Energy Security Fellows Program

Brazil's Push for Energy Diversification

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Brazil is a global leader in renewable energy, with its share of the country's energy matrix constituting three times the world average at 48 versus 14 percent. At 83 percent renewable sources, its electricity matrix is even more impressive (compared to the global average of 25 percent) thanks to its hydropower, biofuel, wind, nuclear, and solar energy sectors. Brazil has relied on its mature biofuel and hydropower industries, as the second and third largest producers in the world, respectively, to meet domestic electricity demand. However, these two established renewable energy sources have experienced supply shocks from extreme weather and thus become less reliable. This has motivated Brazil to diversify its energy sources, with planned increases in output from nuclear, wind, and solar energy. Looking at the five current renewable energy sources reveals that solar and, to a lesser degree, wind are the two sectors with the most potential to support diversification needs.

Hydropower, 65.2 percent of Brazil's 2020 electricity matrix, is a mature industry with limited room for growth. An ongoing drought has "reduced water reservoir levels to 24 percent of their capacity, on average, and left Brazil facing the prospect of power shortages." This has decreased hydropower's output, rendering Brazil's largest electricity source unreliable. Building new hydroplants is controversial and legally restricted as most of the remaining potential is in the Amazon, of which over 60 percent are on indigenous lands. Together, the water supply shocks and restrictions on expansion have resulted in bouts of energy instability and pushed Brazil to prioritize diversification.

Similarly, biofuel is an established renewable energy sector that has faced supply shocks and controversy. Biofuels, equating to 9.1 percent of the 2020 electricity matrix and fueling over half of the country's car fleet, have also been affected by drought and other extreme weather events that reduce crop production. The "food-versus-fuel" debate, which questions whether using crops, and their respective farm land, to meet growing demands for fuel could limit the supply for consumption. This possible impact on food security has made relying on the sector controversial, with some members of the international community (such as the European Union) raising concerns about sustainability. These factors necessitate a look to other renewable energy sectors for diversification.

Brazil's nuclear energy sector was accelerated by a 1975 agreement with West Germany to supply eight nuclear reactors in fifteen years, but it took twenty-four years to build one reactor. Currently, Brazil has one nuclear power plant with two reactors supplying 2 percent of the country's electricity. A third reactor has been in development since 1984 but has been marred by political and economic issues as well as construction delays. Brazil's National Energy Plan 2050 calls for adding 10GW of nuclear energy over the next thirty years. The third reactor should support that goal and is scheduled to be completed by 2026. It is also the last nuclear unit to be built as a public works project, opening up private sector involvement. However, cost

projections for the third reactor have already more than doubled (from €2.1 billion to €5.6 billion) and there are environmental concerns such as reactor sites being prone to landslides. These factors coupled with the history of delays restrain nuclear energy's contribution to Brazil's energy diversification needs.

Conversely, wind energy is a newer sector for Brazil, which held its first wind auction in 2009. It has since exploded in growth, increasing from 2GW of onshore wind capacity in 2012 to topping 20GW in 2021. The Brazilian Electricity Regulatory Agency (ANEEL) is already forecasting that it will grow to 25GW by next year, while a 2019 World Bank study estimated the country has over 1,000 GW of untapped offshore wind capacity. Brazil's northeast, which hosts over 90 percent of installed capacity, provides over half of the country's wind energy potential with its vast coast. Hindering this success story, wind energy installations have caused some environmental and societal issues. A 2020 Brazil Institute report found that "one-quarter of host communities have mobilized against [wind power installations'] impact on dunes and coastal areas, birdlife, rights to access land, and cultural communities." Wind energy also has created fewer jobs than hydropower and solar energy. The vast potential explains its attractiveness, yet it comes with economic, societal, and environmental risks that could prevent it from reaching its full potential.

Solar energy, Brazil's newest energy sector, is also its best opportunity for low-risk energy diversification. Brazil has the fifth largest solar capacity in the world with over 3,000 hours of sunlight per year and vast, undeveloped land. Like wind energy, its northeast region is well situated for solar energy. Even though solar energy comprises the smallest portion of the electricity matrix at 1.7 percent, Brazil is in the world's top ten countries for fastest solar energy growth. Solar energy is projected to jump to over 38 percent of the electricity matrix by 2050. Politically, there have been no pushbacks against solar installations and the solar energy industry also creates more jobs than wind. With such potential and a low political risk, the Brazilian Government and the International Energy Agency foresee solar emerging as the lead growth sector. The IEA forecasts that up to 70 percent of upcoming additions to installed capacity will come from solar alone, making it a key component in energy diversification.

Energy security and political considerations have pushed a renewable energy leader to diversify its energy mix. Brazil's solar and wind energy sectors provide immediate opportunities for diversification – and for investment – with their massive, untapped potential. Solar in particular offers less political risk due to its higher job creation and lack of controversy, which is why it will play an important role in Brazil's future energy matrix.

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