BRAZIL'S ENERGY TRANSITIC DRIVEN BY ANDRITZ

COUNTRY REPORT — BRAZIL

New technologies and a reorganization of the power sector bring opportunities.

Brazil – Famous for football, Brazil is also recognized as a hub of innovation. ANDRITZ is one of the companies contributing to this success.

Despite the introduction of other generation sources such as wind and solar, hydroelectric generation still forms the basis of Brazil's electric matrix. ANDRITZ Hydropower is delivering new solutions, enabling the successful integration of these intermittent sources.

The energy transition underway in Brazil means changes to the generation profile and the integration of intermittent renewable energy sources. It brings new demands, as well as new business opportunities. President Dieter Hopf explains, "Hydroelectric plants provide predictable energy to meet demand, due to the water stored in the reservoirs, which brings a great benefit to the stability of the system, unlike the intermittent sources that provide energy spontaneously according to the weather conditions. Up to a certain point, hydroelectric plants managed to compensate for this intermittent generation from wind and solar, but it seems that the system needs new solutions to maintain stability."

When Brazil's large hydro plants were constructed, they were not built to compensate for intermittent sources. Due to the stresses associated with these new modes of operation, the lifespan of these plants is being curtailed. As a result, a wave of refurbishment projects has been generated in which ANDRITZ participates very successfully. For example, the Sobradinho and Jaguara hydroelectric power plants, in Bahia and the interior of São Paulo, respectively.

Having developed a new generation of machines and solutions that can rapidly respond to these load variations, ANDRITZ is currently the market leader. Using these new generations of machines, hydroelectric plants can operate across the entire range of heads for energy production, thus making operation more flexible.

Another core product from ANDRITZ is reversible pump turbine technology, a model that is mainly used in Europe, North America, China and Japan and which functions as a 'mega-battery'. This technology has not yet arrived in Brazil. However, according to Dieter Hopf, pumped storage hydropower plants will be needed in the country soon.

The Synchronous Condenser is another solution offered by ANDRITZ that is in high demand. It is extremely valuable in stabilization of the transmission system. Currently, the company has six units in production at the Araraquara factory, which serves a large part of the global market.

BRAZIL

Total population: 215.31 million
GDP per capita: 9,455 USD

Total installed hydro capacity: 109,778 MW
Installed pumped hydro: 20 MW
Hydropower capacity added: 332 MW
Hydro capacity under construction: 463 MW
Share of generation from hydropower: 63.1%
Hydro generation per year: 427,114 GWh
Technically feasible hydro generation potential: 1,250,000 GWh

All figures concern 2022;
Sources: TheWorldBank, IMF, IHA, Hydropower & Dams World Atlas 2023

"It is important that regulatory bodies reassess the tariffs of hydroelectric plants considering these ancillary services, compensating for intermittency in addition to promoting power auctions, and encouraging additional functionality of facilities with reservoirs and/or reversible plants in order to maintain a secure and fault-free electrical system," Hopf says.

63.1% Share of electricity generation from hydropower in total production

ANDRITZ is also a pioneer in the green hydrogen sector, with three contracts already underway in Europe. To showcase this technology, the company recently opened its headquarters in Austria to a delegation of Brazilian businessmen, members of the Ministry of Mines and Energy, and the national energy regulatory authority ANEEL, where, in addition to getting acquainted with technologies for the production of green H_2, they could also see reversible plant solutions and multi-purpose power stations.

"ANDRITZ, as a technology company, is extremely well-prepared to play a prominent role in the energy transition and has been working intensely with various stakeholders in the electric power generation and transmission market to promote increasingly innovative solutions," Hopf concludes.

ANDRITZ CONSOLIDATES ITS PRESENCE IN LATIN AMERICA

ANDRITZ Hydropower Brazil set out a strategic goal to remain integrated within the energy markets of Latin American countries and, in 2023, the company consolidated itself as a leader in solutions and new technologies in the hydroelectric sector. This is evident through a new contract signed for the modernization of the Baygorria hydropower plant in Uruguay. ANDRITZ is also actively involved in projects such as the Salto Grande hydropower plant and the Yacyretá hydropower plant, both located between Argentina and Paraguay.

The scope of the Baygorria project involves increasing generation output by supplying new Kaplan runners and generators. In November 2023, the model test of the turbines was conducted in the ANDRITZ laboratories in Linz, Austria, which confirmed technical guarantees

Belo Monte hydropower complex; with two powerhouses and a total installed capacity of 11,233 MW providing enough clean and renewable energy for about 60 million people.

for the client. Once the scale model tests are approved, the project is released for execution.

These tests simulate the operation of the rotor at various blade opening angles and heads, validating the efficiency of the new rotor. They also guarantee minimum operation levels, minimize cavitation, and ensure established hydrulic standards are met for maximum system efficiency.

Future projects, such as those in Salto Grande and Yacyretá in Latin America, are pivotal in the region's energy outlook, and the active presence of ANDRITZ is crucial in supporting customers with information about the modernization of hydroelectric plants.

Regarding Salto Grande, in April 2023, the client defined the modernization phases of the plant, prioritizing automation as the next step. ANDRITZ is involved in this process.

Meanwhile, at the Yacyretá project, ANDRITZ is in the final phase of delivering excitation systems, as well as exploring prospects for new contracts related to the continuous modernization of the plant.

ANDRITZ' scope of works in these projects encompasses a diverse range of elements, focusing on automation, generators, and turbines. However, the company is open to expanding its activities according to viability and specific customer demands.

In addition to its direct involvement in these projects, ANDRITZ Hydropower Brazil has established itself as an essential partner in the group. This unit is actively supporting projects not only in Brazil but also playing a significant role in other ventures in Latin America, with activities in Chile, Colombia, El Salvador, Peru, and Mexico.

"These binational projects represent not only significant milestones for ANDRITZ but also underscore the company's continued commitment to leading the way towards excellence and innovation in the Latin American energy market, reinforcing its position as a key figure in the transformation and modernization of hydroelectric plants in the region," stressed Dieter Hopf.

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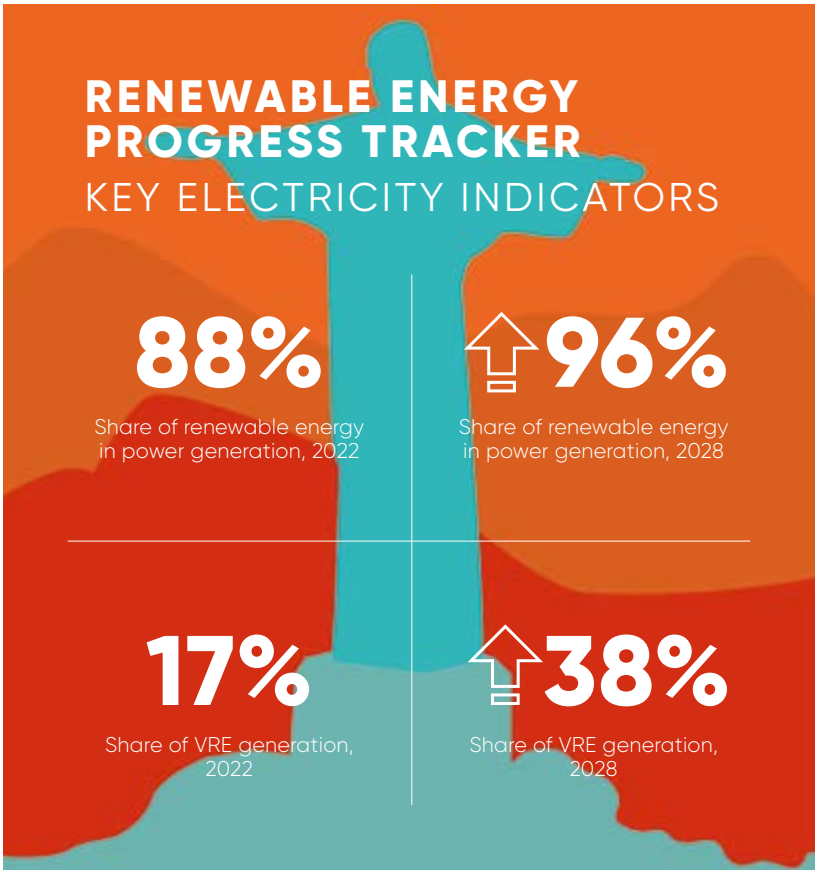
Installation team of the rehabilitation of the generator of Unit 1 at Jaguara hydropower plant

Generator of Unit 1 in the pit of Jaguara hydropower plant on the Rio Grande

Successfull model test of the Kaplan turbine for the Baygorria hydropower plant, Uruguay

Outside view (right) and installation work of Kaplan turbine (above) at Sobradinho hydropower plant on the São Francisco River, Brazil



Source: IEA

EXPLORING NEW OPPORTUNITIES IN ARGENTINA - ANDRITZ AND THE POST-CONCESSION SCENARIO

In the dynamic transformation of Latin America's energy sector, Argentina emerges as a focal point, offering fertile ground for innovation and market advances. ANDRITZ has thus directed its attention to new opportunities and strategic partnerships in this country. After identifying industry needs, ANDRITZ promoted its supply potential to enable future projects.

In the context of awarding concessions, Argentina has adopted a stringent approach, implementing a 'Due Diligence' process to assess the current state and magnitude of necessary investments. Currently, these concessions are under review by the Federal Government. It is important to note that the dynamics and strategies adopted in managing concessions in Argentina are distinct and decentralized.

"ANDRITZ, with its experience and innovative capabilities, is ready to navigate the new energy landscape of Argentina, contributing to progress

and sustainable development and strengthening its position in the region," noted Hopf.

Regarding energy generation, both Brazil and Argentina have similar systems, blending private and public generation. Both have a centralized control agency regulating price policies through the market. These similarities establish a strong foundation for ANDRITZ' activities in both countries.

INTERNATIONAL FORUM IN URUGUAY FOR THE ENERGY SECTOR IN LATIN AMERICA

In September 2023, Uruguay hosted a significant gathering: the International Forum on Challenges and Strategies in the Renewal of Hydroelectric Plants. This event not only provided a crucial space for discussions about the future of energy in the region but also served as a strategic meeting point for leaders and professionals in the sector. After identifying industry needs, ANDRITZ promoted its supply potential to enable future projects.

The ANDRITZ presence at the forum not only consolidated its position as a segment leader but also strengthened the company's connections with various energy market sectors across Latin America. Alongside renowned competitors, important suppliers, and major clients like EBY (Entidad Binacional de Yacyretá), CTM Salto Grande, and EBI (Empresa Binacional de Itaipú), ANDRITZ highlighted its presence and competitiveness and demonstrated its complete readiness to offer excellent services and products with full regional support while presenting the second stage of the Salto Grande Rehabilitation project.

The forum comprehensively covered diverse topics. From digitalization of plants and diagnostics, through to project management methodologies focused on plant modernization, the event served as a melting pot of ideas and innovation for the energy sector. International consultants shared valuable perspectives, contributing to advances and enhancement of the sector's and emphasizing the importance of collaborative work and innovative solutions in the context of hydroelectric energy in Latin America.

Yacyretá hydropower plant on the Paranâ River, Brazil

AUTHOR

Cleania Barros
hydronews@andritz.com