Met masks are no longer required.

WindCube lidars are standards-compliant, bankable, and capable of supporting wind projects across their full lifecycle.

Eliminating Met Masts: **Lidar as a Standalone** Wind Measurement Solution

Ryan Matt



Energy Yield Assessment



Permanent Met Mast Replacement



Power Performance Testing



Offshore

Intro: Historically, met masts were considered essential for wind measurement. However, advances in lidar, coupled with updates to international standards, have removed both the technical and regulatory need for permanent towers. This work reviews recent updates to international wind energy standards, and relevant ISO guidance, with a focus on how these documents formally recognize lidar as a standalone wind measurement solution.

Along with being compliant with international standards, lidar solutions are becoming more widely adopted due to their financial, safety and time-related advantages. Compared with traditional met masts, lidar systems significantly reduce upfront capital costs and eliminate the need for tower installation. They remove the risks associated with working at height, improving overall site safety. In addition, lidar units can be deployed rapidly, relocated with minimal effort and used across multiple sites, enabling faster data collection and greater flexibility during early-stage development.

Energy Yield Assessment

IEC 61400-15-2*

- Standalone lidar systems permitted for energy yield assessment wind speed and wind direction measurements.
- When properly sited and verified, lidar uncertainty are comparable to traditional met masts.
- Can measure wind at multiple heights covering the full rotor swept area, improving vertical wind profile characterization per IEC guidelines.
- Continuous profiling of full rotor swept area allows more detailed energy yield modeling, reducing vertical uncertainty in financial forecasts.
- Lidar can be used in complex terrain with validated flow model corrections.

Permanent Met Mast Replacement

Major ISOs

- Lidar can replace permanent met masts for continuous wind measurements, meeting ISO requirements for site wind monitoring, turbine performance verification, and long-term data logging.
- The increased data heights of a lidar measure the full rotor swept area which becomes valuable wind resource data for repowering.
- Provides high-resolution, hub-height measurements needed for ongoing operational assessment, predictive maintenance, and lifetime energy capture validation.

Power Performance Testing

IEC 61400-12-1
IEC 61400-50-2
IEC 61400-50-3

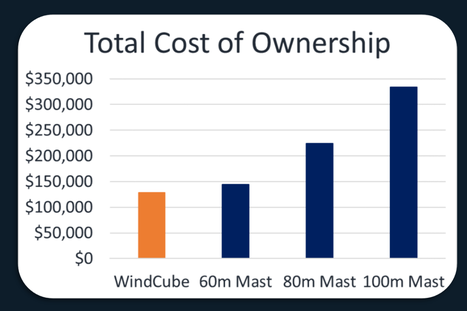
- Ground-based lidar measurements can be used to measure hub-height wind speeds in accordance with IEC 61400-50-2, supporting power performance testing (PPT).
- IEC 61400-50-3 allows for nacelle-mounted lidar (NML) for contractual PPT.
- Nacelle-mounted lidar are always aligned with the inflow, reducing measurement uncertainty.
- Remote verification of lidar positioning and measurement volume ensures compliance with IEC-specified distances from rotor swept area and turbulence measurement locations.

Offshore

IEC 61400-50-3
IEC 61400-50-4
IEC 61400-50-5**

- Lidar is explicitly permitted by IEC 61400-50-3 for power performance verification, by 61400-50-4 for long-term energy assessment, and 61400-50-5* will further standardize lidar use across asset monitoring and operational phases.
- Meets standard requirements for measurement volume, uncertainty, and calibration when deployed according to manufacturer and IEC guidelines.
- Supports hub-height, rotor swept area, and wake effect measurements critical for site assessment, layout optimization, and turbine performance validation.
- Can be used throughout the project lifecycle, from pre-construction energy assessments to post-construction performance verification while remaining IEC-compliant.

* 2026 Release
** 2027 Release



Above: Total (ten-year) cost of ownership comparison between WindCube and various meteorological masts. Met masts' costs are estimated and averaged based on inquiries with installers and developers. All costs include maintenance and warranty extensions.

Right: Although lidar units have been around for 20 years, only recently has the industry starting adopting them for stand alone use. This safer, cheaper, and quicker method of collecting wind data is now being adopted in IEC standards which will quickly change the methods of wind development and operations.

Evolution of Lidar Use in Wind Energy

- **2006** WindCube 1.0 Released
- **2010** WindCube 2.0 Released
- **2017** IEC 61400-12-1 allows lidars use in power performance testing
- **2019** WindCube 2.1 Released
- **2022** IEC 61400-50-3 allows nacelle mounted lidar to perform PPT both on and offshore
- **2025** WindCube 2.1XP Released
- **2025** IEC 61400-50-4 allows WRA from lidar offshore
- **2026** IEC 61400-15-2 expected to be released

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References: IEC 61400-12-1, IEC 61400-15-2, IEC 61400-50-2, IEC 61400-50-3, IEC 61400-50-4, IEC 61400-50-5

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