

## Leading Brazilian Wind Developer Uses Vaisala's Triton to Validate Complex Terrain

*PEC Energia's early adoption of the Triton remote sensing system pays off in confidence in their P90 predictions, successful participation in the national energy auctions, and the ability to support Brazil's energy development goals with reliable, long-term energy production.*

One of Brazil's leading renewable energy companies, PEC Energia, is also an industry leader in adopting remote sensing technology for use in its wind resource assessment projects. Operating in a demanding policy environment in which federally managed energy auctions are the main procurement mechanism and a high degree of certainty is required, PEC Energia uses Vaisala's Triton® Wind Profiler to make confident, rapid decisions about which projects to pursue, and to reduce the uncertainty of energy production estimates used for project financing.

PEC Energia was formed in 2008 by the merger of three leading engineering companies with over 150 years of experience in the construction sector. Now PEC Energia is one of Brazil's leading renewable energy developers, and the company has an active pipeline in several Brazilian states. Like other Brazilian wind developers, PEC had to adjust rapidly to tighter requirements for participating in the country's energy auctions in the spring of 2013.



*Brazilian wind developer PEC Energia uses the Vaisala Triton Wind Profiler to conduct the advanced wind measurement campaigns that are a vital part of the company's development projects.*

### Challenge

- Stay competitive in a complex policy environment and a changing economy
- Reduce uncertainty about the wind resource in large sites affected by complex terrain
- Invest development resources appropriately and efficiently while managing a large pipeline of projects
- Maximize the value of projects for financing while avoiding stiff penalties for under-production
- Meet aggressive regulatory deadlines in developing projects that have won bids

### Solution

- Using the Vaisala Triton Wind Profiler, conduct brief measurement campaigns around development sites to accurately characterize the wind resource in complex terrain and reduce spatial uncertainty
- Use Triton data in wind resource assessment and due diligence reports to reduce uncertainty about the P90 figure, allowing the projects to be financed more profitably and with less risk
- With the help of Vaisala SkyServe Wind Data Service, Vaisala's technical support, and training and certification for local in-country engineers, control bottom-line costs and prevent delays in wind measurement campaigns

### Benefits

- Increased confidence and speed in decision-making at every step of the wind development process
- Low maintenance costs and high return on investment
- Additional wind data used in financial due diligence and turbine layouts
- Easy re-deployment across large, geographically distant locations

*“The PEC Energia team invested early in remote sensing technology because we see its potential for helping us meet Brazil’s rapid wind development goals. Triton gives us added confidence in preparing our bids. We use it for measurements in complex terrain, spatial and height extrapolations, and to reduce the uncertainty of our annual energy projections. Triton is one of the most helpful tools we know, and the most cost-effective solution for reducing uncertainty in complex terrain.”*

*Carlos Bergamo, Director of Engineering,  
PEC Energia Ltda*

## Brazil’s Complex Policy Environment

An energy crisis in 2001–2002 spurred reforms in Brazil’s energy sector; these provided incentives for wind developers and spurred intense competition to win long-term power purchase agreements. With plenty of wind resource available, especially near Brazil’s windy east coast, and aggressive development timelines, Brazil now has one of the world’s fastest-growing wind power industries. The Brazilian wind sector is expected to install 10–13 GW over the next five years.

The development landscape is complex, with a nationally run auction process administered by the Empresa de Pesquisa Energética (EPE), the country’s federal energy planning agency under contract to the Brazilian Ministry of Mines and Energy (MME). The EPE typically conducts two to three energy auctions each year. The auctions are designed to ensure that the country’s promising wind resource is developed responsibly,

and regulations are adjusted based on global experience to encourage best-practice development. Brazil’s leading companies have participated enthusiastically in this initiative by Brazil’s national government.

To participate in an auction, a wind developer must submit a bid based on annual energy projections (AEPs). Before 2013, the EPE required all bids to use an AEP based on a probability of exceedance of P50 — the amount of energy your wind farm is calculated to exceed 50% of the time. In 2013 the EPE changed this requirement to P90, or the amount your wind farm is calculated to exceed 90% of the time.

The change in requirement allows for more efficient and professional management of the overall electricity generation system, but it places pressure on wind developers to improve the quality of their wind resource assessments. Developers who win a tender must meet aggressive project construction deadlines, produce the amount of energy contracted for in the tender, and deliver it at the bid price. If the wind project under-produces, the owner must buy power at prevailing market rates and re-sell it to EPE at the bid price, usually incurring a hefty loss. If a project produces excess power, it may be sold at a floating spot energy price, or even at a punishment value; this increases the PPA risk, and moreover, and excess power is of no benefit at the critical project financing stage.

In addition, Brazil has a rapidly growing private market for energy, outside of the auction process. This market is regulated by ANEEL, Brazil’s energy regulatory agency. When a developer begins planning a project, they often have not decided whether to develop the project inside of or outside of the auction market. To stay competitive, developers must plan their measurement campaigns and wind resource assessments to be competitive in both contexts.

## Technology Choices for Wind Measurement Campaigns

It is well known that higher-height wind measurements are critical for accurate wind resource assessments. With turbine hub heights continually rising, even the 120-meter meteorological towers that are becoming common in Brazil are not enough to form a complete understanding of wind resource across the full rotor sweep of a turbine. Moreover, with large parcels of land under development, many in complex terrain, it is cost-prohibitive to build enough met towers to form an accurate energy assessment for a project.

PEC Energia is one of the leading companies in Brazil whose successful use of remote sensing systems is driving wider adoption throughout the wind industry.

Before investing in the Vaisala Triton Wind Profiler, PEC Energia, like most developers in Brazil, relied exclusively on meteorological towers to provide data for wind resource assessments.

Elder Rampazzo, a mechanical engineer at PEC, is responsible for evaluating the electricity generation potential from the company’s renewable energy projects. He also coordinates the company’s certification programs and wind resource assessments, and is involved in the auction bidding process and regulatory monitoring of project energy generation.

According to Rampazzo, the company saw the potential of Triton for validating shear extrapolations made using measurements from met towers. “We wanted to have more certainty, internally, than we were getting from the met tower data. We bought a Triton and used it initially to validate our shear extrapolations.”

PEC has several met towers, ranging in height from 80 to 140 meters, erected on each site it is developing. “We wanted to use whatever tools we had to reduce our uncertainty,” says Rampazzo. “And we chose the Triton for its reliability, convenience, and economy.”

## PEC’s Best-practice Approach to Wind Resource Assessment

Once PEC had begun using the Triton, they realized it had potential to help them decide whether to pursue a bid in a specific area or not; and that using Triton data could also help reduce the uncertainty associated with complex terrain – a situation faced by most of the wind developers in Brazil. Over time, they incorporated the Triton into their standard development best-practices.

Rampazzo says: “Our approach is based on using public or private maps to gain an initial understanding of the wind resource on a site. To further qualify the site, we install a met tower or a Triton. If the project seems promising, we continue with a full wind resource assessment.”

Most Brazilian wind projects are in complex terrain, and the PEC team quickly saw the potential for using Triton to reduce uncertainty in complex terrain. “It’s very easy to make mistakes in simulations when you talk about complex terrain, even if you’re using the most updated techniques for modeling”, says Rampazzo.

“Triton is one of the most helpful tools I know,” Rampazzo adds. The company uses Triton for short deployments on sites to check their calculations of the wind resource in planned turbine locations. “In some of the places where we’ve installed a Triton, I won’t say it would be impossible to install a tower, because nothing is impossible. But it would definitely be cost-prohibitive.

Whenever we’re bidding on a project, we want to have the Triton there – not just to validate shear, but to record its own data. We use Triton data to get additional confidence about our energy estimates.”

## Multi-layered Requirements for Project Financing

If a developer will be selling energy on the Brazilian auction market, they must present a wind resource assessment with a P90 estimate to qualify to be allowed to bid. This wind resource assessment must conform to EPE requirements, which currently mandate the use of met towers in measurement campaigns.

The Brazilian Development Bank (BNDES) finances up to 80% of the total capital expenditure of wind farms in Brazil regardless of whether the energy is sold on the auction market or the free market. As part of the financing process, BNDES requires two wind resource assessment reports from trusted certifiers – all of whom have produced wind resource assessments for PEC and recognize the use of Triton data to reduce uncertainty in wind resource assessments.

How does a developer juggle all of this? Rampazzo says: “In the auction market, if you’re not producing enough to sell, you are punished severely. But, you are financed based on your annual energy production estimates. So the most important thing is to get your energy estimates accurate.”

Developers need to instrument their projects based on the bid qualification requirements, but the best companies are adding measurements to reduce uncertainty on top of the EPE requirements. “We used the Triton for our own estimates because we want to be sure of how much energy we can produce,” says Rampazzo.

## A Success in Pernambuco

Triton data helped PEC Energia to pursue a winning bid in Paratama, Pernambuco. “For all phases of the bidding process, we need the data with the most certainty possible – and this is where Triton helps us,” says Rampazzo. At this writing, PEC is very close to finishing the build and generating over 150 MW of energy. Triton was invaluable in better understanding the wind shear, inflow angles, and the vertical component of the wind. The Triton data was part of the wind resource assessment report and financing package for this project.

## Cost and ROI

“Triton is the most cost-effective solution for reducing uncertainty in complex terrain,” says Rampazzo. He compares the cost of ownership of a Triton to the cost of ownership of a 100 meter met tower for three years. In Brazil, met towers are relatively inexpensive. However, “Triton is a tool that can be used and re-used. We’re not using it as a met tower replacement, but as a supplement – they are two different tools. For reducing uncertainty in complex terrain, or any other situation where we would need to move the Triton for shorter deployments, the value we receive from Triton is far greater. We’ve installed each Triton in eight or nine spots already. If we had moved a met tower there, it would have been way more expensive. In fact, it wouldn’t have been physically or financially feasible for us to measure that many locations with met towers. Having Triton allowed us to be much more creative in designing a wind measurement campaign to reduce more uncertainty. If you can find 0.2 more megawatts mean energy on one project, you’ve paid back the cost of purchasing the Triton in one and a half years.”

## Why Service Is Part of the Equation

Triton's simple installation, reliability, and autonomous operation make it an attractive choice for PEC. Rampazzo says: "Triton does not need a lot of maintenance, it can operate by itself for over a year. Power consumption is very low — we just use two solar panels to keep each of our Tritons powered-up."

Nonetheless, support is important to PEC. "Whenever we needed Vaisala's technical support or technical advice, it was really easy. We just sent an email or went into the website or placed a phone call, and we always got a response within a day. Your staff was really helpful and really efficient. Any maintenance issues we had were not very substantial, and most were solved within one day,"

says Rampazzo. Danilo Bueno, one of PEC's field service engineers, agrees. "I usually call them from the spot where the sodar is being installed."

Taken as a whole, Vaisala's support and service have helped PEC keep the costs of operating and maintaining their Tritons low. Bueno says: "Spare parts are not that expensive, and the operation and SkyServe maintenance costs are not that high." Rampazzo agrees: "Most of the cost of owning a Triton is the up-front purchase — we pay once for hardware, and then pay very little after that."

## Help for the Whole Pipeline

Being able to move their Tritons around to where they are is needed most is of enormous benefit to PEC Energia. With

several projects under development at any given time, it would not be feasible to build additional met towers to measure in new locations to reduce topographical uncertainty or make accurate energy projections for different turbine layouts. PEC has their Triton scheduled to do brief campaigns on five or six development parcels during the next year and plans to continue using it as a part of their standard development process.

"We plan on using our Tritons in five or six more locations, including several sites on a parcel with really complex terrain. I think it's inevitable that wind developers will use the Triton more and more, and it's going to be widely accepted as a reliable and accurate kind of wind measurement," says Rampazzo.

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