

Market Acceleration & Deployment – Environmental Research at DOE National Laboratories

2019 Wind Program Peer Review

Program/Activity Area Lead

April 30 – May 2, 2019



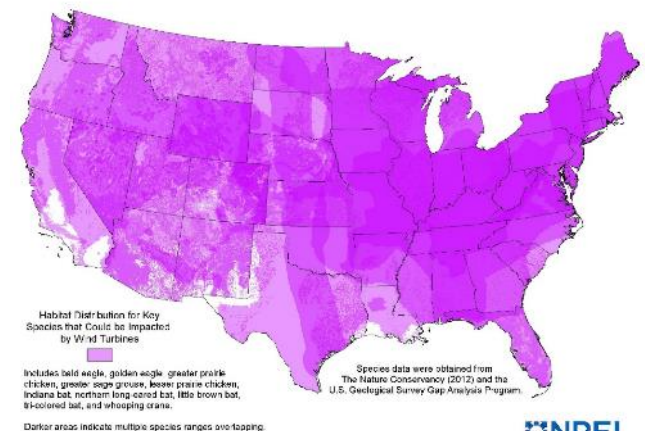
Wind Office Strategic Priorities

Clean, low-cost wind energy options nationwide

	Land-Based Wind	Offshore Wind	Distributed Wind
Technology Development & Scientific Research	Atmospheric Science & Wind Plant Systems Engineering	Atmospheric Science & Wind Plant Systems Engineering	Atmospheric Science
	Standards and Certification	Standards and Certification	Standards and Certification
	Technology Innovation	Technology Innovation	Technology Innovation
	World Class Testing Facilities	World Class Testing Facilities	
	Tech to Market Commercialization	Tech to Market Commercialization	
	Integrated Systems Design	Integrated Systems Design	
		Offshore Specific R&D	
		Advanced Technology Demo Projects	
Market Acceleration & Deployment	Advanced Grid Integration	Advanced Grid Integration	Advanced Grid Integration
	Workforce and Education Development	Workforce and Education Development	Workforce and Education Development
	Stakeholder Engagement	Stakeholder Engagement	Stakeholder Engagement
	Environmental Research	Environmental Research	
	Siting & Wind Radar Mitigation	Siting & Wind Radar Mitigation	
Analysis & Modeling	Evaluate and Prioritize R&D	Evaluate and Prioritize R&D	Evaluate and Prioritize R&D
	Model Development and Maintenance	Model Development and Maintenance	Model Development and Maintenance
	Techno-economic Analysis	Techno-economic Analysis	Techno-economic Analysis
	Electricity Sector Modeling	Electricity Sector Modeling	Electricity Sector Modeling

Mitigate Environmental Barriers: Making the Case

- Over 100% of available wind resource constrained by key wildlife species
 - Golden Eagles constrain up to 1,714 GW (21%)
 - Bats affected by wind energy overlap with 100% of the available wind resource
 - Greater & Lesser Prairie Chicken constrain up to 974 GW (14%)
- Concern over impacts on wildlife, including several species of tree roosting bats
- Cost of monitoring and mitigation measures present substantive economic hurdles for projects
- Addressing wildlife concerns adds legal and regulatory uncertainty to projects
- For offshore wind, questions regarding monitoring and mitigation have slowed and added uncertainty to permitting processes.
 - Noise issues run the risk of limiting construction windows
 - Absence of monitoring tools has stymied project planning



Deploying Wind Nationwide: Strategy for Lowering Environmental Cost, Improving Environmental Performance and Reducing Regulatory Barriers

Focus Issues

- Bats
- Eagles
- Prairie Grouse
- Offshore Wind



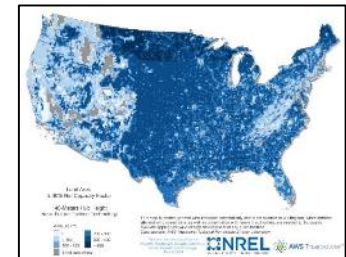
Near-term Actions

- Inform and catalyze the development of technical solutions



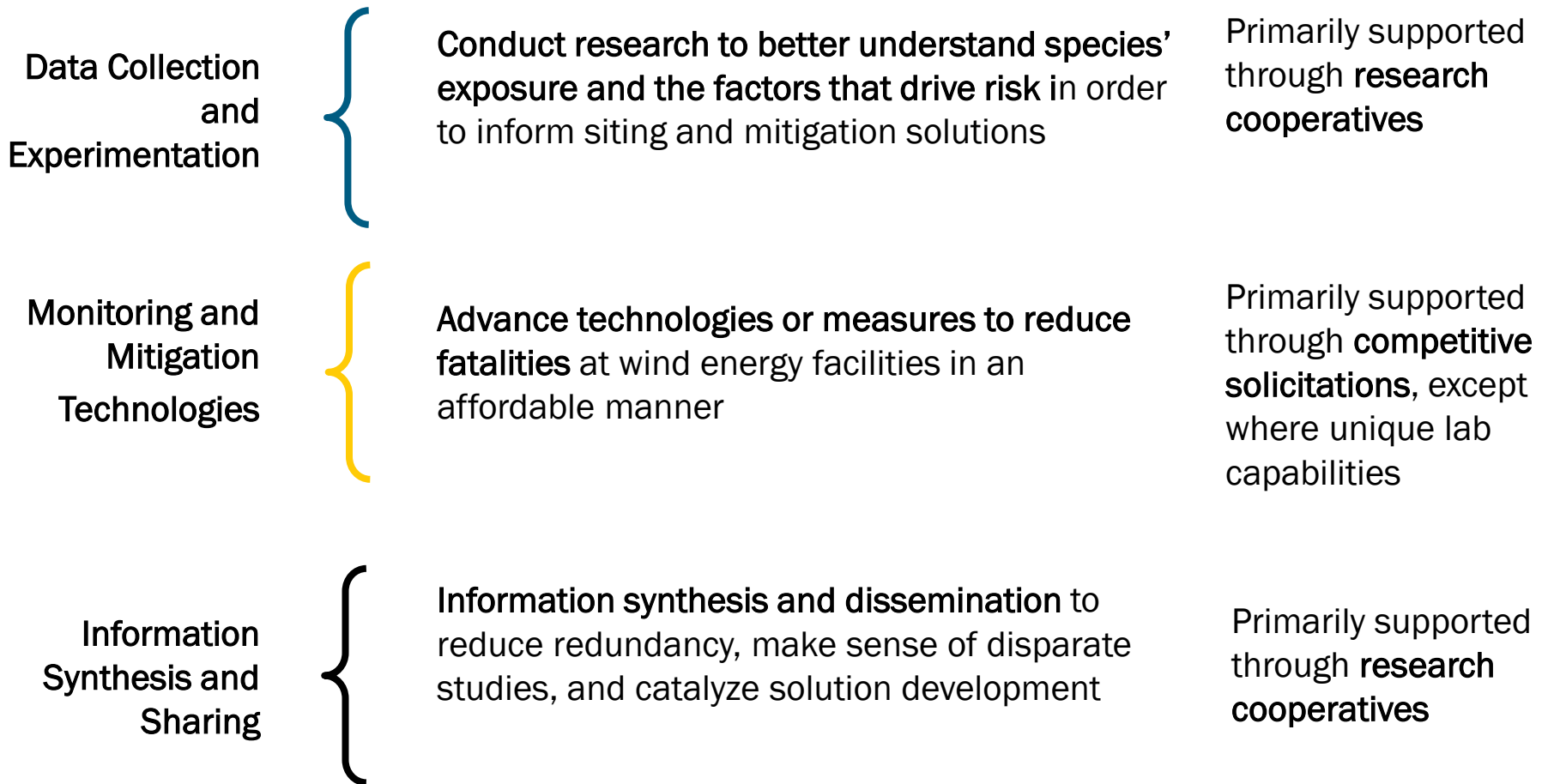
Ultimate Goals

- Improve wind farm operations, lower costs, & improve environmental performance
- Preserve or expand geographic areas available for development
- Reduce siting & regulatory uncertainty for developers

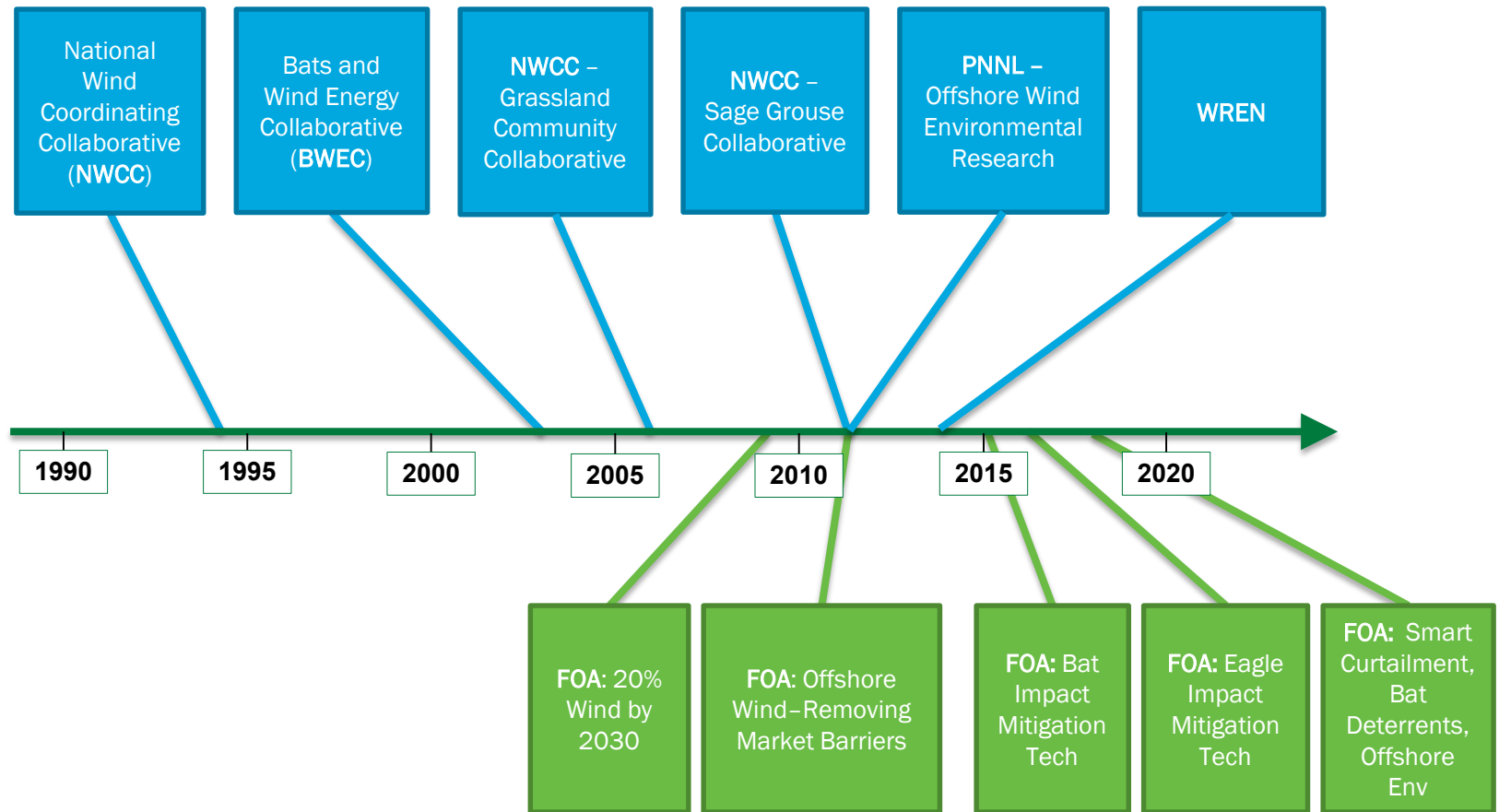


Mitigating Environmental Barriers Research Strategy

Objective: Reduce wildlife barriers to wind deployment by developing informed technical solutions to wildlife impacts



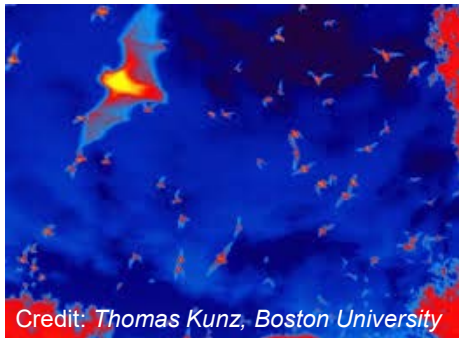
Mitigate Environmental and Siting Barriers – US DOE Research Funding Timeline



Research Priorities: Bats

The Wind Power Program currently envisions supporting future research:

- To improve understanding of the **factors that drive risk** to bats at wind turbines, including research to better understand the underlying relationship between bats and wind turbines
- To develop and assess potential **monitoring and minimization measures**, including refinements to curtailment strategies and development of deterrent devices, and
- To develop and assess **potential compensatory mitigation measures** as needed in the future



Research Priorities: Eagles

The Wind Power Program currently envisions supporting future research:

- To improve accuracy and **reduce uncertainty around estimates of take at wind farms,**
- To develop and assess **potential impact avoidance and minimization measures,** and
- To develop and assess potential **compensatory mitigation measures**



Research Priorities: Prairie Grouse

The Wind Power Program currently envisions supporting future research:

- To evaluate the **potential impact of wind turbines** on prairie grouse species, and
- To develop and validate **compensatory mitigation options**, as needed



Research Priorities: Offshore Wind

To address the various environmental offshore wind concerns over the next fifteen years, DOE developed a number of approaches under the following general research themes:

- **Collect environmental impact data** (avian collision, acoustic impacts & habitat use) to understand risk,
- **Support development and validation of monitoring and mitigation technologies** at first-generation projects, and
- **Synthesize environmental impact data and validate predictive models**



Research on Environmental Benefits of Wind

Accrued Benefits to Date

The climate and air-quality benefits of wind and solar power in the United States

Dev Millstein , Ryan Wiser, Mark Bolinger & Galen Barbose

Nature Energy 2, Article number: 17134 (2017)

doi:10.1038/nenergy.2017.134

[Download Citation](#)

[Energy and society](#)

[Environmental impact](#)

Received: 02 February 2017

Accepted: 14 July 2017

Published online: 14 August 2017

Abstract

Wind and solar energy reduce combustion-based electricity generation and provide air-quality and greenhouse gas emission benefits. These benefits vary dramatically by region and over time. From 2007 to 2015, solar and wind power deployment increased rapidly while regulatory changes and fossil fuel price changes led to steep cuts in overall power-sector emissions. Here we evaluate how wind and solar climate and air-quality benefits evolved during this time period. We find cumulative wind and solar air-quality benefits of 2015 US\$29.7–112.8 billion mostly from 3,000 to 12,700 avoided premature mortalities, and cumulative climate benefits of 2015 US\$5.3–106.8 billion. The ranges span results across a suite of air-quality and health impact models and social cost of carbon estimates. We find that binding cap-and-trade pollutant markets may reduce these cumulative benefits by up to 16%. In 2015, based on central estimates, combined marginal benefits equal 7.3 ¢ kWh⁻¹

- <https://www.nature.com/articles/nenergy2017134>

Projected Future Benefits

Benefits



GHG: 14% less GHG;
\$400 Billion savings



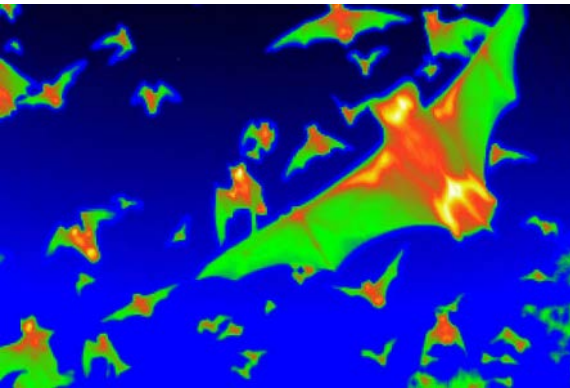
108 Billion savings;
22,000 lives saved



260 Billion gallons
[23%] less consumption



Bats and Wind Energy Cooperative



Multi-Stakeholder Collaborative working to develop and disseminate solutions to reduce to the greatest extent practicable or, where possible, prevent mortality of bats at wind energy facilities

Signature Accomplishments:

- Pioneered Curtailment to Reduce Impacts to Bats
- Pioneered Ultrasonic Acoustic Deterrents

Why Does DOE Support?

- Ensure that we're working in step with industry, NGOs and researchers
- Means to prioritize, fund targeted research, ensure active engagement on issues, ensure research is synthesized and disseminated.

DOE Supported Activities 2017-2018

- BWECC Management
- BWECC Science Meetings
- Generalized Fatality Estimator Development
- Bat Behavior Research
- Peak Bat Fatality Analysis - Smart curtailment
- Thermal Video Analysis Software
- Wind and Wildlife Regulator Trainings Synthesis of Operational Minimization
- BWECC Syntheses 2012-2017; 2018-2020
- Synthesis of Deterrent Research

National Wind Coordinating Collaborative



Forum for outreach and collaboration on understanding interactions and solving challenges for wind energy and wildlife

Historical Accomplishments

- Hosted 12 Bi-Annual Research Meetings to discuss state of wind/wildlife research
- Hosts quarterly webinars, develops fact sheets on wind/wildlife impacts and research developments
- Facilitate Sage Grouse Collaborative
- (2011) Comprehensive Guide to Studying Wind Energy/Wildlife Interactions
- (2013) Grassland Community Collaborative completed a comprehensive seven-year research project in Kansas which suggested that wind energy does not strongly affect Greater Prairie-Chickens.

Why Does DOE Support?

- Proven track record in convening and disseminating information on environmental research
- Trusted entity for bringing stakeholders together to support research around grouse issues

DOE Supported Activities 2017-2018

- NWCC Leadership, Outreach, and Engagement
- Analysis of Effects of Wind on Grouse
- Facilitation of the Sage-Grouse Research Collaborative
- Wind Wildlife Research Proceedings



WREN & Tethys

WREN (Working Together to Resolve Environmental Effects of Wind Energy): established by the [IEA Wind](#) Committee in October 2012 to address environmental issues associated with commercial development of land based and offshore wind energy projects.

- US Partners: USFWS, NOAA, BOEM
- 13 Member Nations

Tethys: a searchable library designed facilitate the exchange of information and data on the environmental effects of wind

- Studies available via database or map
- Information on webinars, events, and international research efforts and policies

Why Does DOE Fund?

- Leverages lessons learned from Europe, particularly with regards to offshore wind
- Prevents duplication of efforts and catalyzes solution development
- Tethys database ensures international information sharing benefits all parties

The screenshot shows the Tethys website interface. At the top, there is a navigation bar with links for 'ABOUT', 'TETHYS CAPTURE', 'CONNECTIONS', 'BROADCASTS', and 'HELP'. Below this is a banner image of an orca. The main content area is divided into four categories: 'Marine Energy' (Generating electricity from the sea), 'Wind Energy' (Generating electricity from wind on land and at sea), 'Marine O2' (Addressing environmental effects of ocean energy like aquaculture), and 'WRE' (Tracking wildlife resource conservation and connectivity). On the right side, there are buttons for 'NEW USER' and 'KNOWLEDGE BASE', and a 'SCREEN SIZE' selector. A 'Tethys Story' section is also visible at the bottom right.

<https://tethys.pnnl.gov>

Technology Development & Innovation Program



Objective:

- Provide early stage technology developers opportunities to develop and validate emerging technologies utilizing the resources at the National Wind Technology Center

Why Does DOE Fund:

- Increases number of potential future technology solutions
- Overcomes major barrier to environmental instrumentation testing – access to wind turbines

Thermal Tracker

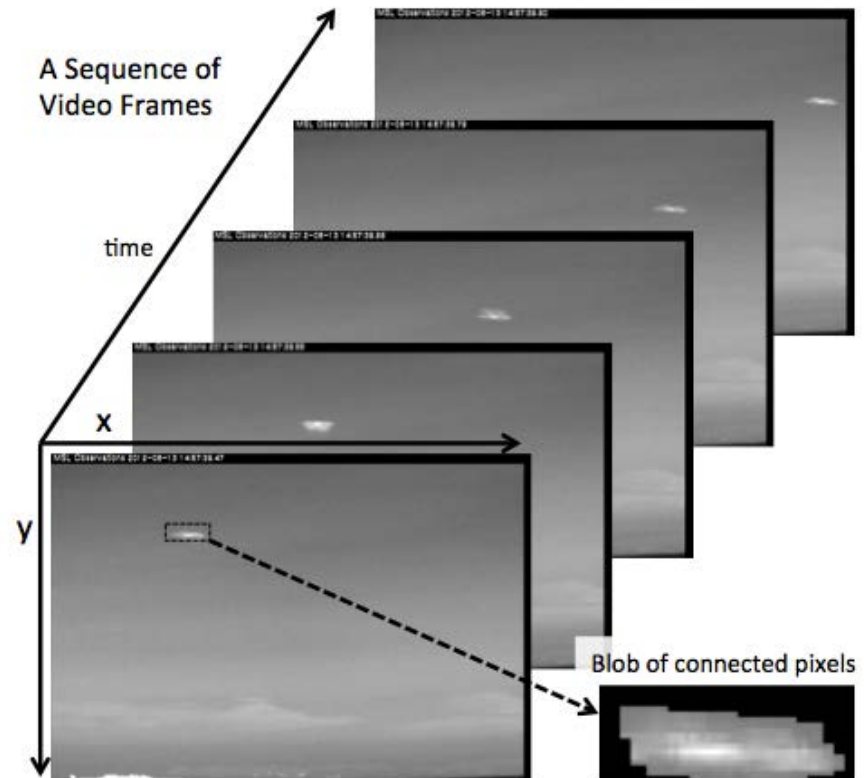
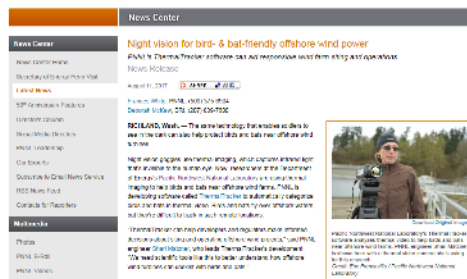
Goal: Advance the science of risk assessment for offshore wind to birds and bats by providing by developing software for 3-D monitoring of birds and bats around offshore wind farm

Why Does DOE Fund?

- Need for automated, cost effective tools for continuous monitoring in the offshore space
- Lack of tools for monitoring avian and bat behavior around offshore wind turbines

Accomplishments:

- Real time data analysis
- 3-D tracking
- Successful detection and classification of species groups



Environmental Research Accomplishments (2017 to 2018)

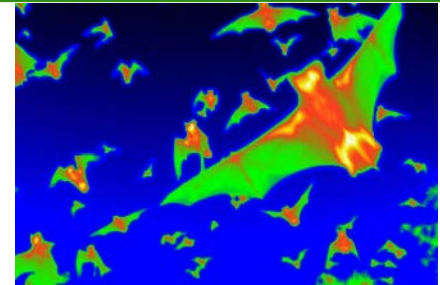
Program Accomplishments:

Transformative Research

- 5 bat deterrent projects complete or near completion
- 6 eagle impact minimization studies under way
- Using FY18 funds, recently awarded 9 new studies across three topic areas. \$6.2m in Federal support, \$9.5m in total project value.
 - Smart curtailment
 - Further bat deterrent development
 - Offshore wind monitoring and mitigation technology development

International and Domestic Leadership

- Strategy development, program members gave at least 15 talks during this timeframe
- Initiated WREN



Environmental Research Accomplishments (2017 to 2018)

Lab Accomplishments:

BWEC

- BWEC Synthesis
- Generalized Fatality Estimator
- Wildlife Training for Regulators

NWCC

- Bi-Annual Wind Wildlife Research Meeting proceedings
- Webinar series with over 1000 live views and 1,500 recording views
- Bi-weekly newsletter with approximately 2,000 subscribers

TD&I

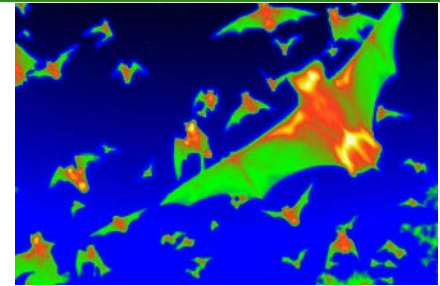
- Successful established program, funded two projects
- Four workshops on program and instrumentation needs

WREN

- Paper on how to move from assessing impacts on individuals to populations
- Two international workshops
- Fact sheets and webinar series (Over 600 live views and 3,700 recording views)
- Tethys Database
 - 500 new documents added to Tethys
 - 52 Tethys blasts with over 800 new Tethys blast subscribers

Thermal Tracker

- Real time detection, tracking, and classification
- 3-D monitoring capabilities



Environmental Research: Near Term Future Priorities (FY19 and beyond)

Strategic Area	Future Priorities
Bats	<ul style="list-style-type: none"> • Potentially contribute partial support to population studies for hoary bats • Further research to understand the drivers of risk • Further work to develop and assess minimization solutions, lower their costs, ensure they work across species and regions
Eagles	<ul style="list-style-type: none"> • Further research to understand the drivers of risk and tools to model risk • Further improve impact minimization tools • Research to underpin compensatory mitigation tools
Grouse	<ul style="list-style-type: none"> • Research gaps prioritization • Impact evaluation research
Offshore Wind	<ul style="list-style-type: none"> • Research to assess impact • Develop impact monitoring and mitigation tools • Research synthesis and dissemination
Emerging Issues	<ul style="list-style-type: none"> • Explore/understand potential environmental impacts of development in regions that will be made accessible through the use of taller towers • Develop solutions to challenges arising from larger rotors (e.g.,ersonifying the entire rotor swept zone with deterrents, cost of curtailment)
Analysis	<ul style="list-style-type: none"> • How to integrate environmental variables into wind plant optimization • Cost and deployment implications of environmental compliance (e.g., curtailment) and cost and deployment impacts of solution development