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National Wind Speed Traceability for Enhancing Brazil's Wind Energy Infrastructure

Through a national airspeed traceability chain, INMETRO links SI base quantities to reliable wind-speed measurements, thereby expanding metrological support for Brazil's wind energy industry

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The Challenge

Brazil has rapidly expanded its wind energy sector and is currently among the global leaders in installed wind power capacity, exceeding 30 GW and representing around 15% of the national electricity grid. Wind farms are predominantly located in the Northeast region, where wind resources are abundant and strategically important for energy security and diversification. Accurate wind speed measurement is critical across the entire wind energy value chain, including resource assessment, turbine performance verification, certification, and energy billing.

However, until recently, Brazil relied on international calibration services to ensure the metrological traceability and accuracy of airspeed measurements, resulting in high costs, longer turnaround times, and limited national autonomy. To address these challenges, it became essential to establish a national primary standard for airspeed, ensuring metrological traceability to the International System of Units (SI) and strengthening Brazil's technical independence in the strategic energy sector.

The Solution

To ensure metrological traceability of airspeed measurements to the International System of Units (SI), the Brazilian National Metrology Institute (INMETRO) established a complete calibration chain. A spinning disk system, metrologically traceable to national standards of length and time, is used to calibrate a Laser Doppler Anemometry (LDA) system, which serves as a working standard in the airspeed range of 2 m/s to 16 m/s. This approach enables highly accurate, fundamental-based measurements with very low uncertainty. As a non-intrusive optical technique, LDA determines air velocity through the Doppler shift of scattered laser light, avoiding disturbances to the flow and ensuring high measurement fidelity. The system was fully integrated into INMETRO's calibration infrastructure and supported by the development of measurement procedures and uncertainty evaluation methodologies, as well as participation in international comparisons.

As a result, by 2025, INMETRO had established a robust, comprehensive metrological traceability chain for anemometry in Brazil, linking primary standards in length and time to calibration services delivered to industry and to accredited laboratories. The metrology traceability chain (**Figure 1**) is further reinforced through proficiency testing and interlaboratory comparisons organized by INMETRO, thereby ensuring measurement consistency and international comparability.

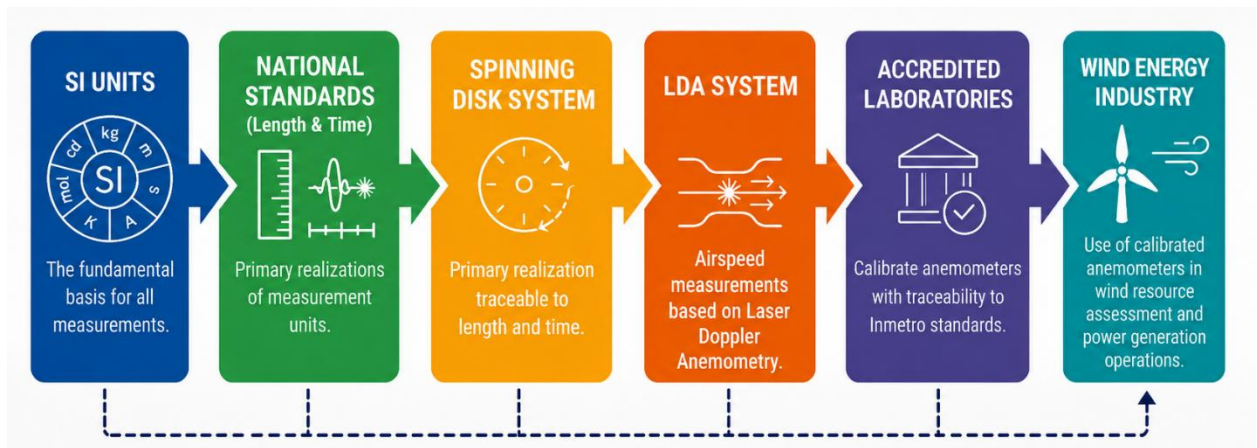


Figure 1. Metrology traceability chain for airspeed measurements to support accredited air speed testing laboratories and the wind energy industry in Brazil.

A Quantifiable Impact

Reliable wind-speed measurements are essential for energy planning, wind resource assessment, project development, performance verification, and wind-farm operation. The quality of these measurements directly affects estimates of energy production and the technical decisions made throughout the lifetime of a wind project.

Over the last 10 years, INMETRO has worked to establish a national traceability system for wind-speed measurements. Brazil can now provide full national metrological traceability in the 4–16 m/s range, which is the range most relevant to the wind-energy industry. It strengthens Brazil’s metrology infrastructure by providing confidence in the calibration and use of wind-measurement instruments that support the sector.

The relevance of this capability is amplified by the scale of the Brazilian wind sector. According to the Brazilian Energy Research Office (EPE), wind generation in Brazil reached 107.7 TWh in 2024,¹ and installed capacity reached 29.55 GW. The Brazilian Association of Wind Energy and New Technologies (ABEEólica) projects 15 GW of new wind capacity in Brazil between 2026 and 2032.² The increasing maturity of the Brazilian wind-energy sector provides opportunities for INMETRO to expand national metrological traceability and strengthen confidence in wind-speed measurements.

¹ EPE – Empresa de Pesquisa Energética, Brazilian Energy Balance 2025: Summary Report – Year 2024, Rio de Janeiro, Brazil, 2025. [Online]. Available: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-885/topico-767/BEN_S%C3%ADntese_2025_EN.pdf.

² F. Silva, Sistema AMA e o Setor Eólico, presented at the 4th Workshop Sistema AMA, EPE – Empresa de Pesquisa Energética, Rio de Janeiro, Brazil, Apr. 7, 2026. [Online]. Available: <https://www.epe.gov.br/sites-pt/aceso-restrito/Documents/Workshop%20Sistema%20AMA%202026-Bloco1.pdf>

By establishing domestic metrological traceability for wind-speed measurement, Brazil reduces its dependence on international calibration and on external SI traceability to expand its energy infrastructure. This strengthens national sovereignty and technical autonomy in a strategic sector, while improving resilience and reducing vulnerability in critical measurement chains. More reliable, nation-level, metrologically traceable measurements also strengthen Brazil's national quality infrastructure and industrial capability and provide the technical basis for public policies, energy planning, project assessment, and investment decisions related to wind-energy deployment. This also underpins the expansion of low-carbon electricity generation in Brazil and promotes sustainable energy solutions that contribute to climate action.

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