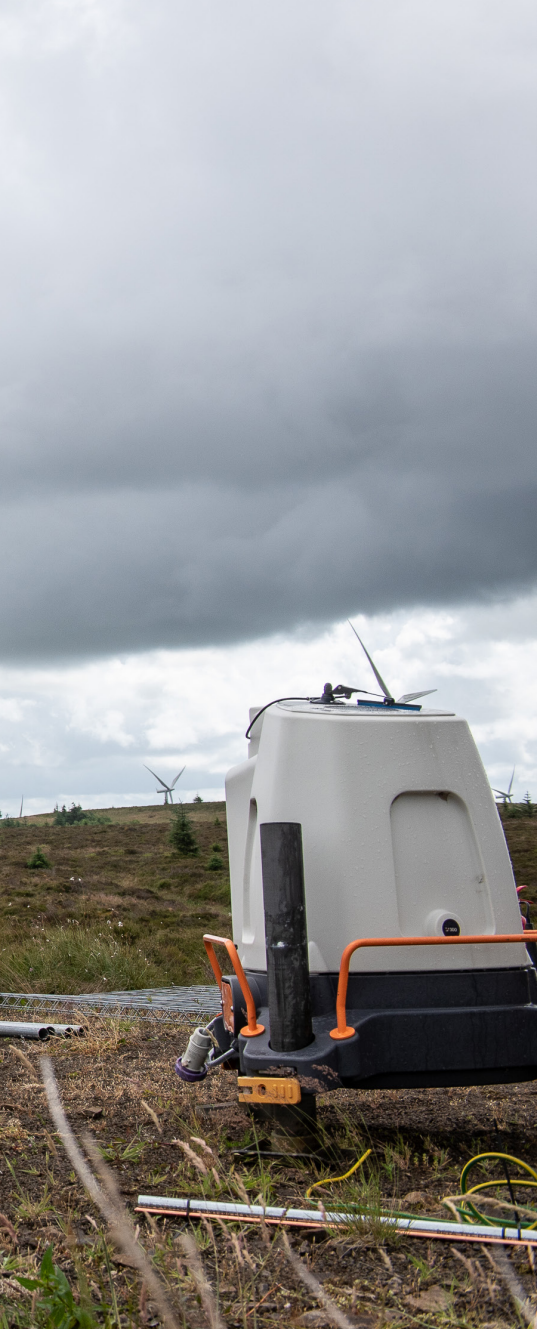
Typical one-day installation of ZX 300 Lidar and remote Power Supply Unit for Wind Resource Assessment

Maximising efficiency through integrated measurements

As the shift towards renewable energy gains momentum, innovative hybrid development projects are emerging to maximise efficiency, reliability, and cost-effectiveness. ZX Measurement Services looks at how integrating wind and solar energy assessments can enhance output and stability, exploring essential measurement strategies for optimising these systems.



The global push towards renewable energy has led to innovative approaches that combine different energy sources to optimise efficiency, reliability, and cost-effectiveness. Hybrid development projects, which typically combine wind and solar energy, are increasingly recognised for their potential to balance the variable nature of renewable energy sources. These systems use the complementary profiles of wind and solar, with solar energy peaking during the day, while wind power often strengthens at night.

By integrating these sources, hybrid power systems can achieve a more consistent energy output, improve grid stability, and enhance the overall capacity factor of renewable installations.

In addition to optimising energy production, hybrid systems offer significant cost savings by sharing infrastructure, land, and maintenance services across different energy generation assets. The integration of energy storage solutions, whether through battery storage or thermal energy storage, can enhance the profitability and reliability of these systems further.

However, the success of hybrid power systems is not solely dependent on energy generation and storage. Equally crucial is the accurate measurement and assessment of the available resources, wind and solar, and the environmental and acoustic impacts of these installations. This article explores the comprehensive measurement strategies necessary for optimising hybrid power sites, drawing on case studies and industry standards to demonstrate best practices in the field.

Wind energy assessment

The role of lidar in wind measurement

Wind energy assessment is a critical component of planning and operating wind farms, whether standalone or as part of a hybrid system. Traditional methods of wind measurement often involve the deployment of met masts equipped with anemometers at various heights. However, these methods can be logistically challenging and time consuming, particularly when dealing with the planning permissions required for erecting tall structures.

Lidar (Light Detection and Ranging) technology has emerged as a game-changer in this area. A typical lidar deployment for wind energy assessment involves a two-person team using a vehicle to access the site. The technology offers several advantages.

Firstly, lidar systems like the ZX 300 offer flexibility. They are compact and easy to deploy, often without needing planning permission, allowing for a rapid setup that can normally be completed within a day. Secondly, lidar ensures accuracy by delivering precise measurements of wind speed at various elevations, including hub height, which is essential for making accurate energy yield predictions.

Finally, these systems can operate autonomously for extended periods, utilising hybrid energy solutions that combine solar power with backup fuel cells, ensuring continuous data collection.

These advantages make lidar a preferred choice for wind energy assessments, especially in remote or challenging locations where traditional met masts may be impractical. By providing accurate, site-specific data, Lidar technology enhances the reliability of wind resource assessments, reducing the risk of underperformance and financial penalties in wind energy projects.

RES' Cairn Duhie wind farm project in Scotland exemplifies the effective use of lidar technology for wind energy assessment. RES, a global leader in renewable energy, opted for a pure lidar approach using the ZX 300 lidar system to gather precise wind speed data across multiple elevations at the Cairn Duhie site. The compact and easily deployable ZX 300 allowed for rapid setup without the need for extensive infrastructure, significantly reducing project costs and environmental impact compared to traditional met masts.

The lidar deployment provided RES with continuous and accurate wind measurements, particularly at turbine hub heights, which were critical for refining energy yield models and ensuring the project's financial viability. This data-driven approach not only supported accurate energy production forecasts but also bolstered investor confidence by reducing uncertainty in the project's performance predictions.

The successful application of lidar at Cairn Duhie highlights the growing importance of advanced, flexible measurement technologies in the renewable energy sector. As developers increasingly face the challenges of remote and complex site locations, tools like the ZX 300 lidar are becoming essential for ensuring the accuracy and efficiency of wind energy assessments.

When conducting a wind energy assessment using lidar technology, it is often possible, and highly efficient, to perform additional measurements for solar energy and acoustic monitoring simultaneously. By using the same personnel, installation vehicle, and on-site resources, developers can integrate multiple assessments into a single deployment, significantly reducing both time and costs.

With a wind lidar deployment, you now open the opportunity for making more from the installation. A two-person team, and a vehicle that has successfully accessed the site is now available. Agreements have been made with land owners for access and documentation supporting the health and safety of the deployment have been accepted. So, what else can we do to maximise this opportunity?

Solar resource assessment

As solar energy technologies mature, the scale of solar installations continues to grow, necessitating more rigorous and independent assessments of solar resources. Accurate solar radiation data is the foundation of any solar project's performance model, which in turn influences its financial viability. Banks and investors require high-confidence energy yield estimates to mitigate the financial risks associated with project underperformance.

Solar resource assessments can involve the installation of turnkey measurement stations that follow international standards such as IEC 61724-1:2021. Whilst satellite data may be used, it is not always available for the areas of interest and soiling loss estimates and ground albedo data can carry higher uncertainties if not measured locally.

In situ Solar Resource Assessment (SRA) stations measure a variety of meteorological and environmental conditions. One key measurement is solar irradiance, which is the primary driver of solar energy generation. It must be measured with high precision to ensure accurate energy yield predictions.

Another important factor is module temperature. Understanding the temperature profile of photovoltaic (PV) modules is essential for predicting energy losses due to heat. Additionally, monitoring soiling conditions is crucial, as dust and other particles on PV modules can significantly reduce their efficiency. Regular monitoring helps optimise maintenance schedules.

With a lidar system being deployed to measure wind speeds at a proposed hybrid site, the same team can now be used to install these solar resource measurement stations. The stations can be calibrated and positioned during the same site visit, capturing critical data on solar irradiance, module temperatures, and environmental conditions.

If we plan ahead and think of common downstream activities that are required on site, are there even more services we could be doing at the same time on site?

Example Solar Resource Assessment (SRA) station installed on-site

Acoustic monitoring

Acoustic noise assessments are a mandatory part of the planning process for wind farms, particularly in regions where noise regulations are strict. The UK's ETSU-R-97 standard is widely used for this purpose, requiring noise levels to be correlated with wind speeds measured at a reference point on the proposed turbine site. This correlation helps in understanding how noise propagates under different wind conditions, which is essential for assessing any potential impacts.

Traditionally, wind speed measurements for acoustic assessments have been obtained using met masts. However, as already mentioned, met masts often require planning permission, which can delay projects, especially when the mast is intended for short-term use. And in the cases being discussed here, the lidar system is already on-site for the wind energy assessment!

And ZX 300 offers something quite unique; precision at lower heights. The ZX 300 can accurately measure wind speeds from as low as 10 meters, which is critical for correlating with acoustic measurements at ground level. The lidar system's ability to measure wind speeds at low heights makes it suitable for acoustic monitoring, ensuring that noise assessments are accurate and reflective of actual site conditions.

ZX Measurement Services typically deploy a ZX 300 wind lidar, powered by a hybrid energy solution, for an eight-week noise measurement campaign. The data collected provides enhanced accuracy in understanding wind conditions that influence noise propagation and supports comprehensive environmental management efforts on site.

Typical acoustic monitoring device installed on-site

Integrate your wind, solar, and acoustic measurements on-site

ZX Measurement Services can support this trio of measurements from a single site visit and a single team resource on that site.

This integrated approach not only optimises the use of resources but also ensures that all necessary data for the wind, solar, and acoustic aspects of the project are collected in a coordinated manner. The result is a more streamlined project timeline, reduced logistical complexity, and improved data quality, all of which contribute to the successful planning and development of hybrid power systems.

Hybrid power systems represent the future of renewable energy, offering a way to maximise efficiency and reliability by combining the strengths of different energy sources. However, the success of these systems depends heavily on accurate, site-specific measurements of wind, solar, and acoustic conditions. By leveraging advanced technologies such as lidar and integrating measurement strategies across different energy resources, developers can optimise the performance of hybrid sites while minimising costs and risks.

As the renewable energy sector continues to evolve, so must our approaches to measurement and assessment. By embracing hybrid measurement strategies, we can unlock the full potential of hybrid power systems, driving the transition to a more sustainable and resilient energy future.

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