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Wind monitoring made easy

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Why wind data monitoring matters – and how to do it effectively

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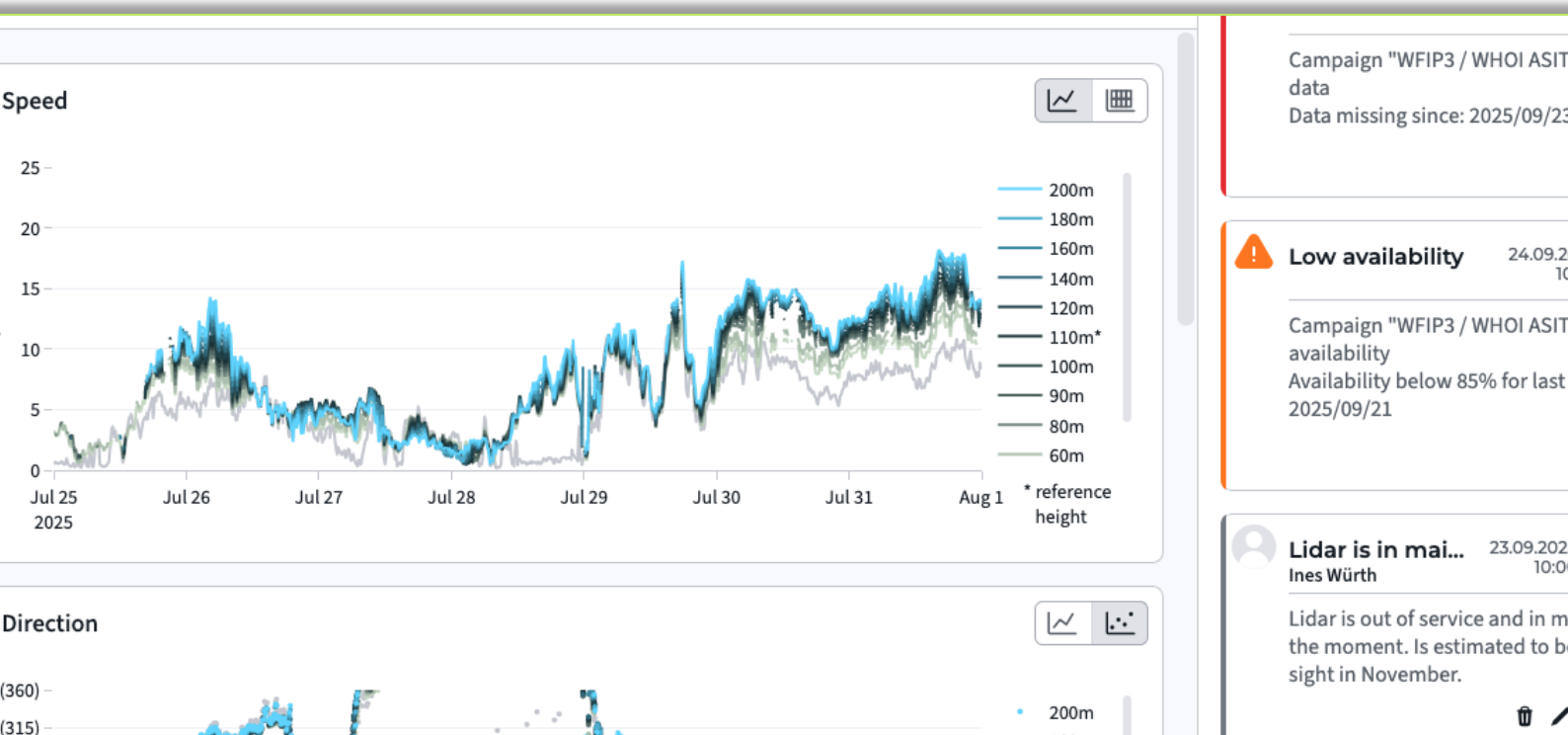

Why wind data monitoring matters – and how to do it effectively

Enerlace White Paper WP2025-01 Version 3 (07 July 2026)

Good wind data monitoring can cut the time your team spends on routine checks by 80% and help you avoid uncertainty penalties that can cost a project hundreds of thousands of euros. This paper explains why that gap exists, what causes it, and how to close it: whether you build a tool in-house, buy dedicated software, or lean on consultants. We'll also touch on why the data you collect today should stay usable long after the campaign ends. It's based on our own experience and anonymised experience from our users.

We'd welcome your perspective on data monitoring: please get in touch with any comments or questions.

Thank you for working with us!

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1 Introduction and executive summary

Reliable wind data is the foundation of every successful wind project. The measurements collected during campaign phases define how a site is evaluated, financed, and later operated.

As the number of measurement campaigns grows, so does the challenge of keeping track of instruments, data streams, and maintenance events.

This paper explains why structured data monitoring matters, what can go wrong, and how systematic, software-supported processes can bring practical improvements to day-to-day work. It also outlines how to estimate return on investment (ROI) and compares three common approaches: building a tool internally, using dedicated software, or relying on external consultants.

In our customers' experience, dedicated software for wind data monitoring and data management, including our own Moli platform, tends to be the simplest option; it's fast to implement, taking just a few minutes to set up; it doesn't tie you to a particular consultant, unlike some software or monitoring services, but instead enables collaboration; and your data remain portable, reducing the risk of vendor lock-in. Building an internal tool is rarely worth the effort, while the ROI from dedicated software can be significant: 4x on time savings alone, and higher still once the effect on project uncertainty is considered.

2 What is wind data monitoring?

Wind data monitoring is the process of regularly, rapidly, and reliably checking wind measurements from ongoing campaigns to check that the measurements are being recorded, quantify data availability, check data, and make sure that campaigns are proceeding as planned.

We see five key stages in monitoring wind measurement campaigns, each with its own concrete payoff, from setting up your campaign through to high-quality, ready-to-use data (Figure 1). We think of this as a data pipeline.

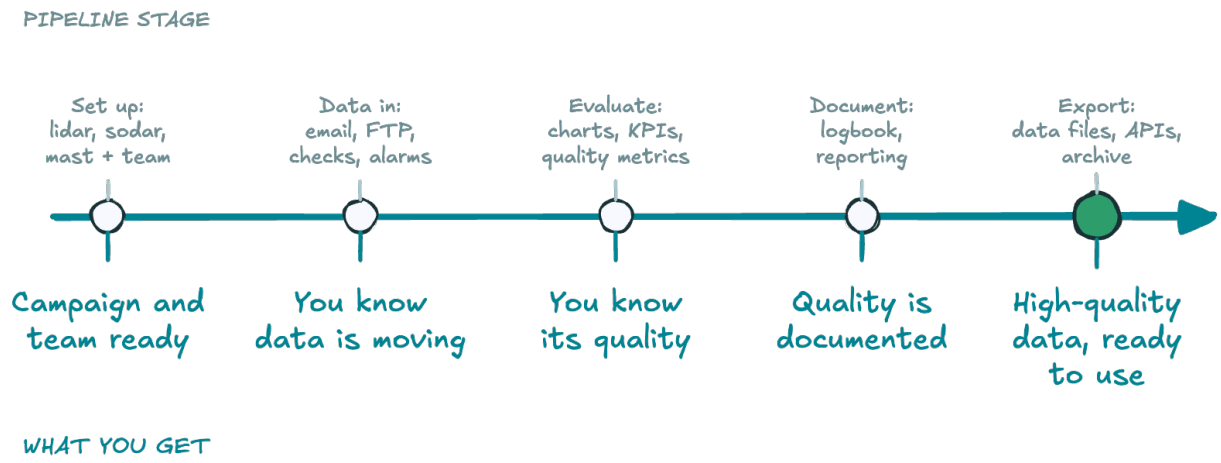

Figure 1 The five stages of an effective wind data monitoring pipeline, and what each one gives you

3 How wind data monitoring works now

Data monitoring in many wind farm developers usually follows well-defined processes but often leverages several different tools. For example, the process might be captured in a document, then copied into a spreadsheet where an analyst records the checks they've made, and then there might be a document which is used as a site logbook. In many cases, the logbook is a collection of emails. Data are stored in a network directory and then analysed using spreadsheets, self-built code, or established industry software as needed. These tasks can take several days each month, per campaign (*Table 1*).

Table 1 Example of the cost of common tasks in a typical data monitoring pipeline during a wind resource assessment campaign

Tasks	Time required	Associated Costs	Annual Frequency	Annual Cost
Daily checks	1 hour /week @ €100 / hour	€100 / week	Every week = 50 weeks	€5,000
Weekly checks	1 hour / week	€100 / week	Every week = 50 weeks	€5,000
Monthly checks	4 hours / month	€400 / month	12 months / year	€4,800
Monthly reports	8 hours / month	€800 / month	12 months / year	€9,600
Answering one question about a measurement campaign	1 hour / enquiry	€100 / enquiry	Once a week = 50 weeks	€5,000
TOTAL				**€29,400**

These costs come from tasks that could be automated (like checking and reporting), or because the analyst is the only person with access to data, and so only they can answer questions.

We know these costs are too high for many companies, particularly when they are developing multiple sites at once. Companies typically converge on monitoring about 10 measurement campaigns per data analyst, often skipping in-depth checking because of limited resources.

Our goal at Enerlace is to develop software that helps teams work together with a single source of truth for all of their campaigns, thereby reducing these costs and helping raise data quality.

With automated tools, including our own Moli platform, the tasks in Table 1 take far less effort.. We've heard from our customers that the time required for all the Tasks listed in Table 1 for one campaign is about an hour each month.

4 Why wind data monitoring is valuable

A wind measurement campaign is more than just data collection. it provides the evidence every project decision depends on, from initial investigations through to financing

- **Resource assessment:** determines project feasibility and long-term yield.
- **Design and layout:** depends on understanding local wind patterns and turbulence.
- **Financing and due diligence:** rely on transparent, high-quality measurement records.

Monitoring itself doesn't replace resource assessment or investment analysis: that's still the job of your engineers, consultants, and analysis tools. What monitoring does is make sure the data feeding those decisions is complete, available, and trustworthy.

For many wind farm developers, monitoring has become a significant task. Multiple campaigns may run at once, sometimes across different regions and using varied equipment. Each campaign generates a constant flow of data that must be checked, stored, and documented.

In this context, spreadsheet-based oversight or ad-hoc checks are no longer enough. Missed issues or undocumented actions lead to uncertainty and, eventually, lost value. A few weeks of missing data can translate into extended campaigns, extra cost, and more difficult reporting.

The value of consistent data coverage is recognised in standards. For example, **the German FGW TR6 guidance** (FGW Technical Guidelines Part 6, Rev. 12, 2023) requires wind data availability of at least 80% over the measurement period, and a logbook of any changes to the measuring equipment; fall short on either, and you drop into the lowest data-integrity tier, which carries a minimum 5% uncertainty penalty.

So, a few weeks of missing data can translate into higher uncertainty, lower confidence from investors, and additional campaign extensions that cost real money.

4.1 The cost of uncertainty

The cost of uncertainty depends on your business model.

If you sell wind farms as „**ready to build**“ (the layout and design is complete, permitting is complete, the turbine supply agreement (TSA) is in place, and an engineering, procurement, and construction („EPC wrap“) contract is in place), the effect of wind resource uncertainty is to raise energy yield uncertainty and to reduce the median expected yield below P50 value. The yield uncertainty is larger than wind resource uncertainty because of other contributing factors, but for simplicity we'll assume yield uncertainty is equivalent to wind resource uncertainty.

The value of a ready-to-build onshore wind farm currently is estimated at around €1 million per MW for a roughly-50 MW facility. Depending on off-take agreements, the cost of yield uncertainty could be €15 – 30k lost value per MW per 1% of yield uncertainty.

Table 2 Example of the effect of wind measurement issues on the cost and value of a 50MW Wind Farm development project

Issue	Business impact	Associated Costs	Frequency	Average cost per campaign
1-3 weeks of downtime	Gap filling required → expert services, staff time	€20,000	1 campaign in 4 = 0.25	€5,000
1-3 weeks of downtime	Extra 1% yield uncertainty → penalty on project value	€750,000 (lower estimate for a 50MW project)	1 campaign in 4 = 0.25	€187,500
1 month of downtime	1 year extra of measurements → costs including equipment rental, communications, site visits, labour	€250,000	1 campaign in 10 = 0.1	€25,000

Incomplete or lost logbook	Extra 5% wind resource uncertainty → ~5% extra yield uncertainty → penalty on project value	€3,750,000 (lower estimate for a 50MW project)	1 campaign in 10 = 0.1	€375,000
TOTAL				**€492,500**

5 What can go wrong

Our customers used to see the same recurring challenges:

- Problems detected too late: a lidar, met mast, or sodar stops reporting, or is broken and records faulty measurements and no one notices until the monthly review.
- Fragmented workflows between sites and teams.
- Manual handling of files that introduces errors or overwrites.
- Missing or inconsistent logbooks that complicate audits or financing.
- Limited visibility for managers trying to keep an overview.

None of these issues are unusual, but together they create unnecessary risk and cost. Most can be avoided once monitoring is organised and responsibilities are clear.

6 How to do it effectively

Effective monitoring setups often share a few traits:

- A **single overview** of all active campaigns, regardless of location or equipment.
- **Automated data import** so no more manual, time-consuming file handling is necessary
- **Automated checks** that flag availability drops or communication failures early.
- **Consistent workflows** so every site follows the same standards and limits.
- **Integrated documentation** where maintenance actions and notes stay linked to the data.
- **Clear roles** for who monitors, who validates, and who follows up.

When these basics are in place, monitoring becomes part of the routine. Instead of reacting to problems, teams can focus on maintaining data quality and learning from their measurements.

Improving your wind data monitoring can have two direct impacts on your business

1. It can reduce the time you need for typical monitoring tasks, and
2. It can help increase data quality by giving you the chance to increase data availability and enabling documentation. This can reduce uncertainty in wind resource assessments and energy yield calculations.

7 Build versus buy – choosing the right approach

Once the need for better monitoring is clear, teams face a strategic question: build their own tool or use a dedicated platform?

Building internally allows full control and tailoring to company standards, but it also requires ongoing development effort, maintenance, and specialist knowledge. Over time, keeping up with new sensors, APIs, or reporting formats can become a project in itself; your tool will need maintenance to adapt to changing data formats and changing needs. And, the wind data analyst will have to work with the software developers to make sure that they get what they need.

If you're thinking of building your own solution, you need to plan on maintaining it as well (Table 3).

Table 3 Costs of developing an in-house monitoring solution for a small measurement fleet

Item	**Costs**	**Annual costs**
Initial development (1 year)	50% Front-end developer: €50,000 50% Back-end developer: €50,000 33% Wind resource analyst: €33,000	€133,000
Maintenance (annual cost)	25% Front-end developer: €25,000 25% Back-end developer: €25,000 20% Wind resource analyst: €20,000	€70,000
3-year total		**€273,000**

Our customers' experience is that internal software usually only saves about 50% of the time spent on monitoring. This is because the software is expensive and time consuming to develop. Furthermore, it is difficult to justify significant investment in one-off software, and the software that is built is often not treated as a priority for improvement or maintenance. So, internal software often stalls at a "good enough" level that does not save as much time as expected but still incurs overhead for maintenance.

Using dedicated software offers immediate functionality and support from teams focused on this specific problem. It reduces maintenance work and usually lowers long-term costs, though it may allow less deep customisation. But, links into the software using APIs and flexible data import and export options usually allow customisation.

For most developers, the best outcome is to keep their expertise where it adds most value -on data interpretation and quality – while letting software handle the routine parts of monitoring.

8 Why not just rely on a Consultant?

External consultants are an important part of the wind energy ecosystem. They bring experience in campaign design, data validation, and complex analysis. But ongoing monitoring has practical limits.

Consultants usually work in review cycles, not day-to-day operations. This means that issues may be detected with delay, and visibility into live data can be limited. Scaling this model to many parallel campaigns quickly becomes costly.

A balanced setup combines both: your team keeps direct control and visibility through software, while consultants support specific questions or independent checks.

9 Estimating the return on investment (ROI)

9.1 ROI from reducing the costs of typical monitoring tasks

Table 4 shows an estimate of the costs for monitoring 10 wind measurements. Our customers tell us that this is a full-time job at a wind farm developer using existing tools or with in-house software.

With Moli, the time required for monitoring is around 1 day a week, or 20% of a full-time position. The list price for our software is €150/ month, per campaign.

Table 4 Example costs for different solutions for monitoring 10 wind measurement campaigns

	Without Moli	**With in-house software**	**Costs with Moli**
Year 1 costs	Monitoring: €100,000	Monitoring: €100,000 Software development: €133,000	Monitoring: €20,000 Software: Approx €16,000
Year 2 costs	Monitoring: €100,000	Monitoring: €50,000 Software maintenance: €70,000	Monitoring: €20,000 Software: Approx €16,000
Year 3 costs	Monitoring: €100,000	Monitoring: €50,000 Software maintenance: €70,000	Monitoring: €20,000 Software: Approx €16,000
Total costs	**€300,000**	**€473,000**	**€108,000**

→The ROI from using our software is 4x (savings: €192,000, with costs of €48,000).

9.2 ROI from increasing wind resource data quality

Software for wind data monitoring can have a positive effect on data quality:

- Availability can be increased by quickly and reliability detecting measurement downtime, particularly due to sensor or logger failures, and
- Documentation can be linked to data and included in the workflow of checking the data

Low data availability brings costs from extra data requirements and uncertainty penalties (Table 2).

An effective monitoring solution can help avoid long outages by providing early warning of missing data or dropping data availability, thus giving you the chance to act and restore availability. So, the actual ROI depends on your ability to take corrective actions before availability hits critical levels.

→An example: if using external software for monitoring reduces the risk of the events in Table 2 happening by 50%, this is equivalent to saving €100,000 - €250,000 per campaign, for a software cost of around €1,800 per campaign, per year. In this case, your ROI is potentially more than 50x.

10 Conclusion: data monitoring for competitive advantage

Good monitoring is not only about avoiding data loss; it's about confidence. Teams that manage their measurement campaigns effectively:

- Detect and fix issues faster.

- Maintain higher data availability.
- Reduce the need for campaign extensions and site visits.
- Build transparent documentation for financing and audits.

Over time, this consistency becomes part of a developer's reputation. Reliable data and clear processes build trust, both inside and outside the organisation.

The ROI from saving time can be ~4x, while ROIs from reducing uncertainty may be much higher.

Monitoring is only half the story. A campaign's data outlives the campaign itself: it gets revisited at financing, at repowering, at resale, or when a project is reassessed for life extension. Data that's well-structured and documented today saves you from reconstructing it from old spreadsheets and a departed analyst's inbox years later. That's the FAIR principle in practice: findable, accessible, interoperable, and reusable, for whoever needs it next. Your monitoring approach should support this: a good monitoring process makes your data FAIR by default, ready for use now and whenever you need it later.

Contact

If you have any questions, comments, or would like to discuss this in more detail, please contact:

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About us

Enerlace was set up by Ines Würth and Andy Clifton. After 25 years of making meteorological measurements for wind and solar energy or environmental science, we were frustrated with how much manual work was still required to manage data, and how little data were FAIR; findable, accessible, interoperable, and reusable. We set up Enerlace to bring digitalisation and automation to the renewable energy sector and make data FAIR.

Our mission is to speed up the deployment of wind energy by using software to automate repetitive or complex tasks, freeing up experts for more valuable work.

Enerlace grew out of the Chair of Wind Energy at the University of Stuttgart, where Ines and Andy worked before founding Enerlace GmbH in 2024.

Dr.-Ing Ines Würth 	Ines is Enerlace's product owner and an internationally recognised expert in the use of wind lidar. Ines is one of the cofounders of Enerlace. She trained as an aerospace engineer at the University of Stuttgart before joining the Chair of Wind Energy as a researcher. Ines later became the leader of the Testing & Measurement Group, where she was responsible for managing deployments from idea to analysis of scanning- and profiling wind lidar on, and offshore. Ines gained her PhD in minute-scale forecasting of wind power using long-range lidar data in 2021

Dr. sc. Andrew Clifton 	Andy is Enerlace's Managing Director and a pioneer in the use of wind lidar for wind energy. He is one of the cofounders of Enerlace. A mechanical engineer, Andy started out with gas turbines and then gained a PhD in avalanche research in 2007. He deployed his first wind lidar in 2008. His career has centred on technology transfer and commercialisation in the wind energy sector, with a strong focus on wind measurements using lidar. Andy wrote the IEA Wind recommended practices for wind lidar in 2013, led IEA Wind Task 32 on wind lidar from 2018 to 2022, and now leads the digitalisation working group in IEA Wind Task 52, "large-scale deployment of wind lidar". He was the lead author of the 2023 paper, „Grand challenges in the digitalisation of wind energy".

Enerlace is independent and only develops software for managing meteorological data for renewable energy and climate-related applications. We are based in the Black Forest region of Germany. Find out more about us at www.enerlace.de.

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