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Scaling-up infrastructure investment to strengthen sustainable development in Brazil

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By Falilou Fall, Priscilla Fialho and Tony Huang

Abstract

Scaling-up infrastructure investment to strengthen sustainable development in Brazil.

Infrastructure investment has been low in Brazil over the last decades, leaving significant gaps in all infrastructure sectors. To close these gaps, public investment will need to increase and become more effective, while additional private resources need to be mobilised. Improving strategic planning and effectively translating it into budget allocations over time would increase the quality of infrastructure projects. Promoting foreign participation in public procurement would raise competition and value for public money, while strengthening the governance of SOEs would enhance the quality of infrastructure services. Minimising policy and judicial risks would help to leverage more private infrastructure financing, including at longer maturities, while ensuring an adequate risk sharing between public and private actors.

JEL codes: G32, H54, L91, R42

Keywords: Infrastructure, Financing Policy, Financial Risk and Management, Government Investment, Road Maintenance, Transportation Planning

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Résumé

Accroître les investissements dans les infrastructures pour renforcer le développement durable au Brésil.

Les investissements dans les infrastructures ont été faibles au Brésil au cours des dernières décennies, menant à des retards importants dans tous les secteurs d'infrastructure. Pour combler ces retards, l'investissement public devra augmenter et devenir plus efficace, tandis que des ressources privées supplémentaires devront être mobilisées. L'amélioration de la planification stratégique et sa traduction effective en allocations budgétaires au fil du temps permettraient d'accroître la qualité des projets d'infrastructure. La promotion de la participation étrangère aux marchés publics augmenterait la concurrence et la valeur des fonds publics, tandis que le renforcement de la gouvernance des entreprises d'État améliorerait la qualité des services d'infrastructure. Minimiser les risques politiques et judiciaires permettrait de mobiliser davantage de financements privés pour les infrastructures, y compris à des échéances plus longues, tout en garantissant un partage adéquat des risques entre les acteurs publics et privés.

Codes JEL : G32, H54, L91, R42

Mots clés : Infrastructure, Politique de financement, Risque financier et son management, Investissement public, Maintenance des routes, Planification des moyens de transport

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Scaling up infrastructure investment to strengthen sustainable development

By Falilou Fall[1], Priscilla Fialho and Tony Huang

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Over many years, Brazil's growth has been driven by private consumption, while investment has regularly fallen victim to fiscal consolidation needs. This has contributed to stagnant productivity growth and the capital stock has reached a historic low. In 2021, total investment in Brazil was 19% of GDP, lower than in most peers and the OECD average (Figure 1, Panel A). Infrastructure investment is one area of investment with particularly wide ramifications into all parts of the economy, not only with respect to growth, but also social progress and sustainability.

Infrastructure investment has been particularly low in international comparison and has even declined (Figure 1, Panel B). On average, emerging market economies spend 5 to 7% of GDP per year on infrastructure, whereas Brazil has spent under 2% of GDP over the past decade (Raiser et al., 2017). This decline, driven by falling public investment that has not been sufficiently compensated by private investors, has left significant gaps in all infrastructure sectors, with current total investment needs close to 3.7% of GDP per year to close the infrastructure gap by 2030 (World Bank, 2022a). The transport, energy, and water and sanitation sectors have been particularly affected (Figure 1, Panel C). Brazil's infrastructure now performs worse than that of its regional peers and other emerging countries (Figure 1, Panel D).

Infrastructure investment can have a significant impact on growth, especially when accompanied by reforms that increase the institutional capacity for planning, budgeting, and spending efficiently (New Climate Economy, 2016). Raising public investment by 2 percentage points of GDP would increase the capital stock by 8 percentage points and output by 2.5 percentage points in 25 years (OECD calculations based on the OECD Long-Term model, Guillemette et al., 2017). Factoring in the likely effect of higher public investment on total factor productivity, the growth dividend would presumably be even larger. Beyond improving incomes and employment opportunities, infrastructure investment can bring additional benefits in terms of poverty alleviation and social inclusion by increasing the availability of goods and services (Medeiros et al., 2019).

Public investment in infrastructure should increase. However, fiscal space to accommodate higher public infrastructure investment will continue be limited in the coming years. Therefore, to close its infrastructure gap, Brazil will also need to improve the efficiency of public investment, on the one hand, and leverage private sector participation, on the other hand, while carefully evaluating the risks for the public sector. In addition, new infrastructure projects should also take climate risks into account to minimise future maintenance costs and retrofitting needs over the project lifetime, and factor in the potential benefits of infrastructure investments for mitigating greenhouse gas (GHG) emissions.

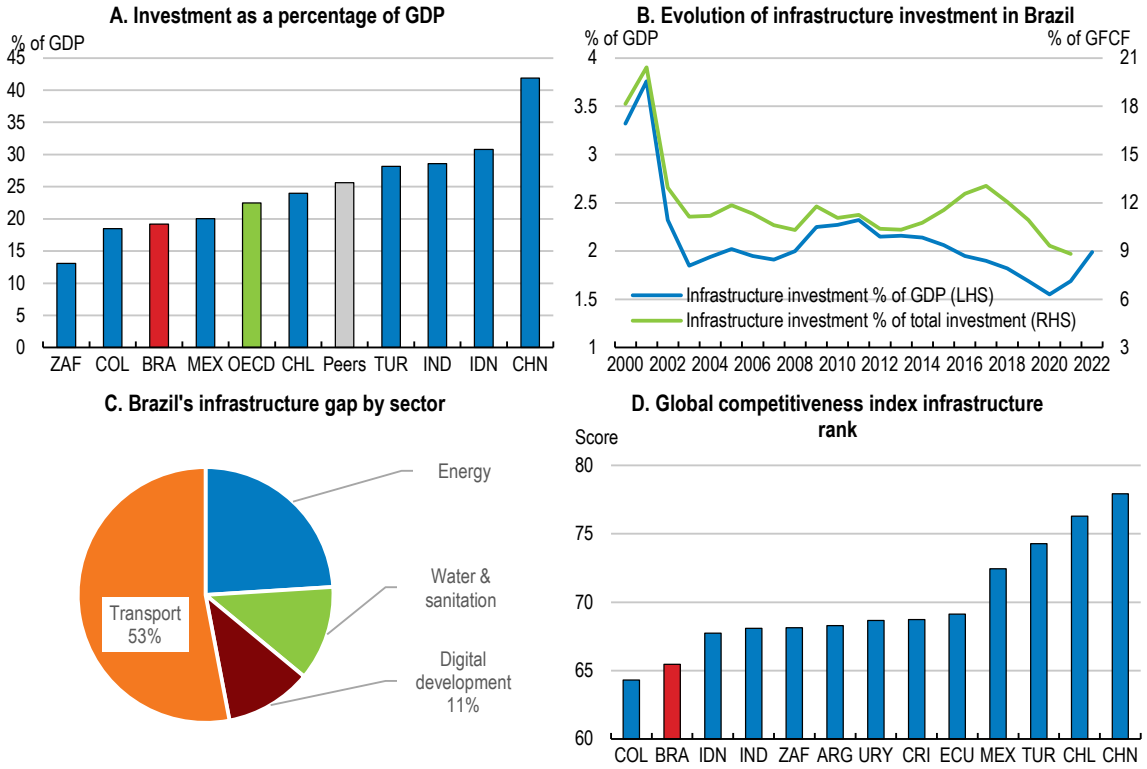
A sizeable new infrastructure programme called "New Growth Acceleration Programme" has been designed to address some of the infrastructure gaps. The large scope of the New Growth Acceleration Programme covers many Sustainable Development Goals (SDGs 6, 7, 8, 9 and 13). The programme will encompass over 2000 infrastructure projects, including public investment projects, private investments through concessions in roads, ports, airports, railways, cabotage maritime transport and private-public partnerships. Beyond the transport sector, it will also include measures to advance the energy transition and ensure energy security, improve urban and social infrastructure, support the digital inclusion and improve water and sanitation. The programme has the potential to reduce poverty and enhance economic opportunities for low income and disadvantaged groups.

This paper analyses avenues to scale-up investment in economic infrastructure in a fiscally constrained environment. The main findings of the paper are:

- Current infrastructure gaps vis-à-vis peer economies affect many different areas, particularly transport, water, and sanitation. Electricity and telecommunications investment should also increase for the catching-up with advanced technologies in telecommunications and climate-change related adjustment for electricity.
- More efficient use of scarce public resources will be key for maximising growth and social dividends from infrastructure investment. The project selection, planning and implementation phases show significant scope for making better use of existing resources.

- Leveraging private infrastructure financing will be key to complement public resources and can be facilitated by mitigating risks associated with infrastructure, developing long-term savings, and financing instruments and lifting the barriers to foreign investment.
- Building climate change mitigation and adaptation considerations into infrastructure planning from the outset will be key for an effective reduction of GHG emissions and to avoid costly retrofitting needs in the coming years.

Figure 1. Infrastructure investment is too low to close the infrastructure gap



Note: Data for Panel A are for 2021, data for Panel C are for 2019, and Panel D refers to infrastructure investment needs to bridge the gaps by 2030. Peers refer to Chile, Colombia, China, India, Indonesia, Mexico, Türkiye, and South Africa.
Source: Kroll 2022; World Bank; World Economic Forum; and OECD calculations.

Infrastructure gaps are widespread

Although Brazil's continental size implies low population density in many parts of the country, Brazil's infrastructure falls short of the standards observed in many emerging market economies and gaps in quantity, quality and access can be identified in most economic infrastructure sectors. Many infrastructure facilities are 30-40 years old, and maintenance levels are low, leading to high operating costs and efficiency losses (Inter.B, 2022). According to the World Bank's most recent Logistics Performance Index, in 2018-2019, Brazil ranked 56th out of 160 countries worldwide in terms of quality of infrastructure. Infrastructure challenges are reflected in high logistics costs, for example, estimated at about 15% of GDP, compared to 8-10% in OECD countries (IDB, 2020). By some estimates, logistics bottlenecks add up to 7% to the cost of Brazilian exports (International Trade Administration, 2023).

Transport

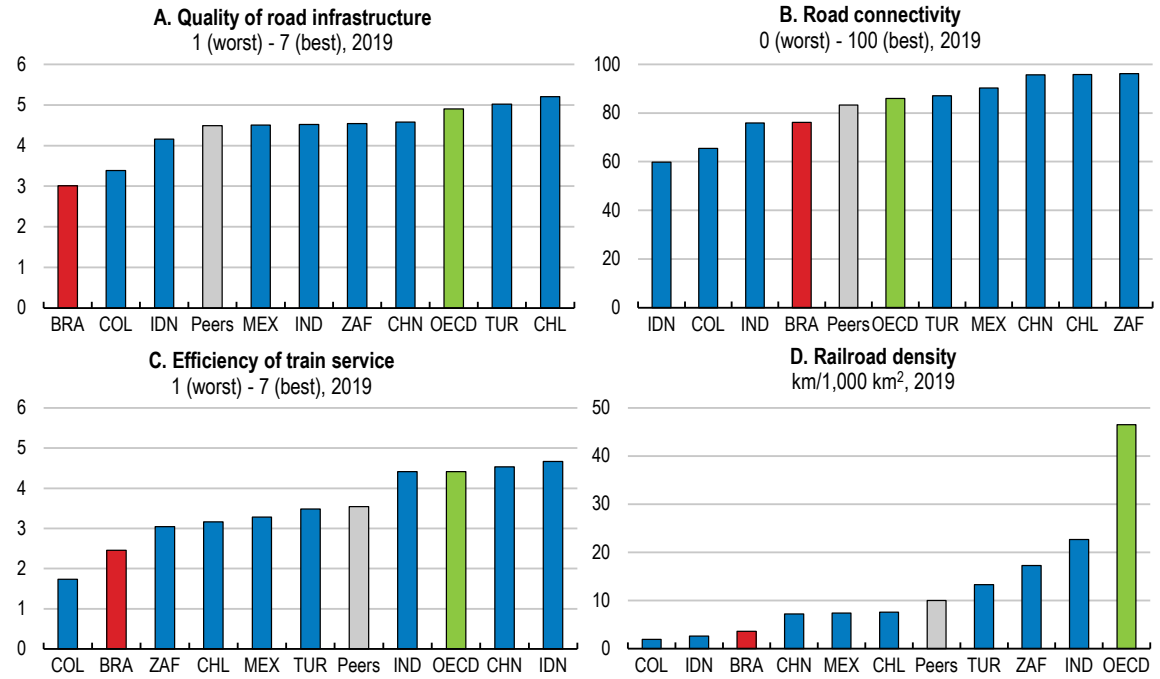
Road quality in Brazil reveals significant challenges, including when compared with peers (Figure 2, Panel A). Only 12% of roads are paved and 23% are in “bad” or “very bad” condition, according to the classification used by the World Economic Forum. Although many motorways are concessions and charge toll, and concession contracts include road maintenance obligations, road quality is nonetheless a widespread concern. Trucks are still the primary method of cargo transport, which increases logistics cost for some products, and with an existing fleet of over 2 million heavy-duty trucks, aged nearly 15 years on average, raises maintenance costs and air pollution (World Bank, 2022a). Furthermore, road connectivity, measured by the average time to connect the main cities, is low (Figure 2, Panel B). New highway concessions have increased since 2019, with an additional 7 sections auctioned, corresponding to 0.5% of GDP in private investments. Other projects are currently being prepared for auction, such as the highway connecting Belo Horizonte to Governador Valadares in Minas Gerais, or have been recently auctioned, such as the northern section of the beltway around São Paulo. However, improving the quality of existing roads and closing connection gaps will require additional efforts. According to some estimates, the current state of the road network may have increased overall transportation costs by as much as 33% in 2020 (CNT, 2022). Brazil’s accession to the International Transport Forum will help in the assessment of these gaps and a better design of future transport policies.

Rail infrastructure fails to keep up with growing demand from commodity exporters (Figure 2, Panel C and D). A third of rail tracks are abandoned and tracks have different widths across the country, making connections more difficult (Vendramini et al., 2020). The main railway terminals are far away from ports and agricultural regions (World Bank, 2022a). Furthermore, multimodal transport infrastructure, based on the interoperability of different transport modes, is lacking. Therefore, only 18% of cargo is transported via railways, with negative environmental consequences (Lo, 2018). Recent auctions to extend railways by over 20 thousand kilometers are welcome and further investments are expected in the coming years, which should help boosting the rail network.

The efficiency of ports has also scope for improvement (Figure 3, Panel A). Around 95% of export commodities flow through the port system, generating annual revenues of 14.2% of GDP and about 120 000 jobs. Still, slow turnaround including long waiting times for ships to load, and unload suggests that connections to global shipping networks are insufficient (Di Bella Filho, 2020; Costa et al., 2022; Figure 3, Panels B-D). Traffic bottlenecks along key road stretches leading to ports are frequent, resulting in higher logistics costs (Lodge et al., 2017; Oliveira et al., 2021). Insufficient capacity of the staging areas in ports exacerbates the congestion and increases truck waiting time. A new port terminal has been inaugurated in Açu in February 2023, relieving some of the congestion. In addition, the construction of six new port terminals has been authorized in 2022, which should generate more than BRL 10 billion of private investment in the sector.

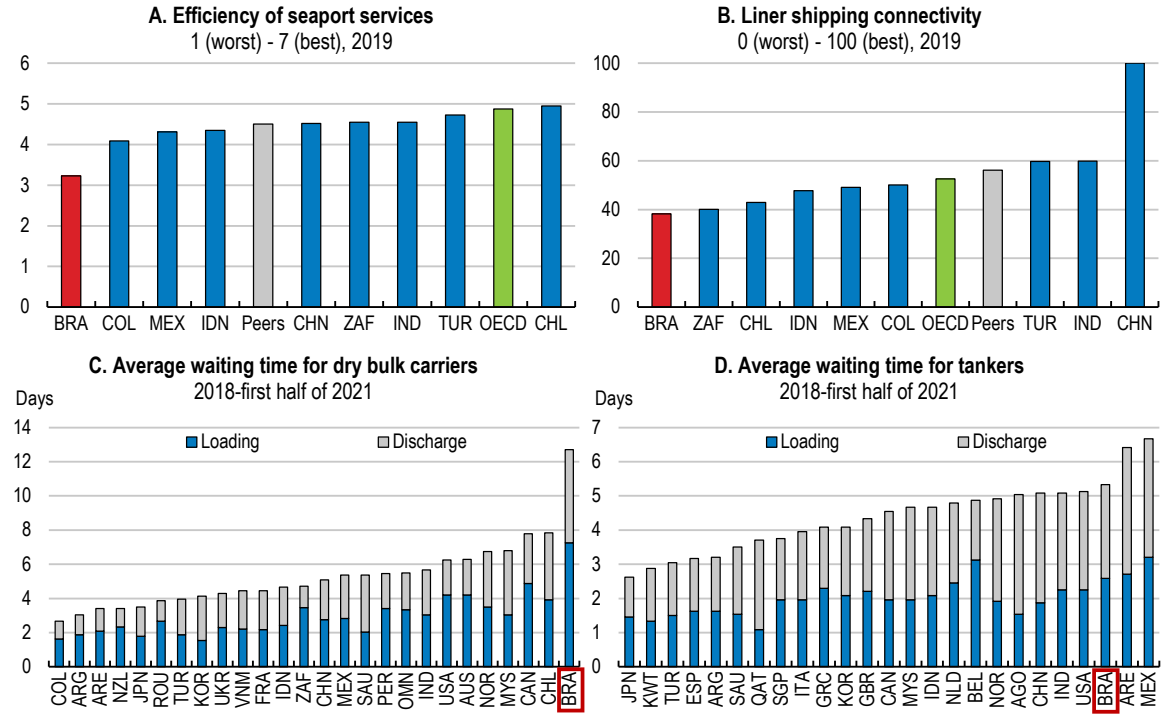
Brazil has comparatively few public transport vehicles given its population size (Figure 4, Panel A). This affects some regions more than others, as urban mobility infrastructure is unequally distributed across regions. Adequate public transport options are often lacking in lower-income regions and suburban areas, where populations travel long distances every day to carry out basic activities. Waiting times are long, routes limited, and safety lacking, exposing users, and particularly women, to violence (ITDP, 2022). Nearly half of all municipalities do not have any public bus service and close to 80% of the bus fleet is not adapted to the requirements of people with disabilities or reduced mobility (NTU, 2023; IBGE, 2021). As a result, only 28% of urban trips relied on public transport in 2022 (Figure 4, Panel B). The implied intensive use of private vehicles generates high levels of congestion (Figure 4, Panel C). Indeed, Brazilian cities are among the 100 most congested cities in the world and among the top ten in Latin America.

Figure 2. Quality of land transportation infrastructure is low in international comparison



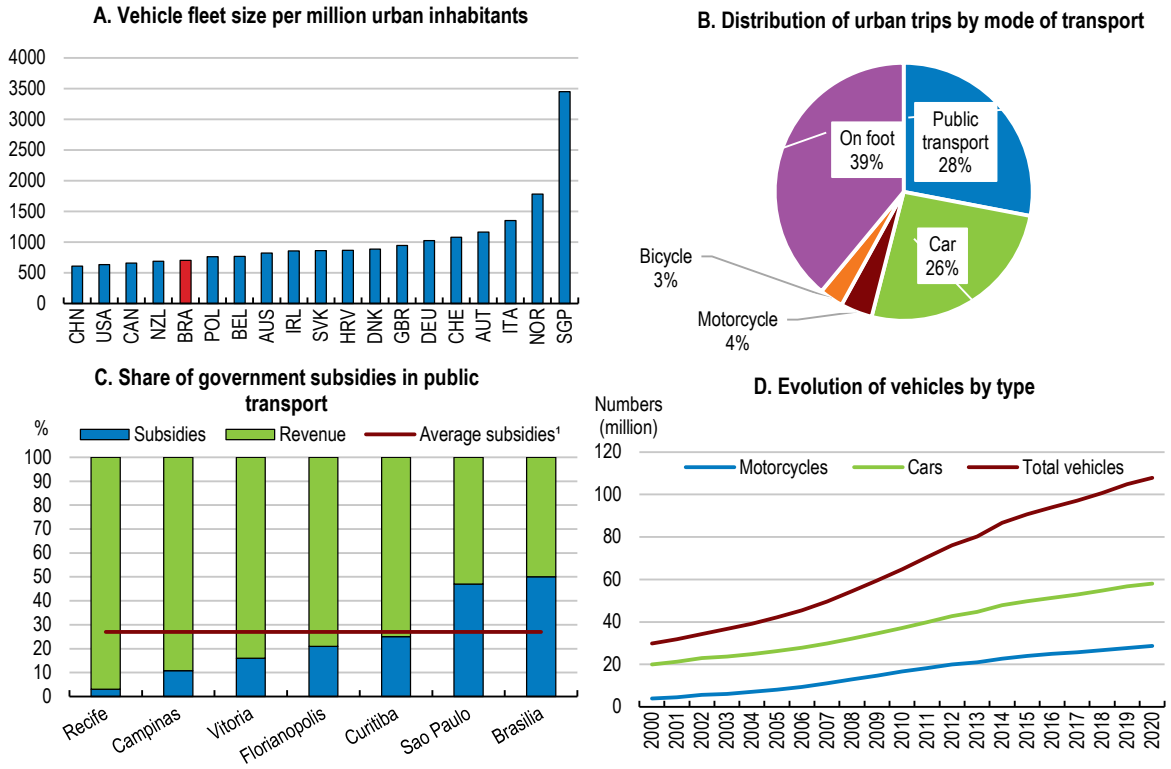
Note: Peers refer to Chile, Colombia, China, India, Indonesia, Mexico, Türkiye, and South Africa.
Source: World Economic Forum; and OECD calculations.

Figure 3. There is room to improve the performance of port services



Note: Peers refer to Chile, Colombia, China, India, Indonesia, Mexico, Türkiye, and South Africa.
Source: World Economic Forum; UNCTAD; and OECD calculations.

Figure 4. Urban public transportation remains underdeveloped



Note: Data in panel A are from the UITP (Union Internationale des Transports Publics) public transport and urban mobility database. Vehicle fleet size refers to the number of public transport vehicles as a measure of public transport supply, and the data are for 2015. In panel B, data are for 2018.
Source: NTU, 2023; UITP (2017). Urban public transport in the 21st Century, Brussels.

Water, sanitation, and solid waste disposal

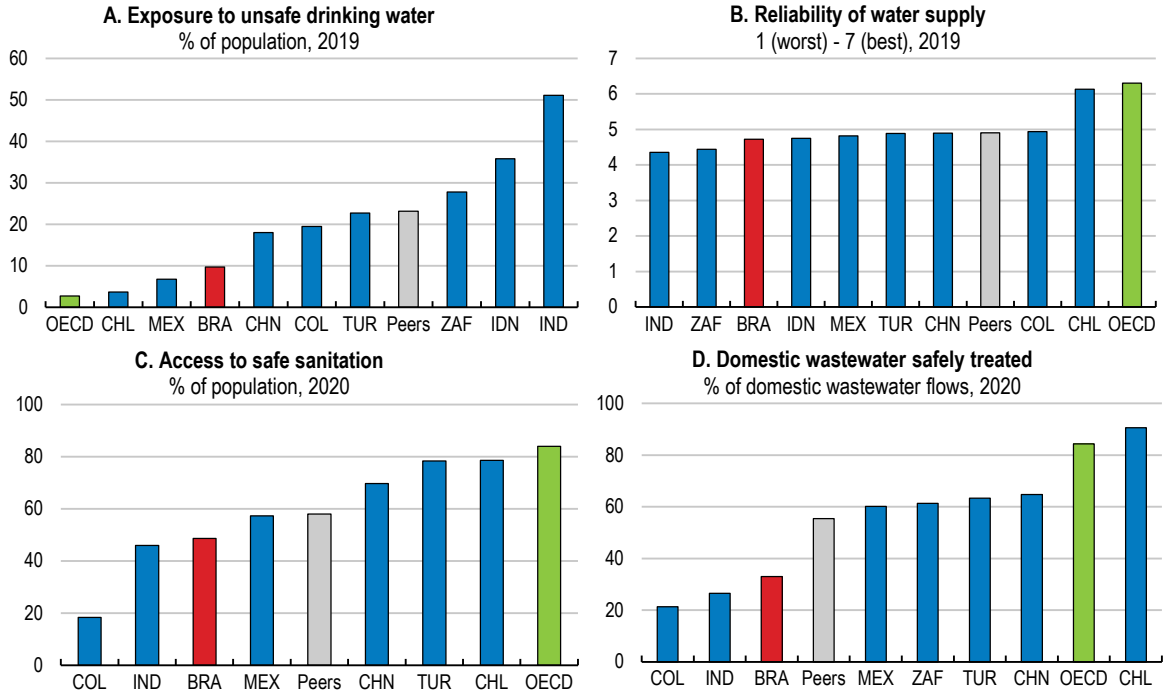
Access to safe water, sanitation and hygiene is a basic human need for health and well-being. Still, 10% of Brazil's population does not have access to safe drinking water at home, compared to 3% in OECD countries (Figure 5, Panel A). The share of the population exposed to unsafe drinking water goes up to 30% in rural areas (OECD, 2022a). Moreover, water supply interruptions and flow fluctuations are frequent (Figure 5, Panel B). Almost a third of all water produced is lost due to low investment in technology upgrade and asset maintenance (World Bank, 2022a). In 2019, the government established a Water Security Programme, with investments planned of about BRL 27.6 billion up until 2035 (about 0.4% of GDP), doubling current investment levels (OECD, 2022a). If executed, the plan should partly address current gaps.

Waste recycling rates are low, as nearly all solid waste goes to landfills or garbage dumping sites (Grottera et al., 2017). Water pollution, caused by poor treatment of industrial waste and sewage, leaking landfills, and diffuse pollution, endangers public health and ecosystems, with a disproportional impact on the poor living in the slums surrounding the largest cities (OECD, 2022a; Water Action Hub, 2020).

More than 100 million Brazilians, or 47% of the population, live in households that are not connected to the sewage system or have other forms of access to safe sanitation (PAHO, 2019; World Bank, 2020a, Figure 5, Panels C and D). Young people are particularly affected, with 39% of schools lacking basic hand-washing infrastructure (WHO/UNICEF) and 3% of children and adolescents having no bathroom at home (Trata Brasil, 2023; World Bank, 2020a).

Access and quality of water and sanitation facilities, which falls under the jurisdiction of subnational governments in Brazil, vary considerably across regions and urban-rural areas (Table 1). Coverage of the public water network is much lower in rural areas, where other forms of water supply, such as spring or rainwater, are used as substitutes (Trata Brasil, 2018). Loss rates in water distribution are lower in southern regions, where the distribution systems are more efficient, with better operations planning and management. Similarly, public sewage services are provided predominantly in urban areas. In rural areas, alternative solutions are used, such as septic tanks, rudimentary cesspits, open ditches, and discharge into waterways (SNIS, 2021). Midwestern and southeastern regions have above national average incidences of sewage overflows into public roads, often caused by rupture or obstruction of sewage collection networks.

Figure 5. Access to water and sanitation is far from universal



Note: Peers refer to Chile, Colombia, China, India, Indonesia, Mexico, Türkiye and South Africa.
Source: World Economic Forum; Our World in Data; United Nations Water; and OECD calculations.

Table 1. Access to water and sanitation services is highly unequal

	Share of population served by public water system (%)			Loss rate in water distrib. (%)	Nr. of systemic shutdowns and disruptions per 100 residents	Share of population served by public sewage system (%)			Treatment rates of sewage generated (%)	Treatment rates of sewage collected (%)	Incidence of sewage overflows per 100 residents
	Total	Urban	Rural			Total	Urban	Rural			
North	58.9	72.0	16.9	51.2	11.0	13.1	17.2	2.4	21.4	85.8	7.5
Northeast	74.9	89.7	32.5	46.3	26.5	30.3	39.3	4.2	34.1	76.0	17.2
Midwest	90.9	98.0	29.6	34.2	6.9	59.5	65.8	5.8	58.5	94.3	43.5
Southeast	91.3	96.1	26.2	38.1	5.9	80.5	84.9	20.0	58.6	76.4	75.4
South	91.0	98.8	44.2	36.7	9.8	47.4	54.3	6.8	46.7	93.9	17.3
National	84.1	93.3	30.6	40.1	12.5	55.0	63.2	7.2	50.8	78.5	43.2

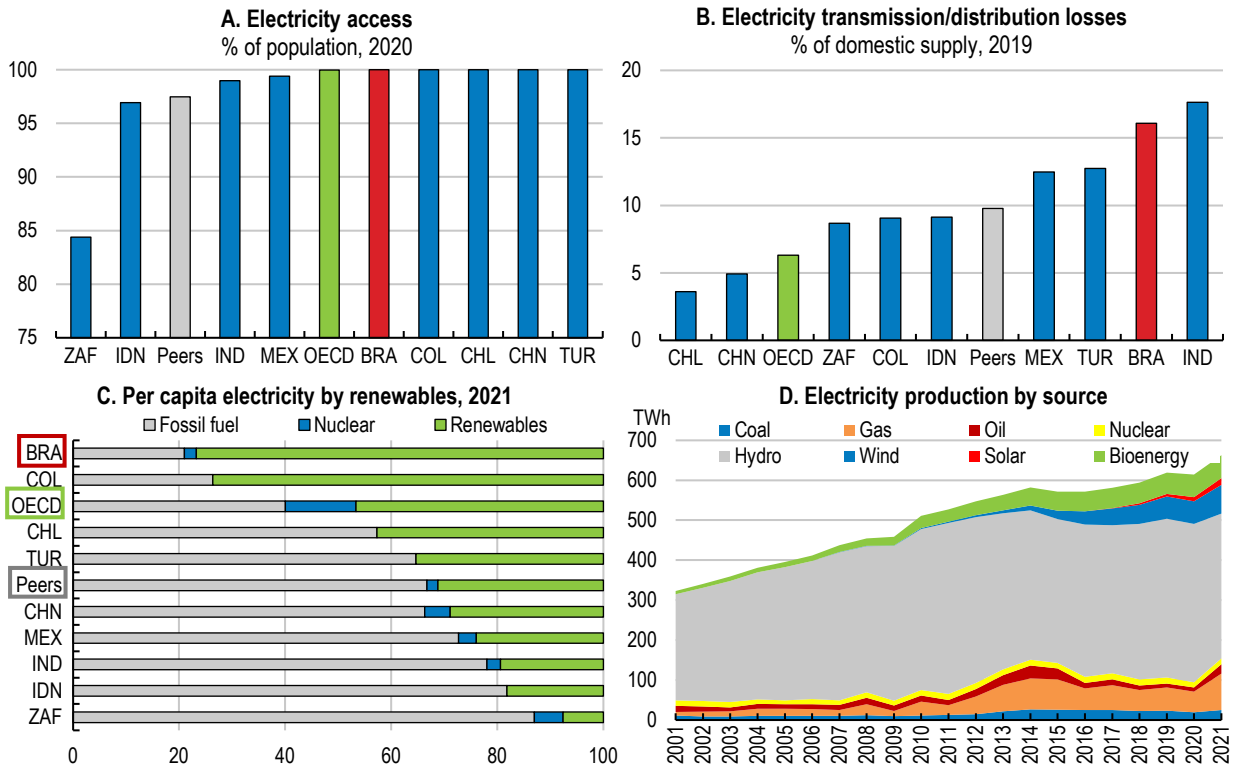
Note: Data refers to 2020. Data for rural areas were calculated using data for total and for urban areas as follows: Share of rural population = (total population served by the system - urban population served by the system) / (total population-urban population) * 100.
Source: National Sanitation Information System (SNIS); and OECD calculations

Electricity

In 2020, Brazil achieved universal access to electricity (Figure 6, Panel A). The Brazilian transmission network, which consists of four interconnected regional subsystems, constitutes one of the largest interconnected systems in the world (OECD, 2021a). However, electric power transmission and distribution losses remain considerably higher than in peer and OECD economies (Figure 6, Panel B). Losses occur through the transmission lines and distribution networks, during the process of electricity transportation, voltage transformation and measurement, but also due to theft (illegal connection or direct network diversion), fraud (meter tampering or deviation), reading and billing errors. In 2020, these losses represented over 15% of total consumption, more than the consumption of the North and Midwest regions combined, creating upward pressure on electricity prices (ANEEL, 2021).

Large hydropower plants have been the dominant source of electricity production, explaining Brazil's high share of electricity from renewable sources of over 70% (Figure 6, Panel C). Brazil's high dependence on hydropower is not without risks, however. In 2021, the depletion in hydropower reservoirs, due to a sequence year with below-average rainfall, threatened the electricity supply for 203 million people who rely on hydropower for two-thirds of their electricity consumption (OECD, 2022a). At the same time, the shares of other renewable sources, such as wind, solar and bioenergy, have increased, reflecting Brazil's massive potential for wind and solar power plants (Figure 6, Panel D).

Figure 6. Electricity generation relies highly on hydropower



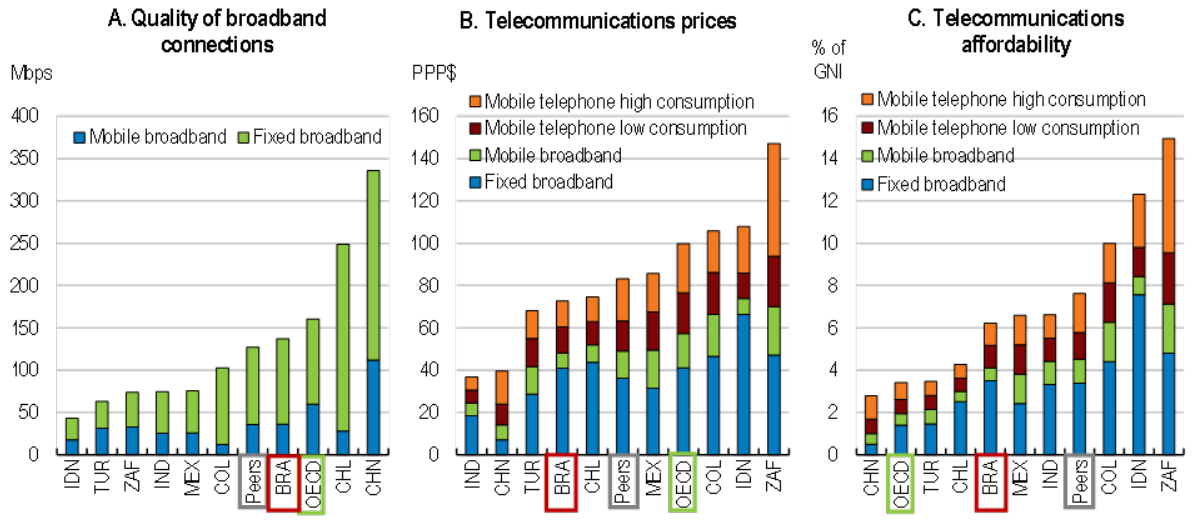
Note: Peers refer to Chile, Colombia, China, India, Indonesia, Mexico, Türkiye, and South Africa.
Source: World Economic Forum; World Bank; Our World in Data; and OECD calculations.

Telecommunications

Despite significant investments in telecommunications infrastructure over the past decade, particularly in residential internet and broadband speed (Figure 7, Panel A), facilitated by greater regulatory flexibility and the entry of smaller companies in the market, the availability of telecommunications services remains unequal. Across the country, nearly 5.5% of public schools do not have access to the internet, and 90% of these are in rural areas (Anatel, 2023). Rural areas also lag in mobile broadband coverage: only 54% of rural residents are covered by mobile services, compared to near universal coverage in urban areas.

High telecommunications prices are a key barrier to the adoption and uptake of services and new technologies, despite telecommunication services being considered essential and indispensable goods and services with reduced tax rates from 2022. A 2018 survey conducted by the Brazilian Network Information Centre found that among those that dos not yet have access to internet, 61% of households identified affordability as the main reason for not adopting the Internet (CGI.br, 2019, OECD, 2020a; Figure 7, Panel B and C). Taxes and fees applied to the telecommunications sector contribute to the comparatively high prices and low affordability, representing 40% of fixed and mobile broadband services prices (OECD, 2020b).

Figure 7. Quality and affordability of telecommunication services lag OECD countries



Note: Mbps refers to megabits per second. GNI refers to gross national income. Peers refer to Chile, Colombia, China, India, Indonesia, Mexico, Türkiye, and South Africa. Panel A shows median download speeds in December 2022. Data in panels B and C are for 2021.
Source: Ookla Speedtest Global Index; ITU World Telecommunication/ICT Indicators Database; and OECD calculations

Improving the efficiency of public investment in infrastructure

Beyond its trend decline, public spending on infrastructure has delivered results that often fell short of expectations in the last decades. This has often been related to shortcomings in planning and project execution, suggesting significant scope to enhance the efficiency of public infrastructure investment. Between 2007 and 2015, only 37% of planned public infrastructure projects were executed (IMF, 2018). More recently, between 2018 and 2020, more than 30% of public infrastructure projects are, either temporarily or permanently, interrupted and paralysed (Figure 8). Furthermore, newly completed infrastructure projects often fail to meet expectations. There are several examples of newly built infrastructure where user demand falls short of projections, leading to financial difficulties and unexpected public subsidies (Abrão Costa and Carrasco, 2018; World Bank, 2022a). Publicly financed infrastructure projects that are paralysed waste scarce public resources, while failing to deliver much-needed services. Underperforming infrastructure assets lock in resources needed for their operation and maintenance, while providing services at a higher cost and of a lower quality.

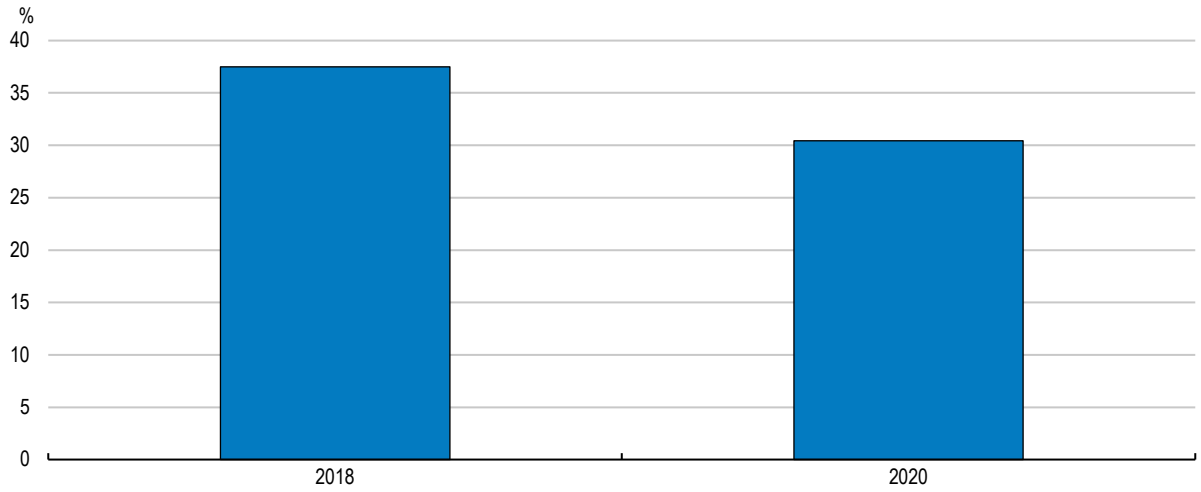
Many factors can influence the successful execution of infrastructure projects. Good quality projects generally start in the preparation phase, with adequate cost estimations over the whole life cycle of the infrastructure. The procurement phase can also significantly affect whether a project is successfully completed within the agreed terms and timeline. An efficient procurement process should be fair and provide equal treatment to bidders, it should promote healthy competition to obtain the best value for money, and it should be transparent to avoid corruption and bid rigging. Poor infrastructure service quality and overly high costs can also be linked with operational inefficiencies emerging after the project has been completed. Suppliers of infrastructure services, whether public or private, need incentives to continue investing in maintenance or capacity expansion, for example.

The broader business environment and regulatory framework also influence the ability to obtain good value for money. In fact, cumbersome and restrictive regulatory procedures, such as barriers to entry, limit competition, and therefore, restrict the quality of bidders, suppliers, concessionaires, and other available partners. Unstable and complex regulations also increase uncertainty and risk, lowering private sector interest. On the contrary, a friendly business environment that encourages innovation contributes to higher

quality standards, and sometimes even lower prices. In markets for infrastructure services, certain segments are often characterised by natural monopoly conditions as competition through a duplication of parallel infrastructure networks is not cost-effective. In these cases, regulation can separate the provision of a network from the provision of services over that network and ensure that service provision over the network remains competitive.

Figure 8. Many public infrastructure projects are paralysed

Share of publicly funded infrastructure projects that are temporarily or permanently paralysed



Note: Includes public infrastructure projects financed by Programa de Aceleração do Crescimento (PAC), Caixa Econômica Federal (CEF), Ministério da Educação (MEC), Fundação Nacional de Saúde (Funasa), and Departamento Nacional de Infraestrutura de Transportes (Dnit).
Source: Tribunal de Contas da União (TCU), "Diagnóstico sobre os principais Desafios Transversais da Infraestrutura (Caderno I)"; SeinfraUrbana.

Strengthening the institutional framework for project planning, selection, and execution

Brazil performs less well than other countries in the region or with similar income levels in the preparation phase of infrastructure projects, while it outperforms others in the areas of contract management and infrastructure asset management (Figure 9). Three preparation-related factors are systemically identified to explain cost overruns, long delays in execution, and poor-quality outcomes: imprecise project design, disputes with stakeholders or civil parties based on socio-economic or environmental impacts not duly anticipated, and funding discontinuity or uncertainty (TCU, *Fiscobras* 2015-2022).

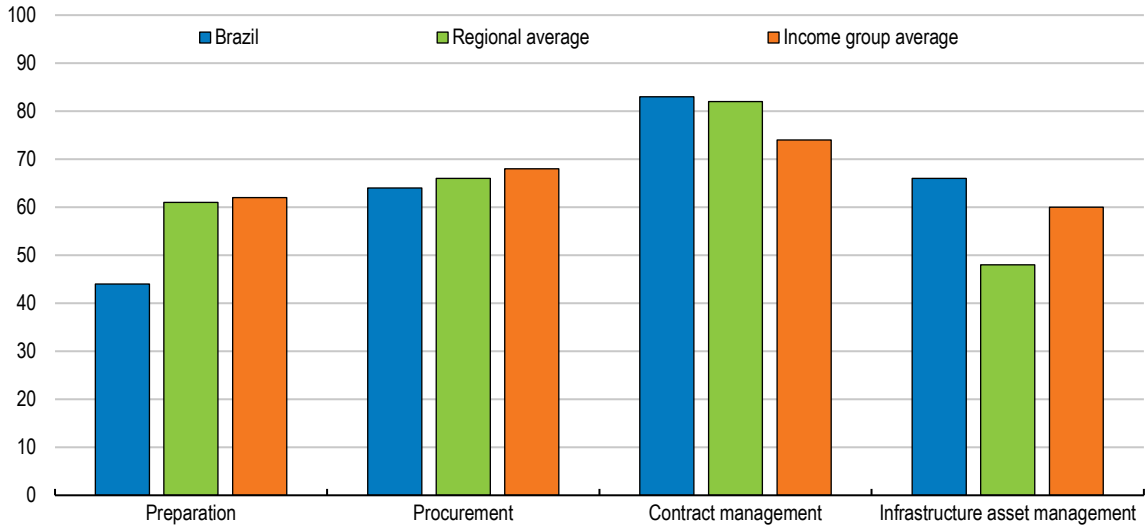
Effective infrastructure planning involves prioritising and coordinating decisions at different levels (OECD, 2014). At the broadest level of coordination across sectors, strategic guidance for public investment in infrastructure is largely absent. Although, sectoral planning documents provide detailed guidelines over a long horizon, there is still little coordination across sectors. Some of these plans benefited from the participation of qualified technicians, firms, and research institutes, but cross-sector collaboration remains limited. For example, there was little participation from transportation operators in the design of the National Energy Plan, little participation from energy operators in the National Transportation and Logistics plan. In addition, civil society organisations are barely represented in any sectoral committee (Insper, 2015; World Bank, 2022a).

Previous attempts to coordinate infrastructure investment across sectors were hindered by scale. In the early phases of the first edition of the Growth Acceleration Programme ("Programa de Aceleração do Crescimento", PAC), between 2007 and 2010, the Federal government defined priorities and coordinated

major infrastructure investments across different sectors and regions, consulting with different stakeholders. However, as the programme was progressively expanded and new sectors were added, the preparation and implementation of projects became increasingly more decentralised. Federal oversight and strategic coordination weakened, relying on varying degrees of technical capacity at the subnational government level instead, and the PAC project execution rate fell significantly (IMF, 2018).

Figure 9. Brazil performs worse than its peers in the preparation of public infrastructure projects

Scores in each infrastructure project cycle phase for public investment using conventional procurement methods



Source: World Bank (2020b), "Benchmarking Infrastructure Development 2020".

Failure to account for ongoing or planned developments in other sectors can result in unrealistic demand and supply estimations. The development of infrastructure in one area will have a significant impact on other sectors. The expansion of roads, rails, and waterways, for example, will have a meaningful impact on the demand for energy, sanitation, and digital services, as new infrastructure will likely direct the expansion of urban areas. The lack of coordination between sectoral investment plans also means that opportunities for cross-sector infrastructure sharing have not always been well identified and exploited. Digital and electricity networks, for example, both require wide distribution and strong cable infrastructure. By sharing infrastructure and working together, different sectors can help one another achieve wider access, higher service quality, and lower costs. Encouraging the participation of extra-sector agents in all sectoral planning committees can also lower the risk of dispute at later stages of infrastructure development, anticipating potential conflicts of interest and indirect undesirable effects.

Recent institutional developments look promising and should be pursued further. To improve long-term infrastructure planning and provide strategic guidance for public investment, the government created the inter-ministerial committee for infrastructure planning (CIP-Infra) in 2020, with representatives from the Presidency, several line ministries, as well as the internal audit court ("Controladoria-Geral da União", CGU). This committee published the first Integrated Long-term Plan for Infrastructure in December 2021 ("Plano Integrado de Longo Prazo da Infraestrutura", PILPI). Based on sectoral planning documents and additional technical studies, the PILPI brings together estimates of infrastructure investment needs in each sector, on aggregate until 2050, and in further details until 2030. Importantly, the PILPI harmonises the methodology and underlying projection assumptions across sectors.

Inter-ministerial collaboration in the definition of a long-term infrastructure development strategy can bring multiple benefits. The involvement of the Ministry of the Environment and the Ministry of Integration and Regional Development guarantees that potential negative environmental and social effects are considered

and identified at an early stage, enabling the development of adequate mitigation and adaptation actions. Through the Ministry of Integration and Regional Development, regional development plans can also be used as inputs to the national plan. Furthermore, local governments can benefit from and use the same projection scenarios as the harmonised national plan, thereby improving the coherence of national and subnational infrastructure investment plans. This is particularly relevant for the development of sanitation and urban mobility infrastructure, which fall under the jurisdiction of subnational governments. The government should continue to promote inter-ministerial collaboration to develop and update integrated infrastructure development plans.

Infrastructure plans should systematically be submitted for public consultation early in the process. Beyond the involvement of line ministries, organisations from the civil society also need to be implicated as early as possible. This includes worker and firm representatives and environmental protection organisations. Even if these organisations participated in some sectoral and local plans, they should also be consulted about an overarching national strategy, especially if this document is to serve as a basis for decision-making on budget allocations. The first version of the PILPI was not submitted for public consultation and the government should consider organising public consultations for future versions of the plan. Public consultations improve transparency, reinforce the legitimacy of strategic documents, and mitigate the risk of conflict (BID, 2020).

Strategic planning documents need some binding power to ensure that they are effectively translated into budget allocations over time. Up until 2023, the Federal government's main medium-term budget planning instrument was a four-year plan, "Plano Pluriannual" (PPA), which defines objectives for all policy areas, including capital expenditures. However, four years is a short horizon to efficiently plan for infrastructure with an expected lifetime of 20 years or more. Full life-cycle costs, including operating and maintenance costs, are not considered in the PPA. Furthermore, projects listed in the PPA are not systematically linked to annual budgets. An annual monitoring report on the PPA implementation is analysed in Congress, but it only includes projects from the current budget year and does not provide updated projections for the remaining period, making it difficult to assess progress on capital expenditures.

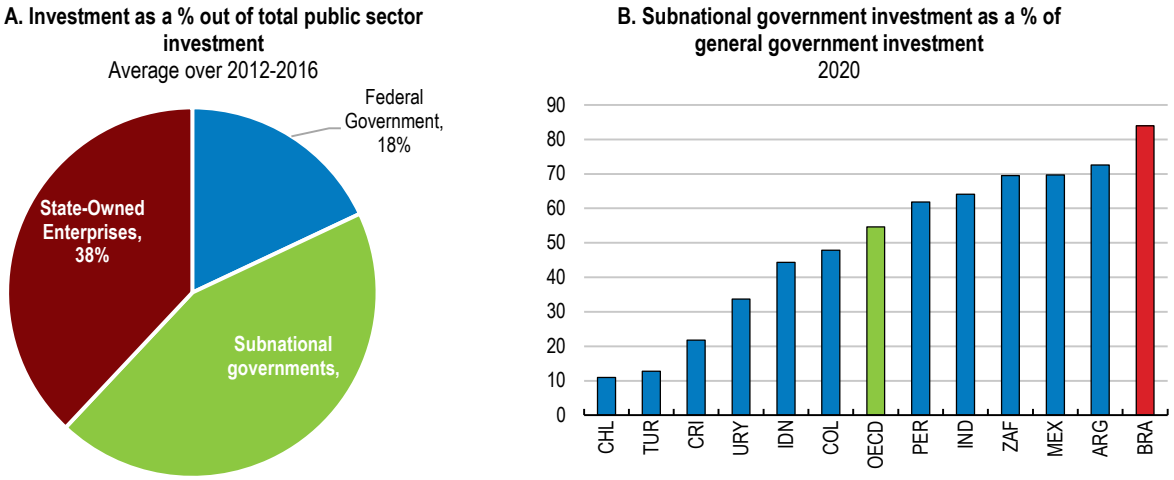
Going forward, Brazil needs to develop additional tools to promote the alignment between long-term infrastructure plans and budget allocations. The PILPI, or an equivalent integrated national strategic plan, could include annual milestones or objectives, and a project timeline, for example. This would facilitate monitoring. The integrated national strategic plan could even become a "project bank" and act as a pipeline of major projects that have been identified as strategic, assessed economically and environmentally, and discussed publicly. A central authority could verify that infrastructure investment using Federal funds reverts to projects identified in the integrated national strategic plan.

In addition, setting up a rolling medium-term fiscal plan, as currently envisaged by the government, would help allocate fiscal space to multi-year investment projects. The new fiscal framework specifies that a 4-year rolling budget should be included as an annex to the budget law each year, in compliance with the medium-term fiscal rules. Such medium-term rolling budget should increase the predictability of resources over time. To maximise its benefits, it should go beyond 4-years for major infrastructure projects, and systematically include life-cycle costs associated with these projects, such as operational and maintenance costs. Another advantage of this medium-term budget would be to facilitate monitoring and compliance with the new medium-term fiscal rules. Limiting the number of projects without a complete financing plan in the different line ministries would also lead to a better allocation of resources over multiple years.

Projects could be included in the rolling medium-term budget based on a clear prioritisation criterion. On top of having been identified in the PILPI as strategic and being backed by rigorous cost-benefit analyses, the government could require an assessment of the degree of innovation, the possibility for expansion, the risks involved, the extent of compliance with good governance practices and safety standards, or the level of local support, among other things. A Multi-Criteria Decision-Making (MCDM) tool could be used to determine the total score and ranking for each project (Hansen et al., 2018).

Most public sector investment is executed by subnational governments (Figure 10). However, local infrastructure plans are not always aligned with federal priorities and a consistent monitoring of infrastructure spending across different levels of government is difficult. Some financing flows for infrastructure spending can be easily monitored, such as automatic transfers from the Federal government to subnational governments. Line ministries can also decide on discretionary capital transfers to finance specific local infrastructure projects, often monitored by the public-sector bank "Caixa Econômica Federal". However, most subnational capital spending is financed from states and municipalities' own resources and borrowing, in which cases there is little federal oversight or coordination. Capital budgets of local governments are not even discussed by the central government and there is no consolidated view of total infrastructure investment by states and municipalities (IMF, 2018).

Figure 10. Subnational governments execute a large share of investment



Source: OECD-UCLG World Observatory on Subnational Government Finance and Investment 2022; and IMF (2018), "Technical assistance report: public investment management assessment". IMF Staff estimates based on official data.

Adding to the issue, the Federal government has traditionally not provided any guidelines on how to assess the economic viability of infrastructure projects and decide on the best funding modality. Consequently, some line ministries prepared rigorous cost-benefit analyses and contemplated the risks of alternative projects to be included in sectoral plans, while others didn't. Similarly, at the subnational level, varying levels of technical capacity have meant that the economic and financial feasibility of some local projects was never assessed. Lack of proper appraisal has often led to non-viable projects reaching the bidding phase.

To address the concern, the government has worked on a series of publications providing detailed explanations on standardised cost-benefit analyses since 2021, based on the methodologies and guidelines that were already in use for national projects in some sectors, such as energy, transportation, and logistics. The guidelines provide recommendations on how to measure social benefits and negative externalities, such as greenhouse gas emissions. A guideline with parameters was also published to ensure that all entities responsible for infrastructure investment adopt the same social rate of return or internal price on carbon, for example. Furthermore, it was established that all projects identified in the PILPI must necessarily present a cost-benefit assessment. These efforts have significant potential for achieving more consistent planning across all infrastructure projects and should be continued.

Beyond issuing guidelines, there is scope for more ambitious action, especially at the subnational level. The federal government should encourage line ministries to adopt these standardised methodologies before allocating funding to local projects. Cost-benefit analyses could be made mandatory before a ministry voluntarily transfers funds to a state or municipality, or yet, before it signs a grant or partnership agreement with local authorities and organisations. Additionally, the government should organise training

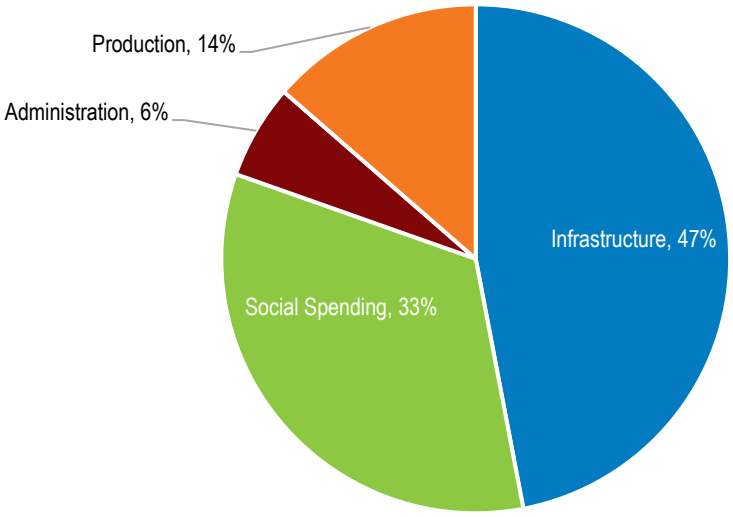
programmes for civil servants at all government levels in applying these methods (OECD, 2014). Such training could be mandatory for subnational government officials dealing with local investment planning and preparation.

Current budgeting practices can at times lead to unpredictable outcomes and foster inefficient allocations. When confronted with multiple potential projects, current budgeting practices lack a clear selection criterion for inclusion in the Federal budget. If a project requires payments over multiple years, there is no mechanism to carry-over budget appropriations, increasing funding uncertainty. Unpaid committed expenditures will compete for resources with new projects in the following years. Moreover, budget sequestration, a practice of revising downwards budget commitments during the year to meet fiscal rules, also adds uncertainty (Figure 11). This creates incentives to skip or speed up the preparation phase and start the execution, undermining project quality. This could be remedied by excluding strategic infrastructure investment projects from budget sequestration.

Beyond the budget allocation phase, failure to assign clear responsibilities for project implementation is another recurrent issue. Local infrastructure projects financed by the national development bank "Banco Nacional de Desenvolvimento Econômico e Social" (BNDES) and the public bank "Caixa Econômica Federal" (CEF) are regularly monitored, and funds are only disbursed after implementation plans have been properly developed, with the technical assistance of experienced bank staff. Complex infrastructure projects financed by these public-sector institutions often benefit from the banks' technical expertise in project structuring and implementation (Box 1). However, most infrastructure projects are implemented by government agencies, non-financial SOEs or subnational governments directly, who often lack project management capacity. Project managers, fully accountable for the implementation of the project, are not even always appointed, meaning that quality control is often lacking (IMF, 2018; World Bank, 2022a).

Figure 11. Budget sequestration affects the execution of infrastructure investment

Distribution of budget sequestration by budget item, average over the period 2010-2016



Source: Instituição Fiscal Independente, "Relatório de Acompanhamento Fiscal, Maio 2017", based on budget laws.

BNDES and local branches of CEF could further expand their project preparation services. Compared to other emerging markets national development banks, BNDES stood out for offering fewer consultancy services than its counterparts, although this has improved in recent years (Frischtak et al., 2017; Box 2). Given public banks' long-standing experience in preparing and managing infrastructure projects, such technical assistance could help filling gaps in project management capacity, especially at the local level. CEF has experience supporting subnational governments with preparing terms of references, terms of

execution, engineering projects, monitoring progress, and verifying that the execution meets initial specifications.

Box 1. Examples of infrastructure projects that received technical assistance from BNDES

BNDES currently mobilises a specialised team of almost 100 experts to coordinate and support the development of public-private partnerships in several infrastructure areas. In 2023, the infrastructure project support team had an active portfolio of 120 projects: 44 at the federal level, 51 at the state level, and 25 at the municipal level.

In 2018, BNDES signed an agreement with EPL ("Empresa de Planejamento e Logística"), a State-Owned Enterprise in the transport and logistics sector, to provide technical assistance with several transport infrastructure projects, mostly roadways, that have been pre-selected by the government. BNDES provided funding for preliminary technical studies and its staff integrated the working group in charge of structuring the selected projects.

In 2019, BNDES provided technical assistance to the city of Macapá in the state of Amapá, to prepare the concession contract for the city's public illumination services. The concession contract included several requirements regarding investment in the illumination infrastructure and resulted in the modernisation of 100% of Macapá lighting poles, with investments up to BRL 99 million.

From 2020 to 2022, 12 sanitation projects structured by BNDES were auctioned. These projects will benefit around 55 million people, with investments estimated at around BRL 118 million.

In 2022, Amapá requested the technical assistance of BNDES to prepare the concession of the urban solid waste management services for 16 of its municipalities. BNDES assisted the state in selecting the contractor responsible for all technical studies necessary to the project preparation.

Also in 2022, BNDES supported the state of Minas Gerais with the development of the terms of reference and the editorial for the concession of more than 432 kms of roadways, which will require approximately BRL 2.6 billion of investment. The auction took place in early March 2023.

In May 2023, the state of Pernambuco required the technical assistance of BNDES to expand its sanitation infrastructure. BNDES will be responsible for hiring and supervising specialised consultants carrying out all the preliminary technical studies. This includes a diagnosis of the current situation in the sanitation sector, estimates of investment needs, an assessment of alternative financing options, economic viability studies for potential concessions, among others. BNDES will also assist with the organisation of public consultations, roadshows to potential investors, and the auction preparation.

Source: Agência BNDES de notícias: Agência BNDES de Notícias – Página inicial; Hub de projetos do BNDES: https://hubdeprojetos.bndes.gov.br.

Aligning public procurement procedures with international best practices

Public procurement planning has improved in recent years. In 2017, public procurement represented around 13.5% of Brazil's total government expenditure and approximately 6.5% of the country's GDP (OECD, 2021b). However, before 2019, public entities purchasing goods, services and contracting public works, such as public agencies, subnational governments, or State-Owned Enterprises, were not required to present public procurement plans. It is now mandatory for all public authorities to disclose in advance the products, services, and public works that will be purchased and contracted each year. Since January 2022, there is also an obligation to formally monitor and report on the execution of these plans. Procurement planning enhances transparency and predictability, facilitates budget and treasury management, and provides a good basis for monitoring.

The preparation of public procurement procedures has also improved. Up until 2020, infrastructure projects could be tendered without any preliminary technical study. Opening a tender when a project is still not clearly defined hurts competition as bidders will not be willing to take on the risk (Section 2.3). It may also increase the final project cost, as bidders factor in risk and uncertainty in the proposed price, or even worse, use materialised risk to renegotiate ongoing contracts. Therefore, making preliminary technical studies for infrastructure projects mandatory was a step in the right direction.

Despite the recent progress, there should be more detailed and standardised guidelines on what to include and how to conduct technical preliminary studies. For instance, market surveys, which aim at identifying possible market alternatives and respective prices, are not always included since it is not a mandatory item (OECD, 2021b). The government should develop a standardised procedure for conducting preliminary technical studies, including market and price research as mandatory items.

Environmental licenses are another key source of uncertainty in procurement processes. Applications for environmental licenses often take place after the public tender has been awarded to a bidder. This means that, in many cases, there is no guarantee that the project being procured will obtain the necessary environmental licence to proceed, which increases uncertainty, discourages potential bidders from participating, and inflates prices, as bidders' factor in the risk and the expected costs in their proposals. The additional construction costs potentially resulting from meeting environmental requirements are not known during the bidding stage, which is the only moment when competition can be harnessed. After the tender has been awarded, one-on-one renegotiations between the winner and the public authority cannot ensure the same value for money. Conducting a thorough environmental impact study on behalf of the public sector agency that contracts the project before entering the bidding phase would bring sizeable benefits. This is usually the case for land transportation infrastructure projects, which are required to conduct Technical, Economic and Environmental Feasibility Studies (EVTEA) and Environmental Impact Studies (EIA), as well as to obtain a preliminary environmental licence, before reaching the bidding phase (Climate Policy Initiative, 2021). This could also be a solution for tenders in the energy sector, for example, where the current practice is that all bidders must apply for an environmental licence as part of the bidding process, even though only one will win the tender, which results in an unnecessary duplication of expenses.

Procurement processes could be streamlined by using standardised procurement forms covering all stages of the procedure. The federal government has been developing standard electronic templates for several procurement documents, such as the terms of references and the editorial. Such templates have been progressively uploaded in the Federal government's on-line platform to manage all stages and documentation related to public procurement, the "Portal Nacional de Contratações Públicas" or PNCP, since 2022. The government should continue such standardisation efforts and consider making the templates mandatory for all types of procurement. This could significantly reduce administrative errors and legal loopholes which have been frequent (World Bank, 2017). By limiting unclear or incomplete tender terms, it could also attract a larger number of bidders.

Electronic procurement encourages participation and increases competition. E-procurement lowers tendering costs for potential bidders, in particular for foreign firms or firms operating in other parts of the country. It can also result in lower administrative costs. The new 2021 procurement law establishes that electronic procurement should be preferred over in-person procedures. However, electronic procurement is not mandatory. Also, there are several e-procurement platforms operating in Brazil. "Compras.gov", the Federal government platform linked to PNCP, only covers part of the public procurement carried out. Many states and municipalities use other portals (OECD, 2021b). Consequently, procurement data and information about prices is difficult to gather and analyse. Brazil should make the use of e-procurement mandatory, unless the submission of physical samples is necessary, using a centralised and unique web platform (OECD, 2021b). At a minimum, it should be mandatory for projects that receive funding from multilateral development banks and from the Federal government to use the Federal government's web purchasing portal "Compras.gov".

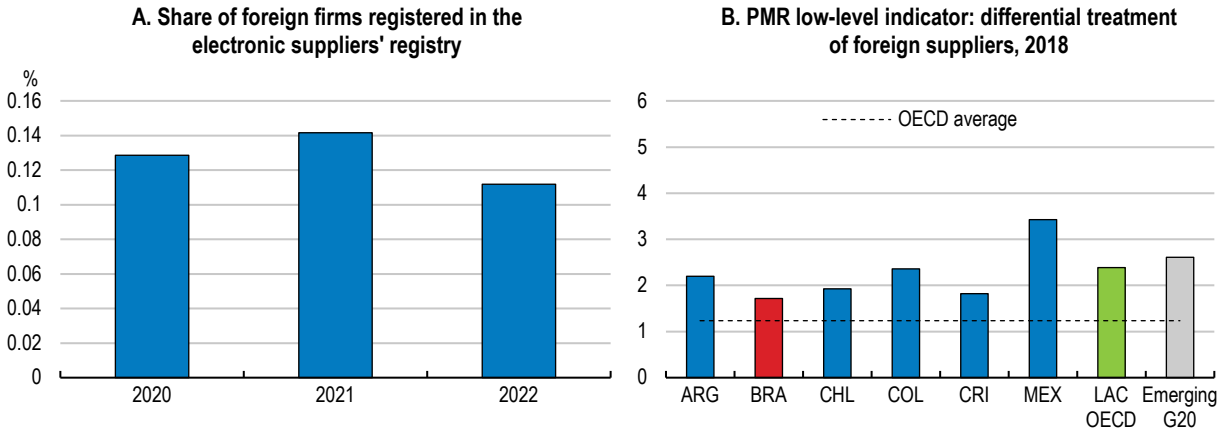
To maximise the participation of genuine competitive bidders, it is important to treat national and foreign bidders equally. Brazil has improved on that front recently. Since 2020, foreign companies can participate in all procurement processes and register in the electronic suppliers' registry, provided they meet all the legal and technical requirements. The requirement to submit certified translations to participate in bids has also been abolished. However, foreign bidders are still required to form a consortium with domestic companies and these consortiums must necessarily be led by the domestic company. In addition, foreign participation is also hampered by high trade barriers, such as local content requirements (Figure 12).

Brazilian procedures can be excessively complex and make bidding less attractive for foreign companies with an informational disadvantage and small business owners (OECD, 2020e). The law regulating the general regime of public procurement is changing. A new law was adopted in 2021, but its full implementation has been postponed to the end of 2023. Until then, public entities are given the choice to apply either the old or the new regime, adding another layer of complexity. States and municipalities have been transitioning to the new regime with different speeds. The co-existence of the two regimes makes it particularly difficult for foreign firms to navigate the Brazilian procurement system on their own. It also discourages small firms, who do not necessarily possess the human resources needed to navigate the complex procurement system (OECD, 2020e). The government should accelerate the transition to the new regime by providing states and municipalities with technical assistance in developing the regulation needed to implement the new legal framework. Workshops disseminating the positive results obtained in the states that are well advanced in adapting the new law, such as Paraná, could be helpful.

Price is not necessarily the only suitable contract award criteria for complex infrastructure projects. Awarding contracts based on the technical performance, functional characteristics, aesthetics, operation and maintenance requirements, technical assistance provided, for example, leads to better outcomes (OECD, 2021b). Likewise, performance-based contracts can pre-empt low output quality. Performance-based contracts define schemes with penalties or rewards throughout the contract period, linking remuneration to the ability to meet pre-defined objectives. These objectives should be based on measurable quality standards and could include, for example, minimal road maintenance requirements.

In Brazil, most tender contracts are awarded based only on price and rarely provide performance incentives (Insper, 2015; World Bank, 2022a). The government should encourage the use of non-price award criteria and performance-based contracts, both when building new infrastructure and when contracting infrastructure services. This would increase concessionaires' incentives to continue investing in infrastructure maintenance, modernisation, and expansion (OECD, 2021b). Non-price criteria and performance-based contracts, nevertheless, require highly qualified staff to assess the technical quality of bids, monitor contract execution, and compare the observed outcomes to well-defined quality standards.

Figure 12. Few foreign firms participate in public procurement



Note: In Panel B, index scale 0 to 6 from most to least competition-friendly regulatory framework. Latin America OECD economies is the average of Chile, Colombia, Costa Rica and Mexico. Emerging G20 economies is the average of eight countries: Argentina, Brazil, China, Indonesia, Mexico, Russia, South Africa and Türkiye.
Source: Portal de Compras do Governo Federal; OECD 2018 PMR database; and OECD calculations.

Public entities often lack the time, human, and financial resources to conduct the procurement process properly. Procurement officials' salaries are low, and training is often inadequate. Developing a specific training and career path for public procurement officials and improving employment conditions could help to attract qualified individuals. Moreover, procurement officials who wrongly and intentionally apply procurement rules can be accused and prosecuted on the basis of penal law and sanctioned with heavy fines, even if such acts do not involve private gains (OECD, 2021b). Consequently, the profession is far from being popular among public officials and public procurers usually favour conservative solutions to innovating ones. Clarifying the interpretation of the procurement law would be a more effective correcting mechanism than applying penal sanctions to individual public officials. This could be achieved in the context of expanding BNDES' and Caixa Econômica's technical assistance services to support public entities throughout the procurement process, as discussed above.

Across the world, public procurement is typically an area that is particularly at risk of corruption. Brazil's complexity, multiplicity of stages and stakeholder involved make infrastructure projects highly vulnerable to corruption (OECD, 2017). Corruption leads to public funds being wasted through higher expenses and infrastructure with lower quality. Those paying bribes often seek to recover their money by inflating prices, billing for unperformed work, failing to meet contract standards, or reducing the quality of materials used (OECD, 2016). Tackling corruption requires strong and independent law enforcement institutions. The autonomy of the Federal police and public prosecutors should be strengthened. Political interference should be avoided through clear rules-based selection processes. Whistle-blowers and officials involved in anti-corruption investigations should be protected against retaliation and intimidation, as recommended in previous *surveys* (OECD, 2020c).

Beyond general measures to fight corruption, other measures could be implemented that are specific to public procurement. For example, to minimise political interference in public procurement, civil servants responsible for auctions should be permanent employees. In addition, each public procurement phase should be carried by a different public servant to maximise transparency and avoid decision-making by a single individual (OECD, 2021b). The committee in charge of managing and developing PNCP, and regulating public procurement, should have financial and decisional autonomy (Mohallem and Ragazzo, 2017). Currently, this system is managed by a team in the Ministry of Management and Innovation in Public Services, making it vulnerable to changes in political priorities.

Lowering the regulatory burden and increasing market competition

Brazil has made considerable progress in modernising its regulatory practices and aligning them with international good practice over the years, but efforts have been mostly at the Federal level, with more uneven progress at the level of subnational governments. Brazilian states have the power to pass rules and legislation with respect to protecting the environment, exploiting water and mineral resources, protecting historical, cultural, artistic, touristic heritages, and landscape, among other things. Municipalities legislate on urban transport and land use planning, for example. These are important areas that will affect the regulatory environment for executing infrastructure projects, and they can at times even give rise to duplication or conflicting regulations across levels of government (OECD, 2022b). Some countries have specific bodies that promote the use of good regulatory practices and alignment across levels of government, such as the National System for Better Regulation in Mexico (OECD, 2022b; Box 2). Brazil could consider the creation of a national regulatory body that would oversee subnational regulatory practices. Organising workshops to share lessons learned, successful cases, and promote the exchange of information, can also be an effective tool for ensuring policy consistency.

Box 2. The National System for Better Regulation in Mexico

In 2018, Mexico issued the General Law for Better Regulation, which aimed at harmonising regulations across three levels of government: federal, state, and municipal. The law institutionalised the National System for Better Regulation, formed by a national council, a national strategy, a national commission (CONAMER), a national observatory, and units for better regulation in every state.

The council meets at least twice a year and is responsible for co-ordinating with state-level entities in charge of better regulation to ensure that the national strategy is implemented at the subnational level. The commission is a federal agency, with technical and operational independence from the government, in charge of providing technical assistance and background studies towards better regulation. The observatory is an instance of citizen participation in charge of monitoring and evaluating the implementation of better regulation at the subnational level.

Source: OECD (2022b), "OECD Reviews of Regulatory Reform: Regulatory Reform in Brazil", OECD Publishing, Paris; Gobierno de México, CONAMER: https://conamer.gob.mx/.

At the federal level, regulatory agencies play a key role in defining the rules and incentives for infrastructure investment in several sectors. They can do so through interventions that tackle asymmetric information, reduce barriers to entry and set standards for portability or interoperability where appropriate. Empirical evidence shows that, when independent, i.e., when operating autonomously and with no undue influence from political forces or private entities, regulatory agencies can significantly improve the performance of infrastructure services delivery (World Bank, 2022a). Agencies that lack autonomy are less likely to publish basic data or perform public consultations. They may also have ad-hoc advisory committees or no committees at all, relying instead on a single decision-making individual.

The Regulatory Agencies Act of 2019 ("Lei das Agências Reguladoras") sought to increase the transparency and the accountability of regulatory agencies. This law made it mandatory for regulatory agencies to conduct ex-ante Regulatory Impact Assessments before introducing any new regulation or modifying existing rules. It also became mandatory to hold public consultations and hearings, to include interested parties in the development of new regulation, and to regularly report to Congress. Some agencies had already voluntarily adopted such practices, but the Regulatory Agencies Act standardised and harmonised processes across all economic sectors, reinforcing the credibility of Brazilian regulatory agencies (Ramalho et al., 2022).

Going forward, the government should continue its efforts to increase the independence of regulatory agencies. Political interference in the appointment of board members has been frequent (Cunha and Goellner, 2020). Delays in nomination processes are recurrent and interim directors tend to be more

vulnerable to pressure. Moreover, although regulatory agencies have some budget autonomy, their allocated funds each year have been volatile and can be affected by budget sequestration (FGV/CERI, 2016). Another recurrent practice is to delay the transfer of allocated funds, creating a gap between financial needs and available resources. Volatility, uncertainty, and delays in funding availability constrain the action of Regulatory Agencies. Regulatory agencies should have a direct mention in the annual Federal budget, separated from their associated ministry's budget line, and negotiate directly with the Ministry of Finance. Their budget should be excluded from budget sequestration. In addition, disbursements could be fractionated in one-twelfth for each month to increase predictability and reduce misalignments.

In some cases, regulatory agencies act both as regulators and authorities in charge of tendering and contracting infrastructure concession projects, which often leads to conflicts of interest (IMF, 2018). There should be a clear separation between the regulatory functions and the concession contract management functions within Regulatory Agencies.

Regulatory agencies can play an important role to promote cross-sector infrastructure sharing. Since 2015, telecommunications operators, working on expanding their cable network, can take advantage of roadways or railways exploited by other operators. Another Decree, in 2020, reinforced that any infrastructure construction works, with public interest, should be able to accommodate telecommunication cables. However, this added burden on transport operators (Benedeti Rosa, 2022). The lack of incentives for transport operators to accommodate the measure led to several judicial disputes. To improve the alignment of interests, the land transport regulatory agency should clarify cases in which fees for passage could apply and statute on their value.

Brazil has also made significant progress in some sector-specific regulatory frameworks, most notably water and sanitation. Before 2020, regulation was under the responsibility of more than 100 local regulatory agencies, who barely met the necessary conditions for developing good regulatory governance (World Bank, 2022a). There was very little regulatory oversight, and it was often subject to local political interference. Since the reform, called "Novo Marco Legal do Saneamento", the national water regulatory agency ("Agência Nacional de Águas e Saneamento Básico", ANA) has the responsibility to establish general guidelines that apply across all states and municipalities, harmonising the regulation and providing clarity and certainty (OECD, 2022a). This will contribute to increase the sector's attractiveness for private operators. For the reform to be effective, it is important to build adequate institutional capacity for ANA's extended mandate, ensuring the agency has appropriate funding, human resources, and competences (OECD, 2022a).

The new water and sanitation law also brought about several innovative developments. New concession contracts must now be attributed through a competitive public procurement process and include an objective of near-universal coverage. This aims to ensure that the most qualified operators, public or private, are selected, and that they have strong incentives to invest in expanding coverage. The new law also establishes that services should be auctioned, grouping several cities or municipalities together. This allows exploiting economies of scale, while ensuring that smaller and remote municipalities are covered. However, adhesion to this grouping has been voluntary, and so far, not many services have been jointly auctioned. The joint scheme was supposed to become mandatory in March 2023, but the deadline has been postponed to March 2025. The government should accelerate adoption of the joint auction scheme. Disseminating information about successful cases and promoting the benefits of collaboration across municipalities through workshops and seminars may improve the adoption of this new tool (OECD, 2022a).

In the railway sector, it is now possible for private investors to expand the network, or exploit idle railways, with a simple administrative authorisation. This should lower administrative costs and increase flexibility. The government, on the other hand, transfers the risk and the burden of infrastructure project preparation to the private sector. The new regulatory framework also states that surroundings can now be exploited to develop shopping malls, private parking, restaurants, or other commercial activities. By allowing private investors to exploit adjacent areas for commercial purposes, and for profit, the government aims to

minimise public subsidies. In early 2022, six months after the introduction of the new railway regulatory framework, more than 2.4% of GDP in private investments had already been authorised, corresponding to 6800 kms of new rail tracks. It is important, nevertheless, to clearly define the new authorisation regime to safeguard public interest and limit space for interferences. Without specific implementing regulations that define the exact terms for the use of this authorisation regime, it is hard to assess the new regime, and there is even a risk that it could lower transparency and accountability (Cozendey and Chiavari, 2021).

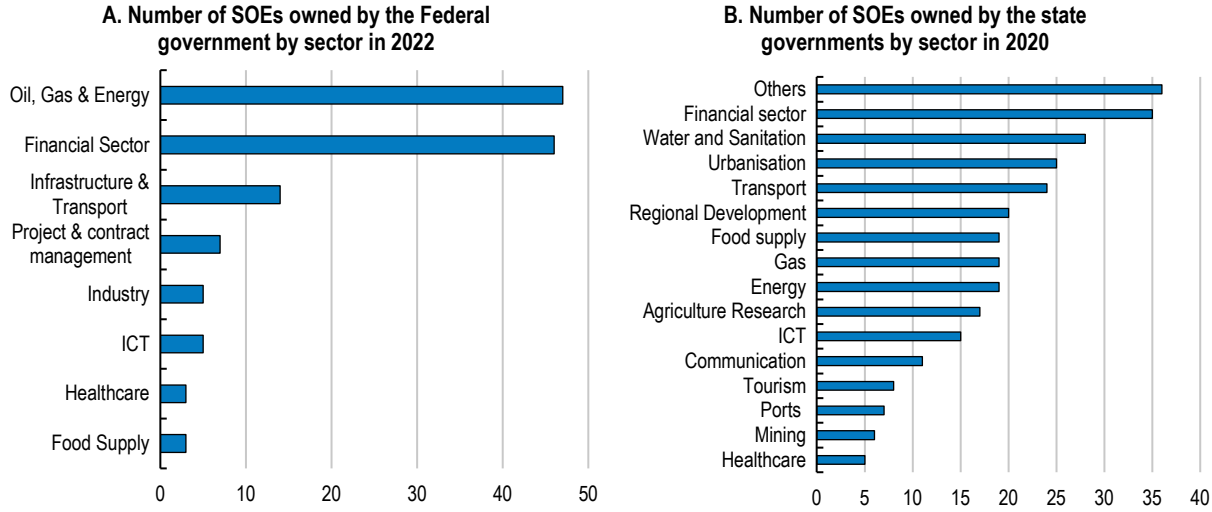
Another area where the regulation improved considerably is the natural gas sector. The government approved a new regulatory framework for natural gas in 2020 which separates the markets for production, transportation, and distribution of gas. Consequently, different firms can now operate in each market, fostering competition. The new gas framework also instituted the authorisation regime for private investors to develop new gas pipelines, which is administratively simpler than concessions. Increased competition in the gas sector is expected to reduce prices, and the new authorization regime to increase investments and the offer of natural gas in the next years.

Improving the governance of State-Owned Enterprises

To make the most of its infrastructure assets, Brazil could also address several bottlenecks in the governance of State-Owned Enterprises (SOEs) delivering public infrastructure services. Brazil has 130 SOEs operated by the central government (Sest, 2022), and another 260 operated by state governments (Tesouro Nacional Transparente, 2021). At the Federal level, SOEs are particularly present in energy sectors such as oil, gas and energy, infrastructure, transportation and logistics services, and Information Technology and Communication (Figure 13, Panel A). At lower levels of government, SOEs play a dominant role in the water and sanitation sectors of almost every state (Figure 13, Panel B). The performance of SOEs is therefore of great importance for the delivery of high-quality infrastructure services.

Public enterprises may help to further legitimate policy objectives and can be an effective policy tool, provided that they operate in a sound regulatory environment. Experience shows that market-led development is the most effective model for efficient allocation of resources. However, in areas where competition is not deemed feasible, where there are “natural” monopolies, like in many infrastructure sectors, there is a rationale for state ownership of enterprises (OECD, 2015a). Nonetheless, SOEs face distinct governance challenges. They may suffer from undue political interference or weak oversight due to distant ownership by the state. Compared to the private sector, SOEs in Brazil tend to underperform when confronted with negative shocks (OECD, 2020d). As a result of underperformance, annual fiscal injections to SOEs are, on average, 0.6% of GDP for the energy and transportation sectors alone (World Bank, 2022a).

Figure 13. State-Owned Enterprises are particularly present in economic infrastructure sectors



Source: Boletim das empresas estatais federais 23ª edição, 3rd quarter of 2022; Tesouro Nacional Transparente, "Raio-x das empresas dos Estados brasileiros", 2020.

The "SOE Statute" of 2016 has helped reduce political interference in the management of Brazilian SOEs and advance the professionalisation of its boards (Vitale et al., 2022). The Statute established clear rules for the appointment of directors, including minimum experience, academic background, and morality requirements, as well as a minimum "cooling off" period if coming from political office. However, full implementation of the new Statute is still ongoing (OECD, 2020d; Vitale et al., 2022). Some national SOEs have not yet been able to prove that their senior corporate officers have the professional experience, knowledge and academic training required. Many SOEs at the subnational level are non-compliant. In fact, there is no federal agency to control nominations at the subnational level. The government should continue to implement the "SOE Statute" and enforce it at all levels of government.

Despite the progress, public authorities are still involved in the management of SOEs. Line ministers or the President of the Republic can nominate CEOs and other senior executives for national SOEs. Although the board of directors must approve the nomination, there is no known case where the board has denied the appointment (OECD, 2020d). Adding to the issue, the government is currently considering reducing the "cooling off" period between political office and an SOE management position from three years to one month ("Projeto de Lei 2896/2022" approved in the lower chamber in December 2022). Major corruption cases in the last years involved the political appointment of individuals to high-level positions in SOEs, often in exchange for parliamentary support, which can reduce the quality of their leadership (Hansen and Burdescu, 2020). Therefore, the government should maintain a reasonable "cooling off" period between political office and taking on a management position in an SOE.

SOEs are sometimes at risk of being used for political purposes that are not aligned with public policy objectives. For example, the government often imposes requirements for SOEs to source inputs from relatively costlier national suppliers. Such requirements can contribute substantially to delays and cost overruns in large-scale infrastructure projects (OECD, 2020d). Another practice has been to set regulated prices for goods and services provided by SOEs, impacting their ability to operate efficiently. This includes, for example, restrictions to increase energy and transportation prices (Vitale et al., 2022).

Not all SOEs have a structural separation between policy-related activities and commercial or competitive ones. Furthermore, most ministries have no clear separation between public officials responsible for ownership functions of SOEs, and those in charge of designing and implementing sectoral public policies (Vitale et al., 2022). This makes it difficult to estimate costs, fund, and compensate for the pursuit of public policy objectives. It also makes it complicated to assess whether compensation is adequate given the

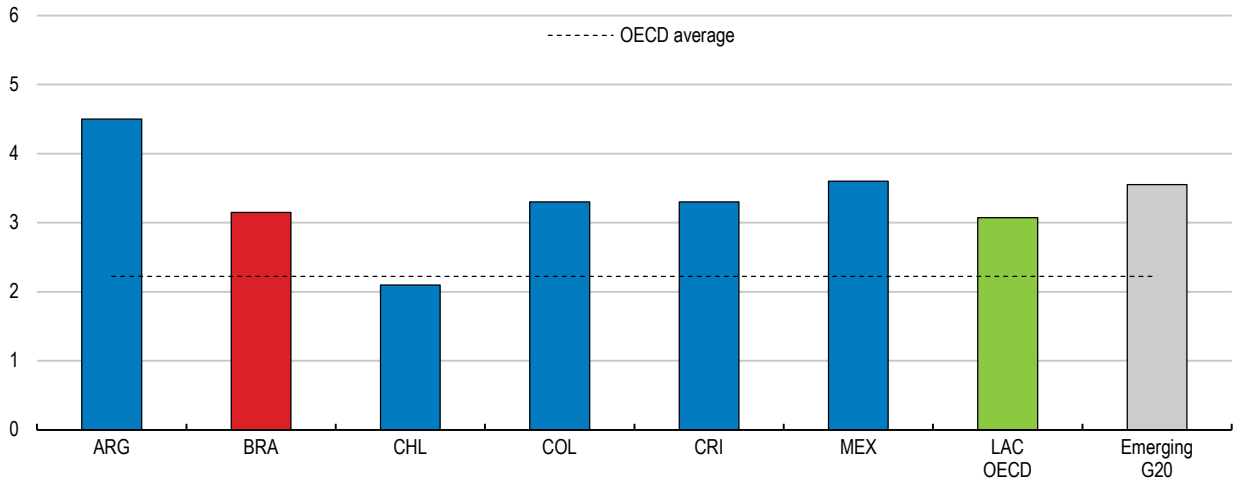
actual costs of fulfilling well-defined policy objectives, as opposed to offsetting financial or operational inefficiencies. Consequently, improvements in SOE performance are often hard to monitor.

SOEs may also be disadvantaged by their status when it comes to transactions on input and labour markets. For example, they must apply complex and burdensome state law for public procurement when purchasing any material and equipment, or when making capital investments. SOEs are also required to use official competitive examinations to hire employees and adjusting their workforce to changing needs in either direction may be bound by more stringent rules than those applying to private enterprises (OECD, 2020d).

The above-mentioned bottlenecks may explain why Brazil still compares unfavourably with the OECD average and the OECD Latin American average in terms of SOEs' governance quality (Figure 14). Against this background, further efforts to improve the governance of SOEs are warranted (Vitale et al., 2022). Public authorities should ensure the swift implementation of the 2016 "SOE Statute" at all government levels, including for subnational SOEs. Identifying the rationale that justifies the public ownership of SOEs and defining clear policy objectives in a transparent manner would help to minimise the scope for political interference as recommended in previous *surveys* (OECD, 2020c; 2018a). Boards of directors should have the power to appoint and remove the CEO, as well as senior executives (OECD, 2020d). Finally, setting financial and non-financial measurable goals would make it easier to improve SOEs performance. Compensation for SOEs' senior leadership should also be aligned with market practices, to attract and retain talented professionals that would otherwise move to privately owned corporations (OECD, 2020d).

Figure 14. There is still room to improve and align the governance of SOEs with OECD standards

Product Market Regulator, low-level indicator on the governance of SOEs, 2018



Note: Index scale 0 to 6 from most to least competition-friendly regulatory framework. Latin America OECD economies is the average of Chile, Colombia, Costa Rica and Mexico. Emerging G20 economies is the average of eight countries: Argentina, Brazil, China, Indonesia, Mexico, Russia, South Africa and Türkiye.
Source: OECD 2018 PMR database; and OECD calculations.

Enhancing financing options for infrastructure projects

Gaps in the financing of infrastructure

Besides spending available funds more effectively, tapping into new funding resources will be key to address the observed shortfall in infrastructure investment. One key bottleneck has been the low

infrastructure investment by the public sector, which has declined considerably over the past decade, both in relative and in absolute terms. In 2010, 57% of total investment came from the public sector, but this share decreased to 33% in 2022 (Figure 15, Panel A). Public investment is mostly concentrated in state-owned enterprises and highways built by the states, while the private sector has become the driver of around two thirds of total investment since 2019. Private investors account for nearly all investments in the telecommunications sector and over three quarters in electricity (Figure 15, Panel B). Public funds made up 80% of investment in the sanitation sector and just over half of the transport sector investments. Railways, roads and airports have seen strong increases in private participation in recent years. However, private investments have been more limited in sectors with high social returns as urban mobility and basic sanitation in rural areas, pointing to the need for public intervention to create the conditions for higher investment (Inter.B, 2022).

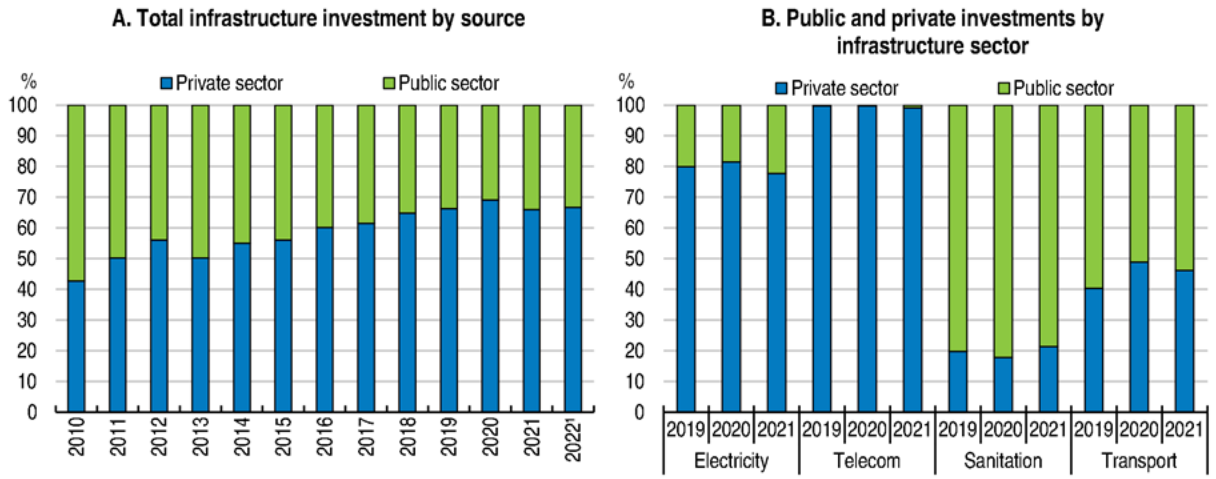
Against the background of budget rigidities and rising mandatory spending, discretionary public investment expenditures have proven to be the only remaining margin of fiscal adjustment. Fiscal consolidations have almost always resulted in cuts to capital outlays, significantly affecting spending on infrastructure. Although the new fiscal framework is likely to provide more flexible conditions for public investment, the current fiscal situation implies that the funds available for public investment in infrastructure are unlikely to increase much in the medium-term.

The lack of financial capacity at subnational levels of government, notably municipalities and states, has been one of the key reasons for under-investment in infrastructure, especially in urban mobility, water and sanitation. Subnational governments are subject to strict rules that limit their ability to take up debt, as a lesson learned from past experience. In particular, they cannot issue bonds, but are allowed to borrow from banks and multilateral lenders, subject to debt ceilings of 200% of net current revenues for states and 120% of net current revenues for municipalities (OECD/UCLG, 2022). Within these strict limits and conditional on the state of their fiscal accounts, states and municipalities can obtain guarantees from the federal government, which reduce their financing costs. The state of their fiscal accounts is evaluated through a rating based on a composite index called CAPAG and the criteria to obtain federal guarantees were significantly tightened.

While the case for caution regarding subnational government debt remains strong, there is substantial heterogeneity in the fiscal situation of subnational governments, and the current framework could do more to reward those with strong fiscal positions, not least to create stronger incentives for states to conduct prudent fiscal policies in the future. For example, states and municipalities with reimbursement capacities could be allowed to issue infrastructure bonds within new margins defined according to their rating under the CAPAG. This would open up access to capital markets for creditworthy subnational governments and allow some of them to finance additional infrastructure investments through capital markets, while distributing the financing burden across the future beneficiaries of such investments (OECD 2022c).

Even if some subnational governments would be able to tap into new financing options for infrastructure investments, opening up additional sources of private investment will be essential to fill infrastructure investment gaps in the medium run. In principle, additional private funds may well be available, both domestically and internationally, with further policy refinements. Private financing and management can also improve the risk allocation if exogenous demand risk is assigned to the public sector, while endogenous or internal project risks are assigned to the private parties, which provides strong incentives for efficiency.

Figure 15. Public investment has declined, and is concentrated mostly on the sanitation sector



Source: Inter.B. (2022); and OECD calculations

However, the private sector will only mobilise new resources if the public sector is able to create the appropriate framework conditions for this investment. This will require minimising avoidable risks such as those related to policy or judicial uncertainty, while properly allocating the remaining risks to create attractive investment opportunities and efficient risk sharing. In recent years, Brazil has accelerated its concession programme to attract further private financing in infrastructure. Most of this private participation has flown into electricity and telecommunication. This provides hope that better policy frameworks, including at the sub-national level, can attract more private investment. Stronger fiscal sustainability incentives for subnational governments would also help to make these stronger partners for private investors.

Diversifying the current model for public-private partnerships

Most private infrastructure investments take the form of concessions, which are contracts whereby private partners are remunerated mainly from user charges or regulated fees. It is the main model of private participation in the management or development of public infrastructure in Brazil. Between 2016 and 2022, 295 projects have been finalised or auctioned for an expected amount of investment of BRL 1.2 trillion (around 12% of 2022 GDP) and around BRL 226 billion (around 5% of GDP) of grants and payment receivable by public entities (Ministry of the Economy, 2022a). The programme of concessions has been expanded significantly from 2019 with around 174 auctions and projects finalised. Among the 166 projects auctioned between 2017 and mid-2021 and compiled by the World Bank's PPI database (2022), 126 were in the energy sector and mostly for greenfield electricity generation concessions, 15 covered highways, among which 4 greenfield projects, 7 were in the airport sector and the rest involved natural gas, water and sanitation, ports, and railways.

Public-private partnership (PPP) projects in the energy and inter-state transport sectors are awarded by the federal government, while state and municipal governments are responsible for local road PPPs and the water and sanitation sector. The latter will likely provide new private investment opportunities following the new legal framework for water and sanitation investments, which enhances the scope for private engagement in the sector and establishes mandatory key performance indicators.

Improvements in the government's concessions programme have accelerated private engagement in infrastructure investment in recent years. The establishment of the PPI Secretariat in 2016 tasked with centralising, selecting, and prioritising projects and monitoring their implementation, has streamlined, and increased the pipeline of infrastructure projects. The PPI secretariat is a dedicated agency attached to the

Office of the Chief of Staff at the Presidency (Casa Civil) that manages priority infrastructure projects across all phases, from preparation to bidding and asset management. PPI decisions require approval from the Council of the Investment Partnership Programme, a body under the Presidency of the Republic with representation from several ministries and public institutions and with technical opinions from experts. This arrangement has led to significant improvements in transparency.

The PPI framework has improved the coordination of large infrastructure projects and PPPs at the federal level (World Bank, 2022a). Key improvements have been in the preparatory phase of projects where the PPI is leveraging the technical and financial capacity of the national development bank BNDES and multilateral organisations such as the International Finance Corporation (IFC) and the Inter-American Development Bank (IDB) to complete project reviews, technical appraisals, and project structuring. BNDES provides technical preparation of projects with the creation of a so-called “Project Factory” in charge of contracting with the PPI. The PPI framework is further strengthened by specific environmental and social provisions, as well as reporting on the quality of services of infrastructures and evaluation and auditing by the National Court of Auditors (TCU). The TCU has provided detailed sector appraisals of infrastructure and has proposed measures to improve PPPs governance and contracting (TCU, 2022).

The lack of technical capacity at the federal and subnational levels of government, notably in some municipalities and states, as discussed in section 2.2., is hampering the further development and appropriate use of PPPs. Planning and technical capacity to develop PPPs, especially at the subnational level, is often weak and concentrated in just a few states and municipalities. The federal government intends to create a new fund to support the development and implementation of PPP projects, including technical and financial studies, at all three levels of government. Congress has approved the creation of such a fund with a government participation of up to 0.1% of GDP. For instance, providing higher grants to municipalities with low financial capacity to cover the extra-cost for projects preparation could improve the pipeline of projects. Brazil could also tap more into technical support from international development financial institutions, as in the successful example of São Paulo roads involving the IFC, IDB and BNDES and auctioned in 2017-2018.

Outside the energy sector, most concessions and PPPs are brownfield investment, showing the underdevelopment of greenfield investment to reduce the infrastructure gap. The participation and awarding of contracts to foreign firms have increased, indicating that the PPI has improved the diffusion of information and the transparency. However, concessions awarded to Brazilian firms are mainly financed by BNDES, regional development banks as Banco do Nordeste do Brasil and to a lesser extent by other Brazilian banks. The diversification of infrastructure financing has not seen significant progress. Only 7 projects received support from multilateral development banks, who have the long-term financing capacity that Brazil needs and could tap into (World Bank PPP dataset).

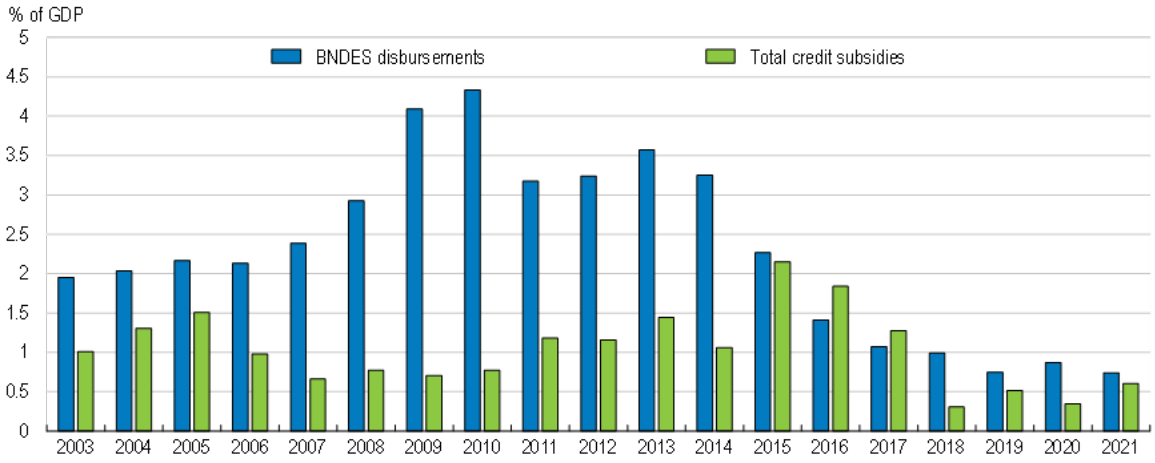
Improving infrastructure financing

The National Development Bank BNDES has historically played a central role in the long-term financing of the Brazilian economy and has been the principal source of financing for infrastructure projects. In the past, access to financing resources below market costs and government transfers allowed the BNDES to provide credit at more advantageous rates than other financial institutions. This dominant role of one public-sector institution, and the associated high fiscal costs that have characterised this model in the past, has been widely discussed, with many studies hinting at the benefits of moving towards a more diversified and competitive structure of the credit market (World Bank, 2018; Byskov, 2019; Frischtak et al., 2017; Pazarbasioglu-Dutz et al., 2017).

In 2018, the previous long-term benchmark rate for BNDES lending that was far below market rates was replaced with a new benchmark interest rate based on market rates, the *taxa de longo prazo* (TLP), for new loans granted by BNDES. This has significantly reduced credit subsidies. The reform and the changes

in the role of the BNDES in the financing of the economy have opened up more space for competition in the credit market. BNDES financing has receded substantially from 2015 (Figure 16).

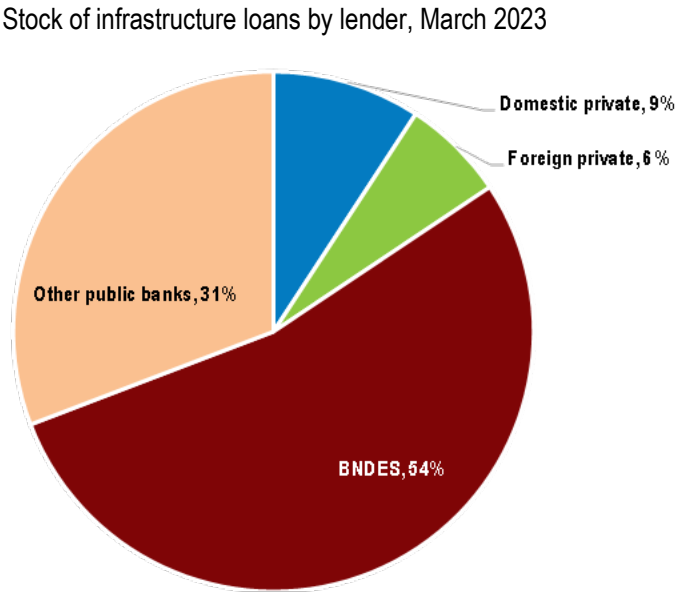
Figure 16. BNDES disbursements and credit subsidies have decreased



Source: BNDES; Ministry of Economy; and OECD calculations

At the same time, indicators of market concentration and competition have been improving and in particular, the number of financial institutions offering infrastructure financing has increased (BCB, 2022). However, public banks remain the main provider of financing for infrastructure. BNDES alone accounts for 54% of infrastructure financing in 2022 (Figure 17).

Figure 17. Infrastructure finance is dominated by public banks, in particular BNDES



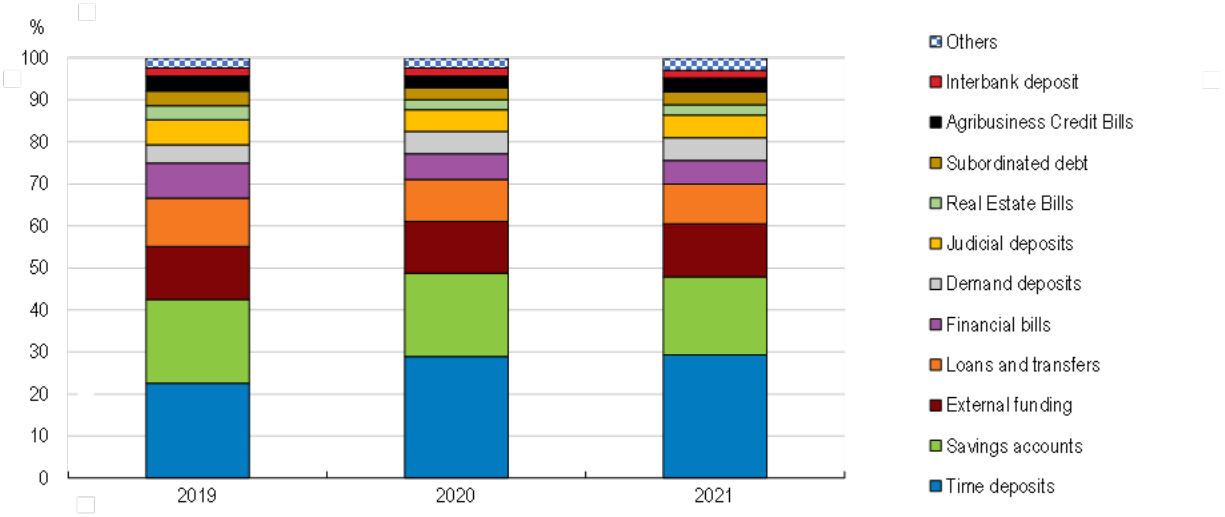
Source: Central Bank of Brazil.

Globally, private bank lending is the dominant source of infrastructure finance, at least for the construction stage of an infrastructure project, with large project debt often syndicated among a group of banks. In Brazil, only 15% of infrastructure financing comes from private banks and lending by commercial banks has traditionally been mainly in the short-term segments, with maturities below 3 years. Moreover, it has mostly financed operations and working capital while infrastructure and other investments have represented the biggest borrowing component for large firms in recent years (BCB, 2022). One reason

why domestic commercial banks are struggling to offer longer maturities is the short-term nature of their own funding, and the resulting risk of excessive maturity mismatch.

Short-term deposits represent the first source of financing for banks and are complemented by inter-bank borrowings, including overnight borrowing (Figure 18). Letters of credit (agribusiness, real estate, and the guaranteed real estate) and longer-maturity instruments, such as those exempt from income tax for individuals, are a relatively small source of financing compared to short-term vehicles.

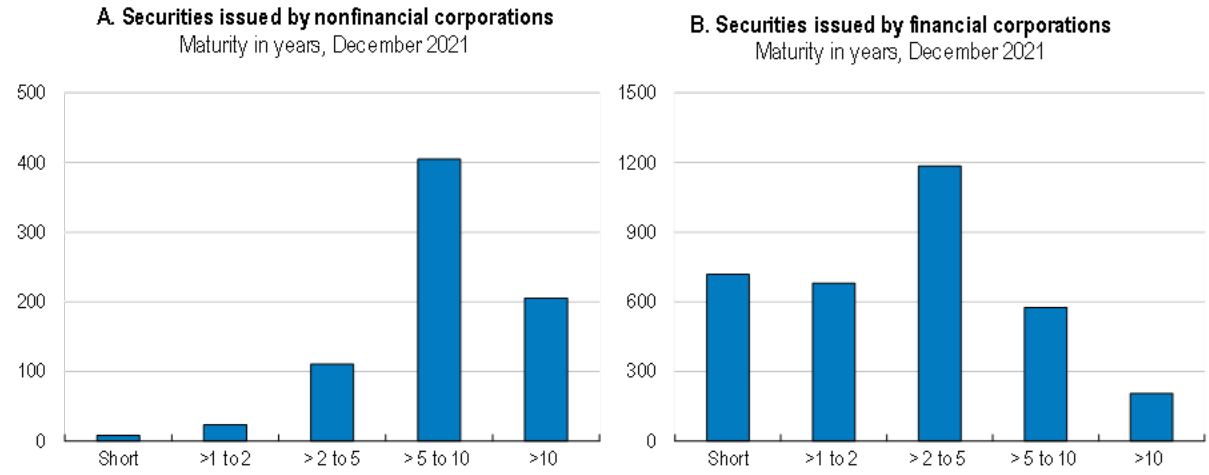
Figure 18. The financing of the banking system is tilted toward short term resources



Note: Time deposits: bank deposit certificates, bank deposit receipts, time deposits with special guarantees from the Credit Guarantor Fund (FGC). Subordinated debt, bank deposit certificates with subordination clause, financial bills with subordination clause, and instruments eligible for capital composition. Others include repurchase operations with private securities, guaranteed financial bills, structure operations certificate (COE), bills of exchange, mortgage bills, box operations
Source: Central Bank of Brazil, 2022.

Access to longer funding resources is still challenging for financial institutions. The mismatch between funding of financial institutions and infrastructure financing needs is illustrated by an asymmetry in the level of securities instruments issued by financial and non-financial corporations across maturities (Figure 19, Panels A and B). In particular, financial institutions struggle to attract funding with maturities above 5 years, which is where the majority of funding needs from firms is concentrated.

Figure 19. Borrowings mismatch by maturity of financial and non-financial corporations

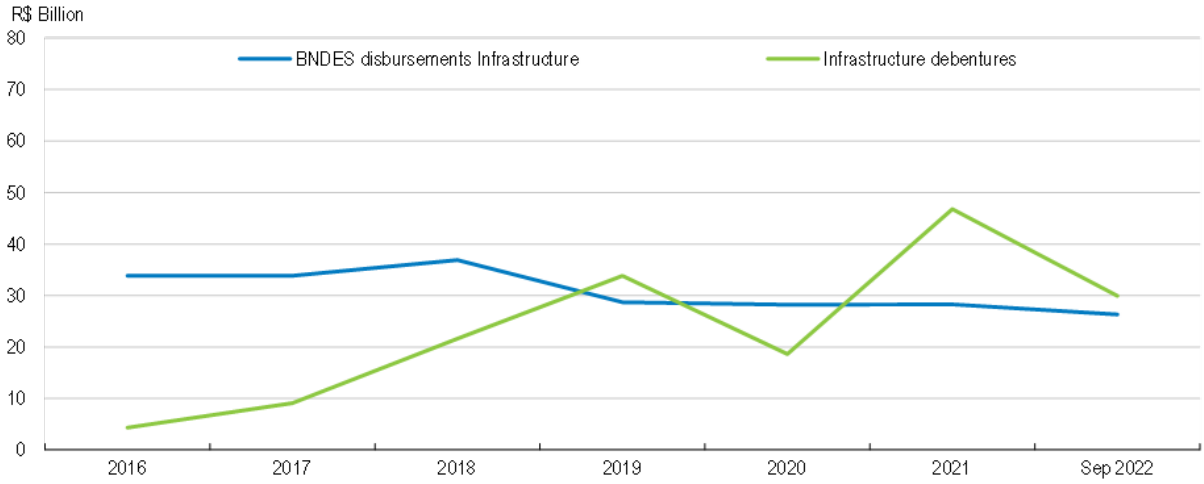


Source: Central Bank of Brazil, 2022.

The difficulties that financial institutions face to obtain funding with longer maturities ultimately reflect a longstanding focus of Brazilian financial markets on short-term assets in a context of scarce overall domestic saving (BCB, 2022). The investors focus on liquid, short-term assets and the underdevelopment of long-term financial markets are a market failure that may have several reasons. A volatile macroeconomic history may be one such reason, but other countries have managed to put behind them a turbulent economic past and make progress in financial market deepening. By now, Brazil has enjoyed more than two decades of successful inflation targeting and relative price stability. Another reason for the reluctance to invest in longer-term assets could be a lack of market confidence in the sustainability of public sector accounts, as long-maturity public bonds would be an important pricing benchmark for other long-term assets. In this context, strengthening the confidence into the future of fiscal accounts, through efforts such as the recently proposed new fiscal framework, plays a key role for the future of Brazil's financial markets and investment capacity. The new fiscal framework is also meant to reduce the need for future public sector borrowing, and lower public net lending would leave more resources for the private sector, which would be channelled through the financial sector.

In recent years, the development of the bonds market has partly compensated the lack of long-term credit for the financing of infrastructure. Special infrastructure bonds called debentures were created in June 2011 to attract investors into infrastructure financing with longer maturities. The debentures are issued by companies or special purpose companies (SPEs) to finance infrastructure projects considered priority projects by the federal government. Infrastructure debentures surpassed BNDES loan volumes for infrastructure financing for the first time in 2019, after starting from low levels in 2016 (Figure 20).

Figure 20. Infrastructure bonds have become the first source of infrastructure financing



Source: Ministry of the Economy, (2022b).

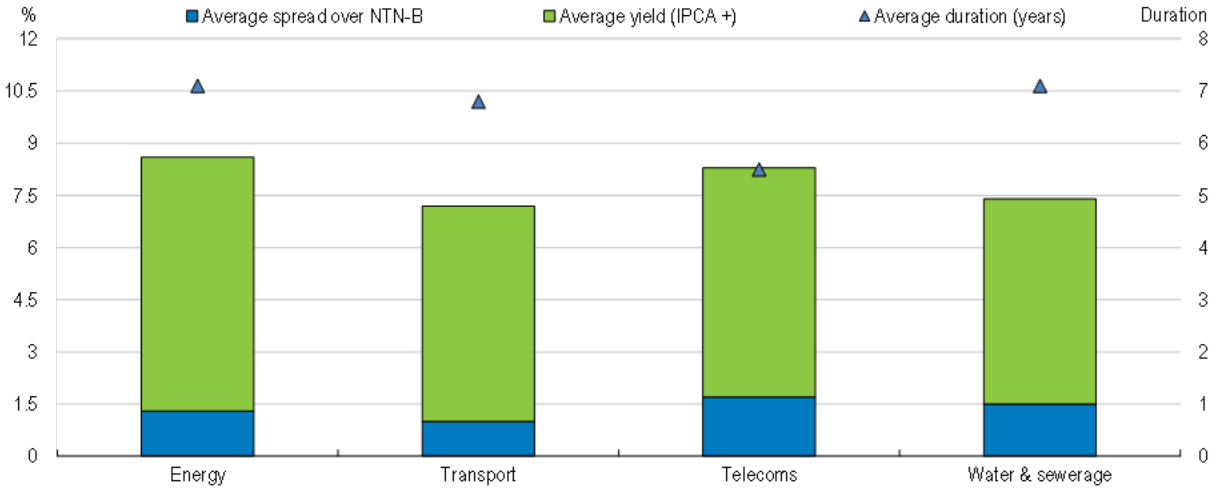
The rapid expansion of infrastructure debentures has been supported by their beneficial tax treatment, with income tax exemptions for individuals and reduced rates for corporate holders, which have been successful in attracting more funds into the longer maturities required for infrastructure projects. Incentivised bonds currently provide higher yields than government bonds (Figure 21).

The use of differential tax treatment to create longer-maturity financial instruments can be seen as a public intervention aimed at overcoming a market failure with roots in history. Once a stable and liquid market for these urgently needed longer-term bonds has been established and markets have gained confidence in this type of instruments, it is likely that public support could eventually be withdrawn. While this consideration has to be carefully balanced against other considerations, including the potential alternative use of these foregone tax revenues, the strategy has had visible success so far. Besides the tax incentives, the public sector through BNDES has itself been investing in infrastructure project bonds, which has

contributed to the development of the market for debentures and ensured continuous liquidity on the secondary market.

Despite this progress, the development of debenture bonds has not covered the full financing needs of long-term infrastructure projects. The average tenure of infrastructure debentures is still below 7 years (Figure 21). Only 12 out of 186 debenture issuances since 2012 had a tenure of 15 years or more. Further improving the incentives for long-term saving instruments for individuals and corporates could be one way to boost the availability of long-term funds, and differential tax treatment of savings tied to a minimum duration of holdings could continue play a role in this. Additional tax benefits for infrastructure bonds with even longer maturities could push out the maturity of infrastructure bonds further. Better targeting the incentives of debentures to sectors where the infrastructure gaps are the highest such as water, sanitation and urban mobility and to projects that have a longer time span would increase the effectiveness of fiscal incentives for debenture financing.

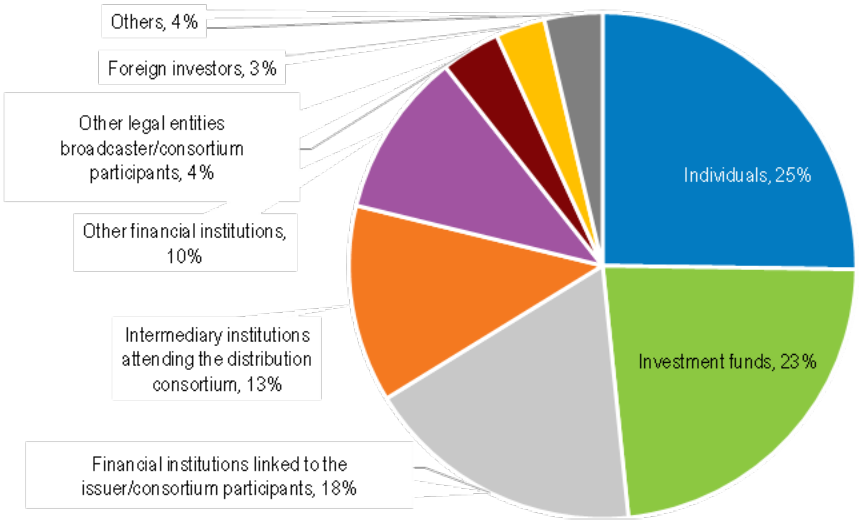
Figure 21. Remuneration, spread and duration of infrastructure debentures by sector



Note: NTN-B refers to National Treasury Notes Series B, inflation-linked government bonds. Yield refers to the remuneration of the bond. Duration measures the sensitivity of the price (value of principal) of an infrastructure bond expressed as the number of years.
Source: Ministry of the Economy, (2022b).

Fine-tuning the current design of infrastructure debentures may help to attract more corporate institutional investors. Currently, individuals and investment funds represent almost half of incentivised-bond investors in terms of value, while private pension and insurance companies, and foreign investors, constitute less than 5% of investors (Figure 22). Individuals and investment funds are often attracted to debentures as short-term investments that have a high liquidity in the secondary market. By contrast, the current design of the tax benefits has been less successful in drawing institutional investors with a genuine long-term investment horizon into infrastructure debentures, as these institutional investors cannot benefit from the current income tax exemptions given that they are not subject to income taxes in any case.

Figure 22. Short-term investors and low maturity dominate the infrastructure bonds market



Source: Ministry of the Economy, (2022b).

To improve the design of incentivised debentures and attract more genuine long-term investors, a legislative proposal was submitted to Congress in 2021 to reform the tax incentives for infrastructure bonds, but approval still pending in the Senate. The new infrastructure debentures modality aims to create a new type of debt security, improve the legal framework of incentivised debentures and correct barriers to the operation of infrastructure investment funds. Under the proposed setup, tax benefits, which previously accrued to investors, would instead accrue to issuing companies, which are subject to income taxes. These issuers would pass on the specific tax benefits for infrastructure debentures to buyers of the securities in the form of higher coupon interest rates or a lower issuing price. In this way, these new infrastructure bonds would attract institutional investors, including those who are not subject to income taxes. The proposed reform of infrastructure debentures has the potential to attract more institutional investors, as it would likely increase the net of tax return of these bonds.

In addition, the draft proposal provides a basis for specific infrastructure funds for individual investors, for which these would continue to get the same tax benefit as they currently do for infrastructure debentures. Ensuring the continuation of the current tax edge over alternative investment options for this class of investors would at this point still be key to maintain the current debenture funding sources, while at the same time tapping into additional funding pools.

Project financing is another financing model with potential to diversify the financing sources of infrastructure projects. After the construction phase, infrastructure projects have typically accumulated their own assets, generate a stable revenue stream and have less need for monitoring. In this more mature phase, global infrastructure financing often resorts to re-financing initial bank loans with project bonds. Project finance is primarily based on claims against the financed asset or project rather than the sponsor of the project (Figure 23). Project finance limits creditor recourse to the assets and cash-flows of the project, capping the downside risks for equity investors or project sponsors.

The development of the project finance model requires the availability of long-term investors, and its viability depends importantly on a comprehensive framework allowing to apprehend the different risks at the different stages (Makovšek, 2018). Reviewing the conditions and bottlenecks for the use of project finance can help to tap into usually less expensive financing sources for a wider range of infrastructure projects (Makovšek and Moszoro, 2018). Currently, sponsors of infrastructure projects in Brazil often have to provide a guarantee for risks associated with the pre-construction and construction phases as there is no external insurance market for these risks. This could be addressed by developing a comprehensive

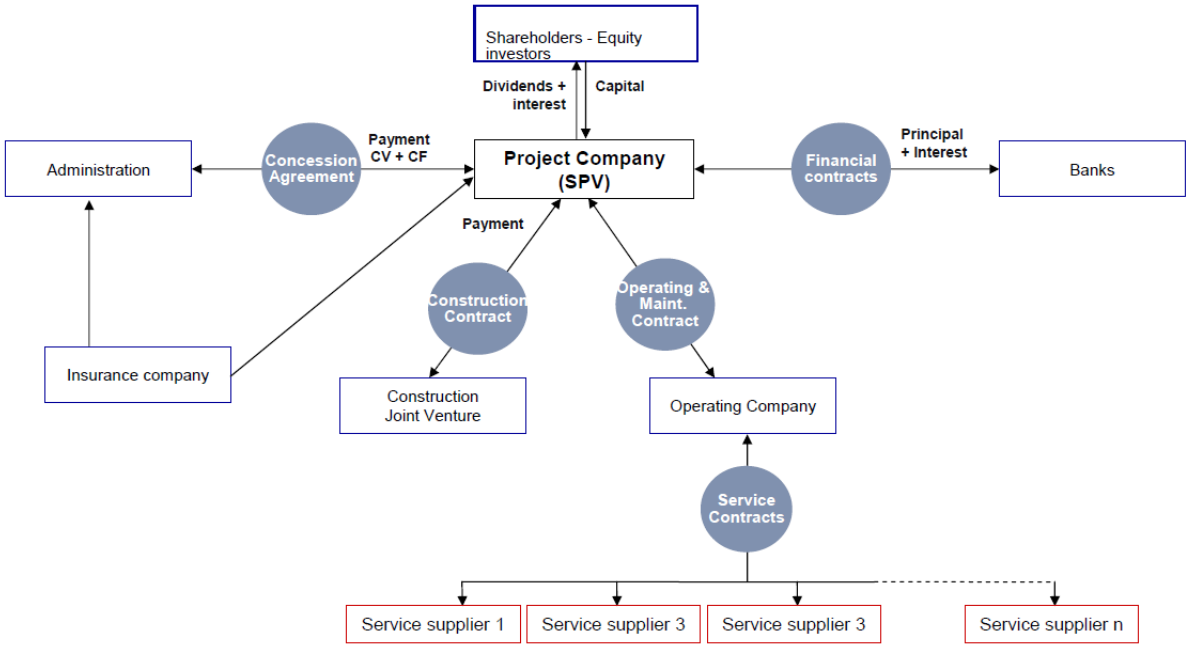
project financing model and the existence of a public-sector institution with the clout and experience of BNDES would give it an obvious role in leading such developments.

BNDES could also play a key role in mobilising financial resources from the private sector by taking a leading role in setting up syndicated loans among groups of banks. Its vast experience in the Brazilian market would make it a preferred partner for potential international investors for whom the cost of pursuing opportunities alone would be prohibitive.

In addition, BNDES could also make better use of its balance sheet by assuming more of the risks associated with infrastructure projects. For example, BNDES could lead the creation of structured financial instruments, which could allow creating tranches that could be purchased by a wider range of institutional investors, including those that are limited to investment grade assets. Mimicking the practices of multilateral lenders such as the IFC, EFSI or EBRD, BNDES itself could make smaller and more targeted commitments that reduce the risk profile for other investors, for example by investing in subordinate or mezzanine debt with loss absorption capacity.

Over the last years, BNDES has indeed increasingly moved away from its traditional role of providing the entire financing of infrastructure projects and ventured into a wider range of instruments to financially support infrastructure investments. For instance, from 2020 to 2022, BNDES has approved over BRL 40 billion in non-recourse or limited recourse projects in the roads, urban mobility, airports and sanitation sectors. Structuring capital market products, issuing guarantees and commitments for the purchases of debentures, the Bank has been helpful in mobilising private funding to the infrastructure sector. BNDES can build on this substantial progress and continue to support infrastructure investments through innovative financing solutions that can eventually lead to substantial improvements in the structure of Brazil's financial markets.

Figure 23. An example of project finance structure



Source: OECD, 2018

Better managing risks and mobilising foreign investments in infrastructure

Greater private financing of infrastructure development and tapping into new funding pools will require rethinking the allocation of different risks, and creating tailored financial instruments aligned with the

desired risk profiles of different groups of investors. Key project risks such as construction risk, demand and revenue risk, political risk, breach of contract, currency risk, and refinancing risk will be of particular concern for investors and lenders. Table 2 synthetises the different instruments available to mitigate these risks and the instruments that governments, or public sector entities like BNDES, have at their disposal to mitigate these risks and crowd-in private investment in infrastructure.

Table 2. Financial risk mitigants and incentives for infrastructure finance

Type of Measure	Instrument
1. Guarantees	1. Minimum payment, paid by contracting authority
	2. Guarantee in case of default
	3. Guarantee in case of refinancing
	4. Exchange rate guarantees
2. Insurance (private sector)	1. Wrap insurance, technology guarantees, warranties, commercial and political risk insurance
3. Hedging (private sector)	1. Derivatives contracts such as swaps, forwards, options etc.
4. Contract design, paid by contracting authority	1. Availability payment mechanisms
	2. Offtake contracts
5. Provision of capital, realised directly by Government or by its own controlled agency or development bank	1. Subordinated (junior) debt
	2. Debt:
	2.1 at market condition
	2.2 at lower interest rate
	3. Equity:
	3.1 at market conditions
	3.2 at more advantageous conditions
6. Grants, generally delivered by contracting authority, even if some dedicated fund at national level may exist. Tax incentives can be delivered by national or local authorities	1. Lump sum capital grant
	2. Revenue grant:
	2. 1 Periodic fixed amount (mitigating the demand risk)
	2. 2 Revenue integration (it leaves the demand risk on the private player)
	3. Grant on debt interests
	4. Favourable taxation schemes for SPV
	5. Favourable taxation schemes for equity investors

Source: OECD (2015b); OECD (2015c).

Private insurers can provide coverage for a range of political and business risks that can afflict infrastructure projects. However, investors, whether in Brazil or elsewhere, face many gaps in insurance coverage. For example, during the construction phase, it is possible to obtain insurance against damage to equipment or facilities because of an accident or unforeseen events (e.g., fire or flood) that are out of the control of the contractor. However, overruns or delays that are caused by the contractor will not be covered by an insurance policy. Similarly, political risk insurance (PRI) policies covering breach of contract will only pay out following a favourable dispute settlement procedure, which could often take years. For other risks, including that the risk of regulatory changes, there is typically no insurance coverage. Finally, tenors for political risk coverage available in the private insurance market are often shorter than the duration of the loans. All these gaps can result in a project company defaulting on its debt repayments.

Public sector providers of insurance including MDBs such as the Multilateral Investment Guarantee Agency (MIGA) and export credit agencies (ECAs) offer a range of political risk insurance products. The largest source of political risk insurance is ECAs (whose support is linked to the activities of home country exporters and investors). These public sector providers can play a crucial enabling role in terms of supporting Brazil's efforts to attract international investors into infrastructure. Public sector insurers offer a major advantage over private insurers since through their political clout they can also deter harmful actions by host country governments and facilitate dispute resolution. However, coverage from the public sector

is meant to provide additionality, not substitute private coverage. These public sector providers intervene, in principle, only when private coverage is unavailable. In addition, public sector insurers often have more stringent terms and disclosure requirements, which may be a disincentive for some investors. In practice, public and private investors often operate jointly, and reinsure each other's risks.

While insurance provides protection against well-defined (and often narrowly defined risks), guarantees provide payment protection for lenders irrespective of the cause of default. The provision of a guarantee from a multi-lateral development bank is often a pre-condition for the participation of international commercial lenders. The Inter-American Development Bank, for example, offers all-risk credit guarantees that protect commercial lenders against loan repayment difficulties.

Guarantees by national governments or public-sector entities are widely used to complement incomplete insurance and provide opportunities for fine-tuning the allocation of risks in infrastructure projects (Box 3). For example, reducing shareholders' guarantee requirements through public guarantees is a key factor for increasing investment in infrastructure, as it allows international and national investors to participate in a greater number of projects and limits the risk born by investors in such projects. In the case of PPPs whose revenues depend on payments provided by a granting authority, Brazil could explore providing guarantees that protect against the risk of non-payment by a government entity.

However, care must be taken in the provision of state guarantees given that they represent a long-term liability for taxpayers. They should therefore be used in a targeted manner to support projects that yield a strong positive net benefit, that would otherwise fail to obtain financing. Such changes require putting in place a transparent system for assessing, approving, and managing guarantees and monitoring the contingent liabilities they entail and should be embedded in a longer-term strategy that prepares the market, and addresses bottlenecks in the institutional and regulatory framework. Projects that benefit from a state guarantee should be subject to a transparent prioritisation process using objective criteria like what should be applied to any public investment decision (Section 2.2). The decision to opt for private-public partnership over traditional public investment financing should follow a thorough and realistic cost-benefit analysis taking into account all associated costs and risks over the entire life-cycle of a project. State guarantees should only cover risks that the private sector cannot manage, while ensuring an adequate risk sharing between public and private actors. In addition, the total liability arising from guarantees provided by the state should be capped through, for example, the establishment of a guarantee fund.

In 2016, the Brazilian government established the Infrastructure Guarantee Fund (FGIE) to guarantee, directly or indirectly, any risks, including non-manageable risks, related to concessions. PPPs implemented by the federal government or state governments are also eligible. The fund aims to directly guarantee risks for which there is no available insurance or reinsurance coverage. The government contributes a maximum of BRL 11 billion to the fund. The fund is managed by the Brazilian Guarantees and Fund Managements Agency (ABGF), Brazil's national export credit agency. However, uses of the Infrastructure Guarantee Fund have been limited by the fiscal responsibility law in conjunction with the PPP law. In Brazil, the 2004 federal PPP law initially sets a ceiling on current spending from PPP contracts of 1% of net current revenue, applicable to all levels of government. The limit was subsequently raised in 2009 to 3% and in 2012 to 5%. New subnational PPP commitments cannot be guaranteed by the federal government if (1) existing commitments already amount to 5% of net current revenue or (2) the new contract would entail commitments in excess of 5% of net revenues at any time during the forthcoming 10 years (Matsumoto et al., 2021).

Hence, states and municipalities with an active PPP portfolio in Brazil include only those with a portfolio below the fiscal ceiling established by the law. Although establishing a fiscal ceiling for PPPs is important, it has created a practical barrier for some subnational entities to develop their own PPP pipelines and portfolios. In practice, limited number of subnational governments meet the requirements to receive guarantees and transfers for the implementation of their PPP programme. The application of the fiscal

ceiling rule to PPPs could be reformed to create more fiscal space for PPP guarantees within the fiscal limit as a priority budget spending programme.

Providing instruments to mitigate the currency risk could open access to sizeable international financing, but it will also imply fiscal costs and risks. The experience of financing infrastructure projects in other Latin American countries such as Chile, Peru, Colombia, and Mexico indicates that the provision of revenues in US dollars has allowed for cheaper and longer-term financing, particularly in renewable electricity generation (IDB-WEF, 2019). The benefits of contracting in hard currency are lower borrowing rates for longer maturities, but it adds volatility in debt service costs in local currency. Most infrastructure project revenues are in local currency, and they are not easily hedged. As identified by IDB-WEF (2019), first, a portion of infrastructure project revenues could be indexed to US dollars. Second, foreign exchange rate hedges could be provided through clauses built into concession agreements or through measures to increase the long-term currency swap market liquidity.

The government could consider the tradeoff of offering power purchase agreements in US dollars covering part of concessionaires' receivables against lower ceiling tariffs in auctions, in specific sectors such as transmission lines and renewables. Revenues in hard currency would enable concessionaires to access longer-term and cheaper financing in international markets. Brazil has recently experienced some forms of currency hedging in airport concession (Gonçalves et al., 2017). In these arrangements, changes in the exchange rate in a period of one year that exceed a reference component are offset by a reduction or increase in the amount to be collected as a grant by the government. Thus, the grant payable to the government varies positively with the appreciation or negatively with the depreciation of the Brazilian currency, with caps applied in both directions. Finally, improving the liquidity of long-term currency swaps is needed to complement the options for hedging. The swap market in Brazil is highly liquid for terms up to five years, but efforts to increase liquidity in longer terms could be useful.

Box 3. Examples of guarantee and financing mechanisms

Danish State Guarantee Model (SGM) for infrastructure investment

The SGM was used for the development of the fixed links across the sea at Storebaelt (1987) and Øresund. It is characterised by transferring the responsibility for Design, Build, Finance, Maintain and Operate (DBFMO) in the PPP model contract to an independent state-owned company or a special vehicle. Financing is based on the company raising loans in financial markets or from the state and can also be equity supported by the state. The state guarantees the loans through a guarantee commission. With the Danish state's high credit rating, favourable loan terms are obtained. Toll charges are collected, which, after covering operating and maintenance costs, are used to pay interest and loan instalments. Compared to PPPs, the SGM's main advantage is that its financing costs are substantially lower. This is partly explained by the fact the state ultimately bears the risks (especially the demand risks) in the

project. But also, as private investors in transport infrastructure require an uncertainty premium, which makes the total financing costs too high compared to the real risk transfer from the state to the private sector (the risk-pricing failures of private financing). On a risk-adjusted basis, the financing costs in the SGM are therefore lower than in the PPP model.

European Fund for Strategic Investments

The European Fund for Strategic Investments (EFSI), otherwise known as the Juncker Plan, was instituted in 2015 in response to the decline in investment levels in Europe in the wake of the global financial crisis. It was prolonged in 2017 with a 26 billion euro guarantee fund provided by the EU budget and 7.5 billion from the European Investment Bank (EIB). The objective is to crowd in 500 billion private investments. The EIB uses these resources to invest in high-risk/high-return projects that would otherwise not receive funding. By making investments in equity or junior debt, the EIB seeks to attract private financing into the more senior debt categories.

EBRD-MIGA risk mitigation solution for infrastructure bonds

The European Bank for Reconstruction and Development (EBRD) and the Multi-lateral Investment Guarantee Agency (MIGA) have developed a joint risk mitigation solution that is designed to boost the credit rating of infrastructure bonds issued for PPP projects.

The mechanism combines two unfunded liquidity facilities provided by the EBRD with political risk insurance (PRI) provided by MIGA.

The Construction Support Facility ("CSF"): An unfunded credit facility designed to provide significant timely liquidity during the construction period in the event of contractor default. The Revenue Support Facility ("RSF"): Subordinated unfunded credit facility designed to credit enhance grantor risk during the operations period of the project. The facility is designed to provide timely debt service in the event of a default by the grantor bridging the period until the arbitration process is completed (usually 2 to 3 years) after which MIGA honours its payment obligation. The MIGA's PRI Guarantee: based on standard three-point coverage (Breach of Contract, Expropriations and Transfer Restriction). Under the "Breach of Contract" coverage, lump-sum insurance proceeds would be paid out following an arbitral award. Under the "Expropriations" coverage, PRI payment is not subject to arbitration award.

The facility was piloted in Turkey in a PPP transaction to build, design, finance and maintain a large integrated health campus located in Elazig, Eastern Turkey for a concession period of 28 years. Under the PPP agreement the Turkish Ministry of Health as the grantor is required to compensate the project company for the availability of the facility. The project was financed through the issuance of a EUR 288 million euro-denominated bond, structured into two tranches. As a result of the EBRD-MIGA risk mitigation facility, Moody's assigned the bonds a Baa2 rating, two notches above Turkey's sovereign rating ceiling, thereby making the bonds eligible for the portfolios of institutional investors.

IFCs Managed Co-Lending Portfolio Programme

The IFC has developed a mechanism, the Managed Co-Lending Portfolio Programme (MCPP) for Infrastructure that aims to mobilise institutional money for investing in infrastructure projects in developing countries. The MCPP for Infrastructure involves a three-way partnership between the IFC, a bilateral lender (Sida - Swedish International Development Agency), and a number of institutional investors. Institutional investors provide funding to a debt fund that will invest in a portfolio of projects that are originated and approved by the IFC. The IFC provides credit enhancement through a first-loss tranche. Sida provides a guarantee on a portion of IFC's first loss position in exchange for a guarantee premium. The fund thus provides institutional investors with an investment grade asset with good returns and excellent diversification benefits. The programme has mobilised up to USD 10 billion over eight years.

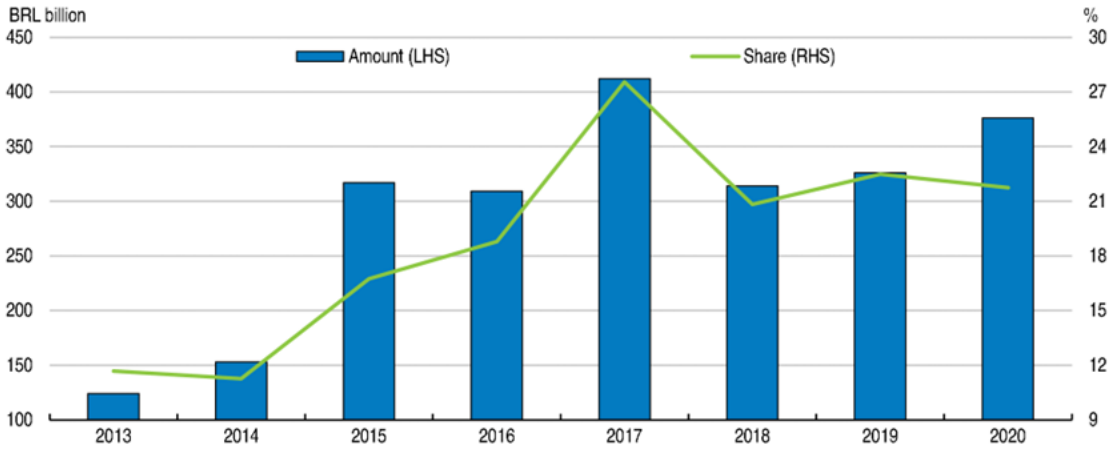
Source: ITF/OECD, EIB, Bruegel, EBRD, IFC and Moody's.

Further expanding green financing

Developing more long-term financing options will also be key for financing the decarbonisation of the economy. Efforts to develop green finance in Brazil have been intensified in recent years. Bank loans to green economy sectors have increased substantially since 2013, amounting to BRL 376 billion (3.2% of GDP) and accounting for 22% of total loan portfolio to corporations in 2020 (Figure 24). In 2021, 111 green, social or sustainability-linked bonds were issued totaling BRL 85.7 billion (0.9% of GDP) (Vendramini, 2022).

Companies and commercial banks in Brazil have shown an interest in Brazil's potential to develop the green agenda. In 2017, national and foreign institutional investors representing around BRL1.8 trillion (18% of GDP) of assets in Brazil have signed the Brazil Green Bonds Statement, committing to contribute to the development of the green bond market in Brazil. Streamlining the green bond framework, harmonising the definition of green finance, and further developing green and climate-risk reporting would increase the scope for green financing nationally and internationally. The lack of a formally agreed green taxonomy and definitions leads to multiple indicators, weak comparability, reliability, and accountability, as well as higher transaction costs. Local banks should be accompanied by, for instance, BNDES to develop aggregate green projects financed in the green bond market directed toward small and medium-sized enterprises. The creation of the Sustainable Rural Credit Bureau in 2022 by the Central Bank is a useful step towards the certification of operations compliant with green bonds requirements (BCB, 2022).

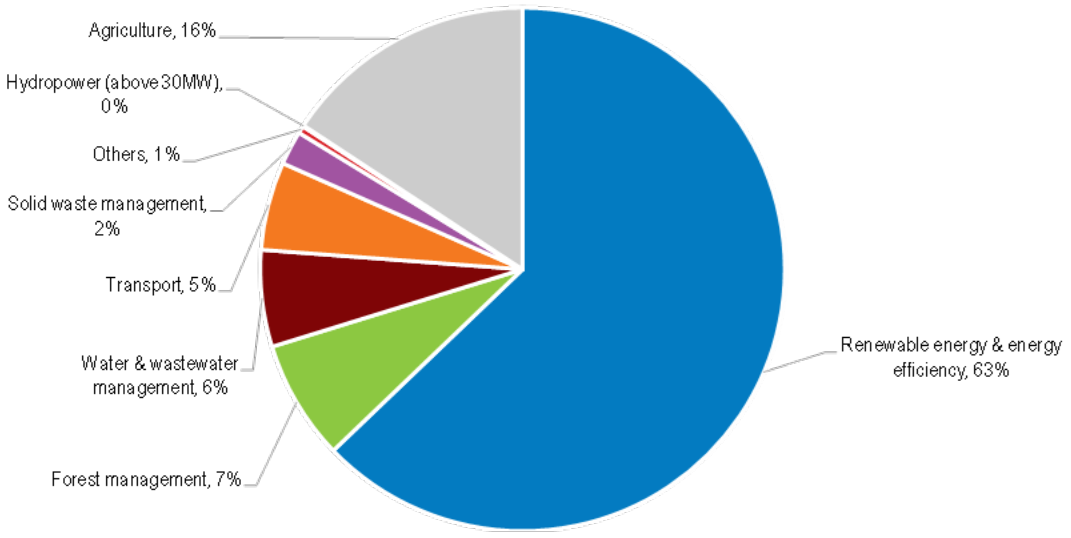
Figure 24. Banks loans to green economy sectors have increased over time



Note: The bars refer to bank loans to green economy sectors in amounts, and the shares (%) refer to the bank loans to green economy sectors as a share of total loan portfolio to legal entities.
Source: FEBRABAN (2018); FEBRABAN (2021); and OECD calculations

BNDES has been instrumental in developing green finance, in particular for the wind power industry (OECD, 2019). Green finance disbursements of the BNDES have targeted mostly sustainable infrastructure projects such as renewable energy, energy efficiency and low-carbon transportation (Figure 25). In 2017, BNDES issued a USD1 billion green bond to raise resources in the foreign market to fund power projects in Brazil (BNDES, 2018).

Figure 25. BNDES's green finance disbursements largely targeted sustainable infrastructure



Note: Data for 2021.
Source: BNDES; and OECD calculations.

Better infrastructure to support climate change mitigation and adaptation

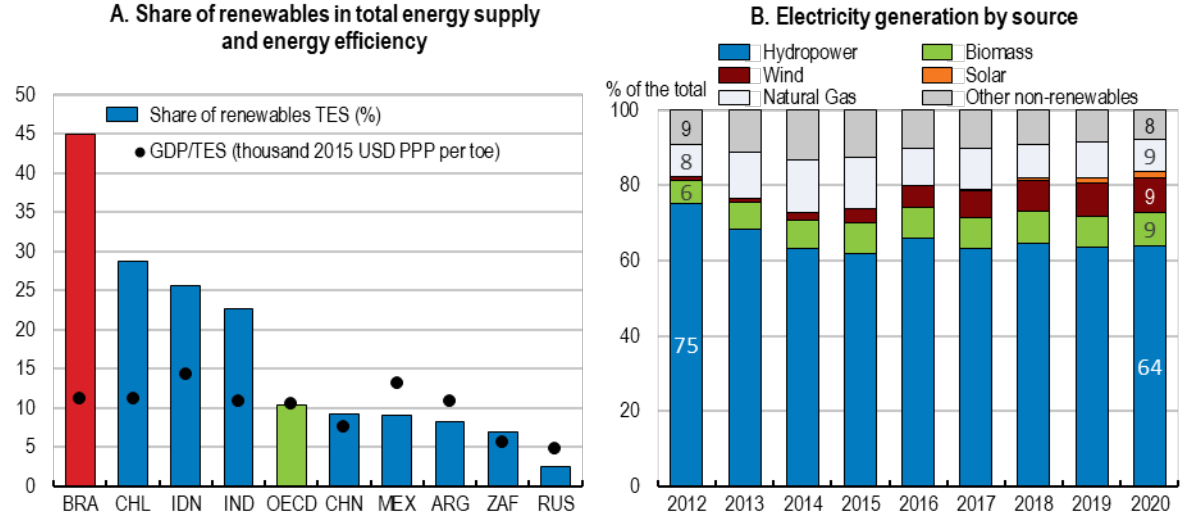
Climate change is an increasingly important factor for infrastructure investments. From a perspective of mitigation, today's infrastructure decisions are almost sure to affect a country's ability to achieve emission reduction targets in the future. From a perspective of adaptation, climate change poses new risks to infrastructure and requires additional investment into making current and future infrastructure more resilient against extreme weather events and natural disasters.

Developing low-carbon infrastructure to mitigate climate change

Low-carbon infrastructure will play a key role in Brazil's transition toward carbon neutrality. This holds particularly for energy infrastructure, which is not only a major emitter, but also determines the scope for emission reductions in downstream sectors. A remarkably clean energy mix and moderate energy efficiency levels underpin Brazil's relatively low carbon intensity (Figure 26, Panel A). Energy-related per-capita emissions are approximately one third of those in the European Union, and one seventh of those in the United States. 48% of overall energy use comes from renewable sources compared to a world average of approximately 15%.

Electricity, which currently accounts for 18% of total energy supply, has an especially low carbon intensity, with 85% of the current domestic supply coming from renewable sources compared to a world average of approximately 27%. The current electricity matrix is based mainly on hydroelectric sources, with thermal power plants used as back-up and to smooth out supply fluctuations from hydroelectric energy, although wind, solar photovoltaic and biomass energy are also gaining weight (Figure 26, Panel B). Brazil is currently the country with the second and seventh largest installed capacities for biomass and wind electricity generation, respectively (EPE, 2021a). Official plans to continue decarbonising the energy sector over the next two decades include the national biofuel strategy, new frameworks for the electricity and gas sectors, and a national green hydrogen strategy.

Figure 26. Energy-related emissions are relatively low



Notes: Panel B: Hydropower includes self-generation, biomass includes wood, sugar cane and resins, others include petroleum derivatives, coal, nuclear, gas, other non-renewables and other renewables.
Source: IEA World Indicators (2020 Edition), Balanço Energético Nacional, 2021, EPE.

Expanding the use of electricity as a source of energy will be key to decarbonise other sectors, such as industry and transportation. According to Brazil's Ten-year Energy Expansion Plan, 65% of future energy-related emissions will come from these sectors (Ministry of Environment, 2021). The necessary electrification will lead to rising demand for electricity.

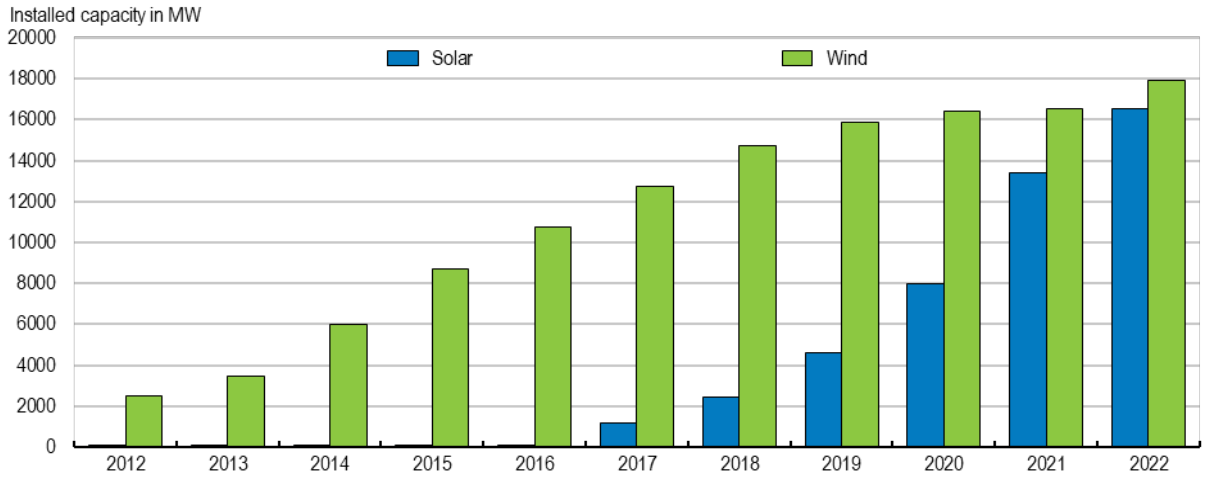
Massive expansions in electricity production capacity will imply looking for alternative low-carbon electricity sources beyond hydropower. Hydropower presents opportunities and risks in Brazil's energy mix. On the one hand, the dispatchable nature of hydropower provides flexibility to the system, while wind and solar photovoltaic sources are intermittent. On the other hand, the remaining unexplored potential of hydropower has been increasingly difficult to tap into due to challenges in obtaining environmental licenses for new hydropower projects. At the same time, hydropower is highly susceptible to severe weather events, such as droughts, prolonged dry seasons, reduced rainfalls, and rising temperatures, likely to occur more frequently as climate changes. Dependence on hydropower poses a critical risk to the country's long-term electricity supply and resilience (World Bank, 2022a). On several occasions, including most recently, low rainfall reduced reservoir fillings to low levels and led to price spikes through wider use of higher-cost thermal plants, and some observers even feared electricity shortages.

Brazil needs to develop drought management plans for new and existing assets setting out accountabilities and actions agreed in advance with stakeholders across all sectors using water. Agreeing upfront on restriction rules and compensation fund is paramount for the successful management of drought events. Brazil needs to have plans in place before a crisis so that actions, accountabilities and desired outcomes are clear at each pre-determined stage of a drought, mitigation measures are established, and the rules for restricting use have been agreed (OECD, 2022d). For example, this could include agreeing drought adaptation measures such as rules for restricting certain types of use as a drought progresses, potentially establishing a compensation fund using abstraction charges so that lower priority users are not financially disadvantaged if they are restricted during a drought. The process for doing so should be inclusive and have formalised governance to ensure that funds are ring-fenced and used for the intended purpose (OECD, 2022d).

Other renewables like wind and solar sources present significant untapped potential in Brazil recent policy announcements point to significant planned investments in renewables. Fairly steady trade winds and long sunshine hours make Brazil ideally placed to venture further into intermittent renewables like wind and

solar, particularly in the north and northeast regions (EPE, 2021b). This could increase energy security and allow for a constant electricity generation, as wind and solar sources are complementary to hydropower in terms of seasonality and between each other across hours of the day. Past deployment of solar water heating across the country shows the enormous potential for distributed solar generation, which has expanded rapidly over the last years (Figure 27). Already, wind and solar are the least expensive electric energy sources in the auctions of the national electricity system and their prices are significantly lower than those of thermoelectric power plants in Brazil, mirroring developments in many regions in the world (IEA, 2020).

Figure 27. Wind and solar photovoltaic energy production has increased significantly

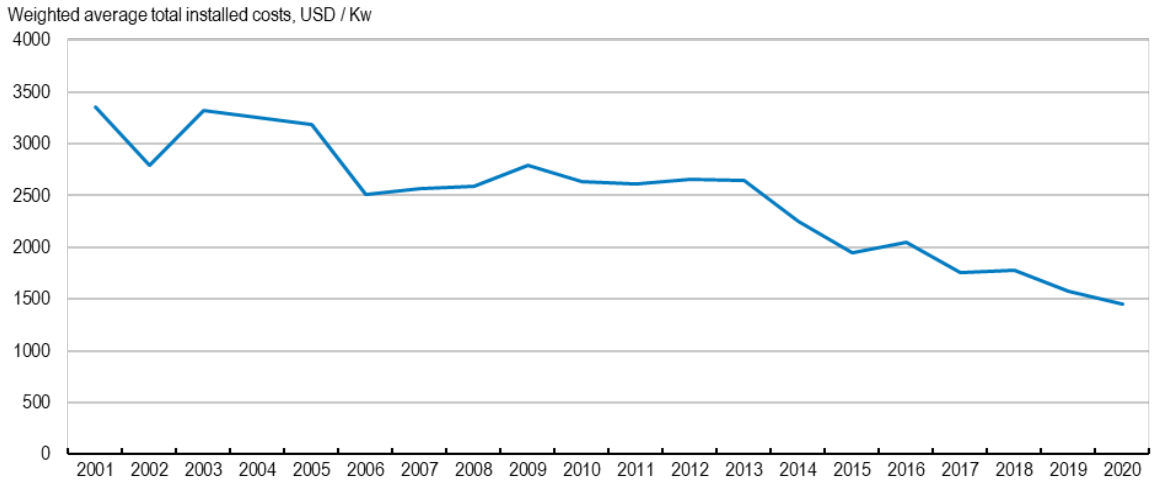


Source: ANEEL, 2020

Wind power has achieved significant progress in the coastal regions and is expected to grow rapidly in the upcoming years. Current installed capacity is 16 GW, but according to the National Energy Plan, installed capacity can reach between 110 GW and 195 GW in 2050. A new law governing the installation of renewable energy plants in territorial waters, inland waters and on the continental shelf is aimed to encourage the deployment of offshore wind turbines and submarine power cables. Both the southern and northern coasts of Brazil offer favourable meteorological conditions for wind power, and technological advances have substantially reduced the necessary capital investments and operational costs (Figure 28).

Further developing the grid and the transmission infrastructure will be key for connecting more renewable energy sources, as their intermittent nature often puts strains on the stability of the network. A recent USD 70 million investment plan by the Climate Investment Funds to support grid flexibility for clean energy integration in Brazil aims to mobilise a total of USD 9 billion in private and multilateral investments, on the basis of a plan implemented by the Inter-American Development Bank and the World Bank Group (CIF, 2023). Moreover, green financing should be further directed to wind energy investment by leveraging financing from BNDES and attracting foreign investments.

Figure 28. Wind energy installation cost has been declining in Brazil



Source: IRENA, Renewable generation power cost 2020.

Solar plant development is already playing a key role in bringing electricity to remote areas. A new solar photovoltaic (PV) installation in Belmonte (state of Pernambuco) became the biggest solar park in Latin America, providing electricity for nearly 800.000 families and generating 2.500 direct and indirect jobs. Additionally, household solar PV panels have allowed further progress, due to their ease of installation and their fairly rapid return to investment, with amortisation possible in as little as six months. Fine-tuning regulatory policies will be a key policy issue for future solar PV deployment. Solar PV grids can be found in more than 5.700 municipalities across the country, with a vast majority of installations within private homes. However, nearly 30% of installations were operating in the unregulated market in 2020 (IEA, 2020). Currently, registered solar PV micro-generators are subject to a net metering scheme in which they receive a one-to-one credit for each kWh fed into the grid while distribution costs are paid entirely by regular consumers. A 2022 law extends the principles of this legal framework until 2045 and establishes rules for the gradual introduction of an infrastructure charge to be discounted from the electricity credits as of 2023. This new law affords long-term legal certainty for those who produce their own energy and insulates them from potential future tariff changes implemented by the national energy regulator ANEEL. Additional tax incentives could be considered for the development of solar energy in rural and remote areas.

Adapting infrastructure to climate change risks

The damages caused by climate events on infrastructure are already detrimental to growth and well-being. Brazil frequently experiences extreme rains, flooding, severe droughts, and other weather-related disasters. Its location in the tropics implies high temperatures and high evaporation potential that facilitates large rainfall. Drought and excess rainfall, resulting in recurrent floods and landslides, are the most frequent and disruptive hazard events, with important impacts on urban areas. Floods comprise over 65% of the natural hazards, and damages related to flash floods and landslides were responsible for 74% of the deaths related to natural disasters over 1991–2010 (World Bank, 2022a).

On average, firms lose approximately 1.3% of GDP every year because of climate-related infrastructure disruptions (World Bank, 2021). The majority (55%) is caused by failures to transport infrastructure followed by power (44%) and water (2%). In 2021, the depletion in hydropower reservoirs due to a sequence of years with below-average rainfall starting in 2013 threatened the electricity supply for people who rely on hydropower for two-thirds of their electricity (OECD, 2022d).

Setting a legal basis for climate-resilient and sustainable infrastructure and cross-sector strategic engagement is key as climate change adaptation measures need to be agreed between relevant ministries. Planning, funding and delivering infrastructure should systematically consider the climate resilience, with

legislative and budgetary support, and clear accountability. An optimised portfolio of infrastructure assets would take into account cost-benefit-analysis, with some assets being climate-resilient but necessarily all. For example, nature-based solutions are among the most efficient to sustainably increase water yields.

Water stress has augmented due to droughts, mainly in the northeast and central regions. Changing precipitation patterns and prolonged dry periods have also significantly impacted rivers and water recharge in key aquifers. Together with rising temperatures, this is expected to affect both energy demand and supply, particularly from hydroelectric sources. As temperatures rise, increasing evaporation from existing water storage facilities will also increase production costs, resulting in higher prices for consumers. Adaptation policies in the water sector include expanding irrigation, dams, and sanitation infrastructure. Preservation policies, such as developing water and land conservation actions within micro-basins in rural areas, also have an important role to play. Industries that are major water polluters should be regulated and incentivised to reduce water pollution (World Bank, 2021).

All types of infrastructure are exposed to the different climate change events (see Table 3). For instance, the rapid, unplanned and uncontrolled urbanisation that has taken place in Brazil since the 1960s has meant building in unsafe areas such as flood plains and steep hillside slopes, which made urban residences and public infrastructure particularly vulnerable. Between 2009 and 2014, nearly every highly populated municipality in Brazil has been affected by floods and about 50,000 low-income homes were destroyed (World Bank, 2022a).

In addition, urban mobility in Brazilian cities is subject to disruptions arising from climate events. Better integrating adaptation policies in urban mobility systems requires focusing on planning of land-use and settlement patterns, and integrated infrastructure projects that consider climate risks assessments. Elaborating guidelines to support municipalities in assessing climate risks and integrate them in land use planning and providing hazard maps and access to climate information to municipalities to perform climate risk assessment would enhance urban planning. Moreover, investing in mass-transit infrastructure would limit individual vehicle use, and therefore reduce the vulnerability of the urban-mobility sector to climate change while at the same time reducing greenhouse-gas emissions. In addition, defining a clear allocation of responsibilities as regards climate risks impacts for new transports' concessions/PPP contracts is key for a proper accounting of climate risk upfront. Low-income municipalities should receive more technical and financial support to adapt their transport infrastructure to climate change risks. Leveraging the deep technical expertise of the national development bank BNDES may be one way to put this into practice.

Transport infrastructure may also be affected by rising temperatures, rainfall and wind intensity, all of which are capable of causing direct and indirect impacts on the road, railway and waterway transport networks. Among such impacts, the most common are floods and landslides, many of which are consequences of extreme weather events. Such disruptions may even compromise interconnection between different transport modes, adding to transport costs by requiring additional safety measures or use of alternative routes. A recent report found that 10% to 12% of the rail network, equivalent to 2000 km of railways, are subject to high and very high risk of landslide, erosion and high temperatures (Min. Infrastructure/PROADATA, 2022).

Road infrastructure is also exposed to climate change risks. Part of the road network in the states of Pará and Maranhão and on the Northeastern coast are exposed to a medium degree of flooding risk. Land slide risks are concentrated in the South and Southeast Regions (Serra do Mar and Serra Geral) and in the Northeastern coastal region (Min. Infrastructure/PROADATA, 2022). Erosion risks, closely related to land use, are concentrated on highways in the state of Pará, in Southern and Northeastern states. 60% of the road network is exposed to high or very high degrees of threat from high temperatures.

The long-term performance and reliability of transportation systems will need to consider and plan for climate change and extreme weather events. As Brazil is expanding its transport infrastructure with new concessions, these should systematically include an assessment of risk and vulnerability to climate change events and clauses clarifying the allocation of responsibilities regarding climate related risks (Makovšek

and Moszoro, 2018). The OECD has developed guidelines to build climate resilient infrastructure covering their design, the institutional framework and enhancing private-public partnering (Box 4).

Adaptation measures encompass different dimensions including governance, information and training, financing and climate risks identification. The governance of transport infrastructure should ensure that structured responses at local levels are in place and resources are provided to facilitate adaptation. Moreover, where needed, technical norms regarding drainage techniques, pavement requirements and equipment characteristics should be revised to make transport infrastructure resilient to climate events. It is also important to continuously improve communication about risk, implement early warning systems, emergency contingency, evacuation and recovery planning (Min. Infrastructure/PROADATA, 2022b).

Investment needs to make infrastructure resilient to climate shocks are estimated at 0.8% of GDP per year between 2022 and 2030 (World Bank, 2022b). These infrastructure resilience investments are worth making upfront as they pay back over time. For instance, in the road infrastructure sector, a 1.2% of GDP investment would significantly improve the climate resilience of the 23% of GDP of new investments needed over the next decade (World Bank, 2022b). Moreover, it would avoid losses estimated at 2.5% of GDP. Such investment would be more efficient than retrofitting roads within the normal replacement schedule.

Box 4. Climate-resilient infrastructure

Designing climate-resilient infrastructure

- Building climate resilience can involve a package of management measures (such as changing maintenance schedules and including adaptive management to account for uncertainty in the future) and structural measures (e.g. raising the height of bridges to account for sea-level rise or using natural infrastructure such as protecting or enhancing natural drainage systems).
- Flexible, adaptive approaches to infrastructure can be used to reduce the costs of building climate resilience given uncertainty about the future. Decisions about infrastructure should consider relevant uncertainties to ensure resilience across a range of potential future scenarios.

Strengthening the enabling environment for the development of climate-resilient infrastructure

- Decision makers need to have access to high quality information, consistent data and capacity to use this information to inform planning. Uncertainties should be clearly communicated and valued, and there should be access to the tools needed to support decision-making under uncertainty.
- Tools for mainstreaming adaptation in critical policy areas and encouraging investments in resilient infrastructure include:
    - spatial planning frameworks to redirect development away from high-risk areas.
    - infrastructure project and policy appraisals, including Strategic Environmental Assessment and Environmental Impact Assessment; and − regulatory and economic standards (such as building codes).
- Climate risk disclosure can help raise awareness of and encourage efforts to reduce climate-related risks to infrastructure but needs to be tailored to national circumstances.

Mobilising public and private investment for climate-resilient infrastructure

- Climate impacts are projected to lead to increases in investment required for infrastructure, particularly water storage, flood defences, and water supply and sanitation in some regions. The use of tools for decision-making under uncertainty can reduce the need for costly retrofitting while reducing upfront costs.
- Developing and communicating infrastructure plans can help investors to identify investment opportunities. Developing these plans provides an opportunity for decision makers to take a strategic view of how climate change will affect infrastructure needs in the coming decades.
- Public policies that promote resilience include public procurement processes that consider climate resilience when comparing competing bids, by accounting for costs over the asset lifetime under alternative scenarios. For Public Private Partnership (PPP) contracts, it is important to clarify the allocation of responsibilities regarding climate-related risks planning, management and response.
- Public finance can be used to mobilise private finance for climate-resilient infrastructure. Blended finance can be used to improve the risk-return profile of investments where appropriate.

Source: OECD (2018b), "Climate-resilient infrastructure", Policy Perspectives, OECD Environnent Policy Paper N°14.

Brazil has put in place an institutional framework to coordinate and implement mitigation and adaptation policies. An Inter-Ministerial Committee on Climate Change was created in June 2023 and charged with the definition of guidelines and strategies for designing, implementing, financing, monitoring and evaluating

policies, plans and actions related to climate change. This includes sectoral mitigation and adaptation plans within the scope of the National Policy on Climate Change - PNMC, the Nationally Determined Contribution and the economic and financial mechanisms to be adopted.

Table 3. Illustrative impacts of climate changes in different sectors

	Temperature changes	Sea-level rise	Changing patterns of precipitation	Changing patterns of storms
Transport	Melting road surfaces and buckling railway lines	Inundation of coastal infrastructure, such as ports, roads or railways	Disruption of transport due to flooding	Damage to assets, such as bridges
	Damage to roads due to melting of seasonal ground frost or permafrost		Changing water levels disrupt transport on inland waterways	Disruption to ports and airports
	Changing demand for ports as sea routes open due to melting of arctic ice			
Energy	Reduced efficiency of solar panels	Inundation of coastal infrastructure, such as generation, transmission and distribution	Reduced output from hydropower generation	Damage to assets: - e.g. wind farms, distribution networks
	Reduced output from thermal plants due to limits on cooling water temperatures		Disruption of energy supply due to flooding	Economic losses due to power outages
	Increased demand for cooling		Insufficient cooling water	
Telecoms	Increased cooling required for datacentres	Inundation of coastal infrastructure, such as telephone exchanges	Flooding of infrastructure	Damage to above ground transmission infrastructure, such as radio masts
			Damage to infrastructure from subsidence	
Urban development	Increased cooling demand	Inundation and increased flood risk	Risk of drought	Damage to buildings
	Reduced heating demand	Changes in land use due to relocation of people living in exposed areas	Flooding	Deaths and injuries
Water	Increased need for treatment	Inundation of coastal infrastructure	Increased need for water storage capacity	Damage to assets
	Increased evaporation from reservoirs	Salinisation of water supplies	Increased risk of river embankments being overtopped	Decreased standard of protection offered by flood defences
		Decreased standard of protection offered by coastal defences		

Source: OECD (2018b), Climate-resilient infrastructure, OECD Environment Policy paper n° 14

The Ministry of Environment and Climate Change is responsible for leading the country's response to climate change and for developing policies and strategies for greenhouse gas mitigation and climate adaptation efforts. In cooperation with the Ministry of Finance, an Ecological Transformation Plan has been developed including economic and social instruments for sustainable management of water resources, ecosystems, biodiversity, and forests The Ministry of Environment and Climate collaborates with the Ministry of Science, Technology and Innovation in order to implement strategies and improve climate modelling services, and to develop the National Adaptation Plan. The National Adaptation Plan should be expanded to cover transport infrastructure and more efforts are needed to integrate sub-government levels in the development and implementation of adaptation policies.

Table 4. Policy recommendations (Key recommendations in bold)

MAIN FINDINGS	RECOMMENDATIONS
Infrastructure gaps are widespread	
Infrastructure investment has declined and is low in international comparison, while maintenance levels are low.	**Increase investment in infrastructure and maintenance, including in transport, energy, telecommunications, water, sanitation and urban mobility.**
Improving the efficiency of public investment in infrastructure	
Cross-sectoral coordination in the planning of strategic infrastructure has been limited, often leading to unrealistic demand and supply estimations, and missed opportunities for infrastructure sharing.	Continue to promote inter-ministerial collaboration to develop integrated infrastructure development plans.
Strategic planning documents are not binding and not systematically linked to annual budgets. As a result, infrastructure investment is not always coherent with national strategies and often lacks technical back-up.	Use integrated infrastructure plans as a pipeline of major, strategic, technically assessed, and publicly discussed projects. Allocate federal funds only to projects identified in this pipeline.
Multi-year projects lack a mechanism to carry-over budget appropriations. Infrastructure projects are often interrupted due to funding discontinuity or uncertainty.	Improve medium-term fiscal planning to allocate resources to multi-year investment projects and increase budget predictability.
Budget sequestration increases funding uncertainty.	Exclude strategic infrastructure investment projects from budget sequestration.
Most public investment in infrastructure is executed by subnational governments or non-financial SOEs, who often lack project management capacity.	**Expand technical assistance by BNDES to sub-national governments for infrastructure projects.**
The environmental licensing process is a source of risk that can discourage participation in the public procurement of infrastructure projects and inflate prices.	Assess projects' environmental impacts and procure environmental licenses before entering the bidding phase.
Inefficient procurement procedures can affect the successful completion of infrastructure projects within the agreed terms and timeline. Procurement data and information about prices, dispersed through several e-procurement platforms, is difficult to gather and analyse.	Continue to develop standard electronic templates for all stages of the procurement process and make their use mandatory for all types of procurement. Make the use of e-procurement mandatory using a centralised and unique web platform.
The co-existence of two public procurement regimes until December 2023 adds a layer of complexity and uncertainty, particularly affecting foreign bidders.	Accelerate the transition to the new public procurement regime approved in 2021.
Public procurement, including of infrastructure projects, is vulnerable to corruption, leading to public funds being wasted through higher expenses and infrastructure of lower quality.	Strengthen the autonomy of the Federal police and public prosecutors. Establish clear rules-based selection processes to minimise political interference. **Improve whistle-blowers protection and continue implementing the National Strategy to Combat Corruption and Money Laundering**.
Regulatory procedures have improved recently and became more aligned with international good practice. However, progress to adopt these new practices at the subnational level is uneven.	Consider the creation of a national regulatory body to oversee subnational regulatory practices. Promote the use of good regulatory practices across all levels of government by organizing workshops to share lessons learned, successful cases, and promote exchange of information.
Delays in transferring funds to regulatory agencies create a gap between financial needs and available resources, adding uncertainty and constraining their action.	Transfer monthly the budget to regulatory agencies to increase predictability and reduce misalignments. Exclude budget allocated to regulatory agencies from budget sequestration.
The 2016 "SOE Statute" has helped reducing political interference in the management of SOEs and advanced the professionalisation of its boards. However, full implementation is still ongoing. Many SOEs at the subnational level are non-compliant.	Continue to implement the 2016 "SOE Statute" at all government levels. Maintain a reasonable "cooling off" period between political office and a management position in an SOE.

Enhancing financing options for infrastructure projects	
Brazilian sub-national entities have been limited in their capacity to borrow by fiscal rules, capacity to pay and creditworthiness.	Allow those states and municipalities with strong fiscal accounts to issue infrastructure bonds, within the limits defined for their rating under the CAPAG.
Institutional investors cannot benefit from the current beneficial income tax treatment of infrastructure debentures as they are not subject to income taxes. Individuals and investment funds represent almost half of incentivised-bond investors, while institutional investors constitute less than 5% of investors.	Implement the planned reform of tax incentives for infrastructure bonds to afford the benefits to institutional investors as to individuals and investment funds. Better target the incentives of debentures to sectors where the infrastructure gaps are the highest (water, sanitation and urban mobility) and to projects that have longer time spans.
Different groups of investors have different desired risk profiles and restrictions. Tailoring financial assets for infrastructure financing to different investor groups may allow tapping into new funding pools.	**Expand the use of structured financial instruments, project financing and carefully designed guarantees to attract a wider range of institutional investors, with the help of BNDES.**
Foreign financing of infrastructure investment remains limited. The currency risk is limiting the international financing of infrastructure projects.	Consider indexing some infrastructure project revenues to the exchange rate. Consider providing partial foreign exchange rate hedges through clauses built into concession agreements.
The lack of formally agreed green taxonomy and definitions leads to multiple indicators, weak comparability, reliability, and accountability, as well as higher transaction costs	Streamline the green bond framework by harmonising the definition of green finance and further developing green and climate-risk reporting.
Better infrastructure to support climate change mitigation and adaptation	
The production of electricity is highly exposed to severe weather events, such as droughts, prolonged dry seasons, reduced rainfalls, and rising temperatures. The current strong dependence on hydropower poses risks to long-term electricity supply and resilience.	**Further diversify renewable energy sources by increasing investments in wind and solar energy, as well as biofuels.**
Water stress has augmented due to droughts, mainly in the northeast and central regions. Changing precipitation patterns and prolonged dry periods have also significantly impacted rivers and water recharge in key aquifers.	Develop emergency contingency plans for the case of severe droughts, including a compensation fund for those affected by rationing. Expand irrigation, dams, and improve sanitation infrastructure. Develop preservation policies, such as water and land conservation actions within micro-basins in rural areas.
The use of wind and solar power is limited by transmission bottlenecks and insufficient grid capacity.	Upgrade the transmission infrastructure to accommodate more intermittent renewable sources such as solar and wind plants.
Urban residences and public infrastructure are particularly vulnerable to climate shocks as a result of rapid, unplanned and uncontrolled urbanisation in the past.	Revise technical norms regarding drainage techniques, pavement requirements and equipment characteristics to make transport infrastructure more resilient to climate events. Better integrate adaptation policies into urban mobility systems. Make climate risk assessments mandatory for infrastructure projects. Elaborate guidelines to support municipalities in assessing climate risks and integrate them in land use planning. Provide hazard maps and access to climate information to municipalities to perform climate risk assessment. Invest in mass-transit infrastructure to limit individual vehicle use and reduce the vulnerability of the urban-mobility sector to climate change.

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