



Financing the Energy Transition in Brazil: instruments and funding sources

EPE and WEF are joining forces on the topic of mobilizing clean energy investments in Brazil. In the months ahead, we will explore ways for Brazil to unlock more finance for clean energy by convening Brazilian stakeholders in a series of country deep-dive workshops. This paper explores what financial mechanisms and sources are currently available in Brazil to fund a clean energy transition. It goes on to highlight priority areas where acceleration of investment is needed.



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Financing the energy transition in Brazil: instruments and funding sources



Empresa de Pesquisa Energética

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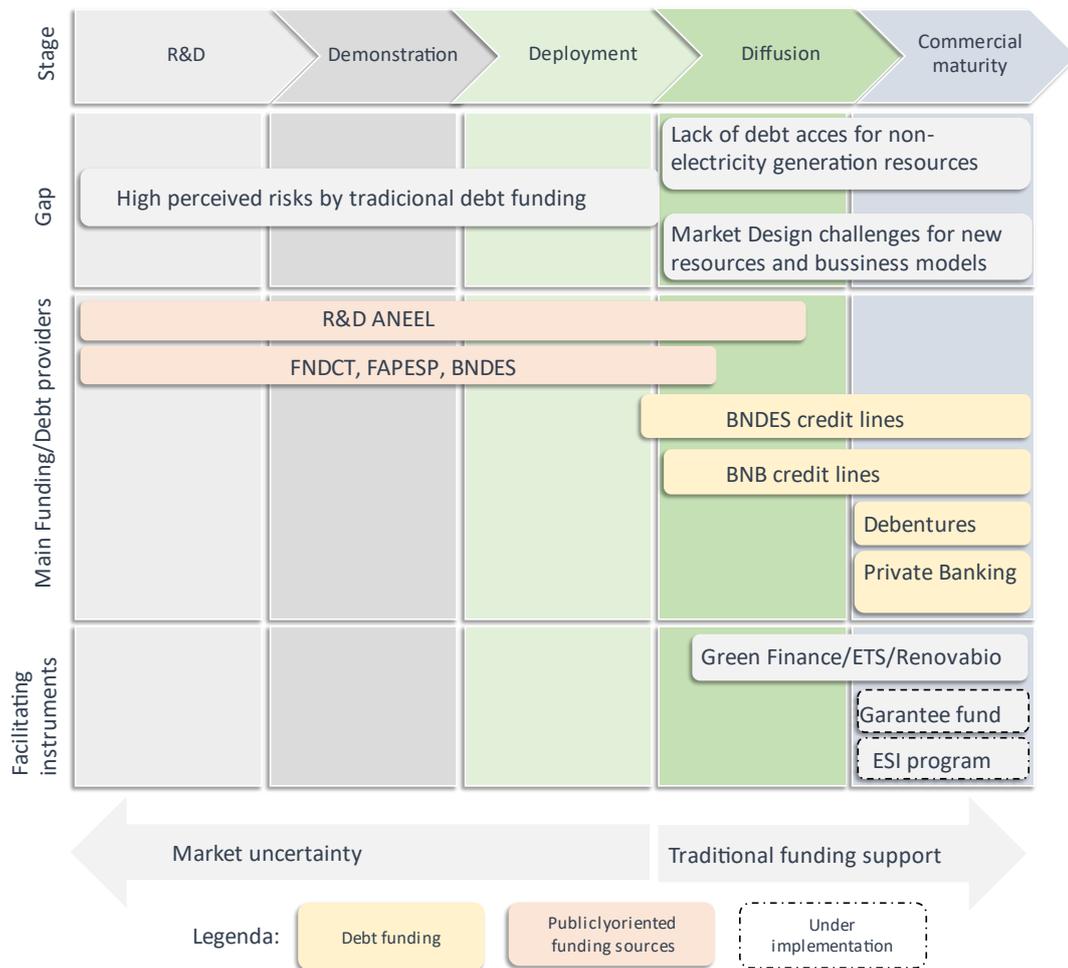
Overview of current financing instruments in Brazil for energy transition

Under the Paris Agreement, Brazil's NDC is economy wide and is therefore based on flexible pathways to achieve the 2025 and the 2030 objectives. Brazil has committed to reducing greenhouse gas emissions by 37% below 2005 levels by 2025 and by 43% below 2005 levels by 2030. Considering that Brazil's NDC is economy-wide and looking specifically to the energy sector, it possible to highlight that assessing the financing gaps and determining financing options is key to fostering climate finance and developing the most efficient technologies to achieve Brazil's commitments.

Financing mechanisms play a critical role in supporting the energy transition pathways charted by governments, in extend that each existing financing structure may prove more suitable for each maturity stage of technologies and scale of the projects. In this sense, some studies addressing financing gaps in the technology cycle may shed light on the discussion about the challenges of financing the energy transition.

Figure 1 summarizes some of the main gaps, the existing debt funding sources, and other facilitating instruments for supporting renewable technologies.

Figure 1- Maturity stage of Technologies, gaps and main financing instruments in Brazil



Prepared by EPE

The presented gaps in the figure are related to different stages of maturity of technological development, but the existing financing mechanism do not necessarily address those gaps. In fact, although there are some opportunities for improvement in financial mechanisms, it is worth to mention the importance of the market design suitability for new technologies and the emerging of new business models in the Brazilian energy sector.

According to the international Energy Agency, among 26 identified innovation areas, only solar PV and onshore wind, energy storage and electric vehicles are mature enough and commercially competitive to conventional energy sources and are on track to deliver their contribution to climate objectives¹. This statement is particularly relevant in the

¹ This statement is also available in World Economic Forum white paper called Accelerating Sustainable Energy Innovation, prepared in collaboration with KPMG. Access: <https://www.weforum.org/whitepapers/accelerating-sustainable-energy-innovation>

Brazilian context, given the fact that it already has a high share of renewable sources in its matrix. However, there are opportunities related to networks and digitization, for integration of new resources, as flexibility providers for the systems. In general terms, the traditional financing suppliers can provide funding to mature energy transition technologies due to its reduced technological and market uncertainty. In this case, the challenges can be addressed by few incentives, green financing or coupling additional risk mitigation instruments in the existing funding structures.

In the early stages of new technologies development there is still much uncertainty about what technology will emerge. Both the technological and commercial risks are significant. This makes it difficult to fund by traditional sources. These financial constraints are one reason why policies, sectoral programs and specialized investors often play important roles in financing the early stages of technology development. There is a need for targeted and well-designed financial instruments to de-risk and stimulate investments from different sources in such new technologies.

Market design changes also imply the necessity for new financing solutions. In Brazilian electricity market, for example, the regulated market auctions were relevant to drive the introduction of renewable sources mix. However, wind and solar energy are currently leading the expansion of the generation matrix through the unregulated market (that represents 30% of total market). The main reason is that those technologies are the most competitive ones to produce electricity from greenfield facilities. This market has been the locus where consumers committed to ESG goals, competitive renewable power generators, and investors searching for sustainability asset opportunities can match, catalyzing a virtuous cycle of development for clean energies in Brazil. Nevertheless, short-term contracts and single off-taker risks introduce challenges for the long-term credit of projects.

Policy driven financing mechanisms can also be applied when local markets and regulatory developments may not stimulate technologies already established in other countries. In both cases, some sectoral programs could provide funding and information for regulatory improvement, before widening adoption. In Brazilian context, one example of this mechanism is energy regulator's (ANEEL) R&D program, especially the strategic calls. It has been an important instrument for mobilizing private investments with a focus on specific areas. This is the case of the Strategic Call "Development of Efficient Electric Mobility Solutions" (nº 022/2018), based on a concept of Innovation Network in the Electricity Sector (RISE, in Portuguese), which approved 30 projects across the country and mobilized R\$ 463.8 million in investments, including a counterpart of R\$ 72.2 million from the companies involved.

This article seeks to present the main financing mechanisms in Brazil for supporting renewables sources and enabling technologies² for energy transition, considering its applicability for early, intermediate and mature technologies.

Financing Mature Technologies in Brazil

The decrease in installation costs, resulting from improvement in technology and the adaptation of procurement mechanisms to changing market conditions, has proven to be an effective catalyst in ramping up investment and building additional capacity³. In Brazil, there are some running examples of providers and mechanisms that help market development and create funding support to mature renewable technologies, in both electricity and fuel sector. Actually, the main sources of debt funding for mature technologies are the Brazilian Development Bank (BNDES) and the infrastructure debenture Bonds.

Figure 2- BNDES and infrastructure debenture bonds comparison



Source: Newsletter- Infrastructure Debentures. Brazilian Ministry of Economy⁴.

Brazilian Development Bank

Until 2019 The Brazilian Development Bank (BNDES) was the main source of debt funding for energy infrastructure in the country and developed a range of financing lines for almost all sizes of projects.

Among the BNDES' products, worthy of mention is BNDES Project Finance, earmarked for financial structuring of investment projects and contractually supported by the cash flow

² Enabling technologies- Technologies that play a key role in facilitating the integration of renewable energy. (IRENA, 2019)

³ IRENA, 2020. Global Landscape of Renewable Energy Finance

⁴ *Boletim Informativo das Debêntures Incentivadas*. 90th Edition. SPE-ME. May, 2021
<https://www.gov.br/economia/pt-br/centrais-de-conteudo/publicacoes/boletins/boletim-de-debentures-incentivadas/2021/newsletter-infraestrutura-debentures-may-2021.pdf>

of this project. Assets and receivables (asset-backed) may serve as guarantees of this same undertaking. This structuring is especially important for the electricity generation market in Brazil, which was traditionally based in long term contracts and PPAs on regulated market. However, since 2018 a range of changes in the Brazilian electricity markets have stimulated the expansion of the deregulated electricity market. However, in view of the new reality, BNDES and other funders have been revisiting their policies to support the sector and adapting them to overcome the challenge of financing projects with PPAs in the free market.

BNDES also participates as a subscriber of securities - i.e., shares, simple debentures, convertible debentures, subscription bonds, options and other derivative products, in addition to participation in asset-backed (receivables) investment funds (FIDC) - in publicly-listed companies, in public or private issuances, or in companies that may join the capitals market in the short or medium term, through a private issuance.

Infrastructure Debentures

In the last 5 years, debt bonds emission has been emerged as an instrument for funding infrastructure projects in Brazil. As energy infrastructure is a strategic priority, these projects enjoy tax benefits and constitute a long-term funding mechanism via the capital market, as an alternative to traditional sources of financing. The number of infrastructure bonds emitted and volume of funding provided since 2014 up to 2020 is showed in table 1.

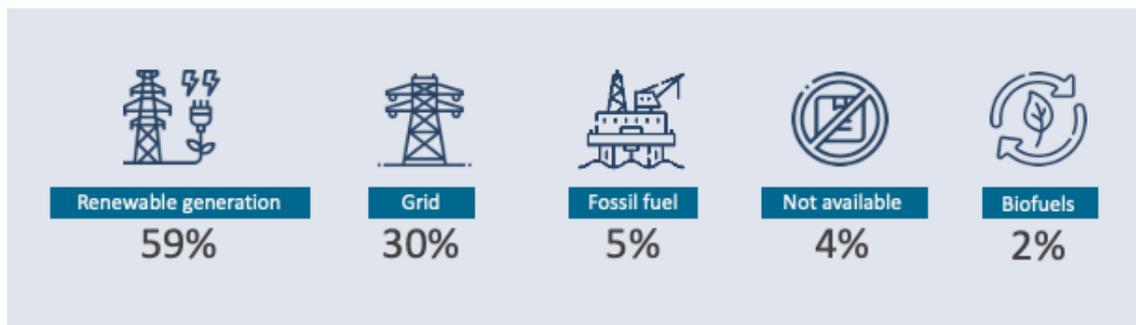
Table 1- Debt bonds funding in energy sector

	2014	2015	2016	2017	2018	2019	2020
Funding provided (Million Dollars)	563	492	888	2.233	4.949	6.765	2.365
Number of bonds	8	11	15	42	68	79	40

Source: Infrastructure Debentures- Newsletter. Brazilian Ministry of Economy.

Historically, the share of renewables generation responds for more than half of all projects in energy infrastructure supported by debenture bonds. It is worth to mention that grid investments are also relevant for integration of new resources and respond for a share of 30% in energy infrastructure.

Figure 3- Capex share of the projects supported by debenture bonds



Elaborated by EPE, from Infrastructure Debentures Newsletter- Brazilian Ministry of Economy

For energy infrastructure, the average ticket of bonds is of 69 million dollars and, according to ME (2021), this amount responds for more than half of the total Capital expenditures, among the bond emitters, indicating suitability of the instrument for large sized projects.

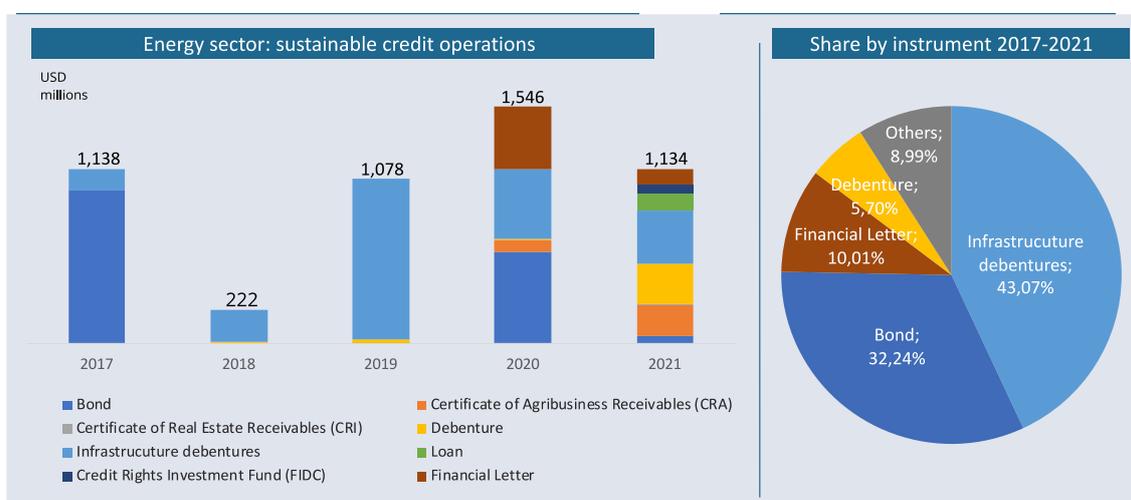
BNB (Banco do Nordeste)

Another source of funding for renewable infrastructure, the BNB (*Banco do Nordeste*) stands as a relevant player in financing micro and small distributed renewable generation in the north-east region of Brazil. Some credit lines are subsidized by a Constitutional Fund for North-East Funding (FNE) and offer special conditions for the citizens, small and medium sized business.

Green instruments in energy sector in Brazil

The sustainable credit operations in the country, covering not only bonds certified by the Climate Bonds Initiative (CBI), but also other mechanisms and themes can be visualized using a database developed by the social organization SITAWI.

Figure 4- Sustainable credit operations in energy sector



Elaborated by EPE, from SITAWI database of green bonds in Brazil

From the data above it is possible to note that the sustainable credit operations have been above 1 billion dollars in the last five years, with the exception of 2018. It is also expected that the year 2021 should significantly exceed the historical average, since considering only data up to June 2021, the volume of resources has already reached the historical average level. Furthermore, looking specifically at the figures for 2021 it is possible to observe a greater diversification of instruments used.

Other Funding and Facilitating Mechanisms for Mature Technologies

A range of private public banks also play important roles in financing systems for mature technologies in Brazil in many ways: (i) Coupled with BNDES, acting as a transfer agent or providing bridge loans; (ii) as green financing and renewables projects main funding source.

Despite the reasonable adequacy of funding sources and financing systems for mature technologies, some mechanisms can create a competitive differential in favor of investments in renewable resources and enabling technologies. As example, we mention a low carbon program in the fuel sector, called Renovabio, which combines de-carbonization targets, biofuels production certification and de-carbonization Credits (called CBio). With the implementation of the program, 200 billion US Dollars investment are expected in the biofuels sector by 2030.

Funding Early and Intermediate Stage Technologies

Early-stage technologies can be embodied in the innovation system and suggest needed improvements to transform a commercially promising “invention” into a business plan that can attract enough investment to enter a market successfully, and through that investment become a successful innovation. Markets usually provide less finance for innovation than would be socially desirable (WEF, 2018⁵). This is why many governments use different types of intervention to increase the amount of finance available for innovation activities.

In Brazil an important driver of private sector participation in R&D investments in clean energy is the public policy that establishes mandatory RD&D clause in each concession, permission and authorization contracts for the generation, transmission, and distribution of electricity, regulated by the Brazilian Electricity Regulatory Agency (ANEEL), as well as for the exploration, development, and production of oil and natural gas, regulated by the National Agency for Petroleum, the Natural Gas and Biofuels (ANP).

⁵ WEF. Accelerating Sustainable Energy Innovation, 2018. Available on: http://www3.weforum.org/docs/Accelerating_sustainable_energy_innovation_2018.pdf

In the case of the electricity sector, ANEEL's R&D Program was established in the 2000s through Law No. 9,991 / 2000 and states that companies in the electricity sector must employ, every year, a minimum share of their net operating revenue in technological research and development projects in benefit of the electric sector. The regulatory agency is responsible for managing and operationalizing this public policy, which has resulted in an average US\$184 million dollars of investments annually.

The R&D program encompasses a range of priorities and strategic themes, which involve national priorities, high complexity in scientific and/or technological terms and low attractiveness for investment as an individual or individual business strategy. The proposed calls in strategic themes, potentially contributes to mitigation of environmental impacts either by providing flexibility to systems or by encouraging the development of renewable sources. Across the years, this has engaged networks between academia and companies in pursuing solutions, new services, costs and environmental impacts reduction in electricity sector. One example is the proposal of ANEEL Strategic R&D Call 21/2016, "Technical and Commercial Arrangements for the Insertion of Energy Storage Systems in the Brazilian Electric Sector," launched in 2016, aimed at proposing technical and commercial arrangements for the evaluation and insertion of energy storage systems in the Brazilian electricity sector.

Brazil participation in United Nations High Level Dialogue on Energy: an opportunity to scale up investments in Hydrogen

In January 2021, Brazil was chosen to be one the leaders in the United Nations High-level Dialogue on Energy. More specifically, Brazil was selected as the leading country on the theme of Energy Transition, one of the central axes of the initiative. The High-level Dialogue on Energy was launched with the aim of identifying ways to accelerate progress towards the goal of providing clean, sustainable, reliable and accessible energy for all.

In this context, Brazil has decided to put forward two energy compacts: (i) transport biofuels, as a mature stage technology, and; (ii) hydrogen, as an early stage technology

In the case of biofuels, Brazil has consolidated experience and international recognition. Brazil's compact on biofuels represents a voluntary commitment to reduce emissions of six hundred twenty million tons of CO₂ equivalent in 10 years. This will contribute to lower the carbon intensity of the Brazilian transportation matrix and to consolidate our domestic carbon market for the biofuels sector.

The second compact is dedicated to hydrogen. Brazil's Hydrogen Energy Compact was prepared as a contribution to the global ongoing process to strengthen the foundations for a hydrogen economy to grow and create large-scale opportunities

to decarbonize a number of sectors that today depend on fossil fuels, seeking the possible synergies between clean electricity and low, zero or negative carbon fuels.

The Hydrogen Compact unfolds in three basic commitments. First, the strengthening support for research, development, demonstration and innovation with focus on hydrogen production and use. This is critical for finding ways to reduce costs, risks and to adapt hydrogen technologies to regional and local context. This will be done by guiding public and publicly oriented resources from existing R&D programs to create a new agenda focused on hydrogen solutions.

Second, the commitment to identify knowledge gaps and provide capacity building both for public and private sectors and increase specific professional training opportunities. This is critical for addressing the scale of the challenge ahead, by means of rapidly increasing the number of experts with a proper understanding of the hydrogen role in the energy transition, and of how they can get involved and support this process. This commitment aims to reduce risks related to a possible lack of qualified workers. In this quest, the Ministry of Education is a key player, in close collaboration with the Ministry of Mines and Energy and the Ministry of Science, Technology and Innovation.

The third commitment is to design an online open and collaborative hydrogen platform in Brazil, with a comprehensive database and a wide range of information available to those willing to take part in hydrogen research, development and get involved in this emerging market, reducing transaction costs.

These three main commitments and work streams under Brazil's Hydrogen Energy Compact, combined with the country abundant and competitive clean energy resources, will be a relevant contribution to reaching carbon neutrality globally and creating inclusive opportunities. In order to do so, the Ministry of Mines and Energy is involving other ministries, agencies, financing institutions and private sector in order to develop innovative solutions to stimulate the hydrogen market in Brazil.

Considering that the Hydrogen compact is an ongoing process to strengthen the foundations for a hydrogen economy, it might be an opportunity to develop and test new bold ideas that could foster investments.

Other sources of funding Early-Stage Technologies

Besides the mentioned RD&D programs of the electricity (ANEEL) and the oil, gas and biofuels (ANP) regulators, there are other institutions that finance early-stage technologies. This includes the Ministry of Science, Technology and Innovations/National Science and Technology Development Fund (MCTI/FNDCT); the Funding Authority for Studies and Projects (FINEP); the National Council for Scientific and Technological Development (CNPq); specific financing lines of the National Bank for Economic and

Social Development (BNDES); the National Nuclear Energy Commission (CNEN); and the São Paulo State Research Foundation (FAPESP).

An initiative called Energy Big Push recently mapped the main sources of public and publicly oriented investments across the country. The result is showed in table 2.

Table 2 – Funding sources for early-stage maturity technologies (in million dollars)

Funding source	2014	2015	2016	2017	2018
ANEEL	264	189	164	199	205
BNDES	84	56	89	85	85
CNPq	2	1	1	1	1
FAPESP	18	17	14	17	18
FINEP	81	81	45	32	12
FNDCT	11	12	11	6	4
Total	458	356	324	339	325

Source: INOVA-E/Energy Big Push Brazil

The Brazilian government is investing in tracking innovation investments in energy and EPE is currently developing a platform that will make all the data developed in the Energy Big Push project available and updated to society⁶. One of the main objectives of the initiative is to present information that allows the identification of any gaps between the different stages of innovation.

The intermediate case...

Over the years, the emergence of new technologies, the process of digitization and consumer empowerment opened space for new possibilities for meeting energy needs as well new paths for de-carbonization and energy transition. However, some of these solutions, already established in other countries, faces some challenges for implementation in Brazil, either for costs or regulatory reasons. As example of this resources, we mention offshore wind generation, batteries and pumped storage, smart grids and electric vehicles recharge. For these cases, the ANEEL R&D program played an important role developing public calls to mobilize investments in these areas and overcome regulatory barriers. As example, we can mention strategic calls for “Developing Electric Mobility Solutions” and “Technical and Commercial Arrangement for Storage Insertion in Brazilian Electricity Sector”, launched in 2018 and 2016, respectively.

⁶ More information can be found in:

https://repositorio.cepal.org/bitstream/handle/11362/45908/S2000343_pt.pdf?sequence=1&isAllowed=y

Another program guided by ANEEL, called Energy Efficiency Program (PEE) aims to promote economic feasible projects in all sectors of the economy, through improving the energy efficiency of equipment, processes and energy end uses. Like the RD&D ANEEL Program, the PEE is a publicly oriented funding provider, allocating a share of the Net Operating Revenues, but in this case, the mandatory amounts are only for distribution utilities.

Also, for the intermediate cases, some complementary elements are under development to better allocate risks in the traditional financing structures in Brazil. As example we mention: (i) creation of a Guarantee Fund for energy- FGEnergia, for partially cover the risk of financial agents in credit operations for Energy Efficiency Projects, and (ii) Energy Savings Insurance ESI-Program, for covering performance risks in small scale efficiency and distributed generation projects.

Conclusion

In the context of the Energy Transition and responding to the challenges of climate change, countries have been building strategies and narratives that help to highlight different implications in terms of opportunities, risks and benefits, based on each country's domestic priorities and status. Within the multiple perspectives, one element stands out and emerges as a consensus: the key role of innovation in the search for sustainable solutions for increasingly complex and dynamic energy systems.

It is important to note that different technological solutions have different implications in terms of risks. For example, mature technologies such as solar and wind normally do no longer encounter financing difficulties, but need to address the risk of ensuring grid access by the time of its completion. Another nature of risk that is relevant for mature technologies is the one related to market design reforms, necessary to address market developments. This is the case, for example, of distributed generation, under a net metering scheme that has been debated in Congress.

When it comes to new technologies and innovative solutions it is necessary to ensure that innovators get access to funding. Based on the long term energy strategy (set in Brazilian National Energy Plan 2050), and considering that in the country there is a significant amount of RD&D resources under regulated and publicly oriented programs managed by the National Electric Energy Agency (Aneel) and the National Petroleum, Natural Gas and Biofuels Agency (ANP), the National Energy Policy Council (CNPE) published a resolution defining energy RD&D priorities, with focus on clean energy solutions and digital transformation. This resolution aims at reinforcing the strategic alignment between long-term sectorial challenges and RD&D investments. The seven priority areas for investment are:

- Hydrogen
- Nuclear energy
- biofuels
- energy storage

- technologies for sustainable thermoelectric generation
- digital transformation
- strategic minerals for the energy sector.

For such investments to be successful, it's essential that the public and private efforts and investments in RD&D are combined and complementary and covering the gap in the middle (valley of death). Blended finance and public-private co-investment instruments can help de-risk investments.