

TC Document

I. Basic Information for TC

▪ Country/Region:	BRAZIL
▪ TC Name:	Modernization of the Brazilian Power Sector
▪ TC Number:	BR-T1529
▪ Team Leader/Members:	Echevarria Barbero, Carlos Jose (INE/ENE) Team Leader; Carvalho Metanias Hallack, Michelle (INE/ENE); Irati Jimenez Dorronsoro (INE/ENE); Loana Vega (INE/ENE); Nicolas Tulande (INE/ENE); Paredes, Juan Roberto (INE/ENE); Verissimo Da Silva, Carolina (LEG/SGO) Team Leader; Carvalho Metanias Hallack, Michelle (INE/ENE); Irati Jimenez Dorronsoro (INE/ENE); Loana Vega (INE/ENE); Nicolas Tulande (INE/ENE); Paredes, Juan Roberto (INE/ENE); Verissimo Da Silva, Carolina (LEG/SGO)
▪ Taxonomy:	Client Support
▪ Operation Supported by the TC:	.
▪ Date of TC Abstract authorization:	04 Aug 2022.
▪ Beneficiary:	Federative Republic of Brazil, through the ministry of Mines and Energy
▪ Executing Agency and contact name:	Inter-American Development Bank
▪ Donors providing funding:	United Kingdom Sustainable Infrastructure Program(SIP)
▪ IDB Funding Requested:	US\$1,000,000.00
▪ Local counterpart funding, if any:	US\$0
▪ Disbursement period (which includes Execution period):	24 months
▪ Required start date:	1/9/2023
▪ Types of consultants:	Individual and Firms
▪ Prepared by Unit:	INE/ENE-Energy
▪ Unit of Disbursement Responsibility:	CSC/CBR-Country Office Brazil
▪ TC included in Country Strategy (y/n):	Yes
▪ TC included in CPD (y/n):	Yes
▪ Alignment to the Update to the Institutional Strategy 2010-2020:	Environmental sustainability; Gender equality; Productivity and innovation

II. Objectives and Justification of the TC

- 2.1 The objective of this Technical Cooperation (TC) is to support the Government of Brazil (GoB) to strengthen its institutional, technical, and regulatory capabilities to promote a greater integration of low carbon technologies in the Brazilian energy matrix.
- 2.2 Brazil is globally considered as the seventh largest Green House Gas (GHG) emitter with an amount of 2.9% emissions. Electricity and other energy use account for 28% of emissions, which after the transport sector, makes it the most polluting industry.
- 2.3 To achieve the climate goals adopted by the Parties to the UNFCCC (United Nations Framework Convention on Climate Change) and its Paris Agreement during the 26th Conference of the Parties; Brazil's National Determined Contribution (NDC) has established the target of reducing country emissions based on the levels of 2005 by 37% in 2025 and by 50% in 2030. To decrease GHG levels in the energy sector, the energy mix must achieve 45% of renewables by expanding the use of renewable energy sources (other than hydropower) in the total energy mix to between 28% and 33%.

- 2.4 The electricity matrix in Brazil is dominated by hydroelectric generation, although this dependence has been gradually reduced. While in 2000 hydroelectricity represented 83% of Brazil's installed capacity and 87% of the generated electricity, in 2021%) and solar generation, which contributed only the hydroelectric source still represented about 63% of the country's installed power and gross electricity production, well above other renewable sources such as wind (9.2%), biomass (9%) and solar generation, which contributed only 3%, significantly below of its potential use, although variable renewable energy resources (wind and solar) have had an accelerated growth in recent years.
- 2.5 As it was mentioned and despite the gradual reduction in hydroelectricity generation, the country's electricity edifice is highly dependent on the availability of water resources for generation. In this sense, a country's vulnerability to different climate hazards such as rainfall or droughts, makes it difficult to provide certainty in the electricity market price formation process which directly impacts the volatility of prices in the electricity system. Thus, to meet the electricity demand, the operator has been forced to allow more frequently the operation of some thermoelectric power plants, increasing the electricity generation cost and Greenhouse Gas Emissions (GHG)¹.
- 2.6 As noted, along with the abundance of hydro-energy resources, Brazil has an enormous potential to exploit other renewable sources such as wind, solar and biomass. Although these renewable resources have had great growth in recent years, in case of solar PV with an amount of 90.4% of micro and macro distributed generation, at this stage, the use of these resources for electricity generation is quite far from its potential low scale use. As a first step to get a more flexible, accessible, and secure electricity matrix around the Brazilian territory, a more diversify energy matrix will be required to be able to reduce its vulnerability, its high dependence on hydroelectric generation and increasing its infrastructure resilience to different climate hazards.
- 2.7 Due to the historical prevalence of hydroelectricity generation, the rules of expansion and operation of the electricity system have been designed around the technological characteristics of this source. Currently the electricity sector is going through a transformation process because of a massive new integration of variable renewables, increase of Distributed Generation resources (DG), sectoral digitalization and automatization process, sector's coupling (energy, transport, telecommunication, etc.), and the need to boost the transition to a zero-emission economy.
- 2.8 In this new scenario with a technological transformational changes, higher complexity, and greater uncertainty, it is required the Brazilian electrical system progressively adapts to this context becoming more flexible and resilient. Moreover, a more sophisticated energy market, pricing signals, and more interconnection arrangements between electricity subsystems and neighbor countries will be essential to optimize the expansion and operation of the system, considering the diversity of Brazilian's energy resources and its geographical dispersion throughout the territory.
- 2.9 To respond to this situation, in April 2019, the Ministry of Mines and Energy (MME) published the Portaria No. 187, which established a Working Group (WG) to lead and articulate a participatory process to carry out proposals, strengthening consensus, to modernize the electricity sector, based on the following pillars: (i) Governance; (ii) Transparency; and (iii) Legal-regulatory stability. The WG deals with topics such

¹ <https://www.epe.gov.br/sites-en/publicacoes-dados-abertos/publicacoes/Paginas/Brazilian-Energy-Balance-2021.aspx>.

as, among others, market environment and mechanisms for enabling Brazilian electricity system expansion, pricing, cost and risk allocation, and sustainability of distribution services.

- 2.10 As result of the WG's efforts, in October 2019 it was presented an Action Plan which included 15 tasks and 88 subtasks to contribute to the modernization of the electricity sector and in response to country needs and country prioritization strategies.
- 2.11 The UK Sustainable Infrastructure Program (UKSIP) is a British fund that provides technical assistance in Brazil to enhance regulatory frameworks and low carbon policies in key infrastructure sectors, such as renewable energy, to enable the market conditions for the private sector.
- 2.12 **IDB's support to the Brazilian electricity modernization process.** The IDB has technically supported the modernization process of the electricity sector in Brazil from very early stages. As stated before, IDB supported the participation of technical experts in the initial discussions of the thematic working groups. In addition, in order to optimize the expansion process of the Brazilian electricity system, IDB through UKSIP resources in 2021 contributed to establish a more effective coordination of new electricity generation projects and associated transmission works to start operating.
- 2.13 Also, in 2020 and 2021, the IDB with UKSIP funds facilitated initial technical support to the WG to assess the feasibility and convenience of carrying out combinatorial auctions for both electricity generation (together with the associated transmission) and energy capacity.
- 2.14 This support has enabled higher and enhanced efficiency of the expansion of the electricity system and cost minimization. The electricity sector in Brazil is going through a transformational change to become more sustainable and low carbon. Thanks to UKSIP, this ongoing transformation contributes to promote the modernization and development of the electricity sector, including the optimization of use of available energy resources, especially renewable, and to reduce GHG emissions.
- 2.15 Nevertheless, more support is needed to transform the electricity sector and to honor the country's NDC commitments. Brazil can capitalize on the work achieved so far with help of past, present, and future UKSIP funds.
- 2.16 Update to the Institutional Strategy 2010-2020 (AB-3008). The TC objective is consistent and aligned with the development challenge of productivity and innovations within the sector (new market structures, new technologies implementation, support of women participation in the sector), and the cross-cutting theme of environmental sustainability and climate change promoting the diversification of the Brazilian energy matrix and working to get a low carbon energy generation matrix. Additionally, the TC is aligned with the Sustainable Infrastructure Strategy of the IDB by supporting ongoing improvements in energy infrastructure to enhance the resiliency of the Brazilian electricity system. The TC is also consistent with the Energy Sector Framework Document (GN- 2830-3), in the thematic area of Sustainability, and the Climate Change Framework (GN-2835-8), in the area of mitigation as it will support the development of clean energy resources in Brazil and accelerate the implementation of Brazil's NDC. The TC is aligned with the United Kingdom Sustainable Infrastructure Fund's (UKSIP) objectives of financing TC operations, and blended-finance operations in sustainable low carbon infrastructure sectors, including renewable energy and low-carbon and efficient energy generation. Moreover, the TC is also aligned with the

Gender Equality challenge by strengthening local capacities in relation to innovative schemes for the installation and O&M of renewable sources.

- 2.17 **IDB's Country Strategy for Brazil 2019-2022 (GN-2832).** The TC is consistent with the objective of improving the business climate and narrow gaps in sustainable infrastructure to enhance competitiveness, promoting better quality infrastructure, increasing share of renewables in the energy matrix, and enhanced energy efficiency. This TC will specifically support developing mechanisms to implement quality infrastructure by: (i) ensuring alignment with socioeconomic development and strategies of developing countries/regions as well as comprehensive response to the needs; and (ii) economic efficiency of infrastructure. The TC is also consistent with the objectives of the Country Strategy for Brazil 2019-2022, which were approved in June 2019.
- 2.18 **Update to the Institutional Strategy 2010-2020 (AB-3008).** The TC objective is consistent and aligned with the development challenge of productivity and innovation, and the cross-cutting theme of environmental sustainability and climate change promoting the diversification of the Brazilian energy matrix. Additionally, the TC is aligned with the Sustainable Infrastructure Strategy of the IDB by supporting ongoing improvements in energy infrastructure to enhance the resiliency of the Brazilian electricity system. The TC is also consistent with the Energy Sector Framework Document (GN- 2830-3), in the thematic area of Sustainability, and the Climate Change Framework (GN-2835-8), in the area of mitigation as it will support the development of clean energy resources in Brazil and accelerate the implementation of Brazil's NDC. The TC is aligned with the United Kingdom Sustainable Infrastructure Fund's (UKSIP) objectives of financing TC operations, and blended-finance operations in sustainable low carbon infrastructure sectors, including renewable energy and low-carbon and efficient energy generation.

III. Description of activities/components and budget

To achieve the proposed objectives, the TC will finance three components:

- 3.1 **Component I: Promote the decarbonization, digitization, decentralization, and democratization of the Brazilian electricity system.** The transformation process in which the Brazilian energy sector is immersed has few past references. This process responds to the new paradigms that guide the development of the energy sector at a global level oriented to promote its decarbonization, decentralization, democratization, and digitalization. This component will facilitate the Ministry of Mines and Energy (MME) to strengthen their capacity to adequately promote the development and consolidation of these new paradigms, in parallel to the ongoing power sector modernization process. Studies and activities to be financed under this component may include:
- i. Implementation of smart-grid and low carbon technologies. Multiple factors such as the need to maintain the criteria of electricity system's performance to manage a greater integration of variable renewable energies; the rapid increases of distributed generation, or electricity storage and transport technologies penetration; as well as the greater awareness and knowledge of consumers who everyday demand more detailed information and new value-added electricity

services; determine the need to undertake a process of digitization and automation of Brazilian's electricity network, promoting the process of transition of its electrical system towards an "intelligent network". Despite the undeniable benefits derived from the installation of smart meter systems, so far, its penetration in the Brazilian case could be classified as timid.

The studies to be carried out within the framework of this activity are aimed to develop a country sector diagnosis and roadmap to achieve net zero emission scenario with a boost of a more digitalized energy network, determine the key barriers and risks that currently exist in the market to accelerate low carbon energy investments; and make an assessment of relevant solutions and bold ideas that address each of the barriers. As a list of potential solutions have been identified, based on anticipated highest impact and possibility to execute, smart meter's pilots will then be defined when relevant while implementation pathways will be articulated for solutions and recommendations that can be applied straight away.

- ii. Promote a decentralized low carbon energy generation framework. The Brazilian distributed generation (DG) industry has been growing quickly since 2015, driven by proper regulations (including net metering regulations), financing availability and technological developments, in addition to the natural incentive for electricity cost reduction. There are around 340.000 operational DG projects that added 4.3 GW of installed capacity to the Brazilian electricity system. This represents approximately only 2% of the total installed capacity in Brazil. Ninety-nine percent of the Brazilian DG projects are photovoltaic installations. The Brazilian DG market is competitive and attractive from a financing perspective; however, some obstacles remain for wider adoption of the technology by all parts of the society and economy. The new energy generation framework will tackle these obstacles to eliminate barriers for further private sector investments.
- iii. Promote a decentralized low carbon energy generation framework and validation of environmental and social benefits of renewal energy in line with mechanisms to guarantee safety supply and competitiveness. Regarding allocation of costs and risks, energy efficiency gains can be achieved with a reduction in an over-exposure to single source of electricity that at the same time can be productive to stable energy pricing and make them more accessible to all the citizens.
- iv. The valuation of the environmental attributes of renewable sources aims to implement competitive and market mechanisms that can add value to the environmental benefit provided by such renewable sources.
- v. While 98% of the Brazilian population currently has access to electricity, a large portion of the country (in the north and north-east) is not connected to the National Interconnected System (NIS). Communities in these regions either have no access to electricity or are predominantly supplied with fossil based. There are a variety of technologies capable of substituting the current diesel generation for these communities, a combination of which needs to be deployed based on structured economic and socioenvironmental considerations. The objective of this activity is to reduce GHG emissions in isolated areas and systems of the legal Amazon through the introduction of renewable energies, mainly individual photovoltaic systems and mini-grids, and the hybridization of generation based on fossil

fuels². Likewise, this activity is aimed at: (i) strengthening local capacities in relation to innovative schemes for the installation and O&M of these technologies, considering aspects related to gender equality; (ii) Facilitate technical support to evaluate the technology solution mix for feasibility and project delivery support; and (iii) Develop economic feasibility assessments depending on the technology renewable energy solution of choice.

3.2 Component II: Strengthen the liberalization and competitiveness in the electricity sector in Brazil, increasing the mobilization of low carbon private investments. This component is oriented to finance activities aimed to promote measures to strengthen the competition and competitiveness in the distribution, transmission, and power generation segments of the Brazilian electricity sector. Among the activities to be carried out within this component, the following can be highlighted:

- i. Generation and transmission. Brazil is a pioneer in electricity commercialization using the auction mechanism. Since 2004, when this mechanism began to be used as a basis for the expansion of the Brazilian electrical system, it has been possible to observe, in practice, the benefits and advantages offered by this scheme. Properly designed market structure will be necessary to: have a better coordination between energy generators and transmission infrastructure required and a new energy auctions structure which can impose better behavioral rules and mitigate market failures apart from the private sector mobilization in the country. It is then recommended to structure both generation & transmission procurement procedures to promote a low carbon electricity market. This will achieve a more effective coordination in new energy auctions between the new contracted power supply and the commissioning of transmission infrastructure linked to the new generation projects contracted. It will also promote greater mobilization and coordination of private sector investments in the expansion of the electricity sector.

In this sense, an evaluation of the economic impacts will be carried out, considering the GHG emissions that could have been avoided, for the Brazilian electrical system that may be derived from the lack of adequate coordination between the entry into operation of renewable generation projects, and the expansion and availability of the transmission system that is required to evacuate and inject this energy in the NIS.

- ii. Transmission of new technologies roadmap. The increasing integration of the large amount of low carbon generation in the Brazilian power system (other than hydro) has becoming a crescent challenge for the actual transmission expansion planning activity. A geographically extended and interconnected power network roadmap needs to be developed, basically designed around the technological characteristics of larges hydropower generation, distant from the main load centers, has now, to be expanded under new and sometimes unexpected conditions. The integration of variable renewable generation (VRG), wind and solar, with the current regulation, which includes the network free access and the Free Contracting Environment (ACL), inserts additional difficulties. Uncertainties

² The Brazilian Ministry of Mines and Energy (MME) estimates that close to \$1.9 billion of investment would be required in the next six to eight years to provide electricity access to isolated systems. The More Light for the Amazon Program, initiated and guided by the MME, is aimed at rural and isolated communities in the legal Amazon but also there are 257 isolated systems with an installed capacity of 1,218 MW in the Brazilian Amazon (more than 90% of this capacity is based on diesel generation).

in generation connections to the network, related to geographical location and to the amount of power, are part of these difficulties, besides the impacts in the system operation, imposed by VRG technologies. Some of the vital network attributes, such as reliability, flexibility and resilience, need to be improved with the rise of the amount of VRG in operation.

- iii. Distribution. With the necessity of better allocation of costs and risks in the electricity sector, it is also important to define and establish the role of energy distribution companies. They will be responsible for energy demand projections and planning for the expansion of the distribution system in its concession areas as well as energy portfolio management for their regulated consumers. Among the specific products to be developed, it is worth mentioning the development of guides and technical studies, and strengthening of capacities, which contribute to facilitating the insertion, in the distribution system, of a greater volume of renewable energies in areas such as the planning of the expansion and reinforcement of the system in a much more uncertain environment than the traditional one, given the aggressive penetration of DG projected in the coming years; evaluation of alternatives for digitalization of distribution networks with an evaluation of the advantages, quantification of benefits, and identification of new potential services to offer to consumers
- iv. Short-Term Market (STM) Improvements. At present, the electricity market has one third of its load negotiated in the STM, growing by 18% in the number of agents in the last 12 months. In the next decade, it is expected that this market will be able to double in size, especially because of the Gob's efforts to liberalize the market. In this context, the Electric Energy Trading Chamber (CCEE) has requested greater security, robustness, flexibility, agility, increased temporal granularity of operations and scalability in the accounting and liquidation of transaction processes of the STM, and in other services provided by the Chamber to the market. Therefore, it is necessary to strengthen the capacities of CCEE to guarantee the security, robustness, and agility of its operations and transactions. To strengthen CCEE's capacities to manage and operate the STM in the coming years, it is necessary to address an institutional modernization process that encompasses three fronts:
 - Review and development of recommendations based on international best practices to get a modernization of the current STM structure to support the current increase in operations.
 - Revision of the evolution of the accounting and liquidation model highlighting the weaknesses and strengths of the model. This modernization process requires a structured and consultative study, involving the market agents and Brazilian financial entities.
 - Provide improvements and a roadmap to the STM to get a mayor agility, granularity (operations in less time) and interoperability (participation of more financial entities).

3.3 Component III: Boost to develop new technologies to support the decarbonization of the Brazilian energy matrix. The segments that are difficult to decarbonize are those in which, for technical or economic reasons, they have limited prospects for replacing fossil fuels with less polluting energy. These include transport and some energy-intensive industrial sectors, such as steel, basic chemicals, and

cement production. New technological routes, currently under development, can mitigate emissions from these sectors, such as the use of low carbon hydrogen.

- 3.4 Hydrogen is an increasing disruptive technology and an important element in the context of decarbonization of the Brazilian energy matrix, particularly in the case of the above-mentioned segments of the economy. Considering this fact, Brazil has made efforts to develop a strategy that makes it possible to boost the country's hydrogen economy. To this end, the National Energy Policy Council (CNPE), through resolution 06/2021, determined that the MME should present to CNPE a proposal for guidelines for the National Hydrogen Program, considering, among other factors, the interest in developing and consolidate the hydrogen market in Brazil and international integration.
- 3.5 Based on the above, this component will facilitate technical support to the development of the guidelines and activities contemplated in the Brazilian National Hydrogen Program. A diagnosis will be carried out, including but not limited to:
 - a state of the art of the hydrogen market currently in the country with structured information on the main buyers, sellers, research institutions involved, technologies used and their respective suppliers of equipment.
 - potential of hydrogen adoption in national industrial sectors,
 - legal-regulatory regulations (as there are already available scattered legislations and regulations in different sectors),
 - and all the incentives for the hydrogen chain granted by Brazil (which include investment of public resources in research and development, incentives to import of equipment associated with hydrogen, regulation, among others).
- 3.6 To ensure that hydrogen is effectively contributing to decarbonization, its entire production chain must have low or zero greenhouse gas emissions. Considering the impossibility of verifying this attribute only from the point of view of the hydrogen molecule, it is necessary to have a certification of the production chain.
- 3.7 In this sense, a certification will be developed, based on a technological platform, which ensures for every final consumer of hydrogen (whether national or international) which carbon level is associated with the molecule.
- 3.8 In addition, there is room for the construction of trading platforms for these certificates, with tracking functionalities that will ensure hydrogen buyers access to their origin.
- 3.9 Technical support to the development of the guidelines and activities contemplated in the Brazilian National Hydrogen Program.
- 3.10 The total cost of this TC will be US\$1,000,000 which will be financed by the United Kingdom Sustainable Infrastructure Program (SIP):

Indicative Budget

Activity/Component	Description	Total FundingSIP
I. Promote the decarbonization, digitization, decentralization, and democratization of the Brazilian electricity system	Assessment of country energy sector scenario to get carbon neutrality by 2050 through the digitization, decentralization, and democratization of the electricity system with the validation of environmental benefits to guarantee safety supply and competitiveness.	100,000

	Country pathways for sector evaluation of the Universalization of Access and Use of Electrical Energy in Brazil and transition to a low carbon social policy	180,000
	Support Brazilian isolated areas and systems low carbon energy generation matrix.	20,000
II. Strengthen the liberalization and competitiveness in the electricity sector in Brazil, increasing the mobilizing of low carbon private investments	Country diagnosis of current transmission lines with the evaluation of the potential transmission line expansion with new technologies, in order to support the transmission planning expansion activity in the integration of low carbon technologies in the Brazilian energy matrix.	75,000
	Energy market sector analysis and recommendations based on international best practices to promote a more competitive market with and higher participation in the private sector	235,000
III. Boost to development of new technologies to support the decarbonization of the Brazilian energy matrix	Technical support to the Implementation of the guidelines and activities contemplated in the Brazilian National Hydrogen Program, including the development of a platform	390,000
Total		1,000,000

IV. Executing agency and execution structure

- 4.1 At the request of the MME, and in accordance with Section C of Annex II of OP-619-4, this TC will be executed by the IDB. The IDB will execute this TC to facilitate administrative and financial management support, and the coordination between the different public-sector entities, mainly the Ministry of Mines and Energy but also other actors involved in the execution and implementation of the final TC products. The *Empresa de Pesquisa Energetica* –EPE, responsible for energy planning in Brazil and dependent of the MME will participate in the execution process of the TC facilitating technical and coordination support to the MME.
- 4.2 The Energy Division (INE/ENE) will be responsible for its execution, in coordination with the IDB Country Office in Brazil (CSC/CBR). The Bank will contract individual consultants, consulting firms, and non-consulting services in accordance with the Bank's current procurement policies and procedures: (i) the individual consultants will be hired in accordance with the guidelines set out in the AM-650; (ii) the procurement process for consulting firms will follow the Bank Policy for the Selection and Contracting of Consulting Firms for Bank-executed Operational Work (GN-2765-4) and the related Operational Guidelines (OP-1155-4), and (iii) the procurement of non-consultant services will follow the Bank Corporate Procurement Policy (GN-2303-28).
- 4.3 In compliance with the Operational Guidelines for Technical Cooperation Products Revised version (GN-2629-1), this TC is classified as Client Support. The technical responsibility is in INE/ENE.
- 4.4 The focal point designated and sector specialist responsible for executing and supervising this TC will be the Lead Energy Specialist based in Brasilia, Brazil, with the support of the Bank Country Office in Brazil (CSC/CBR) and the INE/ENE Team.

V. Major issues

- 5.1 No major risks are anticipated for the development of the TC. However, there could be eventual delays in the development of the studies, due to potential difficulties in coordinating the different counterparts involved: MME with support of EPE and CCEE. This risk can be mitigated by involving the counterparts from the beginning of the execution of the TC. The execution from INE/ENE, with the support of specialized consultants, will help to mitigate these potential risks. The draft of Terms of Reference (ToR) of the studies to be financed have been prepared and agreed to by the counterparts. The ToR for the key studies is ready and the consultants will be procured once the funds become available.

VI. Exceptions to Bank policy

- 6.1 No exceptions to the Bank's policies are requested.

VII. Environmental and Social Strategy

- 7.1 This TC will not finance feasibility or pre-feasibility studies of investment projects associated with environmental and social studies; therefore, it falls outside the scope of the Bank's Environmental and Social Policy Framework (ESPF).

Required Annexes:

[Request from the Client - BR-T1529](#)

[Results Matrix - BR-T1529](#)

[Terms of Reference - BR-T1529](#)

[Procurement Plan - BR-T1529](#)