

Turbine Bat Trace

Publieke samenvatting / Public summary

Aanleiding

Wind energy is essential for achieving Europe's climate and energy goals, but it also creates ecological challenges. Bats are vulnerable to wind turbines due to collisions and pressure-related injuries (barotrauma). Since 1992, bats have been legally protected under the EU Habitats Directive, and in most European countries—including the Netherlands—new wind farms must implement measures to limit bat mortality. As a result, up to 30% of wind turbines are subject to curtailment rules that require them to shut down during periods of expected bat activity. Unfortunately this can even be when no bats are actually present. This approach leads to significant energy and financial losses. Across Europe, bat curtailment-related losses are estimated at €500 million per year, with wind farm operators facing reduced efficiency and income. In the Netherlands, the planned IJmuiden Ver offshore wind farm zone (6 GW) could face losses of €5 million per year under conservative curtailment policies. A smarter solution is urgently required—one that protects biodiversity while maximizing energy output.

Doelstelling

The goal of this project is to develop and validate BatGuardian: a compact radar-based system that can detect bats in real time near wind turbines. By using artificial intelligence to distinguish bats from other flying animals, the system enables targeted curtailment—shutting down turbines only when bats are actually present. This will reduce unnecessary energy losses while improving compliance with ecological regulations. Aside from enabling targeted

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curtailment the project also aims to visualize their flight and or avoidance behavior around the turbines. Very little is known about this, both onshore and especially offshore.

Korte omschrijving

The BatGuardian system will be installed on a wind turbine in the Netherlands, where it will detect bats in real time. Its performance will be validated using a system of thermal and acoustic sensors developed by TNO, providing detailed 2D and 3D tracking data. Over two bat activity seasons, data will be collected to improve detection accuracy. An evolved version of the system will be developed with enhanced durability and marine resistance, preparing it for use on offshore wind farms. To support wider adoption, results will be presented to regulators, wind farm operators, and ecological experts through live demonstrations. Key findings will also be shared at scientific conferences and in technical publications, helping inform future policies and best practices.

Resultaat

The project will deliver a fully functional and if successful, validated BatGuardian prototype, capable of real-time bat detection at wind turbines. The system will be tested in the field and supported by a unique, high-quality dataset that will be able to prove (or disprove) its capabilities. In parallel, an offshore-ready version will be developed, with design improvements based on operational insights. The knowledge gained will be used to support regulatory approval and future pilot deployments. By combining technical innovation with ecological validation, when successful the project results in a practical and low cost solution to reduce bat mortality and unnecessary curtailment—helping accelerate the rollout of sustainable, nature-inclusive wind energy in the Netherlands and beyond.

samenwerking met de Topsector Energie ontsloten.

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