NREL researcher Jason Roadman and veterinarian Seth Oster release a bald eagle from a lift during research at the Flatirons Campus. *Photo by Dennis Schroeder, NREL 35704*

Wind Beneath Your Wings

National Renewable Energy Laboratory's Unparalleled Expertise in Environmental Science and Wildlife Impact Mitigation Helps Project Partners Validate Their Ideas

Advances in wind turbine technology and the need for renewable energy resources drive the rapid expansion of the wind industry in the United States and abroad. Turbine capacity, rotor diameter, and hub height have all increased significantly over the long term. In addition, wind energy has become the most-used source of renewable energy generation in the United States. Continuing this growth while also protecting wildlife requires more efficient, cost-effective technologies for monitoring and reducing the impacts of wind energy on wildlife.

A History of Wildlife Protection

The National Renewable Energy Laboratory's (NREL's) wind energy program has a long history of working to understand and reduce the impacts of wind energy on wildlife to further advance deployment across the United States. That history stretches back to a population study of golden eagles at the Altamont Pass wind farm, where NREL researchers worked with environmental and wind industry stakeholders. This research helped both groups identify and prioritize solutions to protect wildlife while advancing land-based and offshore wind energy deployment.

Today, NREL's Flatirons Campus hosts several wind-energy-wildlife projects. Just south of Boulder, Colorado, at the mouth of Eldorado Canyon, the Flatirons Campus allows staff and project partners to validate their technologies under a wide array of possible climatic conditions. In addition, project partners have access to research turbines, electronics and instrumentation laboratories, meteorological towers, 20 network-connected cameras, state-of-the-art modeling and computational capabilities powered by exascale computers, and calibration and measurement instruments.

These assets make Flatirons Campus a living lab for wind-energy-wildlife research and technology validation. From working with partners to design a state-of-the-art projectile launcher that helps researchers evaluate wind turbine collision detection systems to studying bat and bird interactions with wind turbines to improve deterrent technologies, NREL is making the skies safer for wildlife while also enabling wind energy to soar.

A Three-Pronged Portfolio

The environmental science portfolio can help project partners across three broad categories.

Environmental Processes and Impact Assessment

Advancing technologies and analytical tools can improve understanding of the interactions between wildlife and wind turbines.

Expertise:

- Utility-scale research studies
- Computational modeling and statistical analysis
- Wind turbine instrumentation for data collection
- Spatial analysis.

Species-Specific Scientific Investigations

Researching physiological and behavioral responses of wildlife to wind turbines can foster more informed decisions about wind energy facility siting and operation.

Expertise:

- Wildlife biology and behavior
- Partnership networks to identify future challenges and solutions
- Environmental reviews and modeling.

Cost-Effective Mitigation

Conducting collaborative research can assist in developing cost-effective mitigation solutions that enable wind energy facilities to operate efficiently in a competitive energy market.

Expertise:

- Customized technologies to meet partner needs
- Environmental monitoring programs and effective mitigation strategies
- Information sharing across international networks to identify and disseminate relevant work.

Case Study

Challenge

The Bald and Golden Eagle Protection Act prohibits anyone without a permit issued by the Secretary of the Interior from "taking" a bald or golden eagle. Illegal takings, intentional or otherwise, can result in substantial fines and legal liability for wind energy facilities. This creates a challenge for industry in areas where eagles are present.

Solution

An NREL-led project team combined knowledge of golden eagle behavior, high-fidelity atmospheric wind flow models, and behavior-modeling techniques to develop predictive golden eagle risk estimation models. These models can be used to predict interactions between golden eagles and wind turbines and inform siting and operations of wind energy facilities to help protect wildlife.

Impacts

The golden eagle risk estimation model helps:

- Identify locations that are less likely to result in interactions with golden eagles
- Inform siting decisions for individual wind turbines within a facility to avoid golden eagle interactions
- Identify conditions likely to pose risk to golden eagles
- Optimize investments in impact-reduction technologies by targeting their use where they will have the greatest impact.

Science takes flight at NREL's Flatirons Campus. NREL partnered with Auburn University to develop models that help prevent bird strikes with wind turbines. *Photo by Dennis Schroeder, NREL 35756*

Partner With Us

NREL is proud to partner with state and federal agencies, wind energy developers and operators, technology providers, non-governmental organizations, research institutes, wind turbine manufacturers, and members of academia.

Contact: Cris.Hein@nrel.gov

For more information, visit https://www.nrel.gov/wind/eco-wind.html

Past partners in NREL's wind-energy-wildlife research include:

- American Clean Power Association
- NRG Systems
- Renewable Energy Wildlife Institute
- Oregon State University
- U.S. Geological Survey.

NREL
Transforming ENERGY