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TEN-YEAR ENERGY EXPANSION PLAN

Conclusion of the Electric Energy Generation and Transmission Chapters

In recent years, Brazilian Electric Sector has undergone profound transformations that have led to a change in the electricity generation matrix. In this sense, EPE plays an important role in expanding the matrix through studies indicating PDE and acting in the development of Energy Auctions. Since 2005, 45 generation auctions have been held, where 71.2 GW of installed capacity are in commercial operation and another 11.5 GW are still under construction or in the process of obtaining concessions. Another fundamental aspect is the investments made to expand the transmission system, which today has more than 140,000 kilometers of lines that connect the various regions of Brazil. The only remaining exception is the state of Roraima. This system's robustness makes it possible to take advantage of the complementarity of sources across Brazil, both through diversification of resources and geographic dispersion. In addition, the definition of supply security criteria for the electricity sector from the publication of CNPE Resolution No. 29, of December 12, 2019, and MME Ordinance No. 59, of February 20, 2020, allow the planning studies to effectively determine whether we are in a "safe zone" or not, given the level of risk considered. PDE 2030, approved by the MME in February 2021, has already considered the new supply criteria and PDE 2031 continues with its use and improving the way in which the requirements are quantified.

Regarding the actual situation of the energy sector, the 2020/2021 biennium brought new challenges regarding the water scarcity period and its impacts on Brazilian electricity sector. EPE, which participates in the CMSE, along with other institutions in the electricity sector, was at all times focused on how to incorporate into medium and long-term studies the lessons learned from this short-term conjuncture. Within the scope of these committees, several short-term actions were taken from the second half of 2020 onwards to maintain

adequate operating conditions and guarantee the security of the NIS supply. As a highlight, it is worth mentioning the approval of thermoelectric dispatches outside economic merit order, which sought to correct the signals of the mathematical models that govern the operation of the National Interconnected System (SIN).

During the discussions in 2021, the results of the computer models used in the generation studies pointed to a management of water resources, and consequent operational flexibility of the HPP, which was not verified in practice. It is important to point out that this can only be verified during the scarcity situation, since under normal operating conditions, the service to other uses of water was done without evidencing major challenges. In this context, PDE 2031 brought a new approach to the operational restrictions of the SIN, presenting a form of feedback of the mathematical models from the data verified in the recent past. Chapter 3 presented the proposed methodology and its impacts from the requirements calculation to the reference expansion.

Among the main gains obtained, it is important to highlight that once the energy costs were quantified so that the hydroelectric plants can bring operational flexibility to the SIN, the energy and power requirements pointed to a greater need for expansion, when compared with simulation using official data. This is also noticeable when compared to PDE 2030 requirements. It was also identified that scenarios such as the one that occurred in 2020, when the availability of hydroelectric power was close to 60,000 MW, became more representative in the medium and long-term visions, especially for the 2021 simulations.

When analyzing the indicative expansion of the Free Round Simulations, the new approach to operational restrictions led to the expressive indication of wind and solar photovoltaic plants,

complemented by thermoelectric plants without compulsory generation, demand response and modernization with expansion of HPP. The increase in supply was sufficient to ensure that the supply criteria were met, ensuring that the energy use of the hydroelectric plants to provide the operational flexibility service is considered.

This expressive indication of the growth of renewable sources, mainly wind and photovoltaic sources, which are quite concentrated in the Northeast Region, reinforces the importance of expanding regional electrical interconnections to ensure, in addition to adequate conditions for operational reliability and electrical supply, greater flexibility in management of the global resources available in the system, such as inertia and operating power reserve, making the grid more resilient in the face of variations in load, generation or even the contingency of large transmission trunks.

Regarding this issue, it is important to mention that the transmission assets recommended by EPE in planning studies will result in a significant expansion of the capacity of regional interconnections by the year 2031. Only in the time frame of 2026, the evolution of the total export capacity of the Northeast Region stands out in 150% of the limit existing by 2020, reaching a transfer capacity of 15 GW. It should be noted that additional expansions, still under analysis in proactive transmission studies to be completed by March 2022, will increase this capacity to 30 GW.

Such studies have been carried out considering new planning approaches, in view of the increasing expansion of renewable sources from the Free Contracting Environment - ACL, where there is greater difficulty in managing information regarding the amounts and location of the prospected generation supply. In these studies, the forecast of the total amount of installed capacity for these sources considered the amounts of installed capacity, in the contracting phase, in this commercialization environment, in addition to the annual increments of indicative generation signaled in PDE. The distribution of this potential, for the purpose of assessing the expansion of transmission,

was based on the analysis of a wide sample of data available in the AEGE (EPE), SIGEL (ANEEL) and SGAccesso (ONS) systems, which allowed identifying the points of greater market interest for connecting new ventures.

In addition to these issues, the Plan also discussed the need to improve TUST's locational signal to ensure a more rational use of the transmission system. This measure would also have the potential to facilitate/accelerate the integration of new generators into the transmission system, by adding competitiveness to projects closer to large load centers, notably less dependent on expressive grid expansions. In fact, the importance of this improvement goes beyond the correct and "fair" allocation of costs associated with transmission systems, also interfering in the planning of generation expansion.

Regarding the results for the Reference Scenario, which incorporated energy policy guidelines, including Law No. 14.182/2021, to accommodate thermoelectric plants with compulsory generation, wind and solar photovoltaic renewable supply was replaced. In this regard, it is noted that a challenging coordination of the expansion of generation and transmission assets associated with the integration of this generation projects will be necessary taking into account the current times related to the instruction, inspection and publication of the bidding process for transmission projects.

From an economic-financial point of view, considering the reference scenarios, investments of around BRL 100.7 billion are estimated in new transmission assets by 2031, of which BRL 51.8 billion refer to projects that have already granted, as well as BRL 292.2 billion in new centralized generation assets, of which BRL 100 billion have already been contracted. These transmission investment volumes should still be expanded upon completion of the North/Northeast to Southeast/Mid-West expansion studies, scheduled for the first quarter of 2022. Up to 2036, an additional BRL 180 billion of generation assets are also expected.

Finally, the importance of the role of PDE 2031 is highlighted in bringing an integrated view of the energy sector and, in the specific case of Chapters 3 and 4, focusing on the expansion of the electric energy system. This integration allows Brazilian

electricity sector to maintain its renewable and reliable profile, being an important driver for Brazil's economic development.