

# Wind energy and wildlife share future in the skies and seas

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A wealth of wind energy potential as well as rich and diverse networks of wildlife species can be found off the coasts of the United States. Coastal ecosystems range from beach dunes where turtles and birds nest,

to the shallow water and deep-sea homes of fish and marine mammals, to the skies above where birds and bats take wing above the waves.

The U.S. Department of Energy's (DOE's) National Renewable Energy Laboratory (NREL) has long played a leadership role in fostering positive interactions between [wind energy](#) and wildlife, identifying measures to safeguard the health of coastal species and the surrounding environment while maximizing and strengthening the reliability of turbine output. NREL researchers are collaborating with academic, conservation, regulatory, and industry partners to understand the potential effects of [offshore wind](#) installations on the environment while maintaining optimal energy production.

"Offshore [wind](#) offers incredible potential to supply our country with a vast amount of reliable, clean energy," said NREL Offshore Wind Platform Lead Walt Musial. "At the same time, we know we need to keep improving our approaches to wind plant design, construction, and operations to carefully factor in the needs of wildlife and their natural habitats."

All wind plants, whether on land or in the water, have the potential to disrupt wildlife behavior through day-to-day turbine operation, maintenance activity, and construction noise. Concerns about environmental impacts can lead to other challenges for wind plant operators in the form of extended permitting timelines, unanticipated costs, and curtailed energy generation.

Now, with predictions that the global offshore wind industry will attract \$1 trillion in investments by 2040, researchers are tackling concerns specific to offshore installations. Factors such as noise and acoustic effects, electromagnetic forces (EMFs), and the layout of platforms, foundations, and cables play new and significant roles in the interplay between wind installations and wildlife.

In response, experts at NREL are developing new technologies and techniques to monitor and mitigate wind energy's impact on coastal ecosystems.

## **By Air: Protecting Birds and Bats**

Birds and bats spread seeds, pollinate plants, and control pests. Their activities present important considerations for the siting of land-based and offshore wind energy installations. Careful planning is needed to ensure that turbines do not pose obstacles, shift flight patterns, or disrupt overall behavior.

The remoteness and changeable environment of offshore installations can make it particularly difficult to observe and assess effects of wind systems on wildlife.

"We know bats' patterns of activity and movement are similar offshore to what we see on land. While we're still unsure exactly how bats will interact with offshore installations, we know some species fly near the towers, nacelles, and blades of land-based turbines," said NREL Senior Project Leader Cris Hein. "We anticipate similar behavior at offshore locations, making our continued research to avert bat interaction with turbines all the more essential."

DOE studies of bat activity off the East Coast and the shores of the Great Lakes have shown that although most bat activity occurs within 20 miles from the shore and decreases farther from the mainland, there is still evidence of bat presence as far as 80 miles offshore.

Knowing the species that are most likely to encounter offshore wind turbines can help design strategies most effective in reducing encounters. For example, it may be possible to tune ultrasonic deterrents to the specific frequency range of an individual bat species to limit its presence

near wind turbines.

NREL continues to evaluate the effectiveness of new nacelle- and blade-mounted deterrents, which were designed in collaboration with technology, university, and industry partners. Other NREL research and development projects are examining bat and bird sound and light deterrents, including illumination of turbines with dim ultraviolet lights and a self-contained, self-powered deterrent that can be mounted on a wind turbine blade tip.

Two automated multi-sensor systems for detecting, identifying, and quantifying bird and bat interactions at offshore wind facilities are being developed by Oregon State University and international partners, both in cooperation with NREL and funded by DOE. The most recent project adds machine-learning algorithms to an existing Dutch system of robust vibration sensors, high-resolution cameras, and digital image processing that has successfully detected collisions of large birds with offshore turbines during daylight hours. A separate NREL project uses broadband microphones and a 360-degree field-of-view camera, which will make it possible to detect smaller birds and bats during the day and after dark.

## **By Sea: Safeguarding Marine Species**

Any activities or structures at or below the waterline are likely to affect marine species in some way. These include noise and vibration from offshore wind installation maintenance operations, as well as physical barriers posed by wind systems' cables, foundations, and platforms.

"NREL has a tremendous opportunity to leverage our capabilities from land-based wind and international research efforts to help solve the unique environmental challenges of offshore wind development," said NREL Senior Researcher Rebecca Green. "Our goal is to combine our deep knowledge of next-generation offshore wind technologies with

marine environmental expertise to find the best answers for both wind energy and wildlife."

NREL is partnering with Pacific Northwest National Laboratory on DOE's Offshore Wind Synthesis of Environmental Effects Research (SEER) project to integrate the current understanding and mitigation of impacts of offshore U.S. East and West Coast wind development on wildlife, habitats, and related environmental processes.

Researchers are examining existing monitoring tools, technologies, assessment methods, and mitigation strategies from around the world to determine which can be applied most effectively to U.S. offshore installations and where research gaps need to be addressed. The SEER team is looking at the best ways to measure, model, and mitigate possible risks, such as noise, physical disturbances, and direct contact.

An important outcome of this ambitious initiative will be making recommendations to guide decisions about future research and species-protection priorities, while continuing to advance offshore wind development.

## **On the Horizon: Future Work**

As more offshore wind installations come online in the United States, NREL's work to boost their performance while protecting the surrounding environments and wildlife will continue to grow. Research will expand to investigate the cumulative effects on migrating species and large-scale ecosystems, as well as impacts associated with regional energy needs and utility-scale wind plants.

NREL and its partners will more closely examine issues specific to bird, bat, fish, and [marine mammal](#) species with migratory paths that intersect with offshore wind plant locations. Engineers will begin to apply

findings on behavioral patterns of these various species to system designs and operational standards.

"Our lab has a long history of balancing environmental and wildlife stewardship with innovations to provide more clean electricity for our communities," Green said. "NREL and its partners are dedicated to maintaining the momentum of birds and bats in flight and whales and fish swimming alongside the trajectory of offshore wind industry growth."

Provided by National Renewable Energy Laboratory

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