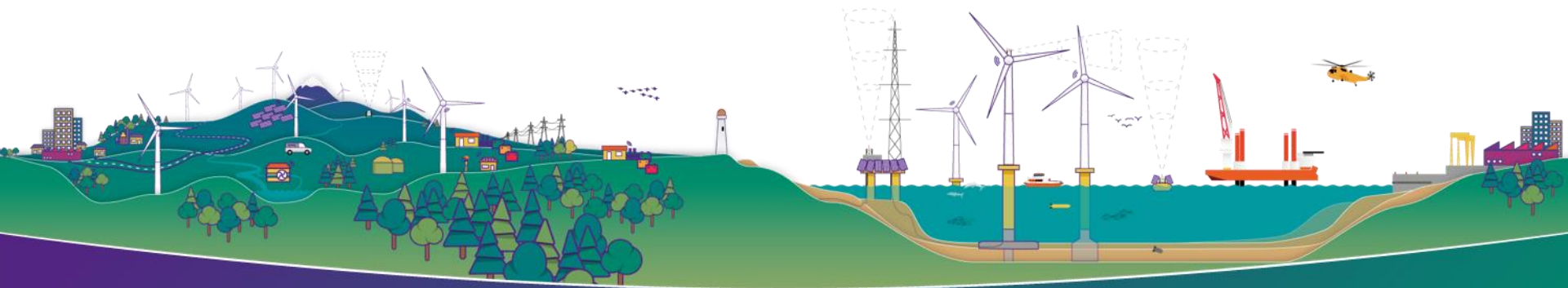


Bat Smart Curtailment: Efficacy and Operational Testing

Award Number: DE-EE0008900

Crissy Sutter

Global Head of Wildlife Technology



Prime: Natural Power

Technical Team: Natural Power, Alliant Energy, Rizea Engineering, Skov, Scada Integration Solutions, NREL

Host Site: Alliant Energy, English Farms, Iowa

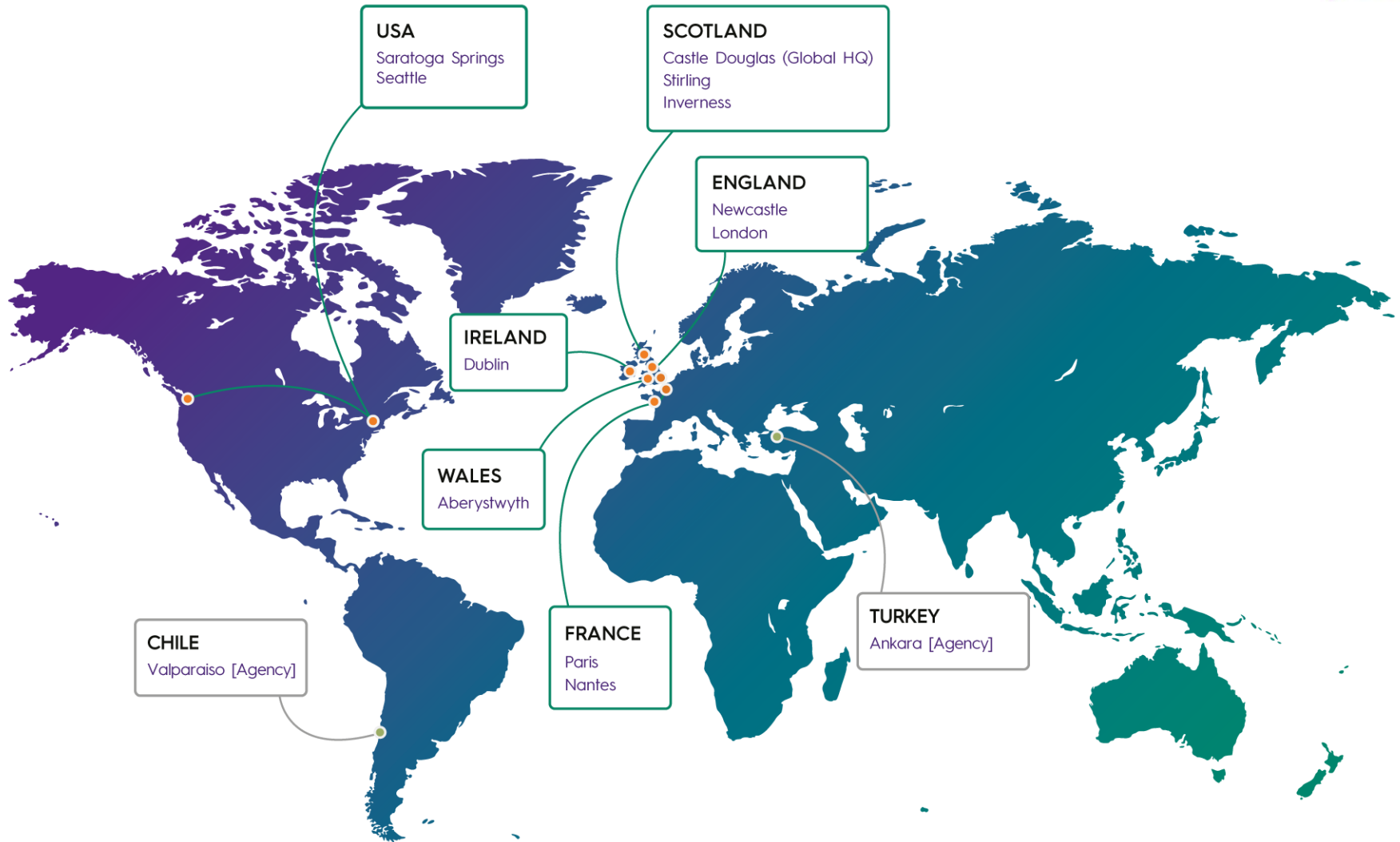
Funders: DOE, Natural Power, Alliant Energy, Wind Wildlife Research Fund

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Program website <https://www.energy.gov/eere/wind/environmental-impacts-and-siting-wind-projects>



Development advisory

- Onshore and offshore EIA
- Clerk of works
- Collision risk modeling
- Bat smart curtailment
- Development consulting
- Environmental social and governance

Construction

- Design optimization
- Pre-construction
- Construction project management
- Negotiation assistance
- Geotechnical consultants

Operational consulting

- On-site and remote asset management
- Full servicing
- HV switching
- Yaw alignment advisory
- Predictive maintenance



Energy yield analysis

- Pre- and post- construction yield assessments
- Lidar and met mast data management
- Monthly operational reporting
- WEBs benchmarking against +4GW live database of wind farms

Technical due diligence

- Buy-side and sell-side, all stages, technologies
- Project finance due diligence (LTA)
- Bespoke advisory
- Corporate PPA advisory

Inspections

- Full-scope end-of-warranty inspections
- Drone blade inspections
- Solar thermographic inspections in development
- Visual inspections

Two main goals

- 1) Address operational concerns that are barriers to Bat Smart Curtailment (BSC) adoption by wind farm operators,
- 2) Test the efficacy of BSC at an operational wind farm

TERMS

Curtailment – pitching blades out to achieve <3 RPM

Bat Smart Curtailment (BSC) – triggered by the real-time risk of fatality. It requires at least 2 pieces of information: wind speed and exposure, as measured by acoustic activity

North American Electric Reliability Corporation (NERC)

Critical Infrastructure Protections (CIP)

Original Equipment Manufacturer (OEM)

Supervisory Control and Data Acquisition (SCADA)

Annual Energy production (AEP)

National Renewable Energy Lab (NREL)

Purpose

- Remove barriers by demonstrating compliance with industry expectation for 3rd party technology
- Demonstrate efficacy for all bats (some species or species groups?)
- Reduce unnecessary curtailment and thereby conserve bats and increase AEP

Three major tasks

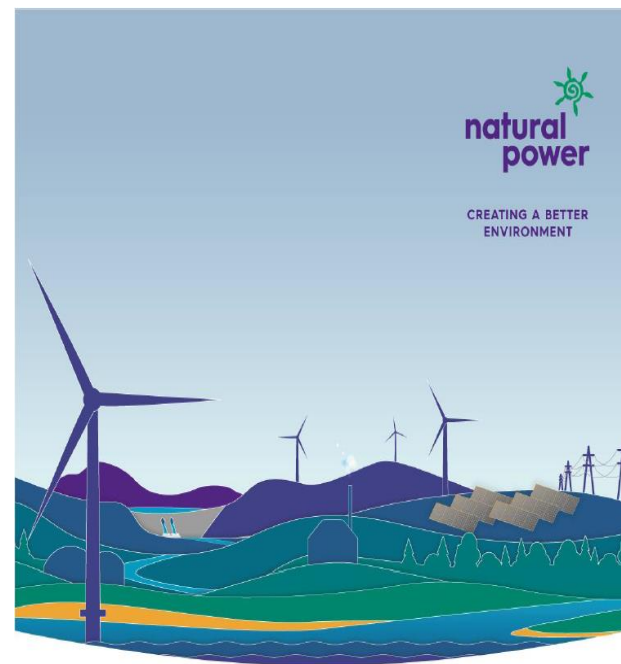
1. Review and improve the BSC system's NERC CIP readiness in collaboration with the NREL.
2. Evaluate system compatibility and ease of integration with one or more OEM SCADA systems at the National Wind Technology Center (NWTC) and mechanical load testing in collaboration with NREL
3. Test the efficacy of BSC at an operational wind farm to reduce fatalities and increase AEP

Task Summary:

- NREL subject matter experts will review the existing Natural Power BSC system and related documentation of CIP readiness. They will identify any weakness or failures to achieve CIP readiness and advise on changes to improve upon and achieve CIP readiness.
- Natural Power will revise the system and documentation based on this review to achieve Level 12 NERC CIP readiness.

Milestone:

- Report from NREL
- Report shared with Alliant as part of a go/no go decision.
- May 2020



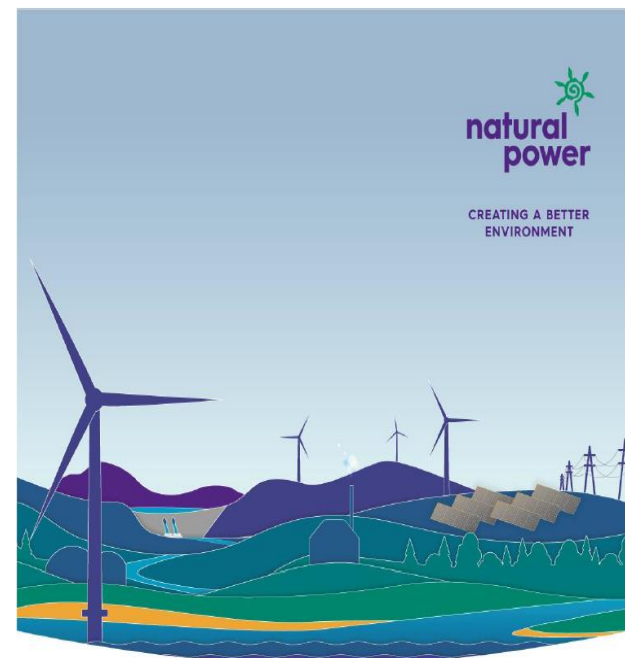
Bat Smart Curtailment - IT Hygiene and
NERC CIP Readiness

Task Summary:

- The Natural Power BSC system will be deployed on the NREL GE 1.5MW turbine located at the NWTC
- The BSC system will be integrated with the SCADA data collection system associated with the GE.
- Relevant loads and power data will be collected over one month with testing planning to start in the spring of 2020.
- Analysis of this data will demonstrate the loads and power effects of the BSC system on an individual utility-scale turbine and will be assessed/quantified from the perspective of annual energy production (AEP).

Milestone:

- Report from NREL
- Report shared with Alliant as part of a go/no go decision
- May 2020



Bat Smart Curtailment- SCADA Integration
and Loading

Task Summary:

- The BSC system will be tested at English Farms during the season of peak activity and fatalities.
- Deployment at an operational wind farm permits evaluation of
 - 1) CIP readiness
 - 2) ease of integration/coordination with OEM SCADA
 - 3) field worthiness/durability, and
 - 4) efficacy/cost and benefit in reducing fatalities while minimizing loss of energy production.
- Success is defined as reducing fatalities by 50% or more at an annual energy production cost of at least 50% less than standard curtailment.
- The test will proceed only if Alliant is satisfied that the system is NERC CIP and SCADA ready.

Milestone:

- Report from Natural Power
- Peer-reviewed publication
- July 2021

English Farms Wind Farm

- Iowa
- Owned by IPL, a subsidiary of Alliant Energy
- 69 2.3 and 2.5 MW GE turbines
- Land use/cover is agricultural
- Operated under a 6.9m/s TAL from Aug 1 to Oct 15 (MYSO)
- Began operations in July 2019
- One year of PCMM - mainly Hoary, Eastern Red, and Silver-haired bat

Study Design

- Being finalized but currently -
 - 28 turbines, 160 x 160m search plots
 - 41 turbines, Road and Pad plots
 - 2 treatments: TBD, smart curtailed
 - Season: Aug to October
 - Third party PCMM contractor

Commercially ready

Completion of the three tasks demonstrate it's readiness to a broader community

- NERC CIP – cybersecurity compliance
- SCADA – universal SCADA integration
- Validation – efficacy in reducing fatalities and recovering AEP