

# Market Acceleration and Deployment Strategy, Focus, and Accomplishments 2017-2018

## 2019 Wind Program Peer Review

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# Wind Energy Technologies Office

## Overview

### Wind Office Vision

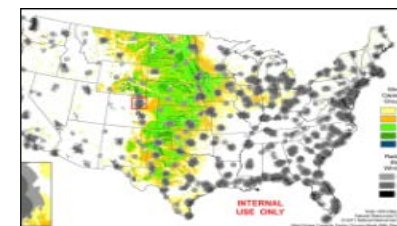
Clean, low cost wind energy as an option nationwide

### Wind Office Scope

The Wind Energy Technologies Office aims to accelerate widespread U.S. deployment of clean, affordable, reliable, and domestic wind power to promote national security, economic growth, and environmental quality. Office RDD&D activities are applicable to **utility-scale land** and **offshore wind** markets, as well as **distributed** turbines—typically interconnected on the distribution grid at or near the point of end-use.

### Wind Office Programmatic Priorities

- **Reduce the cost of wind energy technology**—targeting near-zero costs with no cost fuel —and increase wind value to the economy in all sectors – land-based, offshore, and distributed; contributing to lower, stable electricity rates, with increased domestic manufacturing, and increased domestic investment
- **Improve wind energy grid integration and increase grid resilience and reliability;** with diverse locations providing value to address extreme weather events and cyber-attacks
- **Reduce market barriers and associated costs** to increase options for responsible deployment in markets where wind is cost competitive; with improvements for local communities through lower pollution and minimized impacts to wildlife and the environment



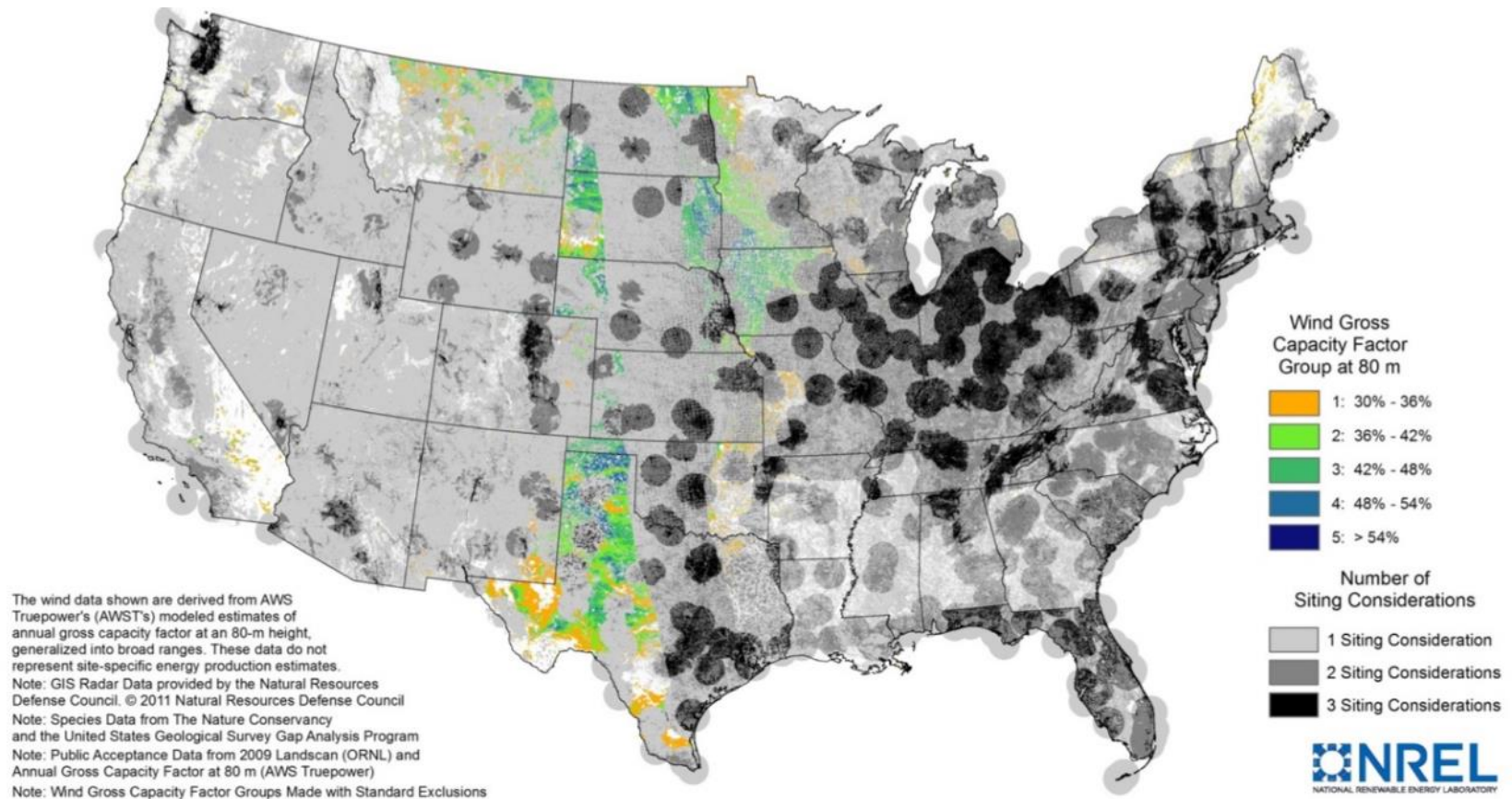
# Wind Office Strategic Priorities

*Clean, low-cost wind energy options nationwide*

	Land-Based Wind	Offshore Wind	Distributed Wind
<b>Technology Development &amp; Scientific Research</b>	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	
<b>Market Acceleration &amp; Deployment</b>	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	
<b>Analysis &amp; Modeling</b>	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

# Why Address Market Barriers?

- Siting and environmental constraints on wind development have the potential to reduce wind deployment by over 4,940 gigawatts, or approximately 80%.
- Siting and developing projects is getting harder.



NREL Unpublished Analysis for DOE

# Mitigate Market Barriers: Making the Case

LCOE and deployment goals will not be met unless market barriers impacting wind development are addressed. Tools to address wildlife, stakeholder, grid, and radar barriers will increase certainty for regulators, decrease risk for developers, and reduce LCOE, leading to more deployment.

## *Program Goal:*

**Reduce market barriers to preserve or expand access to quality wind resources.** Better understanding of impacts and mitigation solutions will increase the certainty of development outcomes and ultimately lead to more deployment.

# How We Organize Our Work

## Grid Integration

### Enable high levels of wind penetration

- *Essential Reliability Services*
- *Market design*
- *Infrastructure development & utilization*

## Stakeholder Engagement, Education & Outreach

### Catalyze public acceptance and develop skilled workforce

- *WINDEXchange*
- *Collegiate Wind Competition*
- *Regional Resource Centers*
- *Wind for Schools*

## Siting & Environmental Research

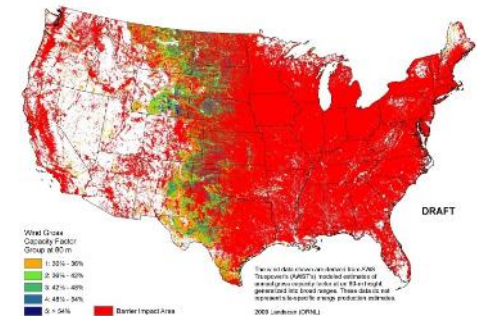
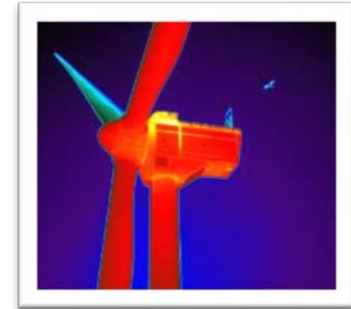
### Developing solutions to siting challenges

- *Radar interference mitigation*
- *Land-based and offshore wind environmental research*

# Why Should the Wind Program Engage in this Work?

The Wind MA&D Team leverages unique DOE capabilities to:

- Carry out R&D beyond the scope of industry
- Convene parties in dialogue and priority setting at the national and international level
- Develop and broadly disseminate impartial, state-of-the-art data
- Catalyze solutions to wind energy deployment challenges
- Leverage expertise from the national laboratories



# Grid Integration

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- **Motivation: Working to ensure the economic, reliable, and secure operation and planning of the power grid.**
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## **Reliability Services From Wind**

*Being good stewards of the grid*

## **Electricity Market Impacts**

*Rules that work for everyone as variable generation increases*

## **Infrastructure development and utilization**

*Understanding transmission needs and how best to utilize what we have*



# Grid Integration (2017 to 2018)

Strategic Area	Key Accomplishments	Collaborators
<p><b>Reliability Services From Wind</b></p>	<ul style="list-style-type: none"> <li>• Demonstration of the impact of frequency response on bulk power systems</li> <li>• Evaluation of frequency response from wind, storage, and pumping loads</li> <li>• Development of coupled Wind and Battery Energy Storage System controls</li> </ul>	<ul style="list-style-type: none"> <li>• NREL/INL</li> <li>• GE</li> </ul>
<p><b>Electricity Market Impacts</b></p>	<ul style="list-style-type: none"> <li>• Provided insights into key drivers of wholesale electricity energy and ancillary service prices</li> <li>• Supported development of “Staff Report to the Secretary on Electricity Markets and Reliability”</li> </ul>	<ul style="list-style-type: none"> <li>• NREL/ANL</li> <li>• EPRI</li> </ul>
<p><b>Infrastructure development and utilization</b></p>	<ul style="list-style-type: none"> <li>• Developed an affordable and effective implementation of real-time weather and forecast based dynamic line rating incorporated forecasting</li> </ul>	<ul style="list-style-type: none"> <li>• NREL/INL</li> <li>• NOAA</li> </ul>

# Stakeholder Engagement, Education and Outreach

**Motivation:** Enable well-informed decisions about wind energy deployment and ensure the availability of a robust workforce



# Stakeholder Engagement and Community Impacts Research Strategy

## Focus issues

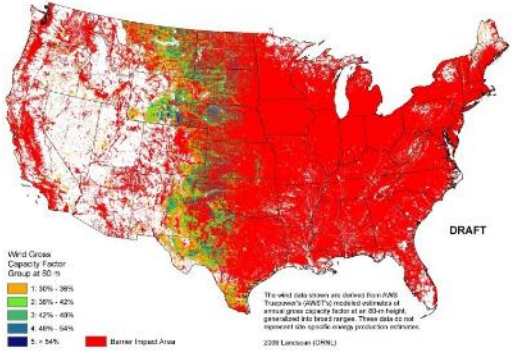
- Community impacts (visual, noise, annoyance)
- Information dissemination and engagement to inform local, state and regional decision making

## Near term Actions

- **Research:** Impacts of wind on individuals, communities, and local economies
- **Information and Tools:** Develop nationwide resources to provide access to the best science and neutral information on wind energy development

## Ultimate Goals

- Wind farm siting, operations and technological advancements are informed and improved by community impacts data
- Informed wind energy deployment decision making



# Stakeholder Engagement and Community Impacts

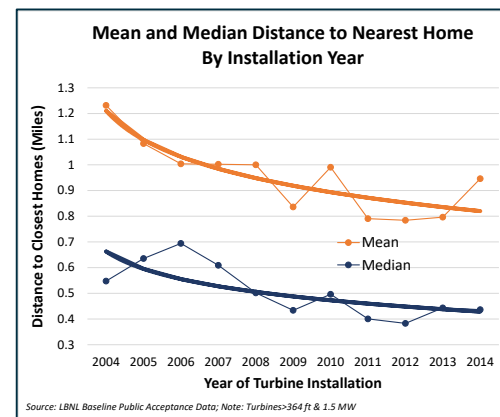
## Selected Accomplishments (2017 to 2018)

### Transformative Research

- Largest ever and first of its kind Public Acceptance Baseline Study (LBNL) (over 1700 respondents)
  - 5 journal papers
  - Webinar series with ~ 700 total attendees
  - ½ day seminar and working session of results at AWEA's Siting Conference in 2018
  - 19 other presentations

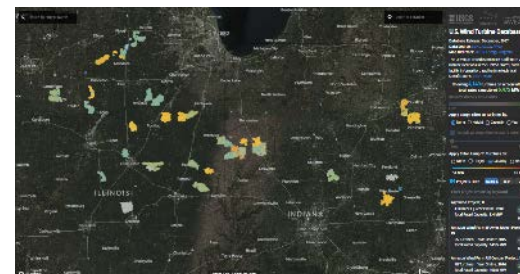
### Seminal Tools

- U.S. Wind Turbine Database (LBNL)
  - Launched April 2018
  - Continuously updated data portal containing the locations and attributes of all wind turbines across the U.S.
  - Over 1 million website hits in 1<sup>st</sup> six months
  - Data combined from FAA, AWEA, LBNL and USGS, including 58,449 turbines wind turbines from 43 U.S. states, plus Guam, & Puerto Rico



### Informative Resources

- WINDEXchange
  - Website with over 270,000 users
  - Wind energy resource maps ~25,000 views in 2018
  - 2017 and 2018 State of the Regions Reports with over 6,300 downloads

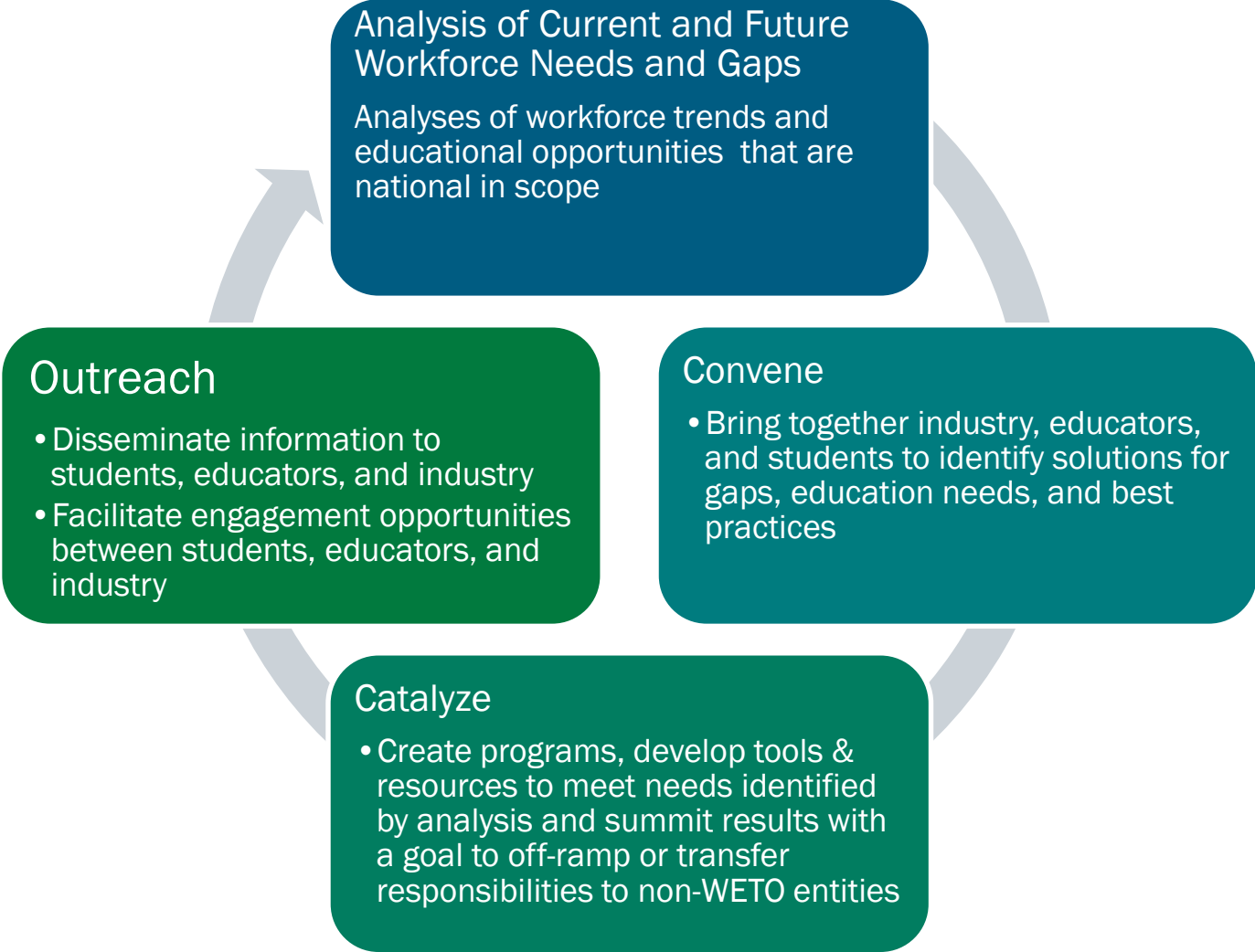


### Impactful Engagement

- Regional Resource Centers
  - Over 172,000 stakeholder engagements
  - RRC information included in 115 policies or plans



# Workforce Strategy



# Workforce Accomplishments (2017 to 2018)

## Transformative Research

- National current and future workforce needs assessment complete and nearing publication

## Workforce of the Future

- Collegiate Wind Competition, as well as support for KidWind
  - Over 30 faculty advisors
  - Over 300 students
- Wind For Schools
  - 60+ university courses and events providing wind and solar education: 800 students engaged
  - 124 turbines registered on OpenEI (141 turbines in the Wind for Schools network)



## Training the Teachers

- Wind For Schools
  - 70+ K-12 educational lessons and presentations providing wind and solar education: 2,100+ students introduced to wind-energy concepts
  - 17 teacher workshops: 270 teachers participated



## National Convener

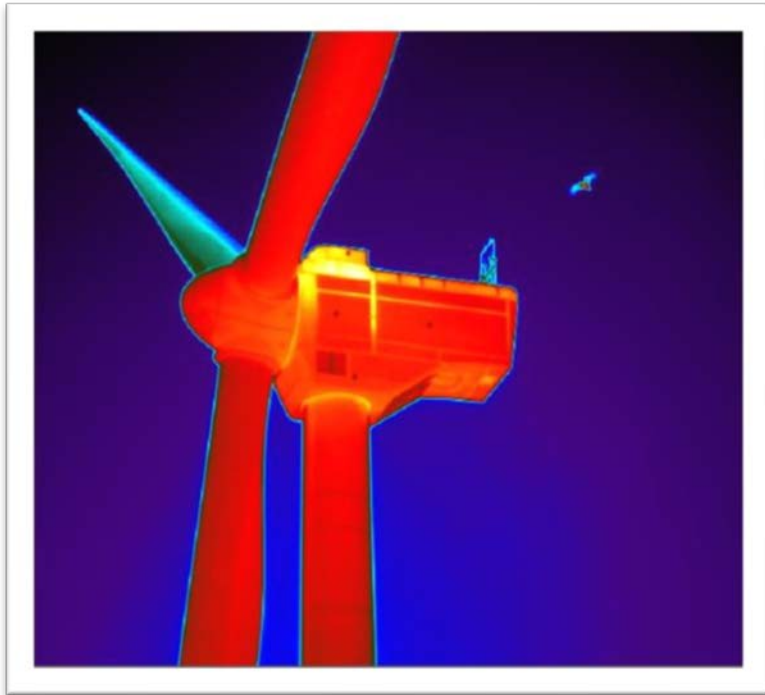
- 2016 National Wind Workforce Summit at AWEA Wind Power



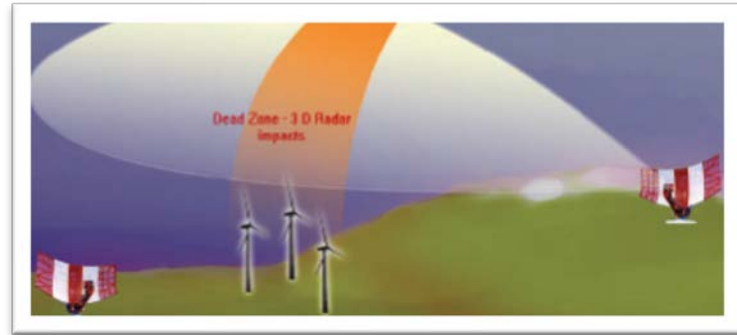
# Siting and Environmental Research

**Motivation:** Facilitate and disseminate research to understand and mitigate wind/wildlife impacts and wind/radar interference

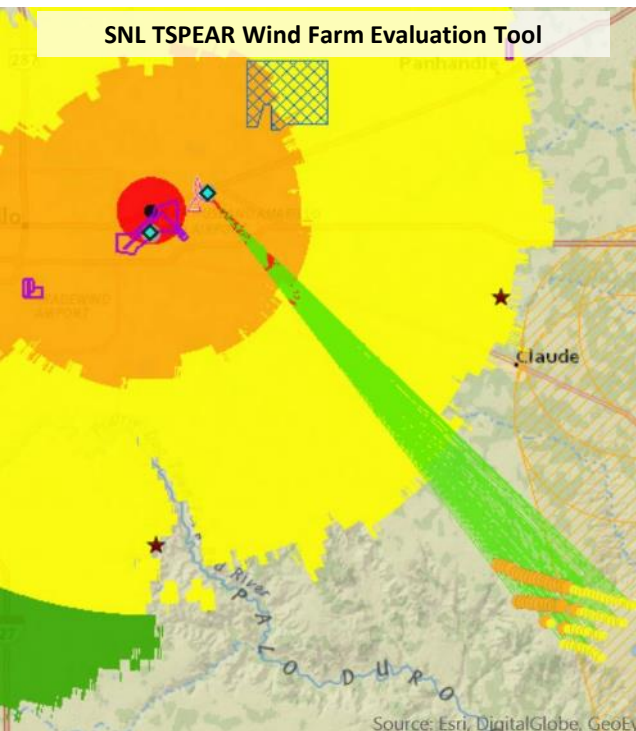
## Better understand and model risk



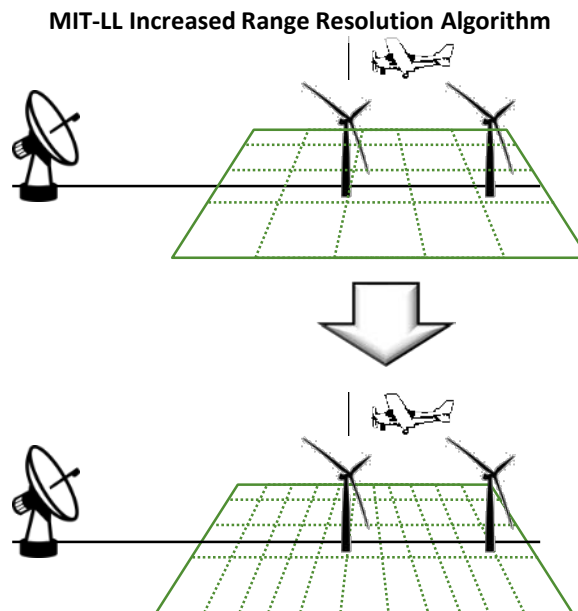
## Develop mitigation solutions



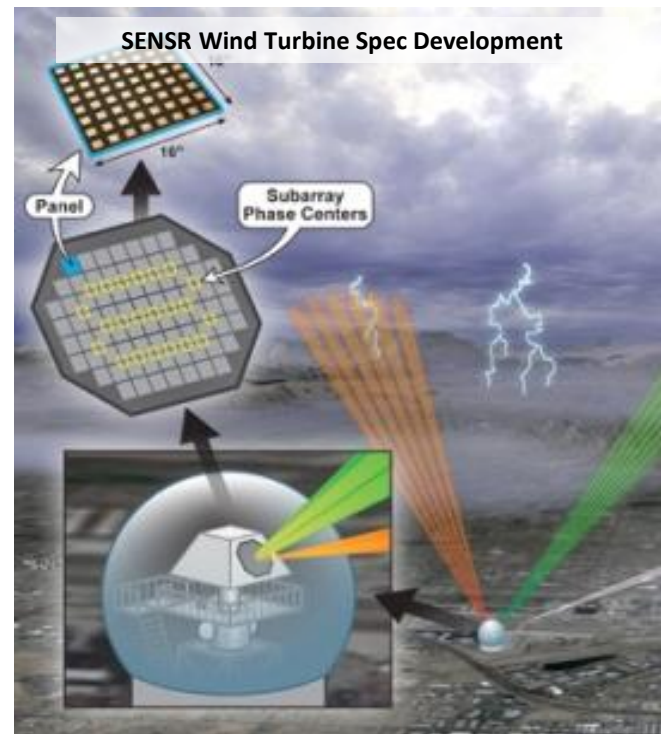
# Wind Turbine Radar Interference Mitigation Strategy



**Strategic Theme 1:**  
Improve capacity to evaluate the impacts of wind energy on sensitive radars



**Strategic Theme 2:**  
Develop and deploy mitigation measures to increase resilience of existing radars to wind turbines



**Strategic Theme 3:**  
Encourage the development of next-generation radars resistant to wind turbine interference

2015 Memorandum of Understanding (MOU) establishes working group (WTRIM WG) to collectively develop and deploy mitigation approaches, allows significant leverage of DOE funds  
Key partners: DOD Siting Clearinghouse, FAA, NOAA, BOEM, DHS



# Radar Accomplishments (2017 to 2018)

## Improve capacity to evaluate the impacts of wind energy on sensitive radars

- US Wind Turbine Database release and integration into agency radar impacts assessment process



## Develop and deploy mitigation measures to increase resilience of existing radars to wind turbines

- Travis AFB, Pilot Mitigation Project



## Encourage the development of next generation radars resistant to wind turbine interference

- Incorporated wind turbine radar interference into specifications for next generation air surveillance radars

# Environmental Research Strategy

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

Data Collection and Experimentation

Conduct research to better understand species' exposure and the factors that drive risk in order to inform siting and mitigation solutions

Monitoring and Mitigation

Advance technologies or measures to reduce fatalities at wind energy facilities in an affordable manner

Information Synthesis and Sharing

Coordinate information synthesis and dissemination to reduce redundancy, make sense of disparate studies, and catalyze solution development

# Environmental Research Accomplishments (2017 to 2018)

## 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

- Lead international environmental initiative
- 6 national or international workshops

## Communicating Results

- **Tethys Database**
  - 500 new documents added to Tethys
  - 52 Tethys blasts with over 800 new Tethys blast subscribers
- **Environmental webinars**
  - Over 1700 live participants and over 5200 views of the recordings
- **Environmental newsletters**
  - ~2000 subscribers

