

ip  **INNOVATIVE PROJECTS**
for the German wind market

The following pages are dedicated to companies whose new products, processes or methods ensure the continued development of the wind industry.



An excerpt of the
BWE Industry Report
'Wind Industry in
Germany 2026'



Decision in Two Days: How 4cast Horizon Is Rethinking Site Analysis

Automated, transparent, and ready for repowering: With 4cast Horizon, 4cast brings speed and precision to wind project planning.

The Challenge:

Time Pressure in Site Planning

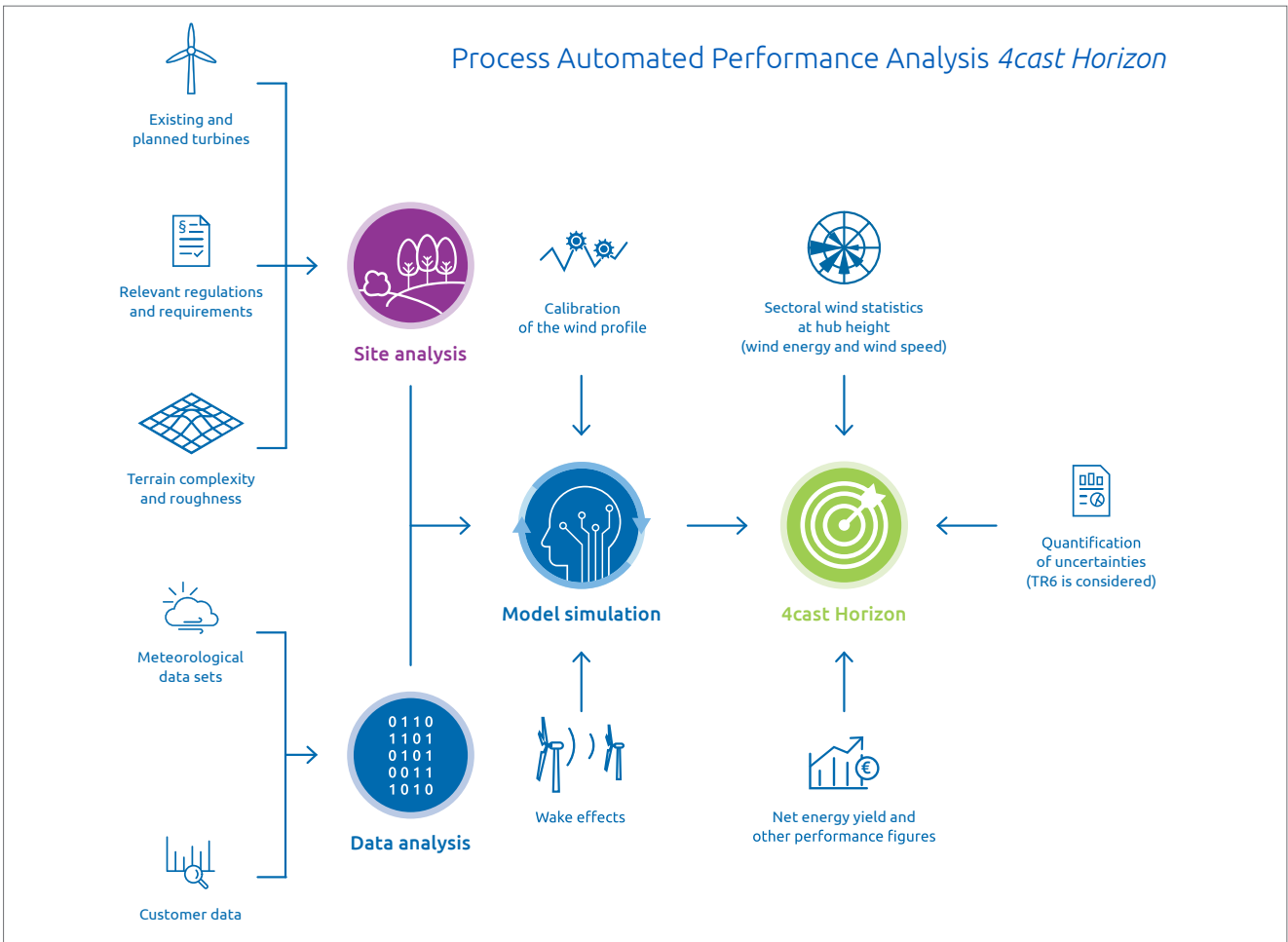
The energy transition requires speed – yet many approval and planning procedures in the wind sector take unnecessarily long. One major reason: site analyses that take weeks, are often difficult to compare, and fail to identify uncertainties early on. But those who want to make decisions need clarity – fast, reliable, and economically sound.

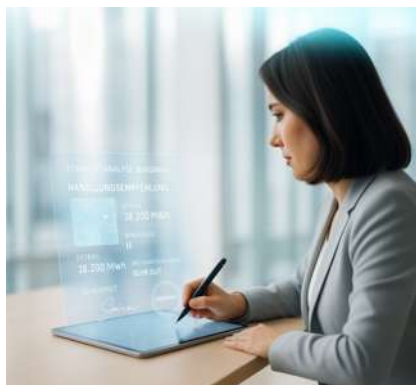
The Solution:

Site Analysis in Two Days

This is exactly where 4cast Horizon comes in. The automated solution analyzes new or existing wind farm locations within just two working days. It delivers a comprehensible assessment of long-term energy production – based on publicly available data, intelligent modeling methods, and more than ten years of expertise in wind forecasting and site evaluation.

Planners receive not only a reliable yield value but also scenario comparisons, maps, visualizations, and actionable recommendations – clearly structured, directly applicable, and in line with current standards. Upon request, the analysis can be supplemented by a DAKKS-accredited expert report.





The Principle:

Automation with Quality Assurance

The innovation behind 4cast Horizon lies in the unique combination of software logic and human validation. Relevant site and climate data are processed automatically, scenarios are calculated directly, and results are verified by experienced professionals. This not only saves time but also reduces sources of error – a clear advantage over purely manual processes.

The Application:

Repowering and More

4cast Horizon demonstrates its strengths especially in repowering scenarios.

Existing production data and site information can be directly integrated to enable more accurate forecasts. This helps to better exploit potential, assess economic viability with greater certainty, and take the next project step with confidence. The solution also provides solid decision-making foundations for hybrid projects and site expansions – early, structured, and reliable.

Contact and Networking Opportunities:

We invite interested companies and experts to connect with us and collaborate on optimizing 4cast Horizon. To schedule a conversation, write to us at alex@4-cast.de or scan the QR code:



Project overview

Initiator	4Cast GmbH & Co. KG
Status	Project launch in May 2024, ongoing development
Location	Worldwide
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Conclusion

4cast Horizon represents a new approach to wind planning: faster processes, reliable statements, and flexible application options. This makes approval procedures more efficient, investment decisions more informed, and expansion targets more tangible. Those who rethink site development need new tools – 4cast Horizon is the solution for rapid site analysis.



heartbeat of renewables

Are you interested in the project and want to know how your community or your business can benefit from it? Contact us. Our contact can be found in the **business directory on page 142.** ▶

A Well-Rounded Solution

Sustainable Heat from the Region – for the Region by ENERTRAG.



Facts and Figures: Wind Heat Storage in Nechlin

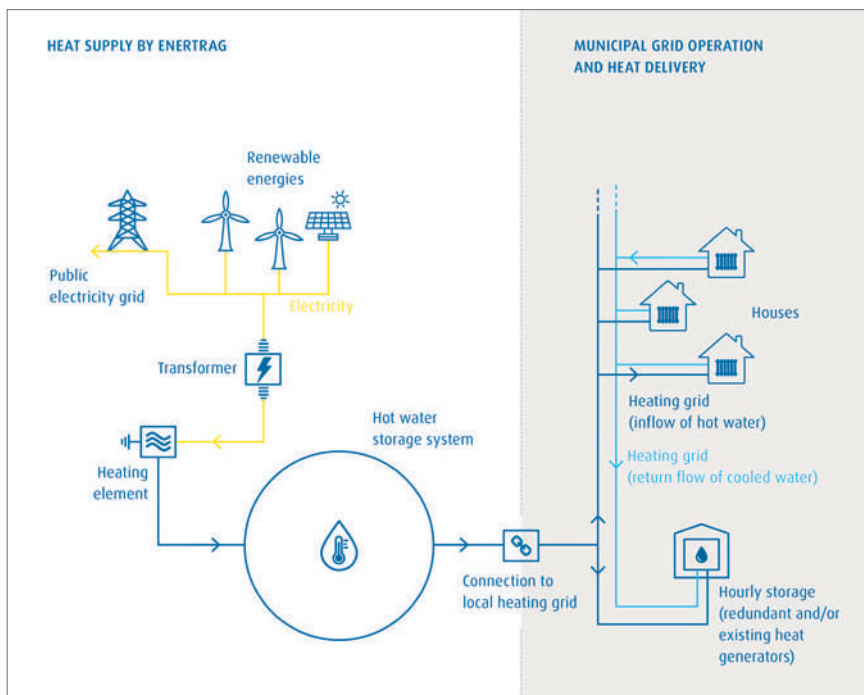
In Germany, heating accounts for more than half of total energy consumption. Since around 80 percent of that demand is currently met using fossil fuels, heating is also responsible for a large share of the country's CO₂ emissions. After all, about every second household in Germany heats with gas, and one in four uses heating oil. Only 14 percent is provided by district heating – and even that is still largely generated from fossil fuels. Starting in 2026, installing oil heating systems will generally no longer be per-

mitted nationwide. Most of the existing oil heating systems were installed in the 1990s, meaning new investments are now due. Time to look for alternatives. Against the backdrop of climate change, the answer is clear: heat from renewable energy sources. But is it reliable – and above all affordable – even for small towns and rural villages?

The village of Nechlin has the answer
A successful example of climate-friendly heat supply can be found in the village of

Nechlin in Brandenburg. Here, wind and solar power provide the community's heat. Nechlin has been working for several years on an intelligent and sustainable energy supply. Citizens participated in the development of a grid based on multiple renewable energy sources, including photovoltaic systems. A local heating network was also established. The nearby wind turbines of the Nechlin wind field produce around 70 million kilowatt hours of electricity annually – about 5 percent of which occurs during especially windy pe-





From Wind and Solar Fields to the Local Heating Network – Municipal Heat Planning with Renewable Energies

riods. While these energy volumes cannot always be fed into the grid, using them locally proves worthwhile. Since early 2020, Nechlin has been using surplus wind power – the kind that would otherwise go unused due to a lack of grid capacity – to heat a thermal storage unit. This wind-powered heat storage system then supplies the entire village with warmth.

How it works

The heating elements in the thermal storage unit are automatically activated via the ENERTRAG Powersystem software. As soon as the transmission grid opera-

tor issues a curtailment signal for wind power, the heating system switches on. This means the wind electricity heats the water in the storage unit precisely during the windy periods when the turbines would otherwise have been curtailed. Depending on the weather, the system can supply heat to all buildings connected to the local network for up to a week – even on the coldest days of the year – without needing another curtailment or recharge cycle. Efficient and cost-effective, this wind-powered heat storage system provides a reliable energy source for the local heating network.

Conclusion

There are many benefits to supplying heat from renewable energy using a heat storage system – for everyone involved. Residents can expect low and stable heating costs over the long term. The prices are competitive compared to current heating costs and typical market rates in the region. What’s more, the heat is 100 % climate-neutral, future-proof, and unaffected by fluctuating global fossil fuel prices. The technology is reliable and easy to operate. No radiators need to be replaced, and there is no obligation to retrofit insulation systems in the homes.



ENERTRAG Operation and the Wind-Powered Heat Storage

Why is operational management so important?

- Ensuring an efficient heat storage system through regular inspections
- Optimizing control systems to minimize heat losses
- Monitoring insulation and heat exchangers

Project overview

Initiator	ENERTRAG SE and Nechlin (Municipality of Uckerland)
Key Facts and Figures:	<ul style="list-style-type: none"> • 2,000 kW rated power • 780 MWh annual output • Commissioned in 2020 • 35 households supplied
Location	Nechlin, Brandenburg



Are you interested in the project and want to know how your community or your business can benefit from it? Contact us. Our contact can be found in the business directory on page 164. ▶

Digitalization with Vision: How DenkerWulf and node.energy Are Shaping the Future of Wind Power Operations

Through smart automation and digital process innovation, the partnership between DenkerWulf and node.energy is setting new standards in the operation of wind turbines – demonstrating how efficiency and legal compliance can go hand in hand in the energy industry.



opti.node Cockpit reduces the costs of operational management in wind and solar parks through automation and increases returns through revenue optimization.

Highlights

- Digitalization of complex energy industry processes for around 600 wind turbines
- Legally compliant, automated electricity tax reporting
- Increased efficiency by reducing manual communication with authorities and grid operators
- Innovation partnership between two energy transition pioneers with a focus on scalability and future readiness

Success Through Standardization: How Smart Digitalization Is Accelerating Wind Power

Anyone discussing the future of the energy transition cannot ignore digitalization – especially when it comes to the commercial management of large wind farm portfolios. DenkerWulf, one of Germany’s most experienced onshore wind farm developers, recognized this challenge early on. In collaboration with software specialist node.energy, DenkerWulf has

restructured and digitalized processes in its commercial operations management. With over 1,300 managed wind turbines, DenkerWulf is a heavyweight in the German wind energy market. The company’s standards: top quality, transparent processes, and legally secure implementation of complex requirements such as electricity tax reporting. However, as the number of projects grew, manually handling these tasks became a major bottleneck.



Through smart automation and digital innovation, the cooperation between DenkerWulf and node.energy is setting new standards in wind turbine operation.

Drastic Reduction in Manual Administrative Effort

The solution: opti.node Cockpit by node.energy – a leading energy data platform tailored specifically to the needs of professional operators of renewable energy assets. Together with node.energy,

DenkerWulf digitalized key steps in its communication with main customs offices, grid operators, and municipalities. The result: automated processes, minimized sources of error, and a significant reduction in administrative workload – with full legal compliance.

Conclusion

For DenkerWulf, this collaboration is more than just a step toward digitalization; it is a strategic lever for professional asset management. In an increasingly dynamic regulatory environment – where data and knowledge must go hand in hand – it is essential to simplify communication with partners and move forward together. Julia Liesenberg, Head of Commercial Wind Farm Management, also sees the collaboration with node.energy as a major relief in handling electricity tax applications and, in particular, during audits by the main customs office for the operating companies managed by DenkerWulf.



“Through our close collaboration with DenkerWulf, we’ve been able to show how our platform efficiently maps even highly complex operator structures. The digitalization of electricity tax reporting is a prime example of how regulatory obligations can be transformed into digital routines – fast, precise, and scalable.”

Phillip Micke, Sales Manager at node.energy

Want to know more? Simply scan.
Scan the QR code and get more information quickly and conveniently:



Project overview

Initiator	DenkerWulf & node.energy
Key Facts and Figures:	Digitalization of complex energy industry processes involving around 600 wind turbines (WTGs)
Status	running
Web	www.node.energy/referenzen/denkerwulf



Are you interested in the project and want to know how your community or your business can benefit from it? Contact us. Our contact can be found in the business directory on page 153 (DenkerWulf) and on page 186 (node.energy). ▶

The Secondary Market Barometer for the Wind Industry

The Secondary Market Barometer by wind turbine.com provides data-driven insights into the supply and demand of used wind turbines – a valuable guide for operators, buyers, and investors.

Orientation in a Dynamic Secondary Market

The market for used wind turbines is constantly evolving – shaped by dismantling, repowering, international demand, and new regulatory frameworks. A clear understanding of market trends is therefore essential. This is precisely where the Secondary Market Barometer comes in. It continuously and anonymously analyzes activity data from the largest international marketplace for used wind turbines – wind-turbine.com – offering valuable insights for market participants. Based on over 13 years of market data, the

Barometer enables a sound assessment of which wind turbines are particularly in demand or offered in specific regions. It thus serves as a strategic tool for operators, buyers, service providers, and investors.

What the Barometer Reveals

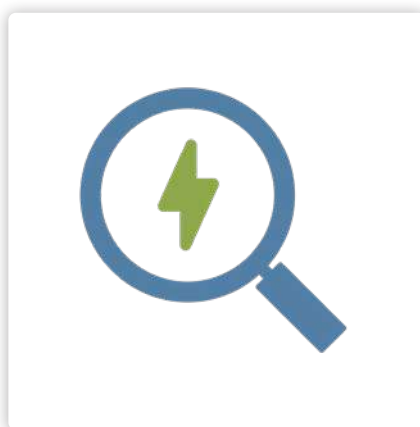
- Demand trends: Which manufacturers' turbines are in highest demand? Which countries show the most purchasing activity?
- Supply structure: Which regions offer the largest stock of used wind turbines? Which manufacturers dominate the secondary market?

- Regional differences: Some markets are strong exporters, while others act more as buyers.
- Temporal developments: Long-term analysis reveals seasonal fluctuations as well as structural shifts in the used turbine market.

Manufacturers, Markets, and Market Logic

The Barometer reflects activity around the world's major wind turbine manufacturers – including Enercon, Vestas, Nordex, Siemens Gamesa, and General Electric. Over the years, changing demand





patterns and emerging markets can be observed. Particularly in developing countries where renewable energy expansion is politically supported, demand for used turbines is clearly rising. At the same time, the Barometer shows which countries are traditional exporters of decommissioned turbines – for example, following plant shutdowns or in the course of repowering projects. This information helps both buyers and sellers make informed and targeted decisions.

More Transparency for Better Decisions

For operators, the Secondary Market Barometer provides a solid basis for deciding when and where to sell older turbines or tap into new buyer markets. Buyers gain clarity on typical price ranges, available quantities, and regional market specifics. Project developers, service providers, and investors also benefit from the market data: they can identify trends early, adapt business models accordingly, and align their offerings with actual demand.

Explore the Secondary Market Barometer: wind-turbine.com/marktbarometer

Conclusion

The market for used wind turbines is international, complex, and constantly in flux. The Secondary Market Barometer by wind-turbine.com brings clarity through reliable data, showing where the market is heading. It increases transparency and supports all market participants in making informed and sustainable decisions – for a more efficient, international secondary market for wind turbines.

Project overview

Initiator	wind-turbine.com
Status	The website is live at wind-turbine.com/marktbarometer
Key Facts and Figures:	Based on 13 years of market data from wind-turbine.com, the Barometer reveals which wind turbines are most in demand worldwide – and where supply and demand originate.



Are you interested in the project and want to know how your community or your business can benefit from it? Contact us. Our contact can be found in the **business directory on page 217**. ▶

RESEARCH IN GERMANY

Insight into the industry of tomorrow

Germany occupies an outstanding position in international wind energy research. The following pages present some research results of industry-related science, which can provide you with valuable insights into the latest technology trends.

Digital Tool Optimizes Wind Energy Yield

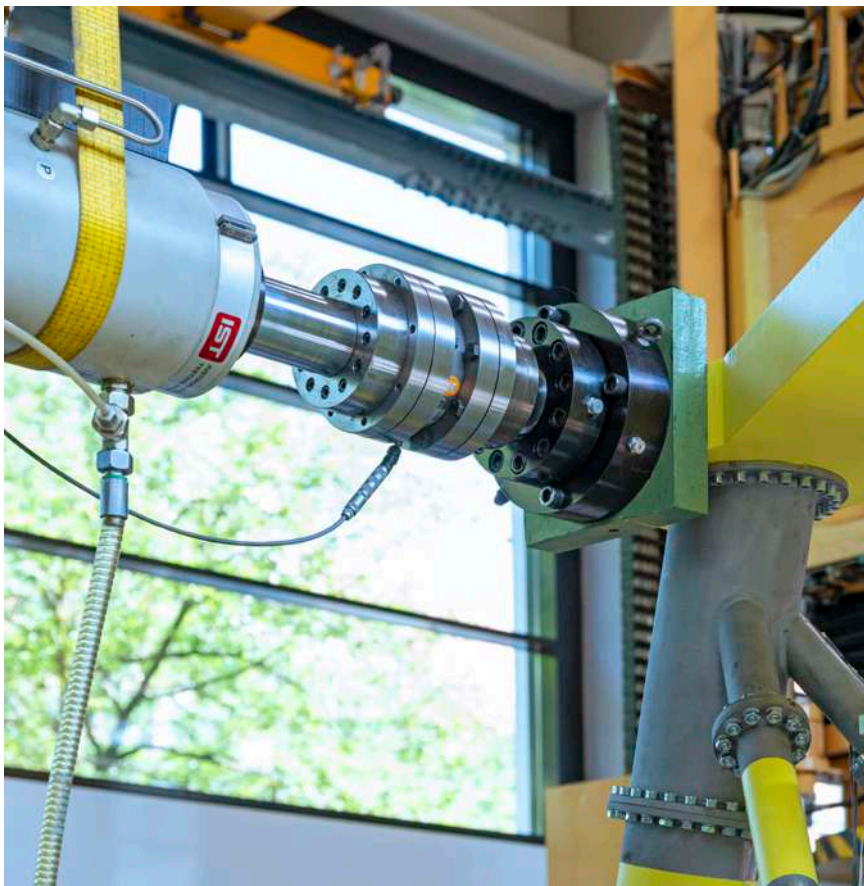
A digital decision-making tool supports wind farm operators in determining whether turbines should be continued in operation or replaced.

Each year, hundreds of wind turbines reach the end of their intended service life of 20 to 25 years. However, engineering assessments show that many older turbines are still safe and structurally sound enough to remain in use.

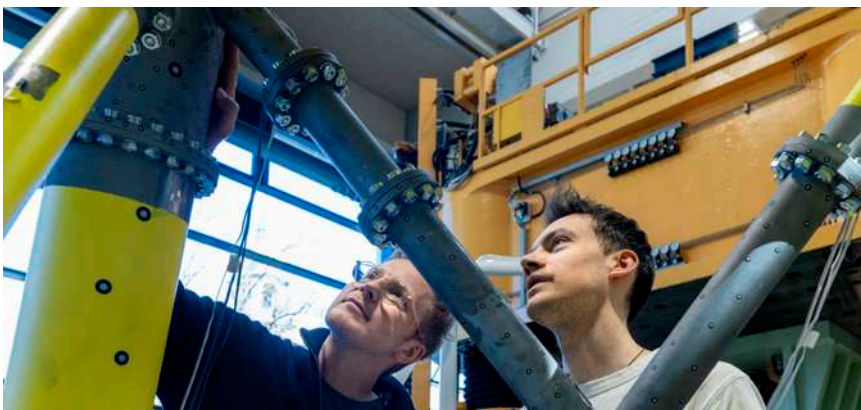
Complex Decision-Making

This poses numerous questions for operators: Is continued operation economically viable? Are the structural components still resilient? Is it worth retrofitting the turbines, or would full dismantling and investment in new systems be more cost-effective?

“So far, wind farm operators have largely been left alone with these decisions,” says Ronald Schneider from the Wind@BAM Competence Center. “Every dismantling process ties up scarce resources that are urgently needed for the accelerated expansion of wind power in Germany.”



Fatigue test on jacket model for offshore wind turbines



top: 3D Jacket – Test structures for offshore jacket substructures
 bottom: The weld seams are a particular focus of the assessment.

To address these challenges, BAM, in collaboration with Jörss-Blunck-Orde-mann GmbH and RWE Renewables GmbH, is developing a digital decision-making tool that considers all relevant factors.

Modular Digital Decision Tool

The tool is linked to a digital twin of the turbine, continuously fed with real-time data on the turbine’s condition via sensors and monitoring systems. If the tool detects weak points, the Wind@BAM Competence Center provides concrete solutions for reinforcing

structural components or advises on how welds can be retroactively strengthened.

The tool is currently being tested for practical application at an offshore wind farm in the North Sea.

Conclusion

The project’s goal is to provide operators with a simple, modular system that enables them to make the optimal decision – continued operation or new construction – in just a few steps.

“The industry has a strong need for such a tool.”

Dr. Ronald Schneider (BAM)

Project overview

Status	Ongoing, “ReNEW” BMWF funding code: 03EE3090A
Location	Berlin

Bundesanstalt für Materialforschung und -prüfung (BAM)
 Departement: Division: Buildings & Structures

Dr. Matthias Baeßler

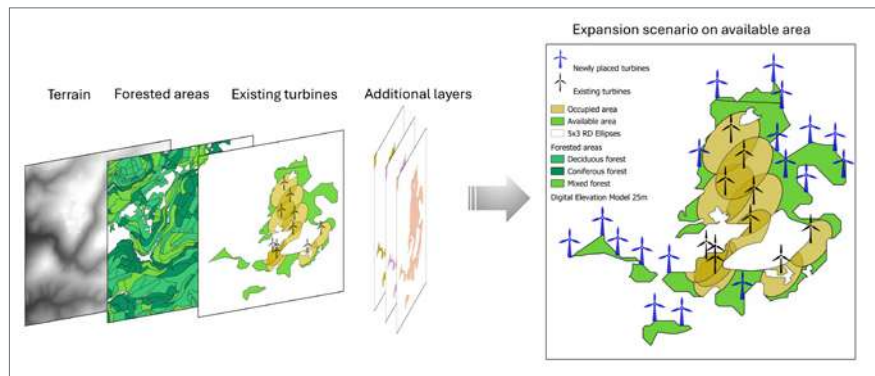
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Are Wind Energy Expansion Targets Achievable?

The MENTOR Project Develops Methods to Analyze the Capacity and Yield Potentials of Wind Energy Areas.

In order to meet wind energy expansion targets, the German Wind Energy Area Demand Act (Windenergieflächenbedarfsgesetz) defines area targets for the federal states. According to the law, they must designate an average of 2 % of their land area for wind energy use. Of central importance for the energy transition is the electricity yield from these areas. However, this yield can be reduced by restrictions on two levels: On the one hand, the installable capacity may be limited by factors such as topography or permitting constraints, including low-flying zones. On the other hand, electricity production can be curtailed, for example, due to shutdowns required for species or emissions protection.



Overlay of GIS layers with designated wind energy areas to calculate expansion scenarios.

Project overview

Status	June 2024–November 2026
Location	Kassel
Fraunhofer IEE	
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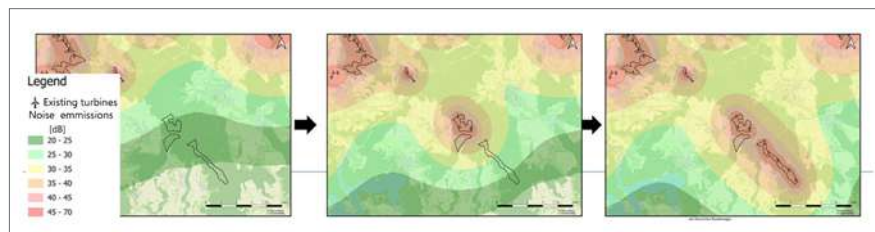
The project is funded by the Federal Ministry for Economic Affairs and Energy on the basis of a resolution of the German Bundestag



The MENTOR project (Development of Methods for the Assessment of Wind Energy Areas Considering Restrictions) is developing an optimization model that enables realistic scenarios for the future deployment of wind turbines while accounting for these restrictions. The project partners – Fraunhofer IEE, University of Kassel, Fachagentur Wind und Solar, and the associated German Environment Agency – are assessing wind energy areas based on identified constraints. The methodology is based on GIS data modeling

combined with time series-based meteorological data. On this basis, a pipeline is being developed to perform automated yield calculations for these areas. These calculations will help quantify the impacts of various restrictions.

The results will be discussed with stakeholders from the wind industry, politics, and regional planning and made publicly accessible via a web interface provided by Fachagentur Wind und Solar.



Restriction Noise: Existing noise levels increase with ongoing expansion, reaching noise quotas limits. © OpenStreetMap Contributors

Conclusion

The methods developed within the MENTOR project enable the automated evaluation of wind energy areas. Building on these results, measures can be derived to facilitate an efficient and accelerated expansion of wind energy.

Advances in Rotor Blade Recycling

Fraunhofer IWES, together with partners, is researching rotor blade recycling methods and testing various approaches.



Separated rotor blade fractions: GFRP, PVC foam, balsa wood (from left to right). Photo: Fraunhofer IWES



Rotor blade "filets", cut into smaller pieces, provide further insights into material properties. Photo: Fraunhofer IWES

High-quality rotor blade recycling requires clean separation of materials – only then is reuse feasible. The biggest challenge lies in separating glass and carbon fibers from the surrounding epoxy resin. Materials like balsa wood and foams can be mechanically separated more easily and reused as construction or insulation material. In contrast, composite materials such as CFRP (carbon fiber reinforced plastic) and GFRP (glass fiber reinforced plastic) require significantly more effort.

Fraunhofer IWES aims to develop a high-quality recycling process that preserves as many of the original material properties as possible. To this end, the institute is

investigating different methods in several research projects, including thermal processes.

Recycling Concept in Place – Details Under Development

In the ReusaBlade project, Fraunhofer IWES is collaborating with a rotor blade manufacturer and other partners to develop a chemical recycling process. The technique uses solvolysis with acetic acid to dissolve the epoxy resin. After successful small-scale laboratory tests, rotor blade components such as root sections or sandwich elements are now being dissolved under near-industrial conditions in an acid bath measuring three by five meters.

Conclusion

The research also focuses on energy efficiency and CO₂ reduction. Through several research projects, Fraunhofer IWES has developed an economically viable disposal concept for rotor blades, which is now being further optimized step by step.

Project overview

Status	December 2023–November 2026
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Location	Bremerhaven
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Fraunhofer Institute for Wind Energy Systems
IWES

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Senior Engineer Department Rotor Blades

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 **Fraunhofer**
IWES

Participation, Acceptance, International Exchange

Research Project IEA Wind TCP Task 62 – Continued German Participation in the IEA Wind TCP Task 62 “Social Science to Support Wind Energy Planning and Participation”.

The expansion of wind energy is a central pillar of Germany’s transition to renewable electricity. Alongside technical advancements, public acceptance remains a critical success factor for the continued – and especially accelerated – deployment of wind turbines. The Task 62 project enables the exchange of experience and the transfer of knowledge, allowing countries to benefit from good practice examples of others. The collaboration is interdisciplinary, and results are continuously shared with wind energy stakeholders in the participating countries:

In open webinars, concrete approaches for optimizing planning and participation processes in wind energy projects are presented. Practical examples clearly demonstrate how local engagement beyond legal requirements can succeed through early and transparent communication,

and how innovative methods such as visualization and gamification can support these processes. Another key focus is the identification of strategies for economic participation and regional value creation – such as municipal involvement, citizen participation, or co-ownership – which can both enhance local support and offer economic benefits for the projects themselves. Previous research also highlights the importance of an organizational culture of participation. Companies that integrate dialogue processes as a fixed part of their project development avoid internal friction and can implement projects more successfully in the long term. International examples are presented to illustrate this.

Conclusion

Public acceptance and related opportunities for participation are key factors influencing the successful and timely implementation of further wind energy projects – in Germany as well as in other countries. International exchange of experience therefore represents an important opportunity to learn from one another and to transfer successful approaches.

Project overview

Status	Ongoing (2025–2028)
Location	International
Institut für ZukunftsEnergie- und StoffstromSysteme, IZES gGmbH Arbeitsfeld Umweltpsychologie	
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Funded by the Federal Ministry for Economy and Energy (BMWE).

Work Packages

Task 62 work is divided up into “work packages” which are projects with international participation focused on a common goal that furthers the mission of the task. Each work package has its own deliverables, and Task 62 reports on these each year.

- Work Package 1 Socio-Enviro-Technical collaboration:**
 Addressing impacts like noise and environmental factors and sharing challenges and solutions with technologists and environmental scientists. This Work Package comes from the Grand Challenges of Wind Energy and seeking greater collaboration among researchers and practitioners.
- Work Package 2 Local engagement and approval:**
 Enhancing planning processes to foster community approval – where to go beyond what the law requires to achieve better outcomes for the community, local authorities, and developers.
- Work Package 3 Organisational culture:**
 The power of integrating meaningful engagement into core business of wind deployment and the obstacles created by not doing so.
- Work Package 4 Project participation and business models:**
 Exploring models for shared economic and other benefits such as community ownership or co-ownership.
- Work Package 5 Tools for improved planning:**
 Using gamification and other methods for better dialogue.

hyBit: Holistic Perspective on the Design of H₂ Hubs

Large-Scale Research Project Generates Basic Knowledge for the Development of the Hydrogen Economy in Northern Germany.



The H₂ hub as the central research object of the hyBit project: the Bremen industrial port with its key actors such as the ArcelorMittal steelworks and swb.

© hyBit/University of Bremen

Hydrogen is considered the “energy carrier of the future.” In the large-scale research project hyBit, led by the University of Bremen, researchers are generating basic knowledge for the development of the hydrogen economy in Northern Germany. The focus is on the transformation of large-scale industrial infrastructures (so-called hydrogen hubs) in Bremen and Northern Germany. The Bremen industrial port with its key actors such as the ArcelorMittal steelworks and swb is the departure point of the hyBit project.

In addition to analysing technological solutions, the innovative research approach aims to actively involve different stakeholders from business, politics and society.

In this context, hyBit advances new methodological approaches for the holistic evaluation and development of the site potential. The work will culminate in the creation of a virtual transformation platform, which, using a digital twin of the site, will offer diverse possibilities for analysing the transformation process and will ultimately enable resilient management of this transformation.

In this context, the Wuppertal Institute is developing concepts for a future hydrogen-based energy and economic system, with a particular focus on analysing the interactions between the development of individual hydrogen hubs and the overall system.

Conclusion

The researchers have achieved significant progress: they established the necessary data and modelling basis, developed scenarios for the potential development of the H₂ hub Bremen within an overarching hydrogen economy, and incorporated the expertise of local stakeholders through numerous workshops.

Project overview

Status	September 2022–February 2026
Location	Bremen
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WINSENT – Research Platform in Mountainous, Complex Terrain

The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) operates a globally unique wind energy test site in complex terrain, developed together with partners from the WindForS research cluster.

The WINSENT test site is located at an elevation of approximately 670 meters above sea level, on a steep escarpment of the Swabian Jura. It features a wide range of meteorological and environmental sensors, along with two specially designed research wind turbines (FWEA) equipped with extensive instrumentation to measure electrical and mechanical parameters. The platform is accessible to both research and industry. It offers access to the turbines' control software, controller source code, and aeroelastic computer models.

This enables testing of new technologies and control strategies. Measurement data collected across the full height of the turbines allows detailed analysis of specific flow mechanisms and the



Photos: ZSW / David Arzt

Project overview

Status	Operational, validation ongoing through the end of 2026
Standort	Donzdorf / Geislingen an der Steige, Baden-Württemberg
Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)	
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Funded by the Ministry of the Environment, Climate and Energy of Baden-Württemberg; Federal Ministry for Economic Affairs and Energy of the Federal Republic of Germany

resulting dynamic behavior of wind turbines in complex, mountainous terrain. A significant portion of the collected data is made available to the scientific community and the public as part of an Open Science approach. These datasets are already attracting strong interest both nationally and internationally, including within the IEA Wind Technology Collaboration Programme.

In addition to technical research, the test site also provides unique opportunities for nature conservation studies. As part of the BfN-funded NatForWINSSENT project, renowned scientists are investigating the behavior of bats, birds, and insects in and around the test site area.

Conclusion

The open research platform WINSENT supports the deployment of wind energy in mountainous, complex terrain by improving wind forecasting models, identifying and unlocking yield potential, and helping to reduce mechanical loads on turbines.

BirdRecorder – Anti-Collision System for Wind Turbines

The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) uses Artificial Intelligence to achieve this.

Machine learning and artificial intelligence are the core elements of the ZSW-developed anti-collision system **BirdRecorder**. Innovative AI methods are used for bird and species detection. “With our self-developed AI solution, we are making a key contribution to the environmentally friendly expansion of wind energy,” explains project leader Nico Klar.

The system can detect endangered bird species such as the red kite at an early stage and switch wind turbines into a safe idling mode in time. It features a modular design, is equipped with a total of twelve cameras, and can be flexibly adapted to different wind farm layouts.

Species Detection up to 1,500 Meters

The intervention zone of wind turbines must cover at least 500 meters to react in time to the typical flight speeds of endangered bird species such as the red kite. BirdRecorder reliably detects such birds from a distance of 800 meters. If a bird enters the intervention zone, the system triggers an immediate signal for the turbine to switch to safe idling mode. Once the bird has left the danger zone, normal operation resumes automatically.

In 2024, BirdRecorder underwent extensive validation at ZSW’s wind energy research test field in the Swabian Jura near Geislingen. The classification accuracy for bird species reached an impressive 96.9 % within the detection range of 0 to 1,500 meters – a major milestone for species-specific turbine responses. Insights gained from real-world operation are continuously incorporated into system development – with the goal of simplifying

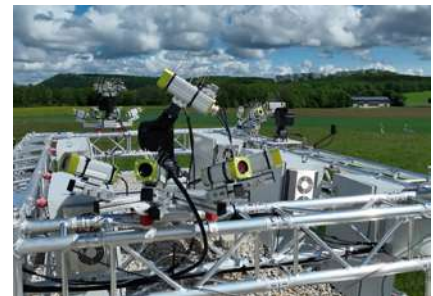


Photo: ZSW / David Arzt

integration into existing wind farms and further increasing detection sensitivity. The system is currently being expanded to include additional bird species sensitive to wind power. At the same time, detection performance is being optimized for challenging conditions – such as poor weather or small targets – to further improve detection reliability.

Conclusion

In the coming years, the expansion of wind energy will increasingly take place at sites with high biodiversity and conservation requirements. Anti-collision systems like BirdRecorder are key technologies to harmonize the protection of sensitive species with efficient electricity generation.

Project overview

Status	Implementation: Planned market launch by late 2025 / early 2026
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Location	Schwäbische Alb
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Funded by the Ministry of the Environment, Climate and Energy of Baden-Württemberg; Federal Ministry for Economic Affairs and Energy of the Federal Republic of Germany