Bird protection at wind turbines: camera-based detection systems in practical use

The conflict between wind energy development and species protection poses increasing challenges for planners and operators across Europe. In particular, the protection of endangered birds of prey such as the red kite or sea eagle has led authorities to impose blanket shutdown requirements or delay permits. As a technological response, AI-assisted camera systems are increasingly being deployed, offering targeted, demand-based control of turbine operations.

One of the approaches is the BirdVision® AI-automated anti-collision system. The concept involves multiple industrial cameras, with wide angle lenses, installed at the base of the turbine tower to monitor the airspace surrounding the installation. These units are housed in weatherproof, self-cleaning enclosures and engineered to maintain reliable performance under challenging conditions, including dust, UV radiation, and precipitation.

The captured image data is processed by a server unit inside the tower. Using object recognition and tracking algorithms, the bird flights are analysed and, if necessary, a stop signal is issued to the turbine control system.

The technical specification includes 360° surveillance. As it is working with optical cameras, the system operates from sunrise to sunset. During the night or in heavy rain and snow, no birds can be detected. Fortunately, protected bird species are not flying around in such weather conditions.

According to independent assessments, the BirdVision® system achieved a 100% detection rate within the defined critical radius (200 m) in 2022. In test operations, 89% of relevant events triggered an automatic shutdown.

Compared to the conventional approach, where ornithologists conduct field observations, these systems are reported to detect around 10% more birds in the danger zone. AI systems can significantly improve the balance between turbine operating time and the protection of bird species that are sensitive to wind power.

Another key argument for their use is the reduction of shutdown durations. The response time from detection to turbine stop is reported to be between 20 and 30 seconds. The demand-driven shutdowns raise the operating time significantly compared to the other blanket measures that block operations for entire months or fixed periods. This flexibility can reduce energy losses and improve the economic efficiency of wind turbines.

Some wind farms in southern Germany have already integrated the technology into regular operation. For instance, since 2022, the Bürgerwindpark Weißbach has improved restrictions during breeding season and agricultural activities with automated control. Projects in the Schwäbisch Hall district and in Lower Saxony also demonstrate that blanket summer shutdown periods can be replaced by demand-driven anti-collision systems.

Beyond protection, the system also addresses regulatory documentation requirements. It continuously records flight paths, panoramic images and video footage, creating an objective foundation for permitting processes. This enables the assessment of potential conflicts and the verification of compliance. Developers can use the data to support environmental reports and optimize planning for new locations.

In parallel with the stereo setup installed at the turbine, the company has also developed BirdVision® Explorer.

This is a mobile version of BirdVision® to explore new potential areas for wind parks and support ornithologists conducting field observations. The Explorer system offers a 360° surveillance view of the place where it is set up.

The system also provides image data, videos of detections, bird trajectories and 3D points which can be exported into other solutions that are also using kml data.

The trend is clear: AI-assisted monitoring systems show promise to reconcile species protection with the economic operation of wind farms.

🖥 birdvision.org/de/

Background: the origins of BirdVision®

The idea for an automated bird detection system was born back in spring 2017 in the context of the Bürgerwindpark Hohenlohe in northeastern Baden-Württemberg, Germany. At that time, two turbines had to be shut down for several months due to their proximity to a red kite nesting site. The park's design, combined with the complex topography and proximity to a forest, had created a situation where, according to the managing directors of Bürgerwindpark Hohenlohe, only a customized technical solution can meet the requirements

The first prototype was installed in 2018. in the Bürgerwindpark Weißbach. The system was evaluated under real-world conditions and continuously developed further to replace radar systems or manual observation by biologists. The technology was based on stereo cameras and AI models for classifying and estimating the distance of birds of prey and other flying objects.

A major milestone was the formal founding of the operating company BirdVision GmbH & Co. KG in July 2019. The company was jointly set up by Bürgerwindpark Hohenlohe GmbH, the image processing firm phil-vision GmbH and AI specialist Dr Michal Lewandowski to commercialize bird protection solutions for wind turbines.

With funding from the German Federal Ministry for Economic Affairs and Energy, as part of the 7th Energy Research Programme, a pre-series system was developed between 2019 and 2022. This included work packages on the classification of bird species found across Germany, the reduction of false detections and the detection of fast-flying or nocturnal species. The funding period concluded in 2022 with a final report and measurable improvements in system accuracy and stability.

In 2021, the system was officially deployed in a regulatory setting for the first time in Weißbach, where it replaced blanket fieldwork-related shutdowns during live operation, initially under the supervision of on-site biologists and later fully autonomously. In 2023, the responsible district authority granted full autonomous operational approval for the Bürgerwindpark Weißbach, allowing the system to independently manage shutdown and restart commands.

In addition to the stereo setup of BirdVision® installed on the turbine tower, a mobile version, BirdVision® Explorer, was also developed between 2019 and 2022. Ongoing development enabled observations in 2023 and 2024, which supported both the planning phase and the biological assessments for two future wind parks of Bürgerwindpark Hohenlohe.

Since 2024, BirdVision® has been available for purchase and is regarded as one of the first automated bird protection systems for wind turbines in Germany. To date, several installed systems are operational in Baden-Württemberg and Lower Saxony.

The appointment of Benjamin Braun as Head of BirdVision in 2024 marked a key step towards securing its continued growth and further developing both its sales and international orientation in a targeted manner.

In 2025, its stereo system also met the monitoring requirements of Schleswig-Holstein's evaluation framework, Germany's first standardized approach for setting quality standards for anti-collision systems.

In addition to meeting the LfU test framework requirements of Schleswig-Holstein and obtaining CE certification, BirdVision® has also adopted the management standards of ISO 9001, ISO 14001 and ISO 27001 to provide its customers with the highest level of professionalism and quality.

Benjamin Braun