Toward new frontiers: How Vaisala wind energy solutions are advancing renewable energy

Solutions Brochure

A human tradition

People have harnessed the wind for centuries, and for countless applications. Today, the wind energy industry has inherited this tradition. It is filled with innovators who use the wind like no one before imagined, and the world is better for it.

Wind energy is one of the key pathways to a healthier, greener, more innovative future. Vaisala understands the potential — and the stakes — of this evolution, which is why we've built the most comprehensive set of weather and environmental technologies available. We're enabling the wind industry to embrace not just new turbines, terrains, and tactics — but entirely new ways of harnessing data and making critical decisions.

Freedom to innovate

Recent evolutions in the wind industry — aided by Vaisala technologies, including WindCube® wind lidar — have given developers, operators, and manufacturers better, bankable data with increased agility and simplicity. This has reduced the risks in wind energy output and the global cost of energy for both onshore and offshore wind farms. It has also unleashed some of the most imaginative and useful innovations in the history of energy.

The WindCube lidar suite, for example, provides the accurate, reliable, universally accessible data while freeing users from old constraints related to siting and compliance restrictions, costly and immovable met mast structures, and uncertainty driven by data extrapolation. Even challenging applications, such as IEC-compliant Power Performance Testing (PPT), have become routine.

We're continuing to help our customers push the industry into new frontiers, including ambitious offshore projects that incentivize and stretch global manufacturing and infrastructure. Many of these projects would be prohibitively risky without Vaisala's modern, end-to-end solutions providing assurance and constant awareness. But now they're helping the wind industry meet the most pressing energy and climate challenges of our time.

The benefits of this innovation are significant:

· Reduced uncertainty, improving financing and protecting profitability, from onshore complex terrain to remote offshore
· Simplification of burdensome processes, such as PPT and WRA
· Increased uptime and safety for assets and personnel
· Informed, data-driven turbine selection and wind farm layout
· Revolutionary data quality and suitability for tomorrow's turbines
· Improved community acceptance and support for wind energy
· Minimized operating costs, optimized performance, and lower LCOE
· Integration of historical data and excellent forecasting for big-picture visibility

Solutions across the wind energy life cycle

Anchored by the proven and widely deployed WindCube lidar suite, Vaisala's universal wind energy solutions are unrivaled in their comprehensiveness and value. Vaisala is the only company on the planet providing end-to-end energy solutions with fully integrated, globally trusted sensing and digital services.

We organize our wind solutions in several intuitive focus areas:

· Prospecting and development
· Construction and commissioning
· Operations and life management
· Research and development
· Turbine development

In 2018, Vaisala welcomed Leosphere, creator of WindCube, to our global family. There was no better way to expand our range of capabilities, serve the entire wind energy life cycle, and enable customers to do things they never could do before. You'll see the impact of the WindCube suite in our expansive, fully integrated solution lineup below.
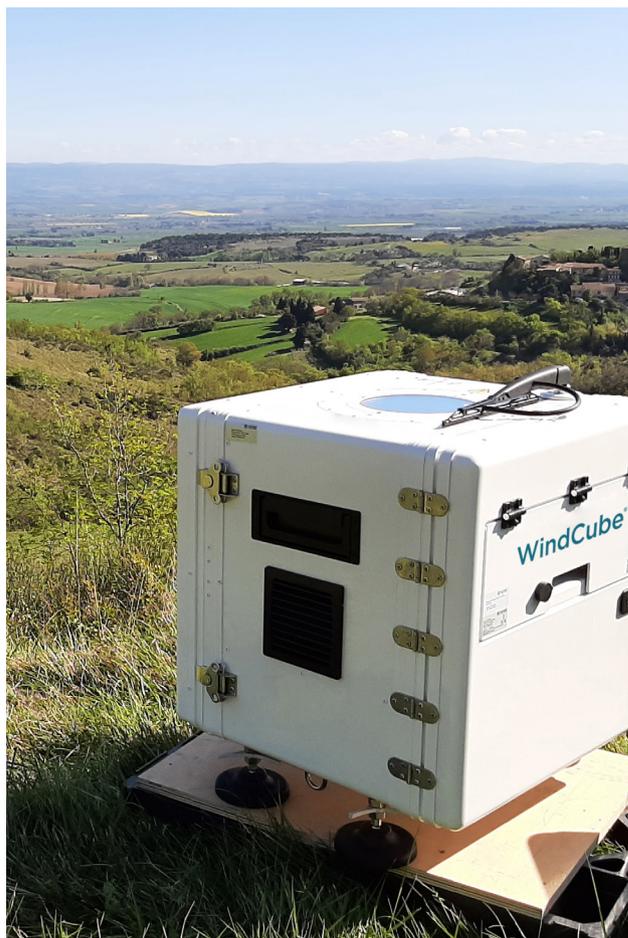
Applications that matter most

		Prospecting and development	Construction and commissioning	Operations and life management
		· Site prospection · Site suitability · Wind resource assessment · Farm extension	· PPT — contractual power curve · Offshore ship operations for build-up	· Permanent wind monitoring · Weather and obstruction light monitoring · PPT — performance verification · Retrofit and performance increase · Site O&M · Offshore ship operations for maintenance · Minutes/hour/day ahead forecasting · Repowering
Wind lidars	Vertical profiler (WindCube)	●	●	●
	Vertical profiler for offshore (WindCube Offshore)	●	●	●
	Long-range scanning (WindCube Scan)	●		●
	Nacelle-mounted (WindCube Nacelle)		●	●
Sensors & systems	Ultrasonic wind turbine sensor (WMT700)			●
	Pressure/humidity/temperature turbine sensor (PTU307)		●	●
	Visibility sensor (PWD20W)			●
	Offshore maritime & helideck monitoring		●	●
Digital services	WindCube fleet management and analytics (WindCube Insights)	●	●	●
	Wind data maps and time series (Historian)	●		●
	Energy forecast (Forecaster)			●
	Historical lightning maps and time series (GLD360, NLDN, Lightning Integrator)	●		
	Real-time lightning data, threats, and alerts (GLD360, NLDN, Thunderstorm Manager, Lightning Threat Zone)		●	●
	Lightning strike wind turbine damage potential (Strike Damage Potential)			●

Applications that matter most

		Turbine development · New turbine prototyping · Equipment for turbine control	Research and development · Blocking effect · Wake losses studies · Wind farm wake effect
Wind lidars	Vertical profiler (WindCube)	●	
	Long-range scanning (WindCube Scan)		●
	Nacelle-mounted (WindCube Nacelle)	●	
Sensors & systems	Ultrasonic wind turbine sensor (WMT700)	●	
	Pressure/humidity/ temperature turbine sensor (PTU307)	●	
	Visibility sensor (PWD20W)	●	
Digital services	WindCube fleet management and analytics (WindCube Insights)	●	●

Solutions at a glance

Vaisala's measurement technologies and data services are ideally suited to a growing, evolving wind industry. Built on trusted principles and technology, they are validated and continuously deployed around the world. This, along with our global presence and service network, makes them the most versatile and reliable technologies available.

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
· Unrivaled thought leadership
· Innovative lidars from a one-stop shop
· Easy, reliable global solution

Wind lidars

WindCube vertical profiler

WindCube is the new standard for wind measurement throughout the industry. Validated by hundreds of independent studies and accepted by all international standards and guidelines, it is augmenting and replacing legacy met masts. WindCube measures the complete wind profile at 20 simultaneous heights, covering the rotor sweep of even the largest turbines. This ensures extremely high data availability and accuracy across heights.

Key benefits:

· Unrivaled versatility for onshore and offshore applications. Easy to locate almost anywhere, WindCube requires little or no permitting or construction. It can be repurposed at will for further campaigns.
· Outstanding data quality that is superior to met masts and much easier to manage. An embedded (and patented) FCR algorithm or full CFD post-processing make it suitable for complex terrain.
· Trusted, bankable insights that make WindCube valuable for securing funding, reducing the cost of equity, and minimizing risk.
· Unmatched service courtesy of the industry's best warranty, accelerated workshop repair, seven global service centers, and premium service options — including 15-day guaranteed on-site repair and pre-validation/validation continuity.

WindCube Offshore

WindCube Offshore equips the WindCube vertical profiler with a robust casing for integration into floating buoys and other harsh offshore locations, such as lighthouses, substations, and vessels.

With offshore wind development accelerating, WindCube Offshore provides the ideal ruggedized option for Floating Lidar Systems (FLS).

Key benefits:

· Retains the precision, reliability, and accuracy of the standard WindCube vertical profiler.
· Provides a competitive advantage for offshore wind developers to move fast, collect bankable and trusted data, and ensure project success.
· Fully secure, cloud-based platform to access systems and measurements data anywhere, anytime.
· On-site (onshore) maintenance for maximum uptime.

WindCube Scan

WindCube Scan reliably and affordably provides full, 3D wind mapping and multi-purpose analyses that are indispensable to onshore and offshore projects. The industry's tool of choice for reducing spatial uncertainty, it is valuable at any stage of a wind farm project, from prospecting to operation. WindCube Scan is fully configurable for multiple uses, including monitoring, atmospheric cross-sectioning, and wind profiling. It can also measure multiple turbine locations at once, creating huge efficiencies in operational assessment.

Key benefits:

· Full 3D scanning at ranges up to 18 km. Multiple scanning patterns make WindCube Scan ideal for many campaign types.
· Extremely flexible and repurposable over a long service life, with outstanding reliability and ruggedness.
· At-a-glance insights and reporting with flexible data management through API, FTP, or a robust GUI.
· Dual Lidar Ready for unprecedented detail and insights. Valuable for offshore WRA campaigns, as well as complex onshore projects.

WindCube Nacelle

Suitable for any turbine type and rotor diameter, WindCube Nacelle provides a complete picture of the wind profile at unprecedented ranges from 50 to 700m (long-range version). By measuring 20 distances simultaneously each second, it provides outstanding data quality and availability — making it the routine choice for contractual PPT and the default system in many turbine supply agreements. It is the first nacelle-mounted lidar classified according to the IEC 61400-50-3 standard and enables PPT on any wind turbine, onshore and offshore.

Key benefits:

· Reliably provides a wide range of data, including shear, veer, turbulence, and rotor induction effects.
· Unprecedented range (up to 700m) and flexibility, courtesy of short- and long-range versions.
· Pairs with WindCube Insights — Analytics software for simplified power curve calculations and PPT analyses using a fast, easy-to-use, IEC-compliant, cloud-based tool.
· Fully manageable through the WindCube Insights — Fleet software, which provides visibility and management for a single lidar or a large fleet.
· Enables in-depth analyses of turbine failures and underperformance, yaw offset, and nacelle transfer function.
· Enables Lidar-Assisted Control (LAC), enhancing turbine efficiency, protecting equipment, and reducing costs.
· The first nacelle-mounted lidar to comply with the IEC 61400-50-3 standard.

WindCube Insights

The WindCube Insights software solutions provide actionable, at-a-glance data analysis and reporting so users can get the most from WindCube deployments. They are modern, cloud-based, easy-to-use solutions that add efficiency while unleashing the power of WindCube data for whoever needs it, wherever they need it.

WindCube Insights — Fleet
For WindCube, WindCube Offshore, and WindCube Nacelle

Key benefits:

· Robust, user-friendly, cloud-based software that makes insights available to your whole team, wherever they are.
· Extendable from one WindCube campaign to full fleet management, so it can grow with users' operations without new procurements.
· Detailed device monitoring and simple data export with access to business-critical insights immediately, on any device.
· Flexible user access rights for security and functionality across an entire team.
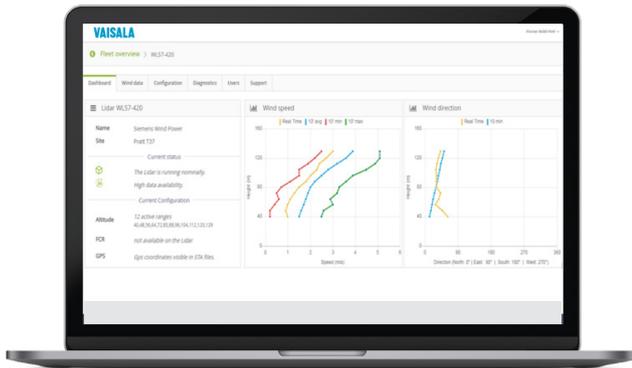
WindCube Insights — Analytics
For WindCube Nacelle

Key benefits:

· Highly efficient PPT and analysis that relieve users of traditionally burdensome processes.
· Produces ready-to-use IEC tables and annual energy production (AEP) calculations in just a few clicks, and offers built-in templating for using SCADA data from any type of turbine.
· Proactively displays which IEC paragraph/standard it is referring to while in use.
· Provides improved data visibility and decision-making for the whole wind farm, whether used for development or ongoing operations.
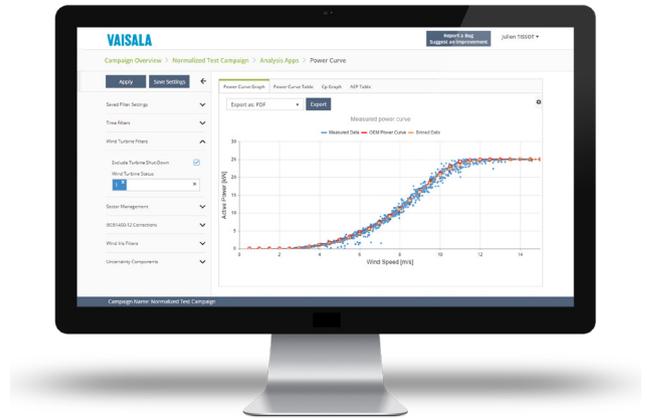
Sensors and systems

Ultrasonic Wind Sensor WMT700

Vaisala's WMT700 is the ideal ultrasonic wind sensor to enable precise and reliable turbine control. Deployed and serviceable worldwide, it has a simple, rugged design and extremely high reliability in any conditions.

Key benefits:

· Simplified design and WINDCAP® technology relies on just three high-quality transducers to ensure the right measurement performance.
· Highly reliable and accurate in the harshest onshore and offshore conditions. Optional heating protects the tranducers, arms, and/or body.
· Easy mounting enables accurate, fast, error-free installation on top of wind turbines.

Visibility Sensor PWD20W

PWD20W is a world-class visibility sensor designed specifically for wind turbine installations. Built on proven Vaisala forward-scatter technology, it allows turbine operators to intelligently adjust their light emissions, improving satisfaction for nearby communities while meeting stringent lighting regulations. Many operators are unaware that current regulations allow for Aircraft Detection Lighting Systems (ADLS) to be improved from basic "on/off" functionality, with real-time visibility values determining how brightly the obstruction lights switch on.

Key benefits:

· Intelligent dimming of lights instead of 100% on/off functionality, which dramatically improves resident satisfaction and acceptance of wind energy installations.
· Aircraft assistance and enhanced pilot safety courtesy of limited light emissions and decluttered visibilty along flight paths.
· Demonstrates compliance and due diligence in a changing regulatory environment.

Pressure, Humidity, and Temperature Transmitter PTU307

The Vaisala Pressure, Humidity, and Temperature Transmitter PTU307 is the ideal tool for wind energy operators and turbine manufacturers to assess the meteorological conditions that lead to icing on rotor blades. Developed specifically for wind turbines, the PTU307 reliably reports the key parameters of pressure, temperature, and humidity without adding substantial cost or complexity.

Key benefits:

- Protects valuable investments with proactive detection and warnings that enable better decisions before a severe icing event causes damage.
- Improves efficiency and uptime through intelligent, decisive blade heating and other ice mitigation practices.
- Helps operators stay compliant, ensuring wind farms are meeting requirements and showing due diligence.
- Built on proven BAROCAP® and HUMICAP® technologies known for accuracy and long-term stability in all conditions. Temperature sensor is a platinum Resistance Temperature Detector (RTD).

Offshore Maritime & Helideck Monitoring

With new global demand, Wind Turbine Installation Vessels (WTIV) face intense pressures to avoid costly delays and risk, and offshore maintenance and transportation operations require nowcasting and accurate weather insights to minimize downtime and improve safety.

Vaisala's offshore maritime system includes sensors and services for wind awareness, thunderstorm tracking and warning, and helideck operations — all tailored to reduce the total cost of energy and make offshore wind energy safer and more cost-effective. From port operations to vessel safety, craning, and helidecks, Vaisala is taking the industry into the offshore frontier.

Key benefits:

- Get accurate forecasting of the wind profile within the first few hundred meters above sea level.
- Track thunderstorm activity and provide real-time guidance for helicopters, lifting operations, crew exchanges, and other crucial operations.
- Minimize risk to helideck operations by providing critical weather data for piloting, equipment transfer, and personnel movement.

Digital services

Global Lightning Dataset (GLD360) and National Lightning Detection Network (NLDN)

There are no lightning detection networks on the planet quite like Vaisala's GLD360 and NLDN. Unmatched in their scope, accuracy, and availability, they inform countless technologies and applications. These networks are incredible strategic assets for many renewable energy applications, including wind energy, where they enable operators to monitor asset availability, receive trustworthy alerts, and stay ahead of hazardous storms.

Key benefits:

- Decisive lightning and storm alerts around wind farms.
- Outstanding accuracy, even beyond the range of radars and satellites. This provides truly global coverage for users anywhere (GLD360) and unrivaled awareness for North American users (NLDN).
- Smarter decisions and improved safety across many applications and operations, as well as reliable early warning capabilities to reduce downtime.
- Data feeds boast greater than 99.99% uptime, latency up to only ~12-seconds, and are delivered over a variety of real-time methods, file types, and APIs to fit various forecasting, alerting, reporting, and analytical needs. Historical lightning data can also be easily accessed and analyzed.
- Available as convenient data services immediately, with no capital costs required.

Thunderstorm Manager

Thunderstorm Manager, part of our Xweather family of subscription based products, is the ideal comprehensive lightning detection and mitigation software system. It makes GLD360/NLDN insights available through a convenient user interface, improving situational awareness and helping customers stay efficient, informed, and ready for anything.

Key benefits:

· Web-based interface provides real-time tracking and visualizations from any device, flexible display options for different lightning types and parameters, and playback from the previous 7 days.
· Provides various alert types and levels, based on specific project needs.
· Includes Lightning Threat Zone (see below) to track specific storms' trajectory, cell velocities, speed, and direction.

Lightning Threat Zone

Included with Thunderstorm Manager, Lightning Threat Zone provides lightning nowcast data for anywhere in the world. Or, through an easily integrated API, the data populates customers' existing weather tracking tools with the exact information needed for better situational awareness of thunderstorm and lightning risks.

Key benefits:

· Single-source, real-time access with 99.99% uptime, making the best data available to any user, anywhere.
· Includes an additional information layer with forecast polygons and velocity vector data for each identified storm.
· Highly localized, early detection of all relevant storms, enabling earlier planning for real threats and avoidance of unnecessary operational disruptions for nonproblematic storms.
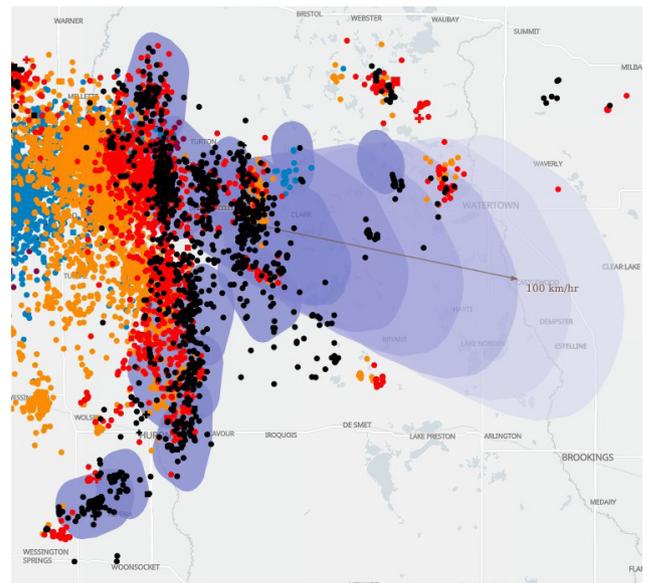
Strike Damage Potential

Accessible through Lightning Integrator or Lightning Exporter, Strike Damage Potential, part of our Xweather family of subscription based products, enables intelligent analysis of lightning strikes, reliabily distinguishing between low-risk strikes and those with greater potential to cause wind turbine damage. This creates substantial efficiency and allows wind stakeholders to plan decisively and quickly.

Key benefits:

· Enables fast, critical lightning insights by simplifying lightning data into strike points and showing the precise location of strikes — both near-real time and historical — that are most likely to have started a fire or caused damage.
· Unrivaled accuracy around the globe, with actionable insights derived from GLD360 and NLDN data.
· Enables earlier interventions that require less time and fewer resources for repairs or wildfire containment.


Lightning Integrator and Lightning Exporter

Lightning Integrator, part of our Xweather family of subscription based products, provides quick and easy access to Vaisala's high-quality, accurate historical lightning data through an API or an easy-to-use web interface. This enables robust, data-driven safety and planning practices, as well as advanced risk assessments and incident reporting — all informed by the best lightning data on the planet.

Lightning Exporter, part of our Xweather family of subscription based products, provides an easy-to-use web interface that lets users download and compile the exact lightning data they need from hazardous weather events near facilities or assets. It enhances report credibility for management, legal teams, unions, or external audiences, and it often eliminates the need to purchase, install, or maintain any lightning detection sensors.

Key benefits:

· Reduced downtime through near-real-time storm analysis, even when a wind asset(s) might have been compromised. Teams make better decisions to maximize productivity.
· Confident, objective evaluations derived from the largest, most sophisticated, most accurate lighting detection networks in the world (see GLD360/NLDN).
· Ultimate asset management and storm visibility, no matter where wind operations are located onshore or offshore.
· Improved asset reliability and liability protection resulting from informed emergency, maintenance, and management practices.
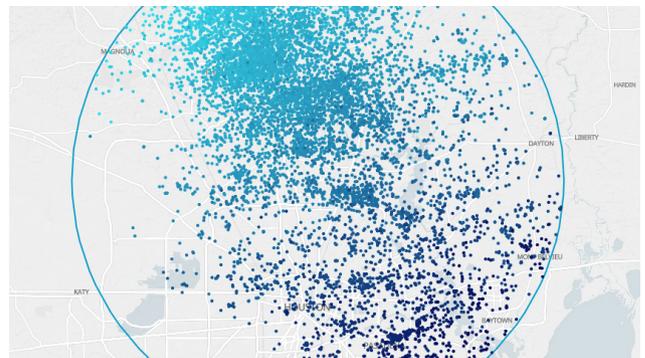
Historian

Historian, part of our Xweather family of subscription based products, offers wind developers access to long-term historical data to drive better decisions. It provides a powerful range of datasets, including time series tools, GIS wind visualizations, and climate variable analyses, to capture the most value from wind projects. It is valuable during the prospecting phase as well as during operation and performance monitoring.

Key benefits:

· Trusted, tested data derived from decades of satellite imagery, global weather data, and cutting-edge simulation models.
· Accurate predictions of project success using quality baselines.
· Early detection and resolution of problems using decades of data instead of weeks or months.
· Simple data integration via FTP or API.
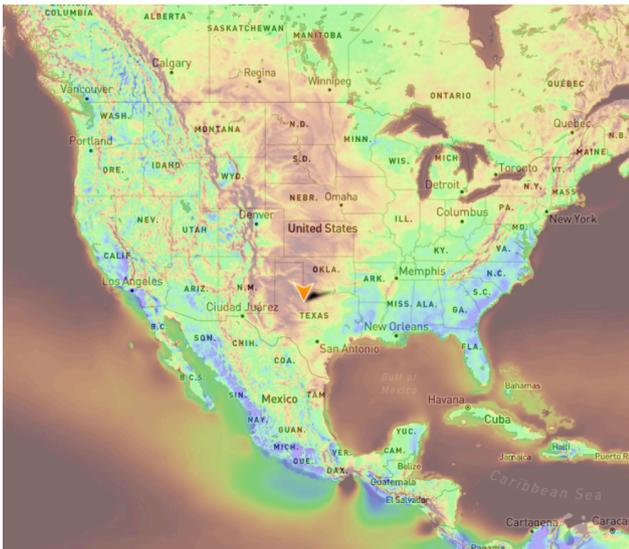
Forecaster

Forecaster, part of our Xweather family of subscription based products, creates exceptionally accurate, site-specific forecasts so asset owners, project managers, and energy traders can effectively manage wind investments. Through a convenient subscription model, it delivers data through customer-specific dashboards and provides an immediate competitive edge in the wind energy market.

Key benefits:

· Site-specific forecasting derived from the industry's best data and sensor technologies.
· Based on mature, reliable technology refined over 20+ years of use and deployments around the globe.
· Integrated machine learning for significantly reduced forecast error and bias.
· Simple integration using an API, plus 24/7 guaranteed availability.
· Can be coupled with lidar to achieve unparalleled forecasting in places where it matters most.
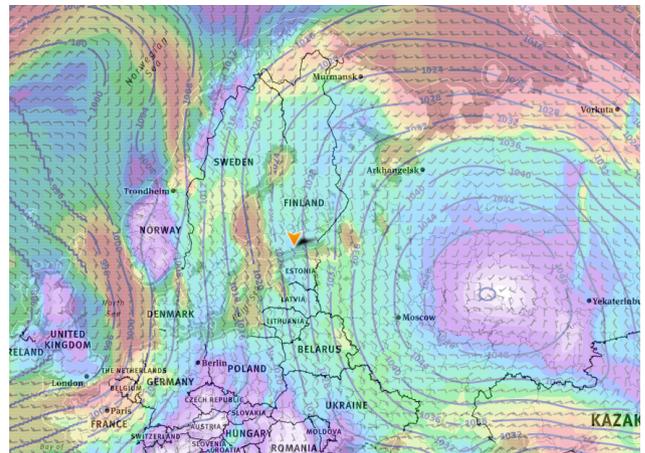
Time to take wind energy ever higher

Vaisala is ready to talk about your wind project and how we can make it better. Contact us today. We'll give your project the fresh air it needs.

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.

vaisala.com/wind-energy