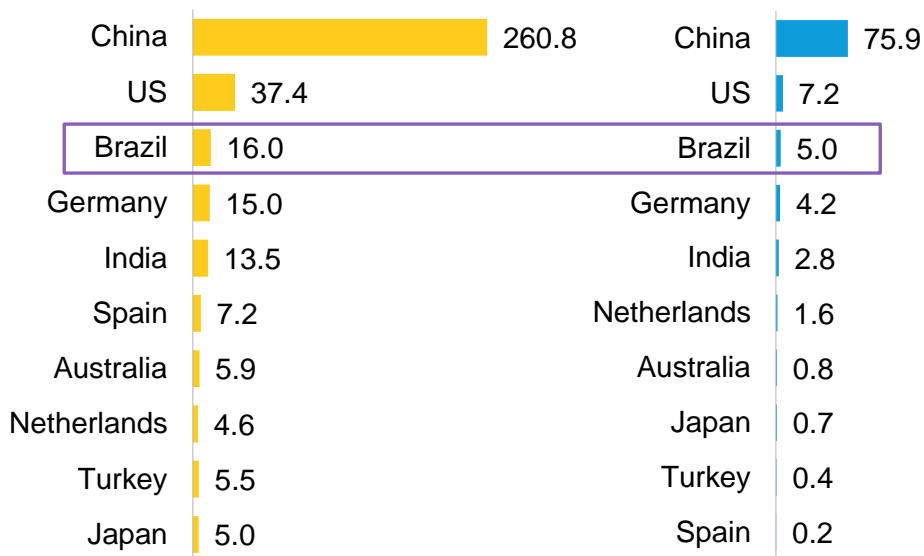
BNDES has also championed successful local content policy in specific areas, considered fundamental to the establishment of a domestic wind supply chain.

Source: BloombergNEF. Note: BNDES stands for Banco Nacional de Desenvolvimento Econômico e Social, MUFG stands for Mitsubishi UFJ Financial Group, EIB stands for European Investment Bank, and KfW stands for Kreditanstalt für Wiederaufbau. Note: 'Other renewables' include large-hydro (above 50 megawatts), storage and co-located technologies.

# Brazil ranks third in the world for new wind and solar

## Solar and wind capacity additions in 2023

Gigawatts



A banner year for renewables has vaulted Brazil into the top tier of clean energy markets worldwide. The Latin American powerhouse clinched third place in new capacity for both wind and solar.

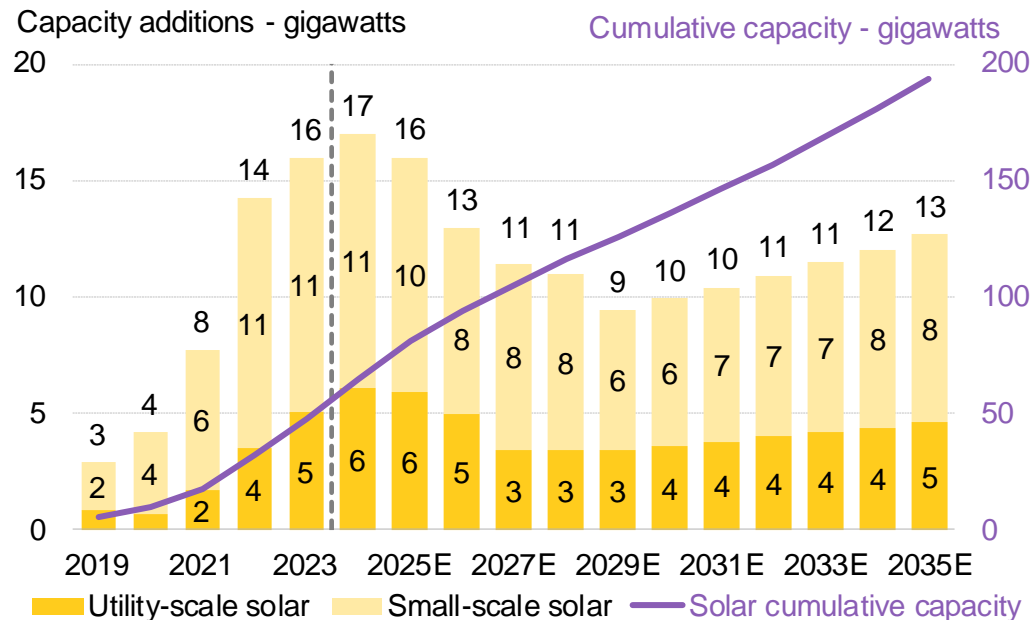
Brazil commissioned a record 5 gigawatts of onshore wind projects in 2023, an 87% increase from 2022.

The country also set a record for solar capacity additions, with 16.0 gigawatts (GW) coming online in 2023, a 12% increase from the prior year. The solar distributed generation segment accounted for about two thirds of the installations, backed up by the country generous net-metering policy.

Source: BloombergNEF. Note: Countries ranked by total wind and solar additions. Wind includes offshore and onshore. Solar includes small-scale and utility-scale solar PV. Solar capacity in direct current (DC).

# Brazil's solar boom is driven by the small-scale segment

## Solar capacity forecast for Brazil



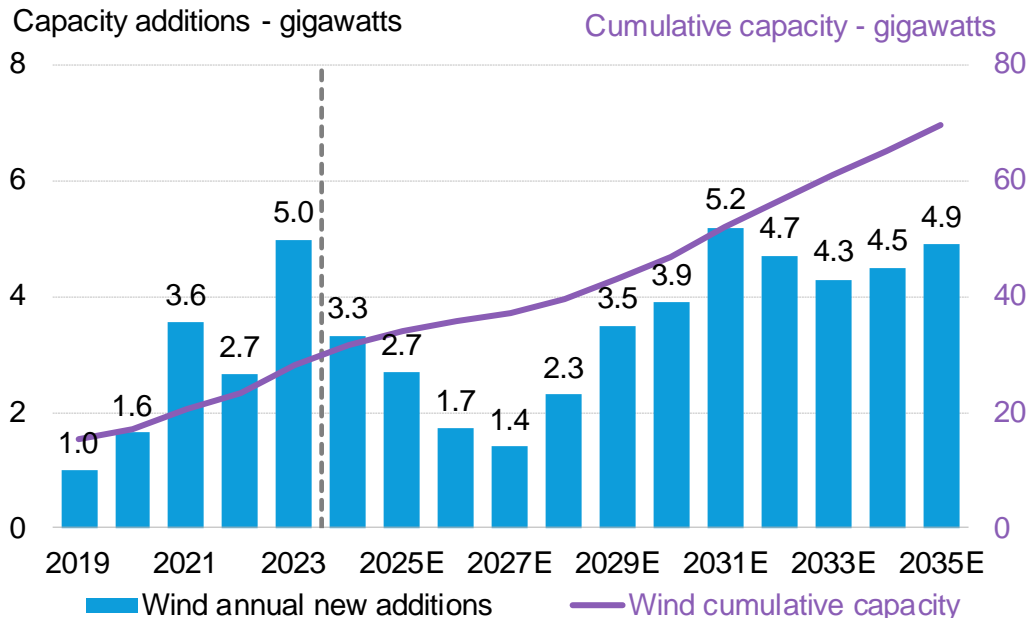
Brazil installed some 16 gigawatts of solar last year, roughly doubling its 2021 capacity additions. The booming small-scale segment (sub-5 megawatt) is eligible for net-metering, allowing generators – both households and commercial consumers – to claim credit for power generated. Relatively high retail power prices make the net-metering incentives even more compelling, and enabled Brazil's small-scale solar sector to take in investment of more than \$17 billion in 2023.

BNEF expects solar to overtake hydro as the largest source of power by the end of the decade. However, the country's small-scale solar is facing development hurdles, such as rising transmission tariffs introduced by a 2022 reform to net-metering legislation, difficulties in getting permits from energy distributors, competition with the wholesale market and import taxes on modules.

Source: BloombergNEF, Agência Nacional de Energia Elétrica (Aneel). Note: Capacity in direct current (DC). Volumes from 2024 on are estimates.

# Brazil's wind market will slow in the short term before picking up again later

## Onshore wind capacity forecast for Brazil



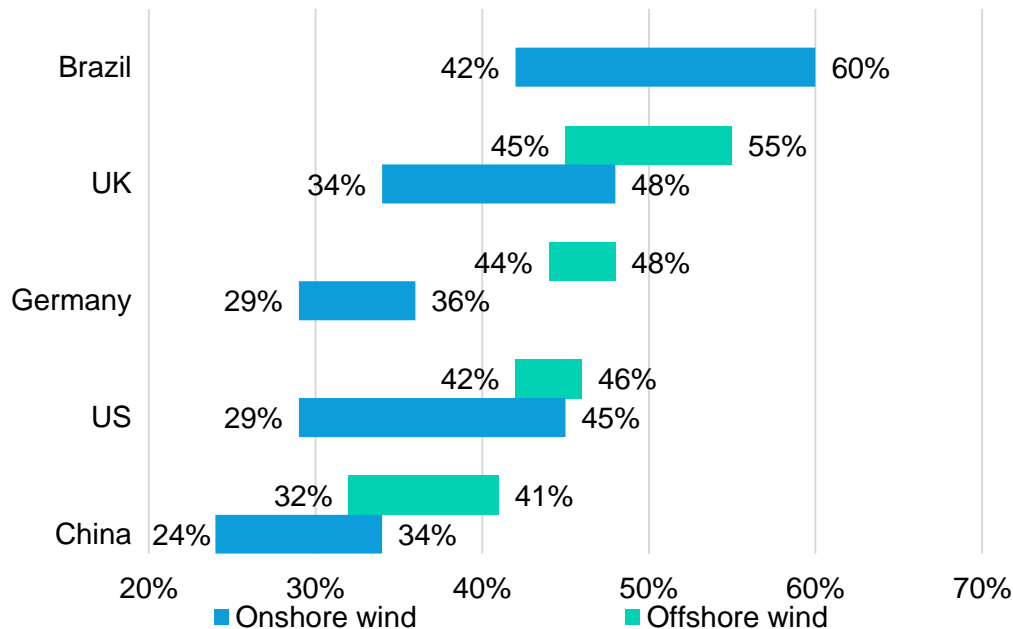
The wind industry in Brazil is facing hurdles. An oversupply of energy across the country's vast hydroelectric fleet, booming cheap solar installations and transmission bottlenecks have decreased demand for new power purchase agreements (PPAs) for wind and limited new permitting and financing activity. BNEF expects annual wind additions to drop from 5GW in 2023 to under 2GW in 2026 and 2027.

Companies in Brazil's wind supply chain are therefore facing a contracting local market and turbine manufacturers have also been impacted by the market cooldown. However, additions are poised to climb again from 2028, tied to the country's increased electrification and demand growth.

Source: BloombergNEF, Agência Nacional de Energia Elétrica (Aneel). Note: Volumes from 2024 on are estimates.

# Brazil has the best wind resources in the world

## Wind capacity factor range in 2023



Brazil boasts a world-class wind resource, with the highest average capacity factors globally. Generation from an average onshore wind turbine in Brazil is even greater than offshore generation in many markets.

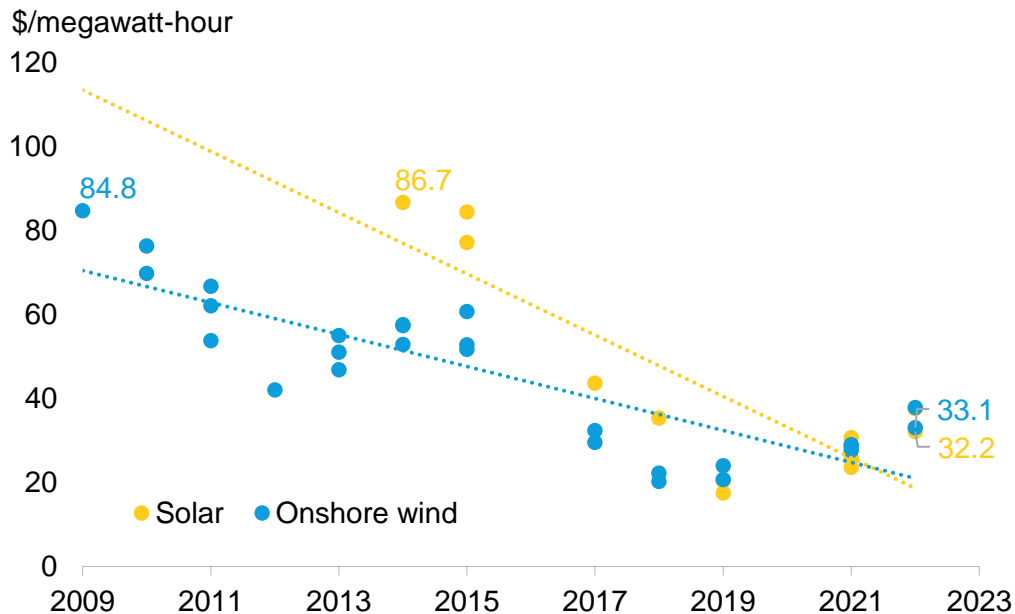
This yields one of the lowest levelized costs of electricity (LCOEs) in the world. Cheap, clean and abundant electricity underpins Brazil's leadership in global decarbonization.

Source: BloombergNEF. Note: Based on the mid scenario from BNEF's 2H 2023 Levelized Cost of Electricity Data Viewer Tool.



# Renewable auctions are a Brazilian success story

## Wind and solar contracted prices in Brazil's auctions

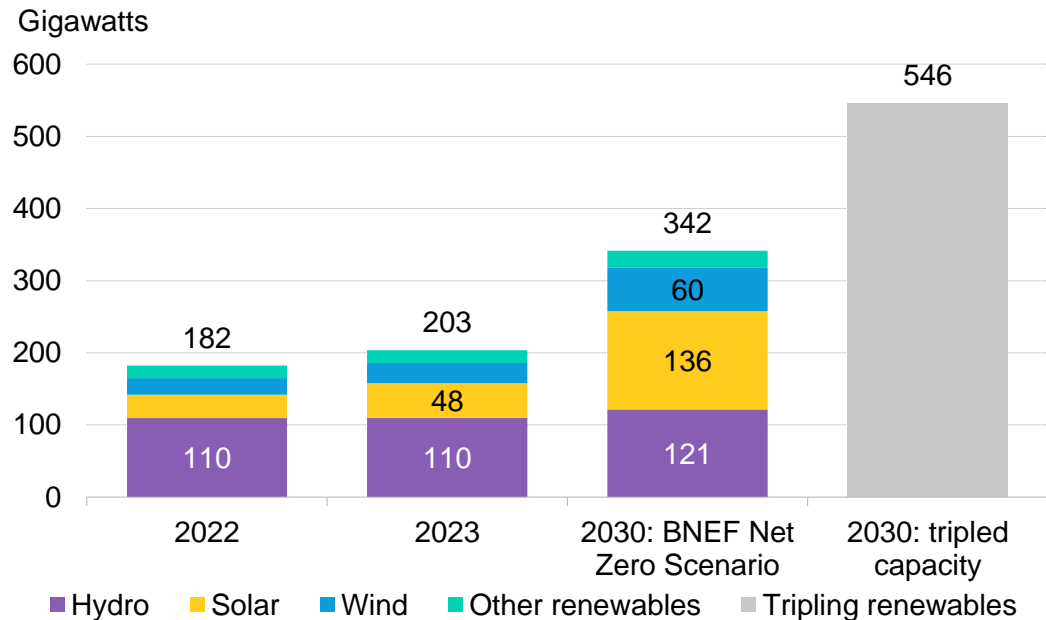


Brazil has pioneered competitive auctions for utility-scale projects, which led to over 39GW contracted since 2009. This success is driven by a combination of long-term contracts (from 15 to 20 years), competitive prices and priority grid access. The first dedicated onshore wind auction in Brazil, back in 2009, awarded contracts at a price of \$84.8 per megawatt-hour (MWh). At the time, the technology was not competitive with conventional sources, and the higher price was crucial for investors to hit their required returns. Fast-forward almost 15 years, and the latest renewable auction in Brazil for the technology closed at \$33.1/MWh in 2022. The trend for solar was similar: prices declined from \$86.7/MWh in 2014 to \$32.2/MWh in 2022. In the last auction, solar prices were even lower than those for wind projects.

Source: BloombergNEF, Agência Nacional de Energia Elétrica (Aneel). Note: Trendlines are a linear regression of auction prices for each technology.

# Brazil needs to double (not triple) renewables by 2030

## Brazil renewables capacity, versus 2030 BNEF Net Zero Scenario



In December 2023, the United Nations Climate Change Conference (COP28) closed with an agreement between negotiators from nearly 200 Parties to take actions towards achieving, at a global scale, a tripling of renewables capacity.

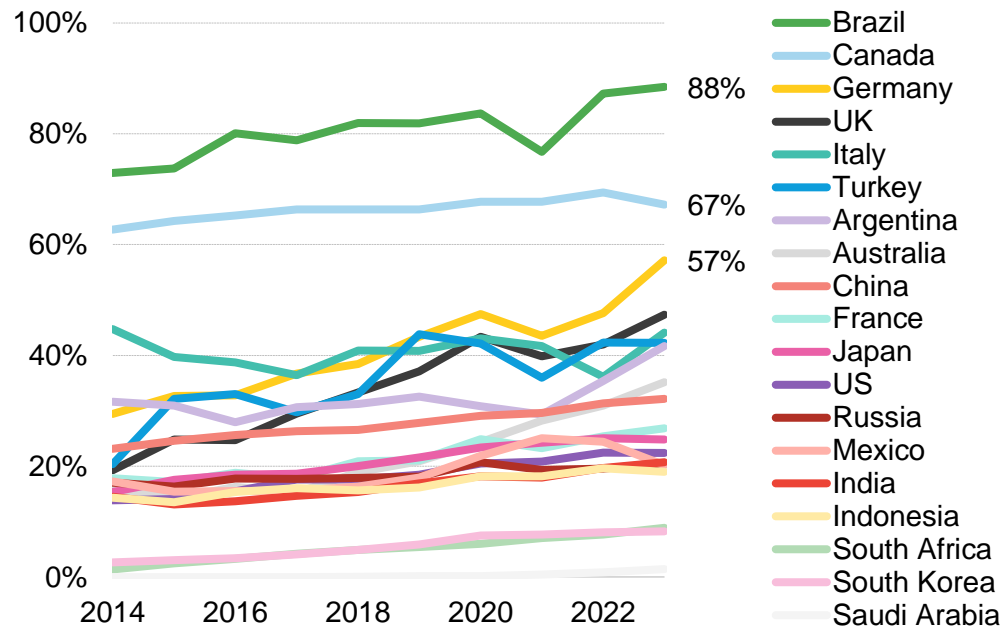
Yet under BNEF's Net Zero Scenario, Brazil only needs to double, not triple, its 2022 renewable capacity by the end of the decade to get on track for net zero. The country's vast hydro generation resources and growing fleet of wind and solar plants led it to secure almost 90% of its electricity from renewable energy technologies in 2023.

Brazil was the world's third-largest market for both wind and solar additions in 2023. This took the country's cumulative renewable energy capacity to 203GW, keeping growth on track for net-zero emissions by 2050 under BNEF's Net Zero Scenario.

Source: BloombergNEF

# Brazil has the cleanest electricity mix among the G-20 members

## Share of renewable energy generation in G-20 countries



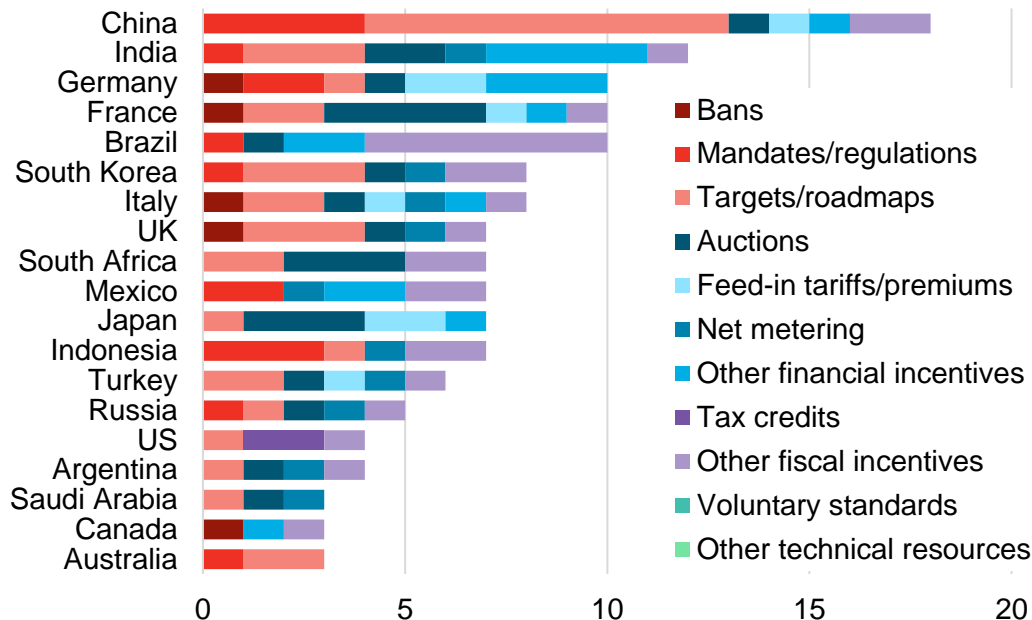
Brazil leads the G-20 members on renewable power generation by a wide margin. This was even the case in 2021, when droughts drove down the country's hydroelectricity production. In total, 88% of Brazil's generation now comes from renewable sources.

Brazil's power sector, long dominated by hydroelectric power plants, has evolved rapidly in recent years, with huge amounts of wind and solar added annually. Including decentralized generation – specifically small-scale and rooftop solar – the country's total installed capacity is now 21% solar and 12% wind, which has boosted the country clean power mix.

Source: BloombergNEF. Note: Renewable energy here includes large-hydro.

# Brazil is well positioned among G-20 members in clean power policies

## Number of in-force G-20 clean power incentives



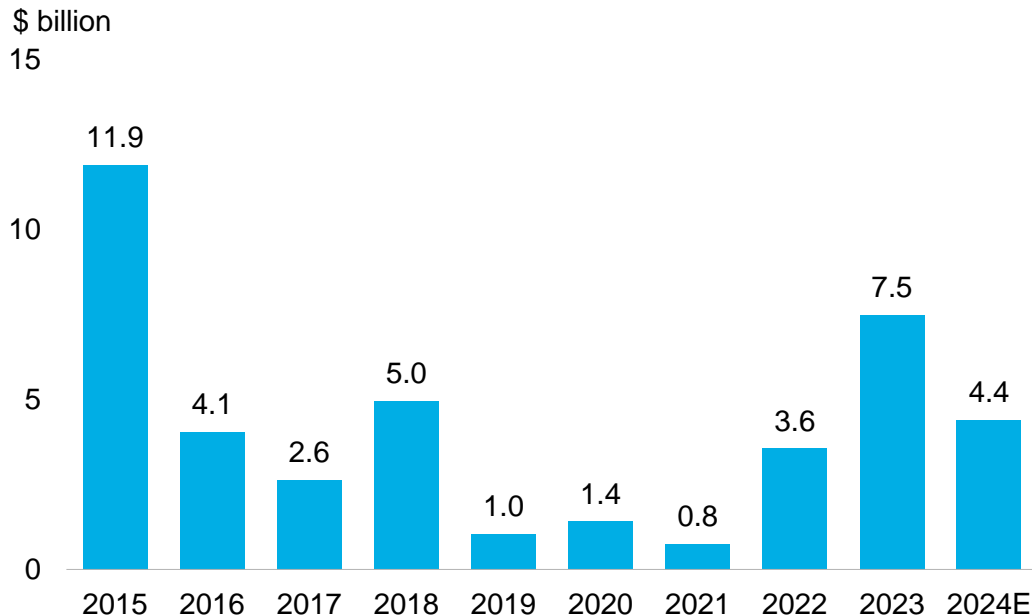
Almost three-quarters of the G-20 members have at least one renewables auction program. This makes such programs the second-most-common type of clean power policy, after renewables targets.

In addition to auctions, mandates and net metering, Brazil offers many fiscal incentives for both demand and supply of clean energy. These incentives are for manufacturers of renewables components, generators and consumers.

Source: BloombergNEF, Nature4Climate. Note: Figure includes EU and national policies, excluding carbon pricing, as of December 2023.

# Brazil's grid investment underpins the renewable energy revolution

## Brazil's planned distribution and transmission grid investment



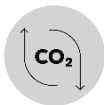
Brazil's transmission auctions have driven \$43 billion in investments over the last 10 years. This has helped reduce bottlenecks and enabled wind and solar generation to flow from where it is produced, largely in the northeast, to where it can be used in industrial areas in the southeast of the country.

Brazil's expansive, interconnected national grid – and its diligent grid planning – is an important part of the country's renewable energy success story. However, it is important that investments continue, to avoid increasing curtailments in generation and to cope with the intermittency of wind and solar.

Source: BloombergNEF. Note: 2024 figures are expected values.



# Decarbonizing transport



Energy scenarios



Renewable energy



**Decarbonizing transport**



Decarbonizing industry



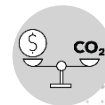
Energy transition metals



Sustainable finance



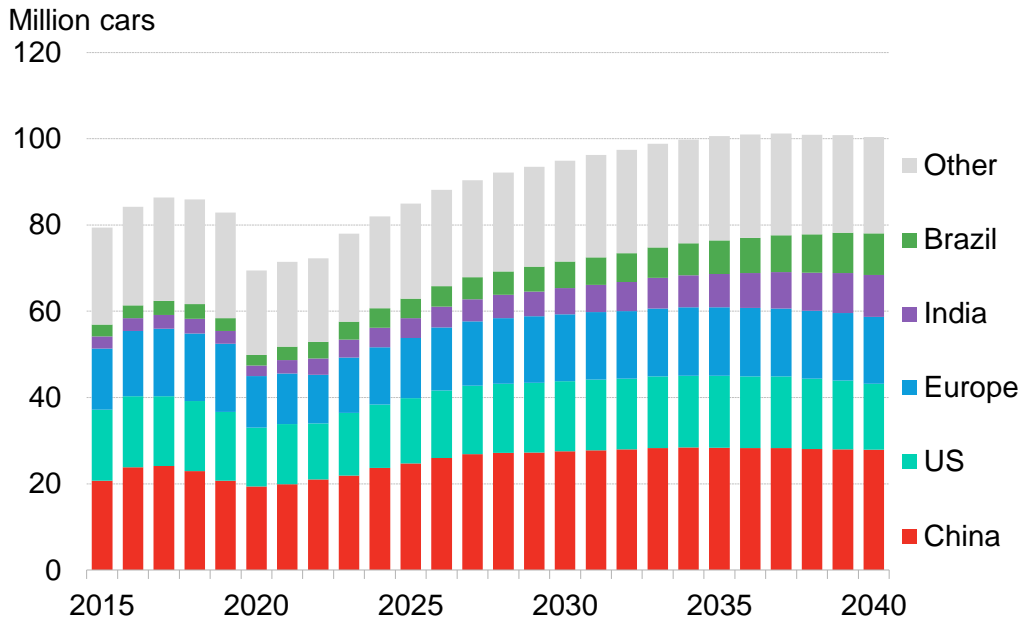
Biodiversity



Carbon markets

# Brazil is one of the world's largest passenger-vehicle markets

## Global annual passenger-vehicle sales outlook in the Economic Transition Scenario



Global passenger-vehicle sales have endured several tumultuous years marked by the Covid-19 pandemic, a semiconductor supply shortage, wars in Europe and the Middle East and a high inflation environment. Yet sales figures are recovering. In 2023, as many as 78 million passenger vehicles were sold globally, up from 75 million in 2022.

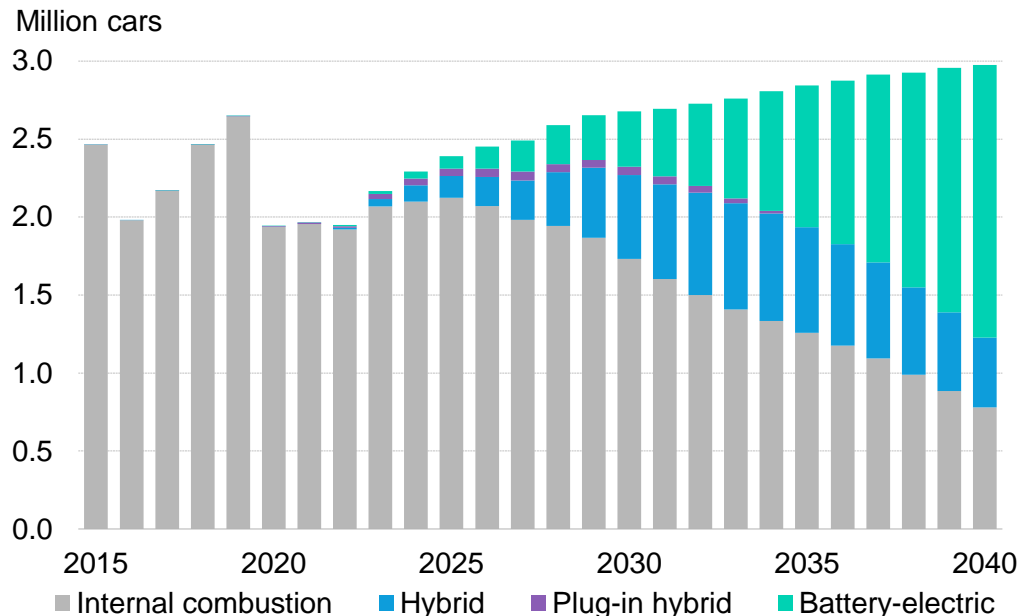
In BNEF's *2024 Long-Term Electric Vehicle Outlook*, the passenger-vehicle market continues to grow this year, but ultimately still falls short of pre-pandemic levels. Passenger-vehicle sales reach a new all-time high in 2026. Annual sales grow to a peak of just over 101 million in 2037, before declining.

Brazil's share of global passenger-vehicle sales reaches roughly 10% in 2040, nearly doubling its 2023 market-share.

Source: BNEF's 2024 Long-Term Electric Vehicle Outlook. Note: 'Other' includes Japan, South Korea, Australia, Southeast Asia, Canada and 'rest of world'. BNEF's Economic Transition Scenario models a transition led by market-forces, and assuming no policy changes.

# EVs are set to grow, but biofuels play an important transition role

## Brazil passenger-vehicle sales in the Economic Transition Scenario



Brazil has a strong automotive industry producing most of its passenger vehicles domestically. Automakers including BYD, Great Wall Motor and Stellantis aim to kick off EV production in Brazil starting this year, but with 2025 being more likely. Local EV manufacturing will be crucial in keeping the momentum going by bringing upfront price parity in Brazil sooner.

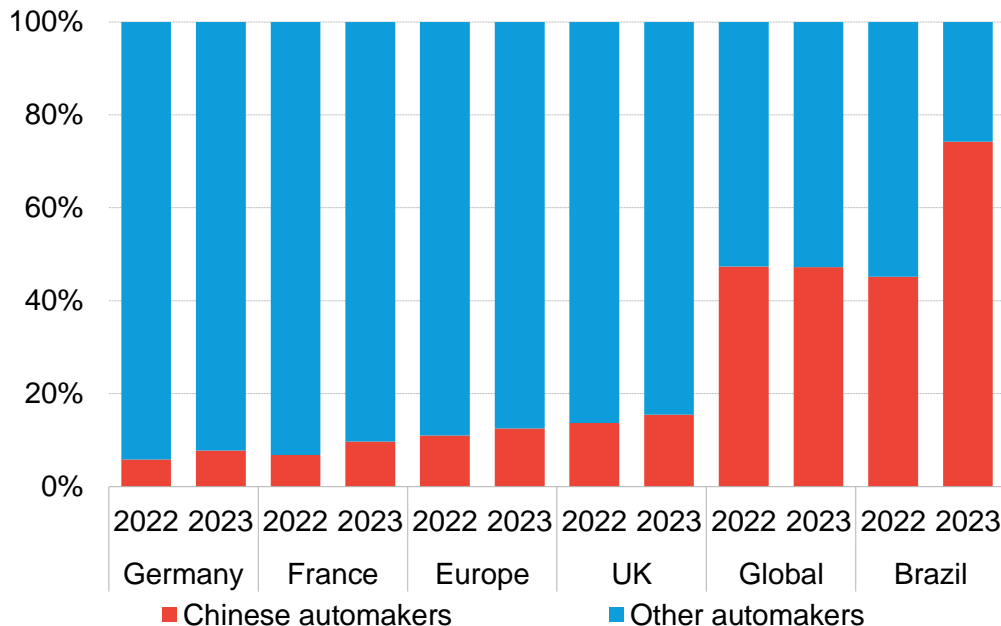
However, Brazil is the second-biggest producer of ethanol globally. It has high blending mandates for gasoline, and most passenger vehicles are 'flex fuel', meaning they can run on gasoline and very high blends of ethanol. As such, there is still a debate among the industry and the government over whether space should now be made for transport electrification.

Source: BNEF's 2024 Long-Term Electric Vehicle Outlook. Note: BNEF's Economic Transition Scenario models a transition led by market-forces, and assuming no policy changes.



# Chinese automakers dominate Brazil's EV market

## Automakers' share of total passenger EV sales



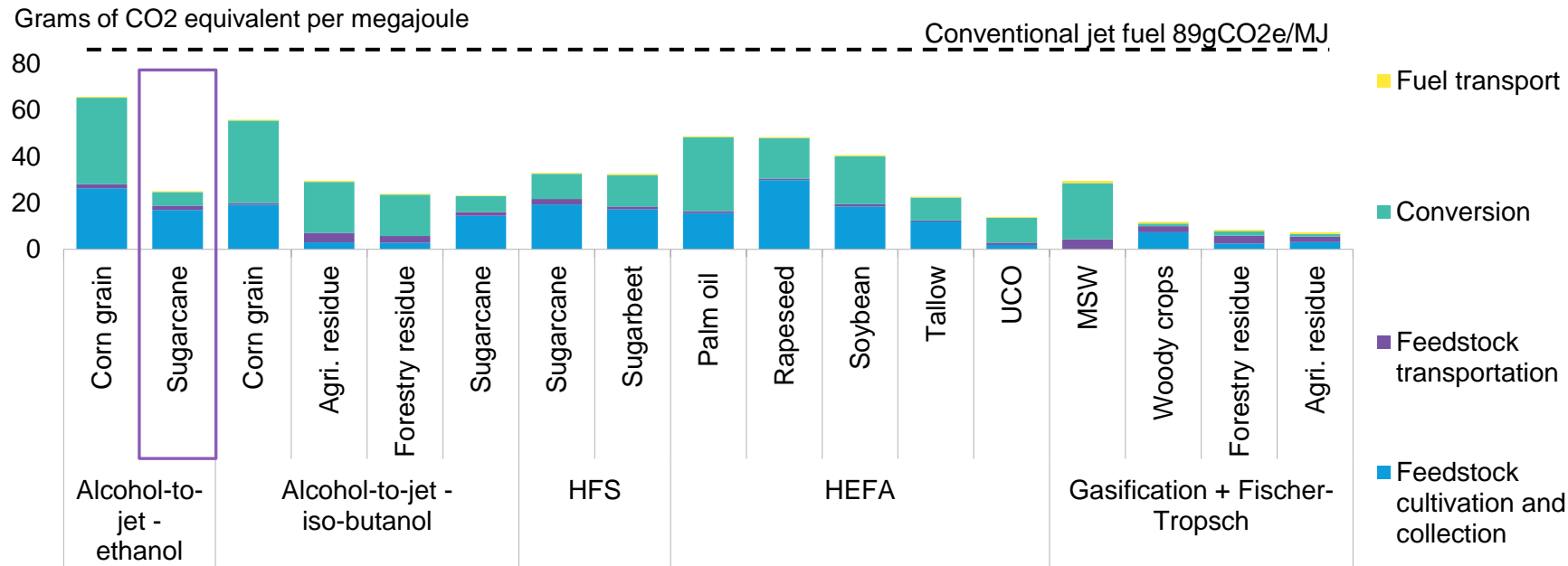
While China accounted for over 59% of global passenger EV sales in 2023, Chinese automakers provided 47% of all electric cars sold globally. This remained unchanged from 2022, but the importance of Chinese automakers grew significantly in a number of emerging EV markets.

Brazil's passenger EV sales nearly tripled in 2023. China-based automakers accounted for 76% of all EVs sold in Brazil – in large part due to the rapidly growing sales from BYD.

Source: BNEF's 2024 Long-Term Electric Vehicle Outlook.

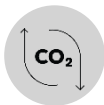
# Brazil's sugarcane ethanol is a clean choice for sustainable aviation fuels

## Lifecycle emissions of different feedstock and technologies



Source: BloombergNEF, ICAO. Based on Corsia Life Cycle Assessments (LCA). Note: UCO refers to used cooking oil, MSW is municipal solid waste, HFS is hydroprocessed fermented sugars, and HEFA is hydroprocessed esters and fatty acids. Values are averages and range by specific material and region.

# Decarbonizing industry



Energy scenarios



Renewable energy



Decarbonizing transport



**Decarbonizing industry**



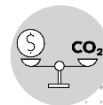
Energy transition metals



Sustainable finance



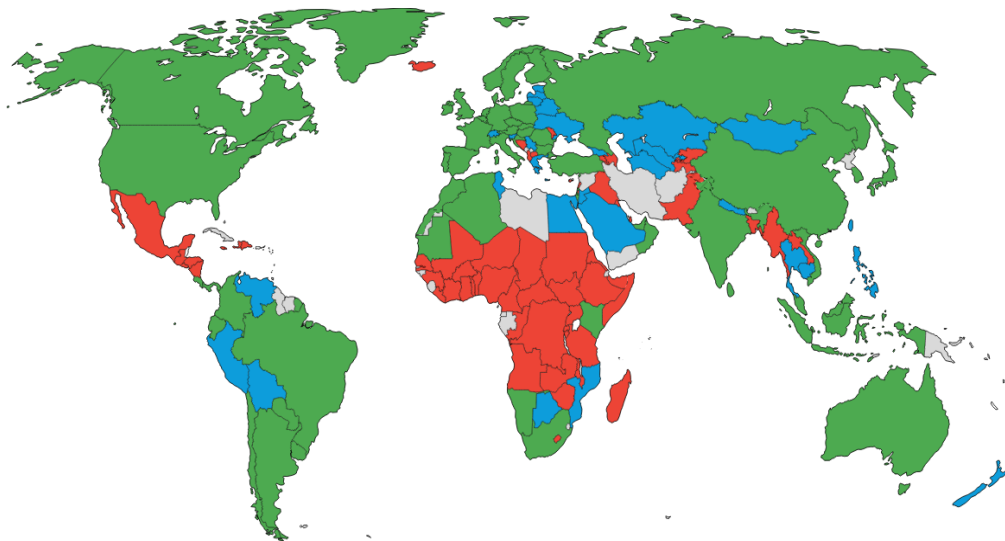
Biodiversity



Carbon markets

# Brazil has approved a much-anticipated clean hydrogen strategy

## Hydrogen strategies



■ Not assessed (30) ■ No activity (58) ■ In preparation (30) ■ Published (53)

Brazil has finally passed its eagerly anticipated clean hydrogen law. The legislation takes a technology-neutral approach to determining which projects qualify and imposes only a lenient carbon-intensity threshold.

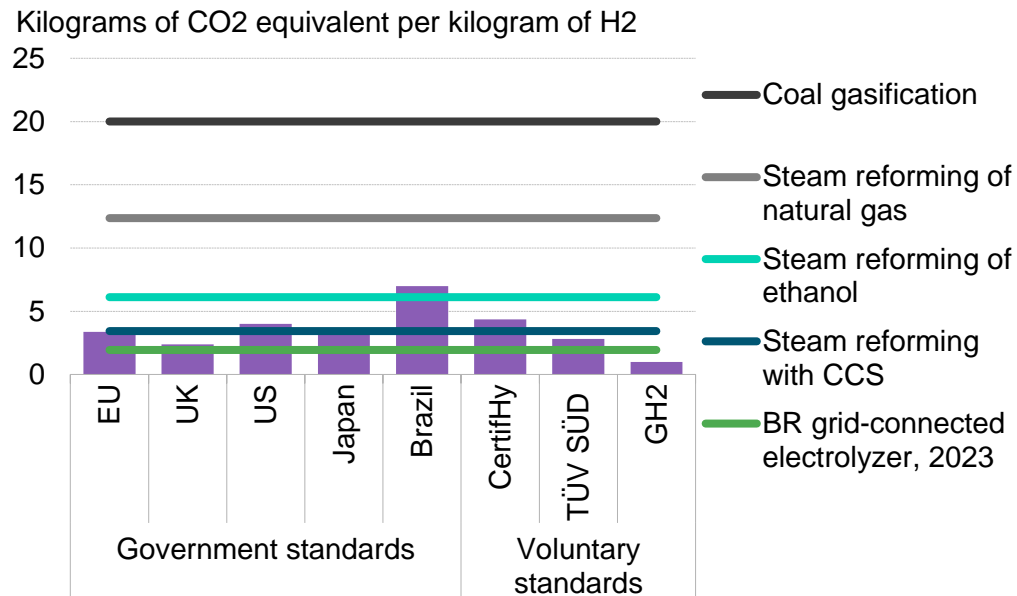
Releasing a strategy signals a market's commitment to hydrogen. Brazil now joins the group of some 54 markets that have a hydrogen strategy.

However, the legislation is only the first step to becoming a clean hydrogen producer. The business case for the technology still needs to be proven in Brazil.

Source: BloombergNEF. Note: Mapped data shows distinct economies with strategies as of March 2023. Brazil was considered published due its August 2024 legislation release.

# Clean hydrogen in Brazil can be produced with biofuels, but with higher emissions

## Standard H2 emissions threshold against emissions from H2 production pathways



Brazil legislation defines ‘low-carbon’ hydrogen as having a maximum carbon intensity limit of 7 kilograms of CO2 equivalent per kilogram of hydrogen (kg-CO2e/kg-H2), which is higher than other government standards.

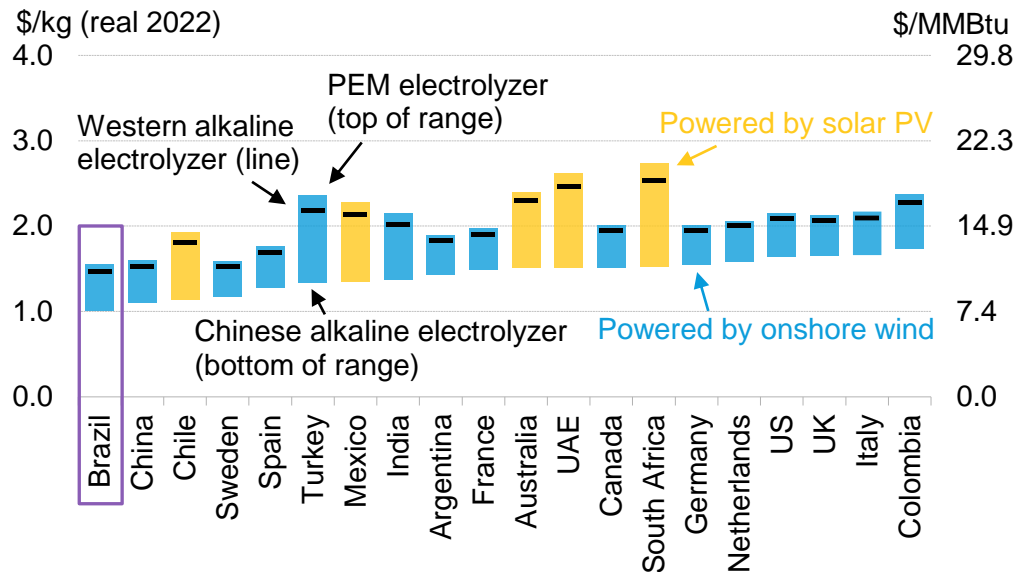
The increased emissions limit was likely intended to allow projects using biofuels – including ethanol, biomethane and biomass – to be able to benefit from incentives, as these projects have a higher carbon intensity.

On the other hand, grid-connected projects in Brazil could have a carbon intensity below 2kg-CO2e/kg-H2.

Source: BloombergNEF, Ember. Note: CertifHy is a voluntary scheme in the European Union for hydrogen certification. TÜV SÜD is set by a German technical certification company. GH2 is a voluntary standard by the Green Hydrogen Organization. Steam reforming with carbon capture and storage (CCS) assumes a 95% capture rate and renewable electricity use. Electrolyzer conversion rate of 53 kilowatt-hours per kilogram of hydrogen. ‘BR grid-connected electrolyzer’ refers to a grid-connected electrolyzer in Brazil.

# Brazil could produce the lowest-cost green hydrogen globally

## LCOH<sub>2</sub> from cheapest available renewable power in 20 markets, 2030



BNEF estimates that Brazil could achieve a levelized cost of hydrogen (LCOH<sub>2</sub>) of \$1.47 per kilogram by 2030 by using onshore wind and western alkaline electrolyzers. That's the lowest levelized cost of any modeled market. However, higher electrolyzer costs observed recently could push to a global LCOH<sub>2</sub> increase.

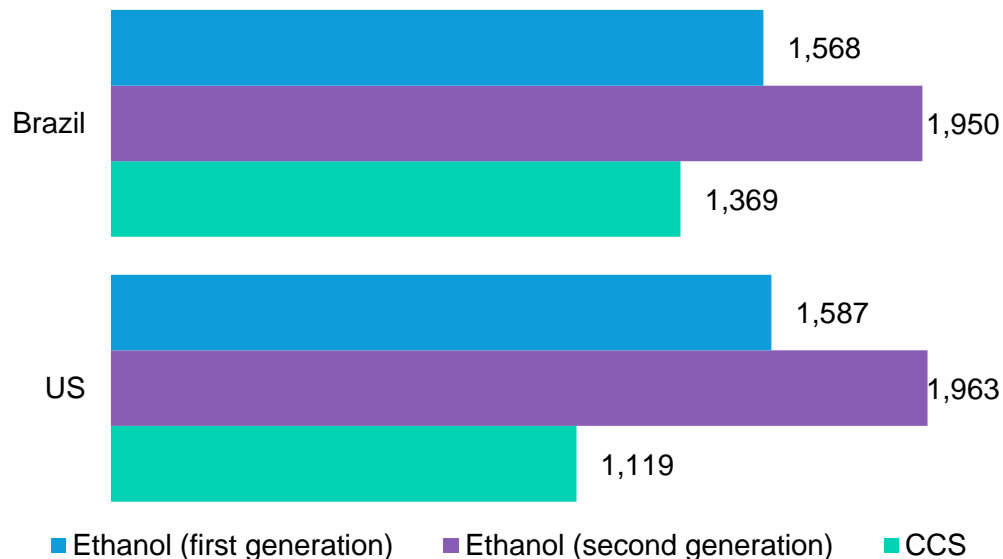
The country's excellent wind resources suggest it has a shot at being the world's lowest-cost producer, at least on an un-subsidized basis. The export opportunity could be vast. But uncertain international demand, infrastructure gaps and subsidized competition all suggest a long road ahead.

Source: BloombergNEF. Note: Based on project financing year. LCOH<sub>2</sub> is levelized cost of hydrogen. Values at the bottom of the range show cheapest hydrogen using a Chinese alkaline electrolyzer, values at the top show cheapest values using a proton exchange membrane (PEM) electrolyzer, and black lines show cheapest values using a western alkaline electrolyzer. Electricity source is either solar or wind, whichever is cheaper. Electricity costs derived from the mid-scenario in BNEF's 2H 2023 LCOE Update: An Uneven Recovery. MMBtu is million British thermal units, kg is kilogram.

# Brazil is well positioned to produce green plastics from ethanol

## Levelized cost of high-value chemicals by decarbonization technology

\$/metric ton HVC



The production of plant-based plastics struggles in markets like the US but thrives in Brazil, where it is a competitive option on the path to net-zero emissions.

There are few near-term options for producing green plastics. The most established production route uses ethanol from sugarcane.

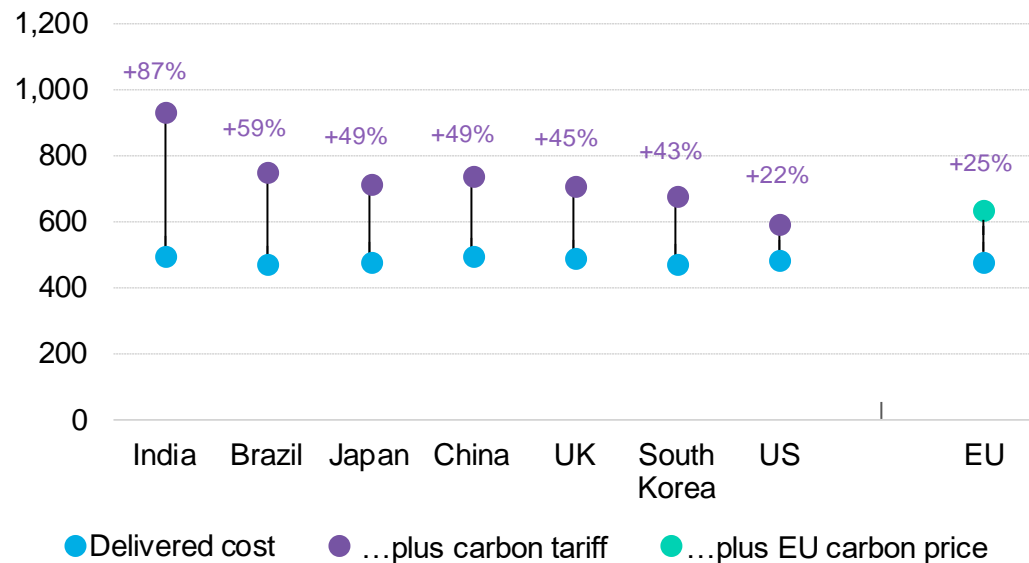
All net-zero petrochemicals come with a green premium, but high-value chemicals (HVCs) made with first- and second-generation ethanol can be a better option than CCS for Brazil, where the price gap is smaller thanks to the competitiveness and value chain of its biofuel industry.

Source: BloombergNEF's. Note: First-generation feedstocks are corn- and sugar-based, second-generation are biogenic waste products. Costs are for a naphtha cracker with carbon capture and storage (CCS) in 2030, in real 2023 dollars. HVC is high-value chemical.

# Carbon tariffs redraw the competitive map for Brazil industry

## Carbon tariff on EU steel imports by country of origin in 2034

\$ per metric ton of steel (real 2023)



The EU carbon border adjustment mechanism (CBAM) will start imposing a CO<sub>2</sub> price on imports in 2026. The impact will be dramatic as the policy is phased in. By 2034, the carbon tariff on Brazilian steel could total 59% of pre-CBAM delivered costs to Europe.

Carbon tariffs will redraw the competitive map, and exporters with cleaner production could reap big dividends. The gap between the highest and lowest cost of delivered steel by country of origin increases by a factor of 12 post-CBAM in 2034.

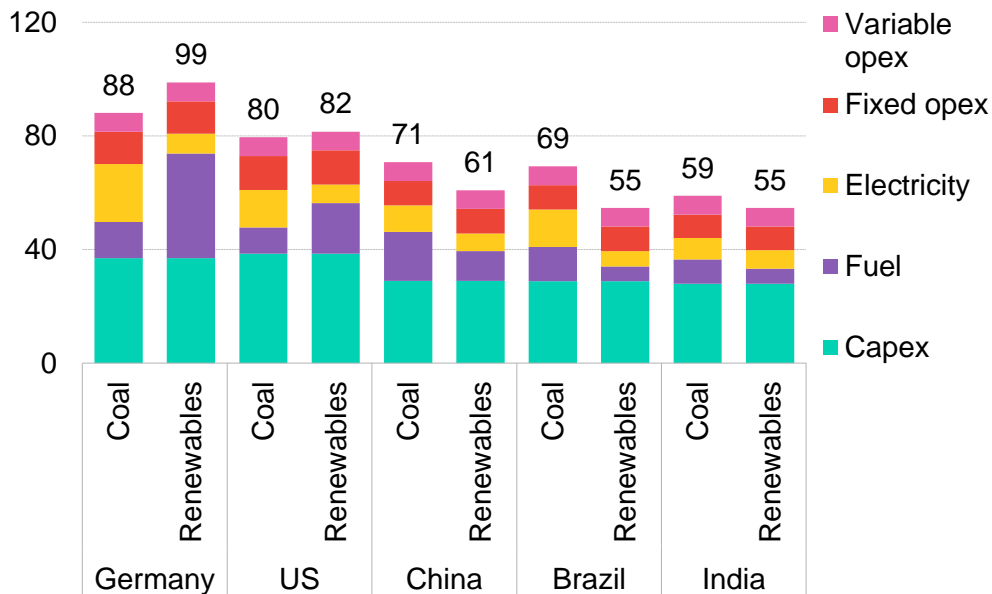
Source: BloombergNEF. Note: Emissions and production costs estimated for basic oxygen furnace crude steel for 2022 and 2030 respectively. Does not deduct carbon costs paid in countries of origin. EU applies zero transport costs to German production cost estimates.



# Carbon capture for cement production could be cheaper in Brazil

## Levelized cost of carbon capture in cement, 2030

\$ per metric ton of CO<sub>2</sub>



In the long term, Brazil needs to think more about carbon capture and storage (CCS). If it manages to build a CO<sub>2</sub> transport and storage infrastructure, it can achieve one of the lowest costs of carbon capture in cement globally by 2030.

A plant's location has an impact on the cost of capture. Cheaper labor costs can substantially reduce the CCS system's capex and fixed costs. Differences in fuel and electricity cost have an equally important impact.

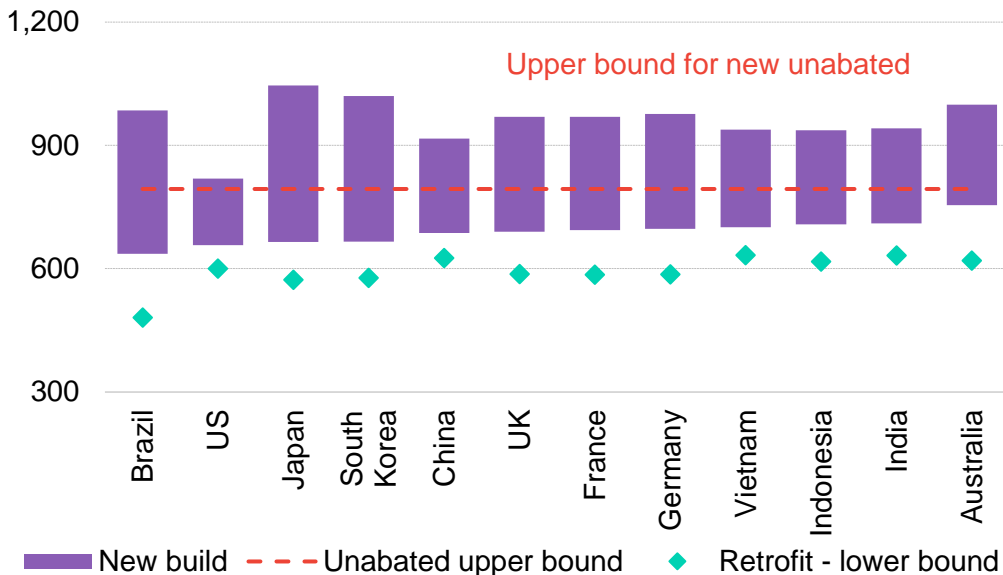
The biggest regional gap is seen using renewable energy and biomass. BNEF's model finds that CCS for cement can be 25-33% cheaper in Brazil, China or India than in the US. With coal the breakdown is similar, with Brazil, China and India becoming 11-26% cheaper and Germany 11% more expensive.

Source: BloombergNEF. Note: Variable opex is equal to \$6.6 per metric ton CO<sub>2</sub> for every market.

# Biomass creates an opportunity for a clean steel industry in Brazil

## Levelized cost of low-emissions steel, 2030

\$ per metric ton of crude steel



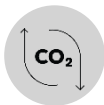
BNEF projects Brazil could have the cheapest net-zero-emissions steel globally come 2030, thanks to abundant availability of biomass and very low electricity prices. Retrofit blast furnaces (BFs) adapted to use biomass and net-zero-emissions recycling are the technologies for producing green steel with the lowest costs in the country and worldwide.

For new-build capacity, a BF using biomass as heat and reducing agent in Brazil is the cheapest option, followed by net-zero-emissions recycling in Japan and DR furnaces with CCS in the US. By 2030, net-zero-emissions steel in most regions can compete with the most expensive new-build options.

Source: BloombergNEF's SteelVal model. Note: Chart range does not include molten oxide electrolysis. Costs are shown in real 2023 US dollars.



# Energy transition metals



Energy scenarios



Renewable energy



Decarbonizing transport



Decarbonizing industry



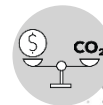
**Energy transition metals**



Sustainable finance



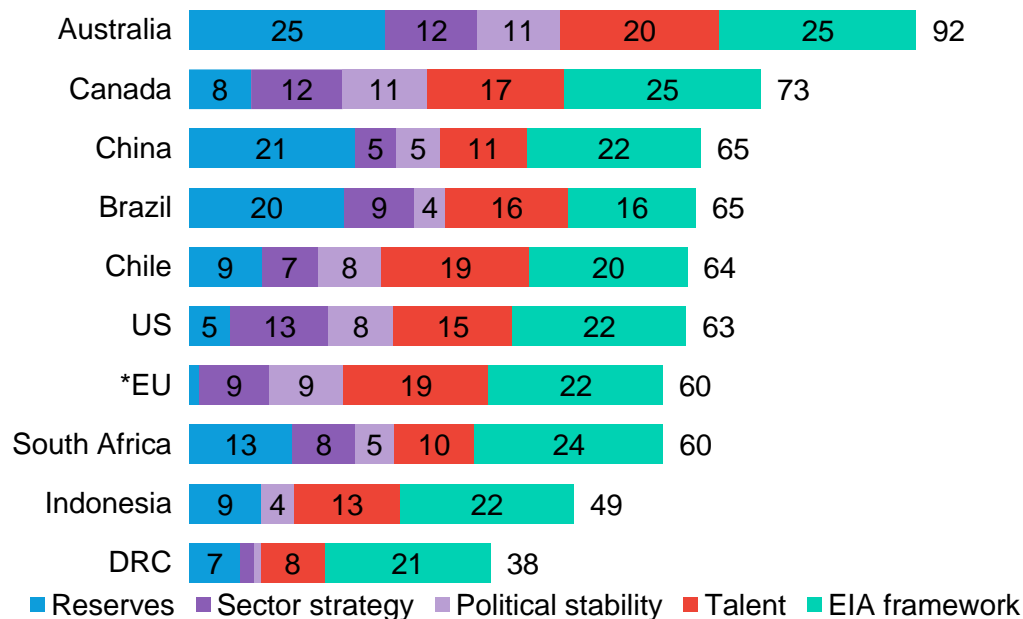
Biodiversity



Carbon markets

# Brazil is a critical source of metals for the energy transition

## Energy transition metals production scores



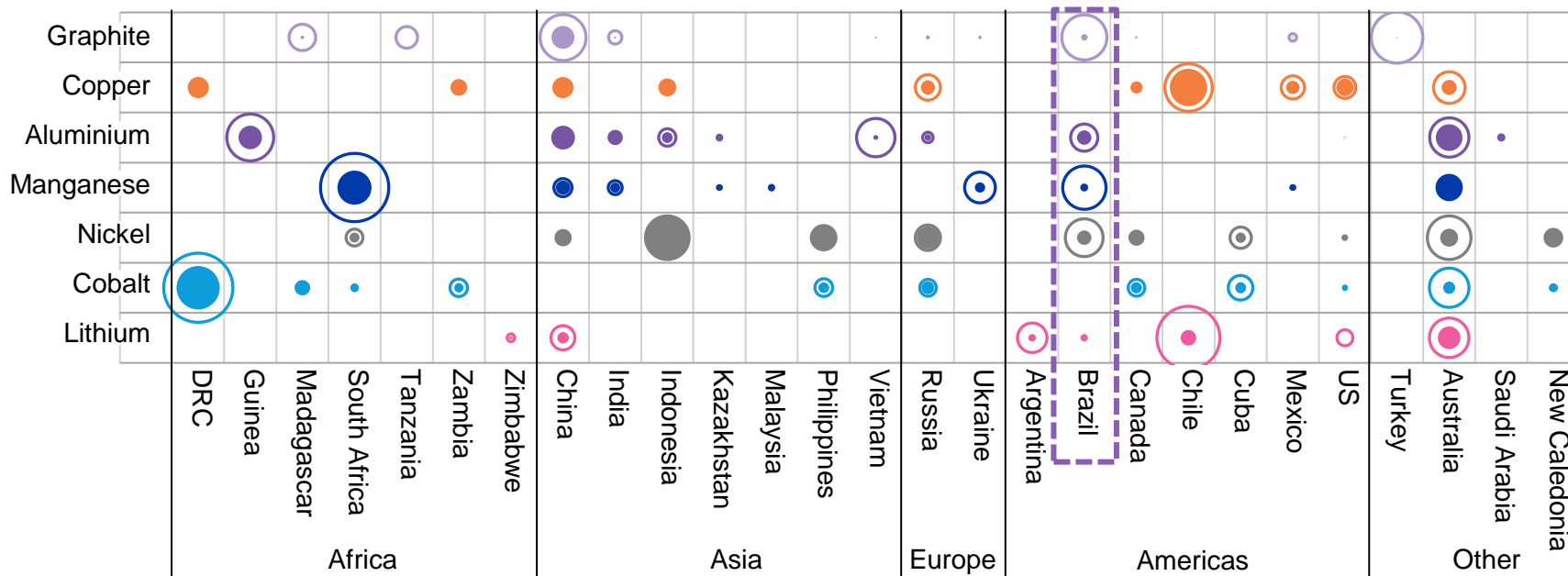
The global energy transition is driving a significant uptick in demand for the metals and minerals that underpin low-carbon technologies. However, the supply of many of these essential raw materials is constrained.

BNEF assessed the readiness of 10 markets to boost supply. Brazil ranked fourth in the overall score, making it a crucial source for raw materials needed to manufacture clean energy technologies.

Source: BloombergNEF's Energy Transition Metals Production Scores. Note: DRC is Democratic Republic of Congo. \*Poland is used as a proxy for the EU's mining salaries and environmental impact assessment (EIA) framework scores. The entire bloc is evaluated for the other categories.

# Brazil is well endowed with mineral resources

## Battery materials reserves and production

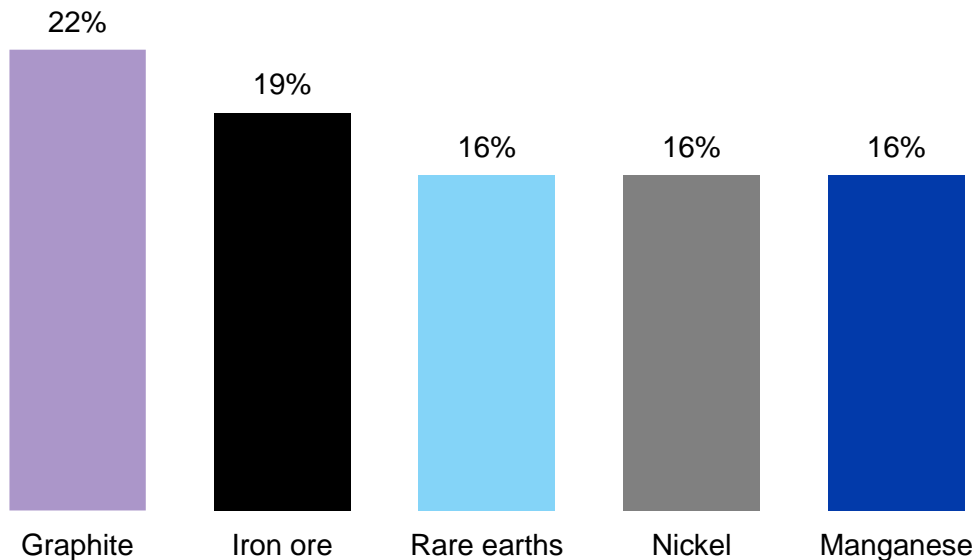


Source: BloombergNEF, US Geological Survey 2023. Note: The solid spheres represent production, the outer circle represents the total reserves. Size of spheres and circles denote proportionality of the resource between regions.

# Brazil holds more than 15% of global reserves for five strategic minerals

## Share of Brazil's reserves out of global total

Share of Brazil's reserves out of global total



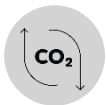
Brazil comes in third in the ranking of reserves of metals vital to the energy transition. It has more than 15% of the global reserves for five strategic minerals: graphite, rare earths, nickel and manganese.

Despite having the world's third-largest reserves of rare earth elements, Brazil's infrastructure for mining these metals is still undeveloped.

Apart from taking a leading position in global iron ore mining, Brazil was also the fourth-biggest graphite producer in 2023. It has the second-largest graphite reserves, after China.

Source: BloombergNEF, United States Geological Survey.

# Sustainable finance



Energy scenarios



Renewable energy



Decarbonizing transport



Decarbonizing industry



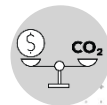
Energy transition metals



**Sustainable finance**



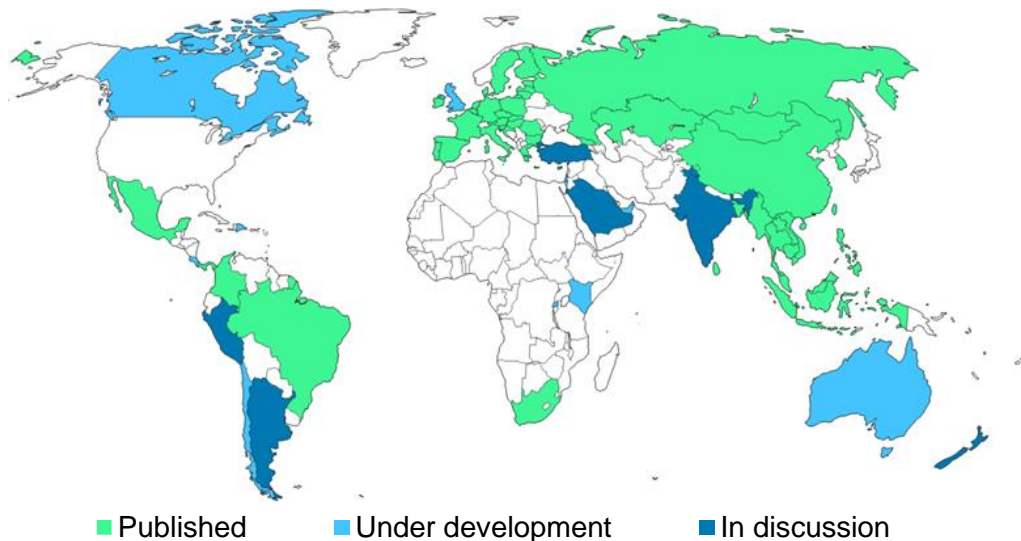
Biodiversity



Carbon markets

# Brazil gets real about its sustainable finance taxonomy

## Green taxonomies across the globe as of July 2024



Brazil already has in place a voluntary, industry-led taxonomy built by the bank association Febraban (Federação Brasileira de Bancos), and the Ministry of Finance published its sustainable taxonomy action plan in December 2023.

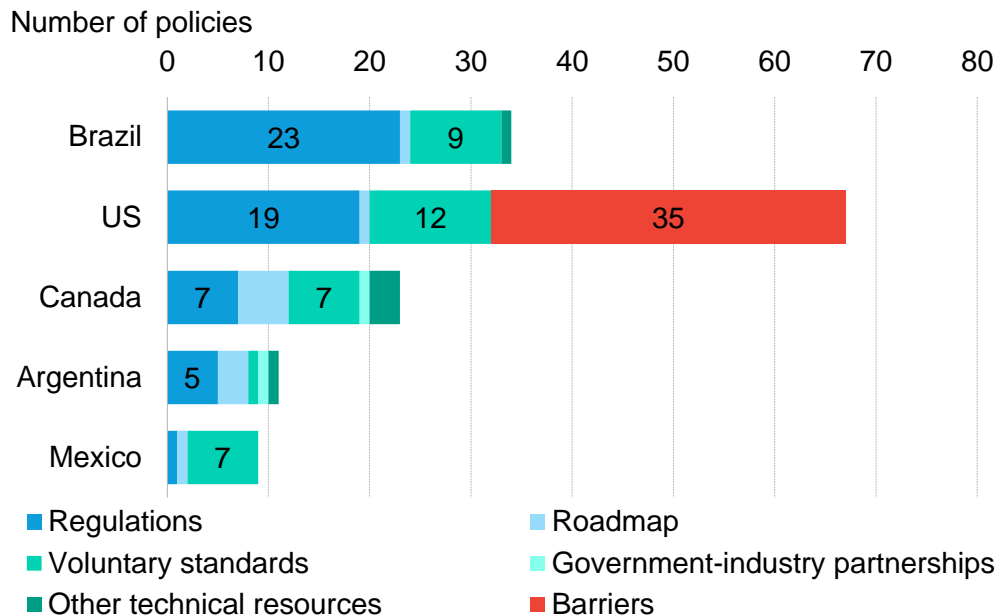
While economies continue to develop their local classification systems, so far only the EU taxonomy mandates reporting, with the rest remaining voluntary. Brazil and the UK seem to be the only other jurisdictions that plan to make reporting compulsory once their green frameworks are out.

Source: BloombergNEF. Note: Brazil is marked as 'published' as the industry-led taxonomy is already in place, although the government-led taxonomy is currently under development. The colors in the map for the members of the Association of Southeast Asian Nations (ASEAN) reflects the existence of ASEAN's green taxonomy. In addition, some ASEAN member states have published or are developing their own versions. Mapped data are for distinct economies.



# Brazil is a policy leader for sustainable finance policies in the Americas

## Sustainable finance policies of G-20 members in Americas, by framework phase



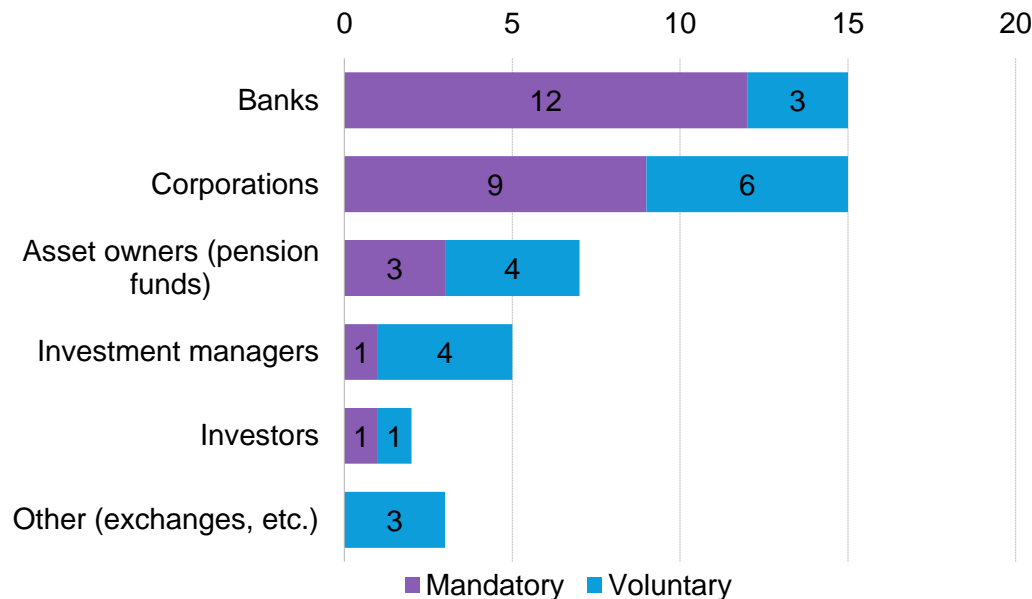
Brazil is the region's leader in sustainable finance policy, with as many as 34 policies targeting corporations, investors and banks. Banks with assets representing more than 0.1% of the country's gross domestic product (of which there are 473 today) must disclose their risks and opportunities from climate change, while 277 pension funds with a combined \$240 billion of assets must disclose ESG data.

Unlike in the US, there has been limited pushback against sustainable finance policy in Brazil. Rather, Brazil's central bank has pushed the country to become a policy leader in the region, with resolutions that require banks to consider and integrate environmental, social and climate risks.

Source: BloombergNEF. Note: Proposed and scheduled policies are included.

# Brazil sustainable finance policies primarily focus on banks and firms

## Number of sustainable finance policies impacting stakeholders in Brazil



Banks and corporations have been the primary focus of the 34 sustainable finance policies in place in Brazil, with 15 policies affecting each one of both stakeholder groups. Banks are subject to 12 mandatory regulations, the highest count of any stakeholder groups.

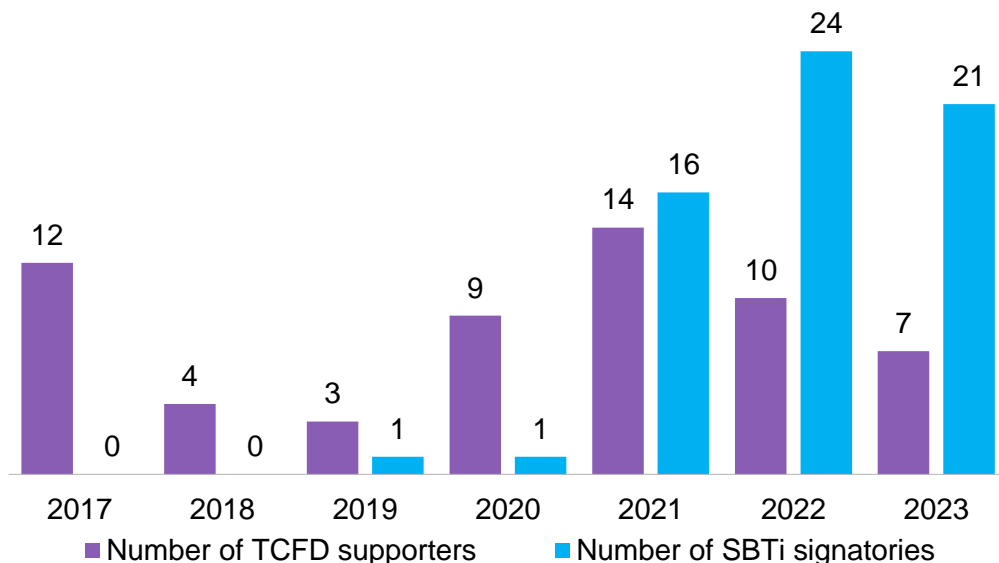
Sustainable finance policy in Brazil has been led by the central bank (known as the BCB) and National Monetary Council (CMN), rather than the federal government, as is the case in the US.

Source: BloombergNEF. Note: Only active policies are included. Bond frameworks are treated as voluntary.

# Brazilian companies ramp up their sustainability commitments

## Brazilian SBTi signatories and TCFD supporters

Number of companies

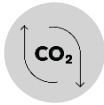


Corporate commitments have slowed since the Task Force on Climate-related Financial Disclosures (TCFD) was disbanded in October 2023. The industry is now pushing for companies to pledge targets to the Science-Based Targets Initiative (SBTi), committing to reduce carbon emissions in line with the goals of the Paris Agreement. Overall, the target-setting represents a natural evolution of TCFD and on broader ESG reporting.

Brazilian companies are gradually increasing their commitments to sustainability. However, adoption remains very slow. In 2023, only 21 companies in total were supporters/signatories of the SBTi.

Source: BloombergNEF, Task Force on Climate-related Financial Disclosures (TCFD), Science-Based Targets Initiative (SBTi). Note: SBTi gathers committed and signed off targets.

# Agriculture, land use and biodiversity



Energy  
scenarios



Renewable  
energy



Decarbonizing  
transport



Decarbonizing  
industry



Energy  
transition metals



Sustainable  
finance



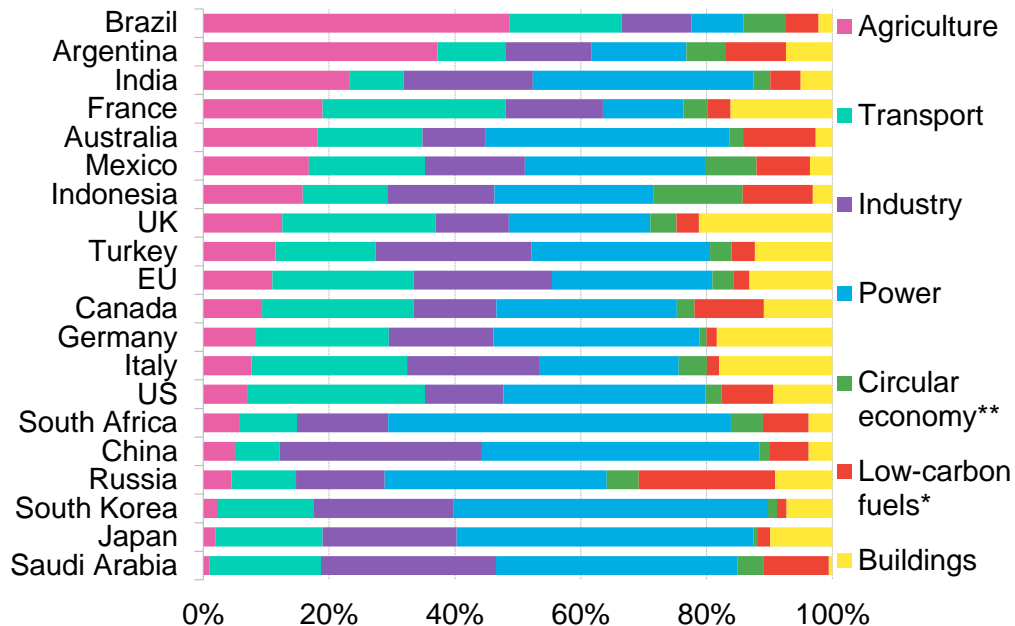
**Biodiversity**



Carbon  
markets

# Brazil needs to decarbonize agriculture for significant emissions reduction

## G-20 members' greenhouse gas emissions, by sector share in 2020, excluding LULUCF



With the exception of China and India, all the G-20 markets have either committed to reach net-zero emissions by 2050 or have a target under discussion. China's net-zero commitment is for 2060, while India's is for 2070.

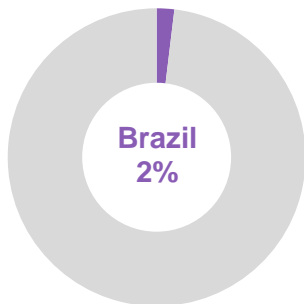
For most markets, the power sector is the main source of emissions. But the story is different in Brazil. Excluding land use, land-use change and forestry (better known as LULUCF), the agriculture sector alone accounts for half the country's total emissions, followed by the transport at 18%, industry at 11% and finally power at 8%.

Including LULUCF expands Brazil's emissions total for 2020 by 39%. Combined with agriculture, the two sectors account for 63% of the country's emissions.

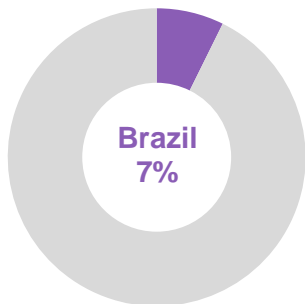
Source: BloombergNEF, World Resources Institute Climate Watch, European Environment Agency. Note: \*Represents fugitive emissions and other fuel combustion. \*\*From waste sector. LULUCF stands for land use, land-use change and forestry.

# Brazil possesses the most valuable ecosystems in the world

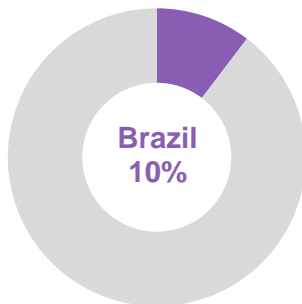
**Global GDP**  
(current \$ share)



**Land area**  
(share)



**Value of ecosystem services**  
(\$ share)



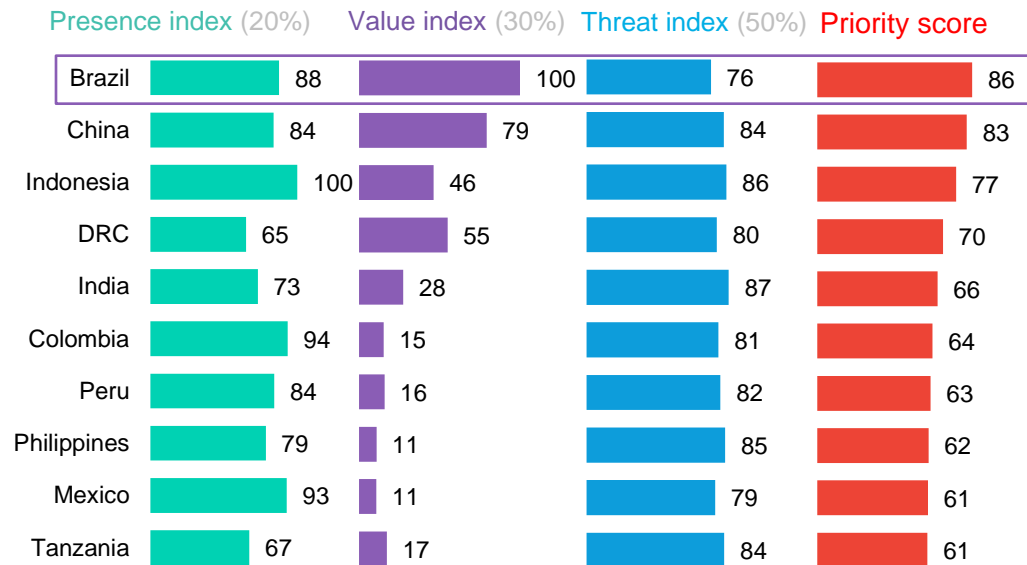
Brazil accounts for 2% of the total global gross domestic product. At present, the country is the eighth-largest economy in nominal GDP terms, and the country's continental size represents 7% of total global land area.

However, the richness of the country's biodiversity puts Brazil at the top for value of ecosystem services, which estimates the amount people are willing to pay to preserve and enhance the ecosystem.

Source: BloombergNEF; World Bank; Jiang, et al., 'Mapping Global Value of Terrestrial Ecosystem Services by Countries', *Ecosystem Services*, 52, 2021.

# Brazil is a top priority for biodiversity markets and finance

## Top 10 BloombergNEF biodiversity funding priorities, 2023



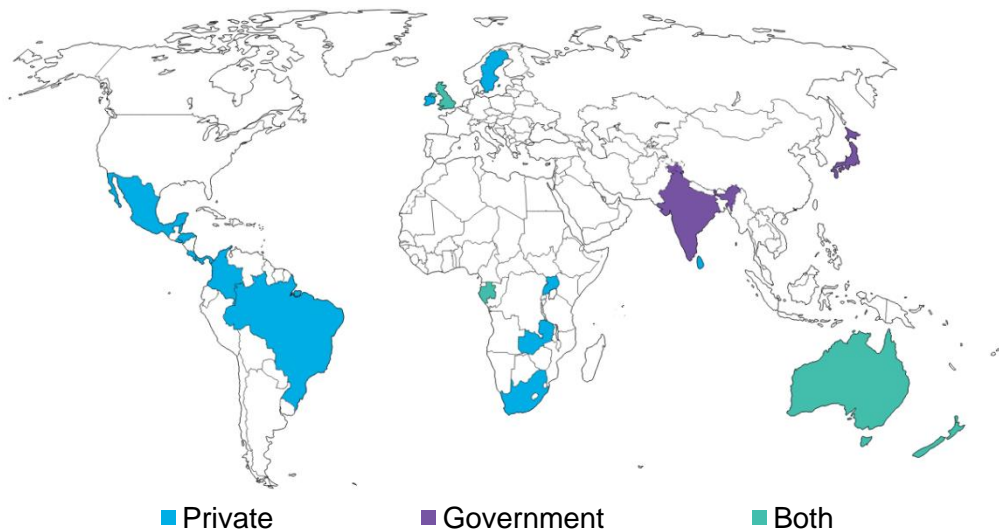
Brazil is the top biodiversity funding priority identified by BNEF, based on the presence of biodiversity, value of ecosystem services provided by nature, and degree to which these resources face threats that can be overcome by support or intervention.

A significant share of the targeted \$1 trillion in annual global funding should be directed at measures to preserve Brazil's natural assets, such as the Amazon and the Atlantic Forest.

Source: BloombergNEF's Biodiversity Finance Factbook: COP28 Edition, Convention on Biological Diversity (CBD). Note: DRC stands for Democratic Republic of Congo. Priority score weighting in grey. 'Presence' indicates species richness, endemism or rarity; 'value' reflects ecosystem services, whether or not these are commercialized; 'threat' indicated the level of risk faced by species or habitat, and local authorities' ability to respond

# 'Biocredits' can help Brazil tackle its biodiversity funding need

## Biodiversity credit and certificate schemes



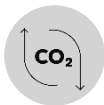
Biodiversity credits are distinct from offsets and have different conservation outcomes. Also called biocredits, biodiversity certificates, and nature credits, each is a voluntary unit created to generate biodiversity uplift. They are mentioned explicitly in target 19 of the Global Biodiversity Framework as a means of increasing private finance flowing into conservation.

While credit supply is flourishing, driven by schemes in Latin America and Europe, few buyers have committed to purchases despite rising interest. Over the longer term, supply may be the limiting factor due to the challenges of scaling, measurement, transparency and monetization. In addition, investment in biodiversity certificates could cannibalize investment in carbon markets.

Source: BloombergNEF's Biodiversity Finance Factbook: COP28 Edition. Note: Includes existing and proposed schemes as of November 2023. Mapped data are for distinct economies.



# Carbon markets



Energy scenarios



Renewable energy



Decarbonizing transport



Decarbonizing industry



Energy transition metals



Sustainable finance



Biodiversity

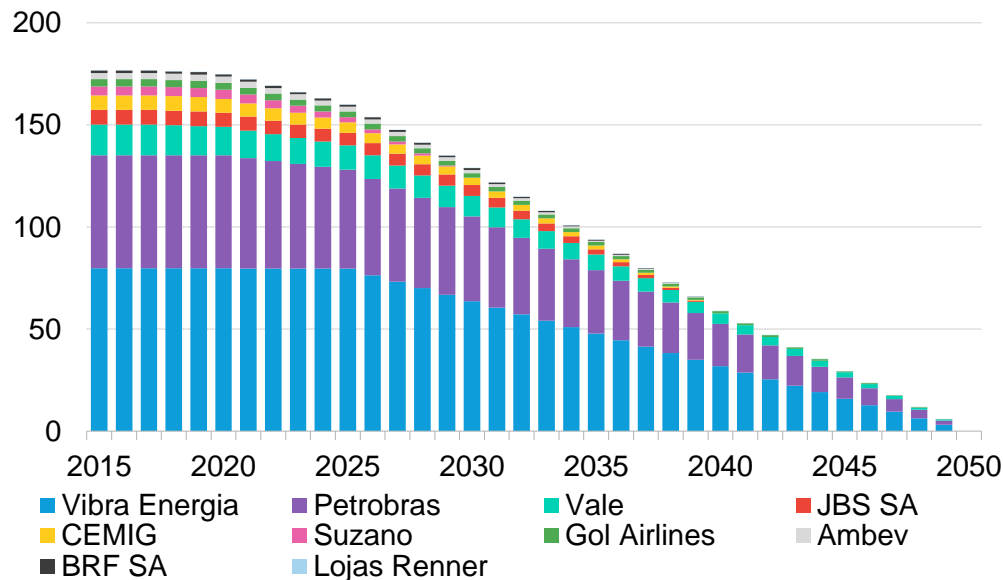


Carbon markets

# Brazil's major companies have set ambitious emissions targets

## Aggregate emissions covered under net-zero goals of Brazilian corporations

Million metric tons CO2 equivalent



The 10 largest Brazilian companies with net-zero emissions goals will collectively need to slash 177 million metric tons of CO2 equivalent (MtCO2e) from their annual emissions.

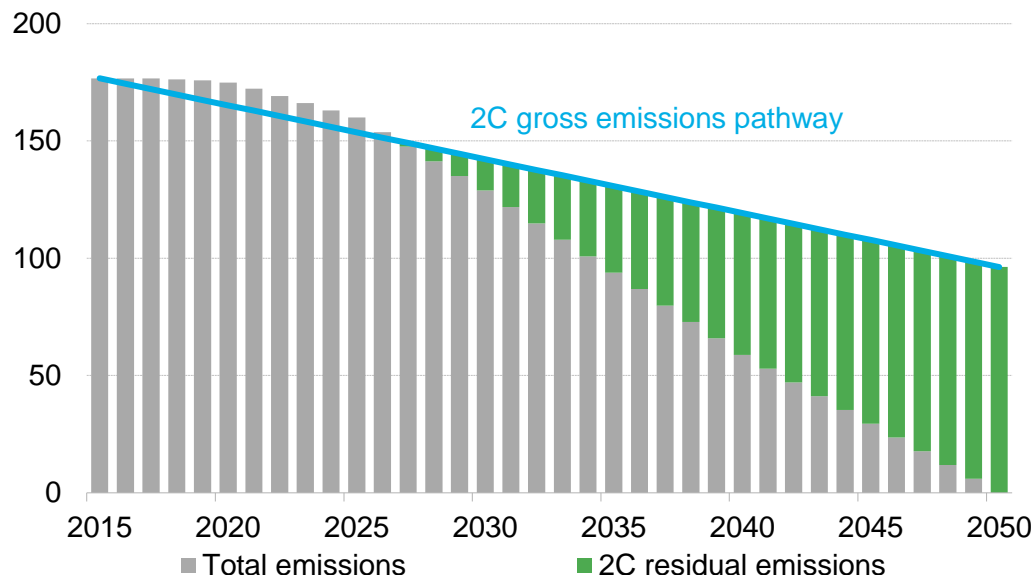
The impacts of these targets could be far larger as companies make them more ambitious. Both Petrobras and Vale only include Scope 1 and 2 emissions in their net-zero goals, which come from their operations. The size of Vale's net-zero target would grow 55-fold if it were to include Scope 3 emissions from the use of its products downstream. The net-zero target of Petrobras would multiply 10-fold with similar changes.

Source: BloombergNEF, Bloomberg Terminal, company filings. Note: Chart only includes emissions covered under a net-zero target.

# Even the most aggressive abatement strategies will have residual emissions

## Residual emissions on 2C pathway of major Brazilian corporations

Million metric tons CO<sub>2</sub> equivalent



From a 2015 base year, if we assume the 10 largest Brazilian companies with net-zero goals reduce their gross emissions by 1.3% every year (which is a trajectory consistent with keeping global temperatures from rising more than 2C in 2050), they would still have 26MtCO<sub>2</sub>e of residual emissions in 2030 and 93MtCO<sub>2</sub>e in 2050.

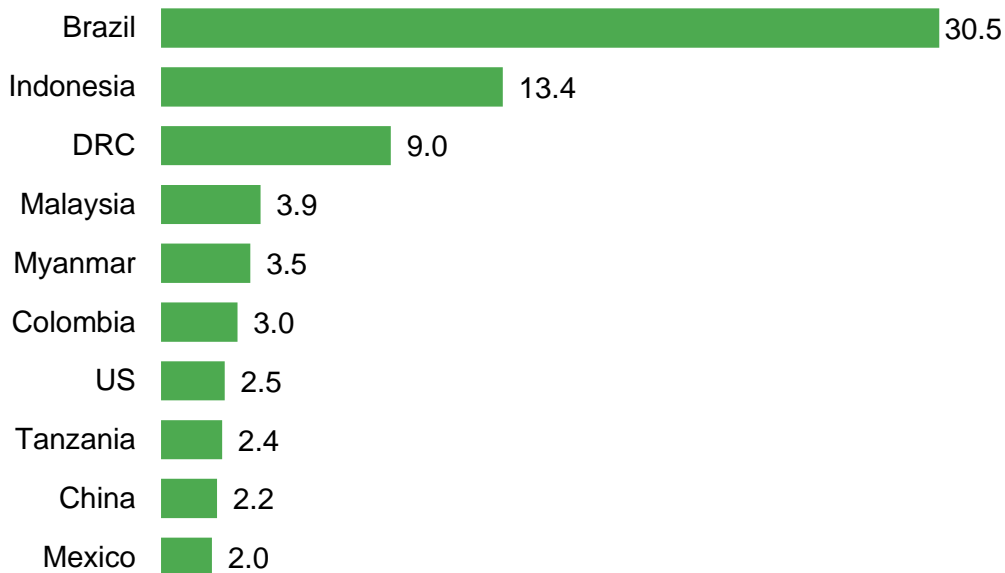
These residual emissions are a company's 'fundamental' offset demand, or emissions that have no viable or affordable way of being reduced and must therefore be offset. Less ambitious gross emission reduction pathways – a realistic outcome for oil majors like Petrobras – would lead to even higher residual emissions. Countries all around the world face similar challenges to reach net zero.

Source: BloombergNEF, Bloomberg Terminal, company filings. Note: Chart only includes emissions covered under a net-zero target.

# Brazil could be the model country for nature-driven climate mitigation

## Top suppliers of nature-based offsets, 2024-2050

Millions of offsets



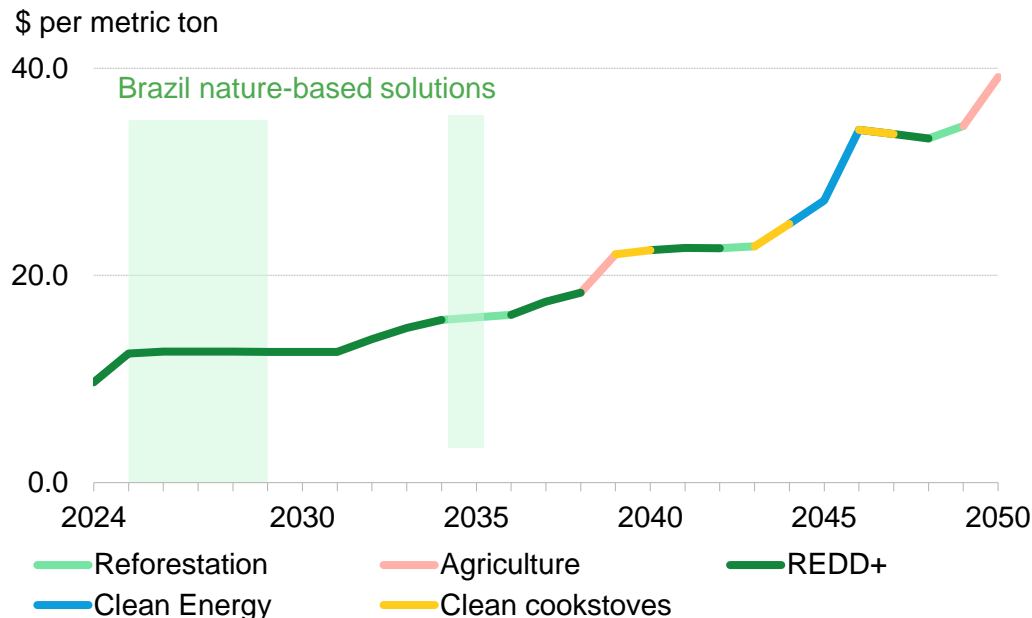
No country comes close to Brazil in terms of nature-based abatement potential. Now Brazil needs establish itself as a carbon offset supply hub for domestic and international companies with net-zero goals. BNEF estimates that over 2024-2050, the country could collectively create up to 30.5 gigatons of CO<sub>2</sub> equivalent of nature-based carbon offsets. With proper investment, some 75% of the abatement in Brazil to 2050 could come from avoided deforestation, known as REDD+, followed by reforestation at 23% and sustainable agriculture practices at 2%.

Brazil's fledgling offset market will need to make a big U-turn to reach this potential. The country issued a record 25.4MtCO<sub>2</sub>e of offsets in 2021, but supply plummeted to 7.6MtCO<sub>2</sub>e in 2022 and 5.6MtCO<sub>2</sub>e in 2023. Issuance has historically been top-heavy, coming from a handful of large REDD+ projects with inconsistent quality.

Source: BloombergNEF, Nature4Climate. Note: DRC is Democratic Republic of Congo.

# A healthy Brazilian offset market could influence pricing at a global scale

## Marginal carbon offset prices – voluntary market scenario

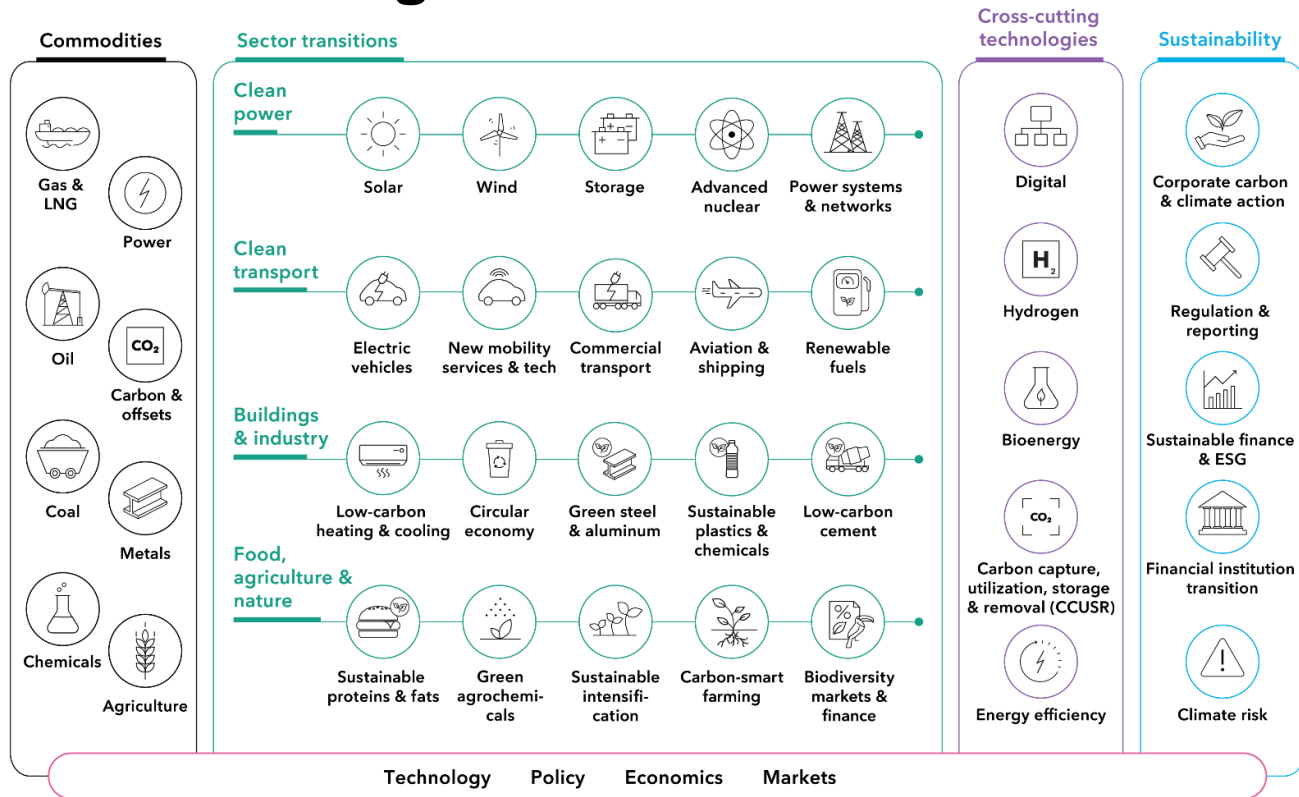


Under the current structure of the voluntary carbon market, where supply is traded globally between different countries, Brazil is poised to set global prices for carbon credits in future years, should it make the necessary investments into building up an inventory of projects. Assuming the voluntary carbon market retains its current structure out to 2050, BNEF estimates the marginal price of carbon credits from 2025 to 2030 could be set by Brazilian REDD+ projects at \$13 per metric ton. Brazilian projects once again set global marginal prices in 2035 – this time from reforestation projects at \$16 per ton.

The dominance of Brazilian nature-based solutions means that any changes to cost, supply or demand in the country could have ramifications on global demand and prices for credits. This is not dissimilar from OPEC's role in influencing global oil markets.

Source: BloombergNEF. Note: Chart is colored by the sector setting marginal prices in each year. REDD+ refers to avoided deforestation.

# BNEF coverage



BloombergNEF (BNEF) is a strategic research provider covering global commodity markets and the disruptive technologies driving the transition to a low-carbon economy.

Our expert coverage assesses pathways for the power, transport, industry, buildings and agriculture sectors to adapt to the energy transition.

We help commodity trading, corporate strategy, finance and policy professionals navigate change and generate opportunities.

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