



STRATEGIES FOR BRAZIL'S ENERGY FUTURE: ANALYSIS OF THE NATIONAL ENERGY PLAN 2050

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ABSTRACT

This analyzes the energy plan adopted by Brazil in the context of global climate challenges, with an emphasis on the goal of achieving Net Zero by 2050, which involves balancing greenhouse gas (GHG) emissions. The expansion of renewable energy sources and the reduction of GHG emissions in Brazil's energy matrix are crucial to achieving this goal. In 2020, the National Energy Plan 2050 was launched, with the goal of transforming the Brazilian energy matrix into a fully renewable one, as well as becoming a net energy exporter, producing enough to meet its needs and exporting the surplus. The Brazilian energy transition faces challenges, including the expansion of renewable sources such as hydropower, wind, and solar, as well as the improvement of infrastructure and logistics to support the growth of these sources. Moreover, sources such as solar and wind energy, due to their variability, require adaptations to ensure a reliable energy supply. In summary, the National Energy Plan 2050 represents a comprehensive and strategic guide for Brazil's energy transition, providing clear goals and strategies to promote technological growth and the use of renewable and non-renewable sources. It is a crucial step towards a sustainable energy matrix and contributes to global efforts to combat climate change.

Keywords: National Energy Plan; PNE 2050; Energy Transition; Renewable Energy.

INTRODUCTION

In response to the climatic challenges that planet Earth is experiencing, countries are planning their strategic energy plans, aiming to steer their economies towards a path of decarbonization and reduction of Greenhouse Gas (GHG) emissions. This proposes an analysis of the energy plan (EP) adopted by Brazil, considering the goals and challenges established towards achieving the Net Zero 2050 target (IEA, 2021; UNFCC, 2023).

The concept of Net Zero 2050 refers to a global commitment to achieve a balance between GHG emissions and their removals from the atmosphere by the year 2050. This approach implies the adoption of strategies that allow for the reduction of emissions, combined with carbon removal actions, such as reforestation and carbon capture (IEA, 2021). Therefore, a well-established energy plan could assist Brazil in this challenge of reducing its daily emissions of harmful gases to the environment.

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METHODOLOGY

The Brazilian Energy Plan for 2050 was studied and analyzed, in addition to using statistics on renewable sources in Brazilian territory to assess the progress of the proposed measures for the Brazilian energy sector.

Brazilian Energy Plan

Countries are seeking ways to meet the growing energy demand that the current technological landscape requires. In addition to energy expansion, Brazil is part of international agreements aimed at slowing and reducing the increase in the planet's temperature (IEA, 2021; WRI BRASIL, 2021).

With the advent of the COVID-19 pandemic and the possible future lack of energy resources to support Brazil's technological growth, the Brazilian federal government has begun to focus on creating strategies for the implementation of renewable energies and the reduction of GHG emissions. In addition to this national concern, Brazil will need to achieve 45% to 50% of renewable energy sources in its energy matrix by 2030, due to the international agreements it is part of, such as NETZERO 2050. (IEA, 2021).

In 2020, the Ministry of Mines and Energy (MME) inaugurated the National Energy Plan 2050 (PNE 2050). Through studies and analyses, the MME understood that 2030 would no longer be viable, as its goals would not promote the use and increase of renewable energy sources, but rather the majority use of non-renewable sources (EPE, 2020).

The 2050 project is a plan with various recommendations and guidelines to be followed throughout the future of Brazil's energy sector, aiming to shift from being a net energy importer to a net energy exporter.

The PNE 2050 is based on four objectives: energy security, return on investments, energy availability to the population, and socio-environmental criteria. Aiming to maximize and accelerate the Brazilian energy transition (EPE, 2020). The PNE 2050 believes that a more viable and sustainable production involves changes seeking rare events, catastrophes, therefore it is capable of adapting and





contributing to the quickest and most systematic solutions that may be necessary (EPE, 2020).

Objectives of the PNE 2050

- Produce enough energy, through renewable sources, to meet all national needs and export the surplus, with a deadline of 2050;
- Reduce the GHG emissions from your energy matrix;
- Achieve by 2030 the percentage of 45-50% of renewable sources in its electrical matrix and reach 75% of renewables by 2050;
- Use natural gas as a backup source during the energy transition until 2050.

Through these, the country will seek to implement an increasingly diversified energy matrix, with natural gas as a solution for a possible shortage (EPE, 2020).

Renewable Energy Sources and Their Challenges

The Brazilian energy matrix is one of the most renewable in the world, thanks to the extensive use of hydroelectric power. However, the PNE 2050 aims to increase the use of renewable sources.

Hydroelectric plants:

To maintain the high participation of renewable sources and low emissions in the long term, hydropower still represents an important element in expanding the supply of electric energy in the national interconnected system (EPE, 2020). Among these, the synergies with other renewable sources, operational flexibility, and the energy storage capacity in their reservoirs stand out, which can be used at any time of the day during certain periods of wind and/or solar radiation absence. This functionality increases the reliability of the energy supply during the transition. (EPE, 2020).

Due to the construction and implementation of hydroelectric plants, this renewable source is the one that most harms the local fauna and flora. Therefore, efforts are being made to implement new technologies aimed at enhancing the potential of the existing plants, thus delaying the need for the construction of new ones (EPE, 2020).

Wind energy:





Wind energy is the second fastest-growing renewable source in the world, trailing only behind solar in capacity increase (IRENA, 2022). The global production capacity in 2012 was 261.95 GW, but in 2022 the capacity was 835.62 GW, showing an increase of 219% (IRENA, 2022).

Among the challenges of wind energy is the investment that needs to be made so that the Brazilian energy matrix can undergo an effective transition, moving from a majority production of hydroelectric power to wind and solar. With the increase in size of the parts of an onshore and offshore solar generator, a logistics system needs to be implemented to enable their transportation to the large plants that will be established in Brazil by the year 2050 (EPE, 2020).

In the case of port access, it needs to be improved in terms of new technologies and organization, both to assist in the handling of wind equipment that arrives by ship for deployment in the territory and for the implementation of generators that will remain in Brazilian jurisdictional waters (EPE, 2020).

Solar

Solar energy is the renewable energy source that shows the greatest increase in installed capacity annually. Thanks to decreasing prices, technological robustness, and the vast existing potential (IRENA, 2022).

The transition to an energy matrix with a significant share of energy from variable sources, such as solar and wind energy, which depend on climatic and temporal conditions, and are uncontrollable, that is, cannot be directly adjusted according to demand, is a global challenge and Brazil is not exempt from this reality.

These sources, dependent on factors such as weather and climate, can generate considerable variations in energy production, which requires adaptations and optimizations in the energy matrix. It is essential that appropriate technologies are adopted to ensure a reliable and high-quality energy supply, overcoming the challenges of greater variability and lower predictability in electricity generation.





CONCLUSION

The Brazilian plan stands out for its comprehensiveness, defined goals, and specific strategies to promote technological growth and the implementation of renewable and non-renewable sources. The PNE 2050, as an integral part of the Brazilian energy landscape, emerges as a useful resource to guide not only the current government but also future leaders, showing the way to achieve the proposed goals and explore the country's natural resources, driving a fully sustainable electric and energy matrix.

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