

**VAISALA**

Pioneering the gold  
standard in science,  
innovation and support  
WindCube: the most trusted  
wind lidar in the industry

Solutions Brochure



# Smarter wind energy

People have harnessed the wind for centuries, and for countless applications. Today, the wind energy industry has inherited this tradition, as innovators use the wind like never before. The world is better for it.



At Vaisala, we create a better world by empowering wind energy leaders, decision-makers, and researchers to create transformative change.

Our successes are rooted in our long history of scientific excellence and industry contribution, our philosophy of end-to-end partnership, and the comprehensive capabilities of the WindCube® suite, which are the most recognized and trusted lidar solutions in the world.

Today WindCube lidars are backed by the best science and metrology and validated by the most demanding testing and certifications in the industry. Just as important, our unparalleled global service and support ensures you can count on us onshore, offshore, and worldwide.

***"The higher the turbine hub heights we're getting, the more uncertain extrapolating shear is from met towers. Today we have at least one WindCube at every development project."***

*Phillip Hurlbut, Meteorologist,  
Pattern Development*



# The WindCube lidar suite: Proven and trusted

10,000+ Wind Resource Assessment campaigns supported,  
1000+ validations against met mast, 500+ scientific publications



## Global services and support you can count on

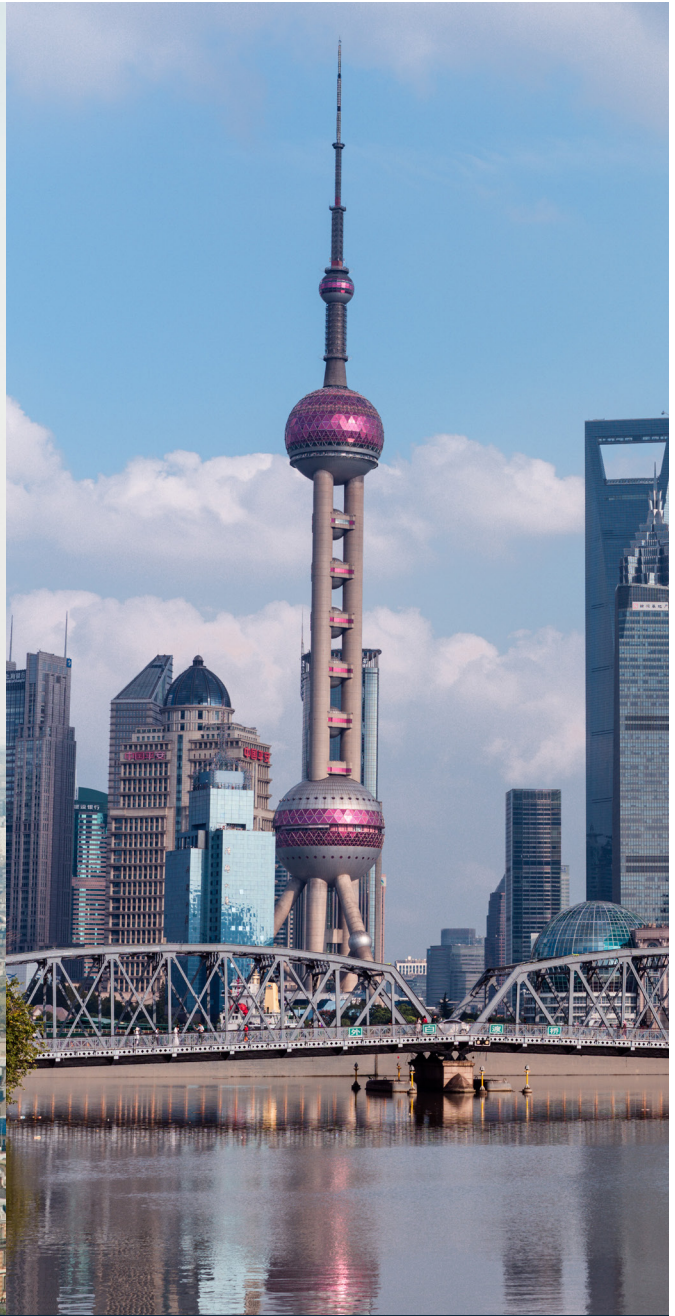
Vaisala's truly global reach brings several distinct benefits to customers. Our size and well-established business practices allow for scalability, worldwide service provision, and stability in changing economic environments.

Our network includes two WindCube factories – both UL-CSA certified – utilizing the highest industry-level manufacturing and related practices from components to final check and

delivery. Our global network of trained partners ensures seamless lidar operations and customer experience across the globe. This is an enormous asset to our customers because it ensures we can meet demand, provide quick and correct servicing, and leverage the most sophisticated manufacturing and verification tools to meet the most rigorous needs – all to ensure every WindCube lidar achieves maximum uptime.







## Welcome to Paris. And Shanghai.

We have two lidar factories to satisfy global demand. Production at both facilities is identical, following the same strict processes and quality control level. The Shanghai factory has been operational since early 2019, and manufactures and services the full suite of WindCube lidars.

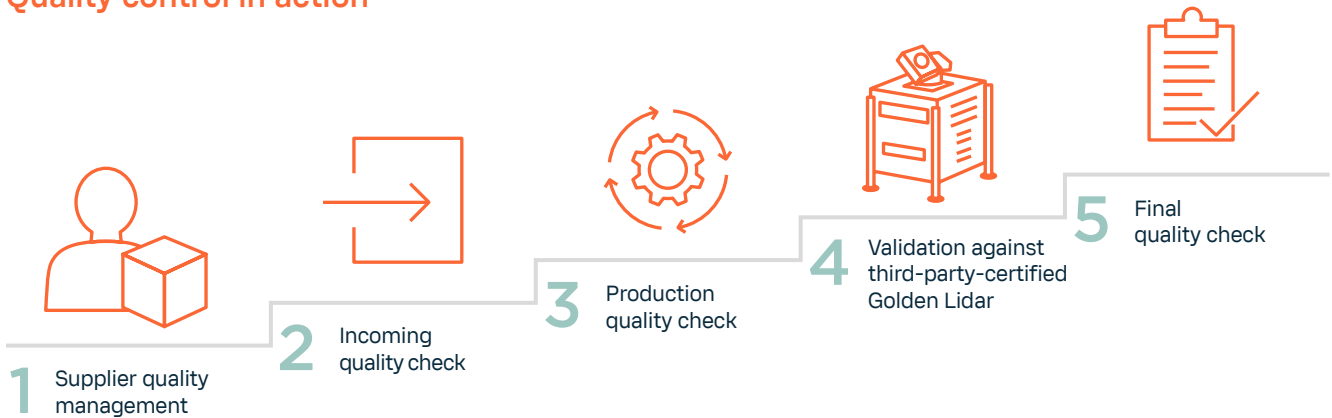
The experience and feedback collected in each factory enriches our overall manufacturing and quality control practices. Having two sites allows us to increase the quality and repeatability of WindCube systems globally, and we are excited to pass these gains along to our customers as our innovation and growth continue.

## Industry-level value

Vaisala leads the way with our industry-level manufacturing and servicing practices, meaning that we apply consistent, rigorous quality-control and testing protocols to each lidar unit and component.

This includes using a unique set of benches and soft tools for manufacturing, testing, and calibration. Many of these are patented by us and have accelerated production while ensuring higher and more uniform quality. For example, as each lidar unit makes its way through the process, it passes through more than 150 electro-optical control points, with more than 60 controlled wind parameters.

## Quality control in action



## WindCube® The iconic and trusted gold standard

- 20+ years of scientific lidar innovation
- 500+ authored or co-authored scientific publications in recent years
- 100+ validations by independent experts



## VAISALA Pioneers of environmental science

- 85+ years of expertise in weather environmental measurements and monitoring
- 2,200+ professionals and a large, worldwide distributor network
- 12% of sales invested in R&D



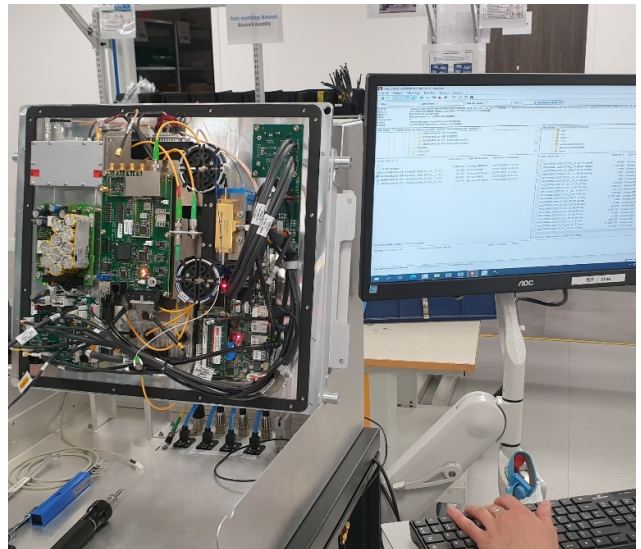
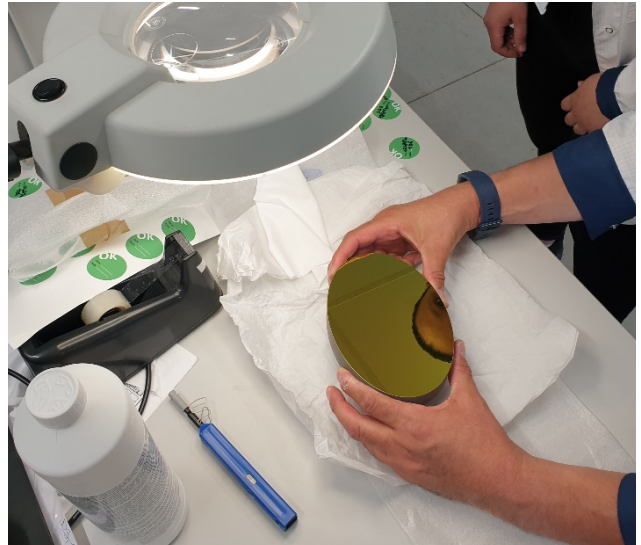
## Certification and bankability

Vaisala products meet the latest and most rigorous international verification standards, including ISO 9001, 14001, and 45001. All WindCube products are compliant to the latest IEC standards, and they are recognized and verified by the world's leading independent certifying bodies and research institutes, including DNV, DTU Wind Energy, UL, Deutsche WindGuard, NREL, and AIST. We have longstanding, fruitful partnerships with more than 20 leading research institutes worldwide.

Every WindCube is validated against a Golden Lidar and shipped with a document of validation issued by DNV. We own several Golden Lidars to ensure speed and continuity of operations. Our Golden Lidars are certified every 2 years across more than 20 key performance indicators, and this process is applied for more than 10 years.

This level of rigor gives us:

- Improved speed while achieving full traceability and quality
- A high degree of certainty in verification results
- Backup capacity using fully certified Golden Lidars
- Weather- and terrain-insensitive processes
- Complete verification across heights, turbulences and CNR levels



## Selected certifications



DTU Wind  
Department of Wind and Energy Systems



DEUTSCHE  
WINDGUARD



PAVANA  
THE WIND & SITE EXPERTS.



# Industry leadership and expertise

## Smarter wind energy

Our WindCube lidar suite's success is built on extensive scientific research, investment, and collaboration. Vaisala's unrivaled scientific contributions and partnerships with over 20 respected wind research institutes have resulted in more than 500 high-level publications on wind lidar. This expertise provides customers with reliable solutions and a strong global partnership they can trust.

## Extensive industry contributions

Vaisala is a member of past and current IEC working groups such as IEC -50 and IEC -15:

IEC 61400-50-3 → nacelle-mounted lidar

IEC 61400-50-4 → floating lidar

IEC 61400-50-2 → ground-based lidar

IEC 61400-50-5 → scanning lidar

Maintenance Team for the entire -50-X series

IEC 61400-15-2 → EYA and WRA



Vaisala is an active contributor to these industry consortiums and working groups:

- IEA Task 52 (Large-scale deployment of wind lidar) dedicated to various topics such as Turbulence Intensity, Lidar-Assisted Control, Complex terrain, Cold climate, Digitalization, and Scanning lidar
- IEA Task 43 (WRA data model) dedicated to data format standardization
- CFARS, ClassNK, FGW-TR6, OWA Carbon Trust, APTWind, FLOWER, and more
- Vaisala partnered with DNV to create the first industry best-practice guidelines on the use of Dual Scanning Lidar for offshore WRA

# Scientific innovation and excellence

## All about data

Lidar has exceeded the ability of legacy systems such as met masts to collect data, report it, and empower users with bankable conclusions. Now that lidar has been used around the world on projects large and small, we have learned several key things:

- Lidar data alone is as accurate and bankable as met mast data, and fully compliant and accepted by all international standards and guidelines, including IEC, IEA, Measnet, TR6 and others.
- WindCube – unique in the industry – is also capable of hybrid wind assessment, seamlessly integrating scalar and vector averaging for highest accuracy and lowest uncertainty.

- Lidar is replacing met masts: It reaches higher altitudes, goes where met masts don't, and helps drastically reduce vertical and horizontal uncertainties.
- The range of data available from lidar is extensive, as is the processing power of lidar units and their related software. These factors improve users' situational awareness and allow for previously unattainable benefits, like out-of-the-box Dual Scanning Lidar solution according to industry best practices.
- The WindCube lidar suite, unlike other measurement instruments, comes with modern, cloud-based management and analytics tools, making its insights more accessible and easier to manage.

*"If we're not using remote sensing devices, we're at risk to actually introduce bias. For most of these met masts, we've seen what we call shear relaxation – a 0.9% over-prediction when we use the mast alone, and 1.8% in energy."*

*Philippe Pontbriand  
Energy Resources Director, RES Americas, Inc.*

## Learn more with these published studies

[White paper: TI measurements for WindCube Nacelle](#)  
Results of Turbulence Intensity of nacelle-mounted lidar from two measurement approaches, which can prove TI measurement accuracy and add value to related topics in research and industrial applications.

[Study: Nacelle-Mounted Lidar reduces the uncertainty of PPT by Met Mast](#)

Campaign results using nacelle-mounted lidar for Power Performance Testing, showing high accuracy and less uncertainty of NML.

[Study: Leveraging scanning lidar offshore: how Europe can learn from Japan](#)

Validation of the Dual Scanning Lidar by GPI in Japan confirming accuracy and suitability of this set up for offshore WRA. The results have also met KPIs set by the Japanese regulator NEDO.

[2023 WindCube scientific digest](#)

Access the full list of studies published in 2023.

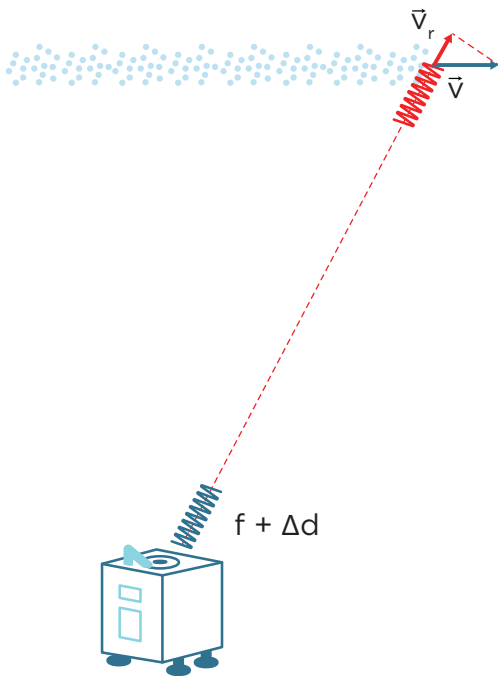


## Harnessing the strength of pulsed lidar

Over decades of research and deployments, Vaisala has relied on pulsed lidar technology to provide the most accurate, precise and bankable measurements for the wind industry.

### Principles and functionality

All lidar types share several key principles. Lidar (an acronym for Light Detection and Ranging, much like "radar" is an acronym for Radio Detection and Ranging) sends light beams into the atmosphere, which are reflected and returned by particulates moving with the wind. Using the Doppler Effect, the lidar analyzes the frequency of those reflections and computes a highly reliable wind speed.



### Benefits of pulsed lidar and WindCube technology

Measures multiple heights simultaneously, providing the full wind profile with no compromises in temporal resolution or accuracy
Fast sampling for a high number of measurement heights (10 heights = 10x faster and 10x more data, for example)
Constant spacial resolution throughout the entire wind profile
Measures greater height and distance ranges, with constant accuracy
Our vertical profilers uses only 5 laser beams, which operate without moving mechanical parts
Can use a unique hybrid wind reconstruction for the highest possible accuracy
Maintains constant accuracy no matter the weather or cloud/aerosol layers
Easy to position almost anywhere because its few (5) laser beams can easily be oriented to avoid obstacles
Provides accurate wind direction over a 0-360° range; not vulnerable to possible 180° error
Can use a 5th (vertical) beam for direct, accurate measurement of vertical wind speed and flow angle
Maintains high data availability and sample rates in a wide range of conditions
Data recovery not affected by strong wind shear or wind turbulence intensity
Uses 50% less power on average

## Revolutionary hybrid wind reconstruction

Our patented hybrid measurement capability is unlike anything available, integrating scalar and vector averaging to reduce uncertainty. Vaisala scientists discovered that atmospheric turbulence exhibits two characteristic sources of bias in traditional measurements. Our hybrid reconstruction algorithm reduces these biases by an order of magnitude and improves accuracy over other lidar types.


Download our Solutions Brief to learn more:  
[Hybrid wind reconstruction solutions brief](#)

Solution Brief  
windcube@vaisala.com

### VAISALA

#### Hybrid wind reconstruction algorithm

Unique, patent-pending method enables lowest measurement uncertainty



**Overall better accuracy** across three measurement classes (Class number 4, 5, 6) for the lowest measurement uncertainty for any lidar-based wind measurement device. This is achieved by combining the unique hybrid reconstruction algorithm with the patented vector averaging method.

**Key Advantages**  
 - Patented hybrid reconstruction algorithm  
 - Patented vector averaging method  
 - Patented hybrid reconstruction algorithm

**New breakthrough:**  
 Combining scalar and vector averaging. The hybrid wind reconstruction algorithm, our hybrid method is a scientific breakthrough unique to Vaisala, that combines scalar and vector averaging to achieve the lowest measurement uncertainty.

While both scalar and vector averaging methods have proven high accuracy in reporting wind industry conditions, the lowest uncertainty is in the wind direction turbulence (but with opposite sign). After observing these phenomena in the field and getting the physics behind them, Vaisala developed the hybrid wind reconstruction algorithm – combining both methods to mathematically eliminate the turbulence sensitivity and provide a truly representative 10-minute value.

This innovative hybrid method further increases the measurement quality and reduces its uncertainty level. Following an independent review conducted over 48 verification campaigns, 2020 confirms that WindCube v2 with hybrid wind reconstruction:

- Reduces measurement errors that the previous WindCube versions using scalar and vector averaging improves the sensitivity to turbulence, which may lead to further reduction in the measurement uncertainty in a wind resource assessment or power performance testing campaign.

	Class number	Class	Standard uncertainty
WindCube (vector average)	4, 5, 6	2.1%	1.1%
WindCube (vector average)	2, 3	1.2%	
Other lidar technology	2, 6	1.1%	
WindCube (vector average)	1, 3	0.6%	

IEC classification and estimated accuracy class (WindCube v2 with hybrid wind reconstruction was fully certified by the Institute of Renewable Energy Research in 2020 according to IEC 61800-51, Edition 2, 2007 (www.IEC.org/iec61800)).

# Unrivaled global service and support

## Industry-leading warranties and support options

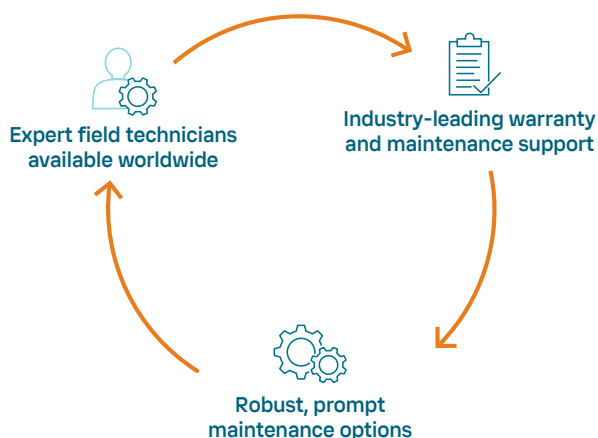
Vaisala offers the best warranty in the industry, as well as robust service and support. For example, for the WindCube vertical profiler, our premium on-site repair option ensures continued operations and eliminates logistical constraints.

Our support extends to ongoing training, including convenient online refreshers through our e-learning platform. These anticipate frequent questions and ensure you get the most from your WindCube investment.

For the WindCube vertical profiler, we also offer validation continuity, which enables users to maintain IEC-compliant validation during repair or maintenance, as well as a pre-validated, off-the-shelf purchase option that can save up to two months of deployment time. Existing customers can efficiently upgrade to the latest enhanced and certified WindCube units, with warranty extension included.

When you purchase a WindCube lidar, we make sure you have excellent experience from the point of sale to onboarding, lidar shipment, training, installation, measurement campaign, data analysis and more. Our dedicated technical support team (including partners) ensures global support.

Vaisala is able to offer this support because our technologies are so reliable, and because we have invested in a global support network that is unlike any other lidar provider. This provides value well beyond accurate wind data, since when you select WindCube lidar, you also gain the trustworthiness and peace of mind that only we can provide.



## Delivering value every step of the way

Vaisala provides the most comprehensive solutions and service available, no matter where you are. In addition to our two WindCube factories, we maintain seven global WindCube service centers and offer a variety of solutions that make deploying and operating lidar even simpler.

## Easy, reliable global solution: Robust support offerings

- Extensive training, including online training refreshers, on-site or remote
- Full maintenance capabilities that maximize operation continuity
- Installation and system integration support
- Technical and scientific support

## Innovative lidar solutions from a one-stop shop: Turnkey offerings

- Customer-oriented software for data management and performance monitoring
- Standalone power supplies and satellite communication solution
- 4G remote communication
- Winter kit
- Data analysis software
- Post-processing tools and algorithms



# What our customers say

At Vaisala, customer trust is the bedrock of everything we do. We work closely with our customers to develop solutions that address the most important industry challenges of today – and pave the way for future innovation.

“We did test one the first WindCube lidars back in the beginning of 2008. At that moment we knew, this is the breakthrough for remote sensing. Since then, Vaisala offers the most comprehensive line of wind lidar on the market.” (Axel Albers – Managing Director at Deutsche WindGuard)

“Portable with good accuracy and availability, our WindCube lidars are a great asset to our wind measurement campaigns.” (Anthony Clarke – Installation Coordinator at RWE)

“Vaisala’s relentless innovation in lidar solutions has allowed EDF to get more precision in wind data acquisition to convert it in more clean electricity.” (François-Xavier Roussel – Performance and Innovation Director at EDF Renouvelables)

“In terms of data quality and performance, WindCube is one of the thoroughbreds of the remote sensing world.” (Iain Campbell – Senior Technical Analyst & Wind Resource Manager at RES)

“Vaisala’s lidars provide our scientific teams with the ability to see and understand complex atmospheric behavior. When we are in the field measuring critical phenomena with their tools, the Vaisala team members are always ready to provide support to ensure our projects succeed.” (Julia Lundquist – Associate Professor at the University of Colorado Boulder)

“Vaisala has been involved in a number of our Offshore Wind Accelerator projects and it has been a pleasure working with them. We look forward to continuing our research into lidar with them in the near future.” (Megan Smith – Head of Offshore Wind Advisory at Carbon Trust)

“Vaisala has been a perfect answer to understanding our complex terrain and I wouldn’t hesitate to recommend them.” (Richard Seymour – Development Director at Infinergy)

“We trust Vaisala in terms of system quality and reliability. Their track record onshore, offshore, and with floating lidar systems has greatly helped.” (Maxime Bellorge – Chief Operating Officer at AKROCEAN)

“We saw that WindCube is a technology that meets our expectations in terms of equipment performance, reliability, track record, and industry expertise. Thanks to the references of different companies worldwide, we found WindCube very well positioned, so we have trusted and chosen it to be used for the first time in our country.” (Ilba Cuadrado – Development Engineer at Celsia)

“WindCube Dual Lidar is a game changer: We can get the whole wind picture with scanning lidar. There are too many good values to describe scanning lidar, and I cannot find a better partner than Vaisala and EKO. Without their expertise, we would not be able to make this happen.” (Atsushi Yoshimura – Manager at Green Power Investment)



# WindCube® The gold standard

WindCube® is the iconic and trusted gold standard in wind lidar. The turnkey product suite offers innovative, reliable, and highly accurate solutions for thousands of customers across the globe. Borne from a passion to advance the field, WindCube continues to take wind energy ever higher through a commitment to four guiding principles:



Trustworthy, superior metrology



Innovative lidars from a one-stop shop



Unrivaled thought leadership



Easy, reliable global solution

“The cost benefits are a big factor; it’s much more economical to get wind speed data [with remote sensing rather than met masts] and a thousand times easier.”

**Nathan Lehman** Energy Analyst, Apex Clean Energy





## Why Vaisala?

We are innovators, scientists, and discoverers who are helping fundamentally change how the world is powered. Vaisala elevates wind and solar customers around the globe so they can meet the greatest energy challenges of our time. Our pioneering approach reflects our priorities of thoughtful evolution in a time of change and extending our legacy of leadership.

Vaisala is the only company to offer 360° of weather intelligence for smarter renewable energy, nearly anywhere on the planet. Every solution benefits from our 85+ years of experience, deployments in 170+ countries, and unrivaled thought leadership.

Our innovation story, like the renewable energy story, continues.

