A Multi-Sensor Approach for Measuring Bird and Bat Collisions with Offshore Wind Turbines

Presented by:

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Environmental
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Consultants

Project Information

- Title: A Multi-Sensor Approach for Measuring Bird and Bat Collisions with Offshore Wind Turbines

- Funded by: U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE), Wind Energy Technology Office

- Award Number DE-EE0008734

- 3-year cooperative agreement

- Project Period: August 1, 2019 – July 31, 2022

Project Partners

Partner	Role/Expertise
Western EcoSystems Technology, Inc. (WEST, Inc.)	Leader in designing and conducting quantitative studies to estimate bird and bat mortality, machine learning
The Netherlands Organisation for Applied Scientific Research (TNO)	Developer of WT-Bird, successfully implemented a system for detecting bird collisions at offshore turbines
National Renewable Energy Laboratory (NREL)	Engineering team with 44 years of experience developing/testing wind turbine technology and sensing platforms
Lake Erie Energy Development Corporation (LEEDCo)	Project developer of Icebreaker Wind Project, committed to deploying an offshore bird and bat monitoring system

Background and Need

- Offshore wind energy is well-established in Europe and is emerging in the U.S.

- Difficult to assess impacts to birds and bats at offshore wind turbines (e.g., carcass searches under turbines not feasible)

- Need for new automated monitoring technologies >>> meet permit requirements

WT-Bird

- WT-Bird system developed by TNO

- System includes vibration sensors and cameras to detect collisions (Figure 1) and alert turbine operators of impact

- Technology has been tested at offshore turbines in the Netherlands and successfully detected large bird collisions during the daytime

Sensors and cameras shown are not to scale.
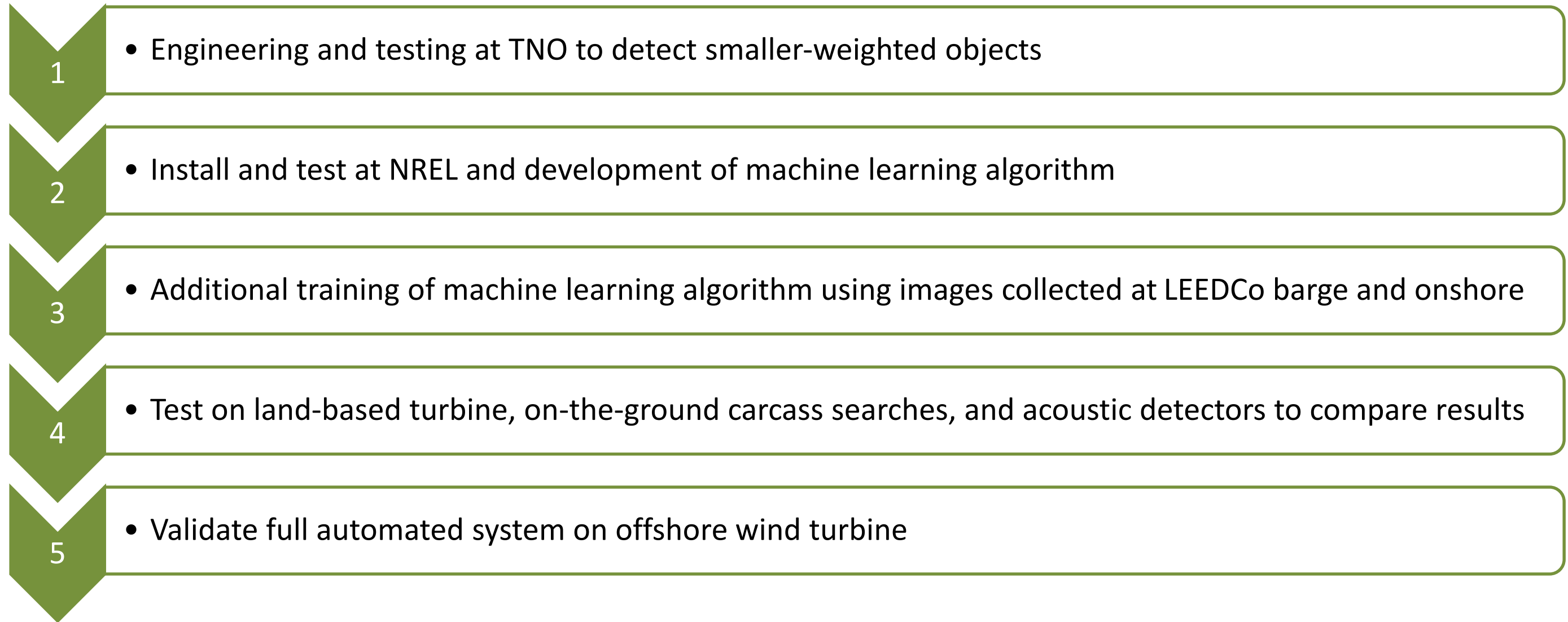Illustrative purposes only.

Figure 1

Project Goals

- Advance WT-Bird system to also detect smaller birds/bats during day and night
- Integrate machine learning to identify guild/species impacted by collision
- Provide a solution for accurately estimating bird and bat mortality rates
    - Times-of-death could also inform smart curtailment
- Promote technologies and support the advancement of offshore wind in the U.S.

Automated System Process

Enhanced vibration sensors detect collision impacts → Cameras store images and video of triggered event → Machine learning algorithm processes imagery data → Identification of guild/species impacted by collision

Major Phases

1. • Engineering and testing at TNO to detect smaller-weighted objects

2. • Install and test at NREL and development of machine learning algorithm

3. • Additional training of machine learning algorithm using images collected at LEEDCo barge and onshore

4. • Test on land-based turbine, on-the-ground carcass searches, and acoustic detectors to compare results

5. • Validate full automated system on offshore wind turbine

Initial Design, Engineering, and Testing

- Improve sensitivity of vibration sensors to detect smaller objects similar to birds/bats

- Test dummy objects of different weights on a stationary blade on the ground at TNO

- Test enhanced system at NREL for refinement, determine best placement for cameras, and machine learning algorithm development

| Dummy ID	Weight	Species Resemblance
D1	5g	Golden-crowned kinglet
D2	8g	Warbler/small bat
D3	25g	Thrush
D4	1,000g	Merganser

Machine Learning Methods

- Video clips/images of birds and bats >>> train machine learning algorithm to detect and classify birds, bats, and non-targets

- Classify objects based on shape, size, and other characteristics (e.g., flight patterns)

- Verify collision and classification by manually reviewing camera footage and through use of acoustic detectors
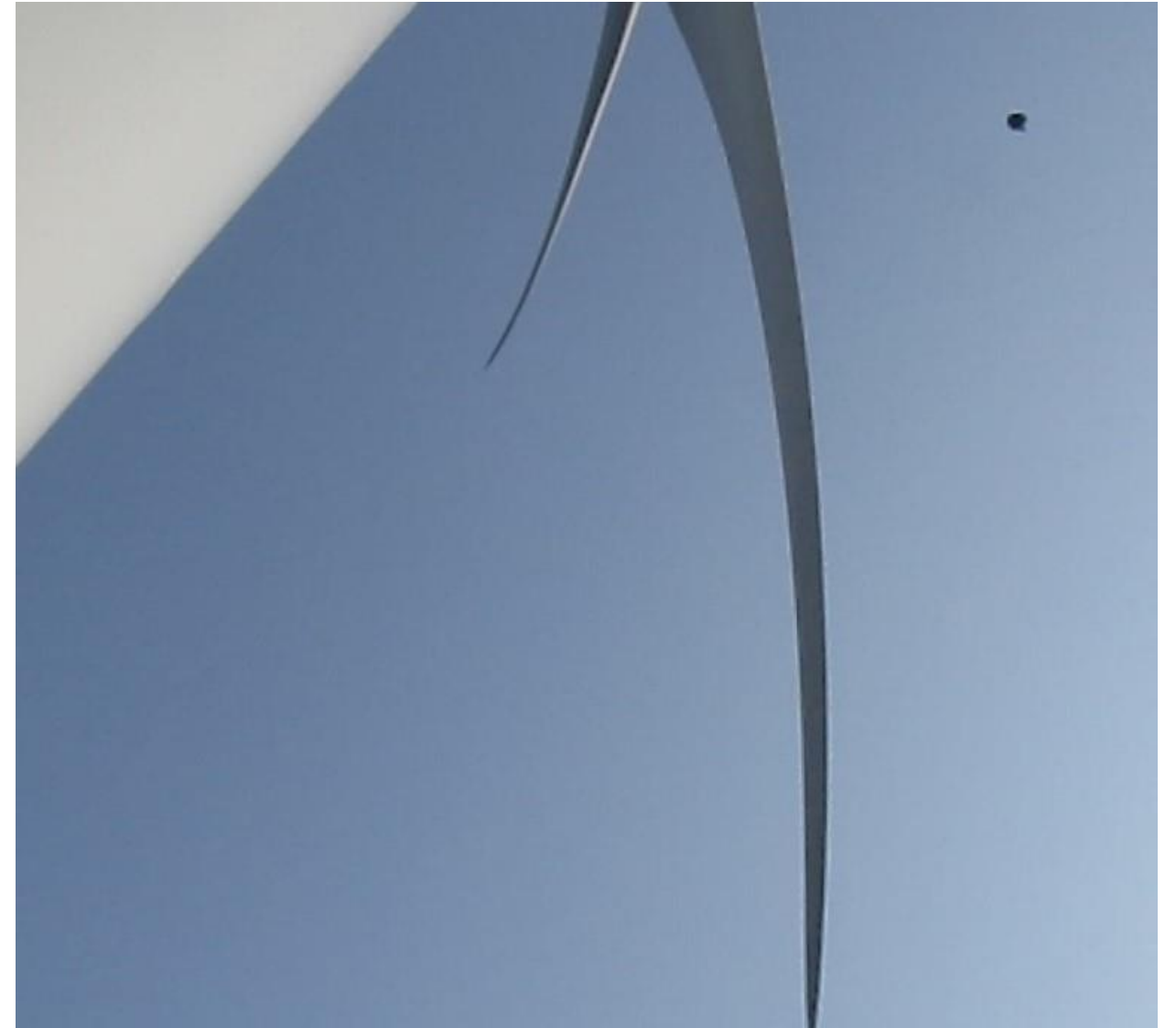
System Validation

- Initial validation on a land-based turbine
  - Host site TBD
  - Concurrent with on-the-ground carcass searches to compare data
  - Estimate bird and bat fatality rates from both methods and compare results
- **FINAL VALIDATION offshore**
  - **Currently planned for LEEDCo's Icebreaker Wind Project in Lake Erie**
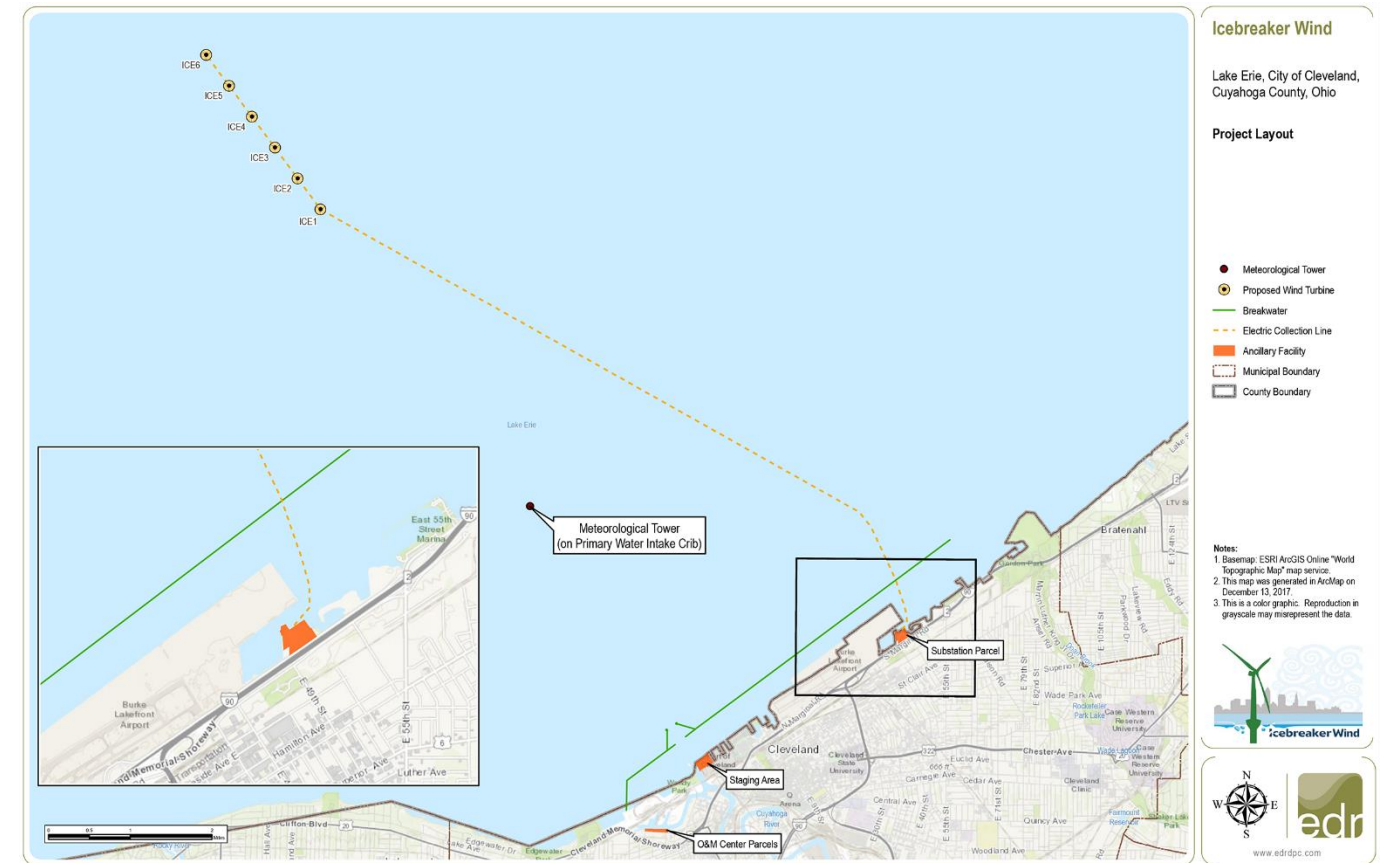
Schedule

Timeline	Task
Fall 2019 – Fall 2020	Design/engineer/test enhanced system at TNO and NREL
Fall 2020 – Spring 2021	Install cameras and acoustic detectors on LEEDCo barge and onshore
Spring 2021 – Spring 2022	Install/test automated system at land-based wind turbine
Fall 2022	Validate system offshore

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