

Advanced Grid Integration

2019 Wind Program Peer Review

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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	
Market Acceleration & Deployment	Advanced Technology Demo Projects		
	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	
Analysis & Modeling	Siting & Wind Radar Mitigation	Siting & Wind Radar Mitigation	
	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

Grid Integration

 Southwest Power Pool
@SPPorg

Follow

SPP set a new **#wind**-penetration record of 66.5% at 2:11 a.m., April 21. Wind served 14,063 MW of the 21,148 MW total load. We also set a **#renewable**-penetration record of 70% at 2:08 a.m., April 21.



2:36 PM - 22 Apr 2019

43 Retweets 56 Likes



43



56

ERCOT Sets New Marks for Wind Production

January 27, 2019

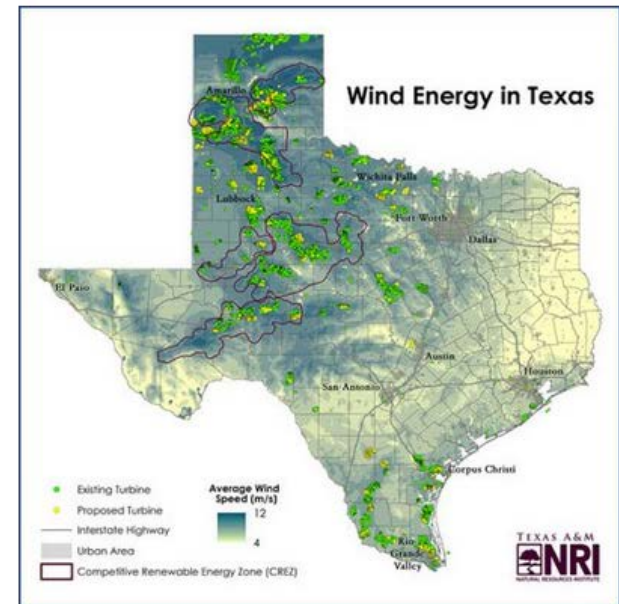
By Tom Kleckner

ERCOT set a new record for wind generation last week, just two days after breaking its mark for penetration.

Wind generators in ERCOT territory — about 90% of Texas — produced 19.7 GW at 7:19 p.m. on Jan. 21, breaking the old mark of 19.2 GW set on Dec. 14, according to market reports. Wind energy accounted for 46.89% of ERCOT's production at the time.

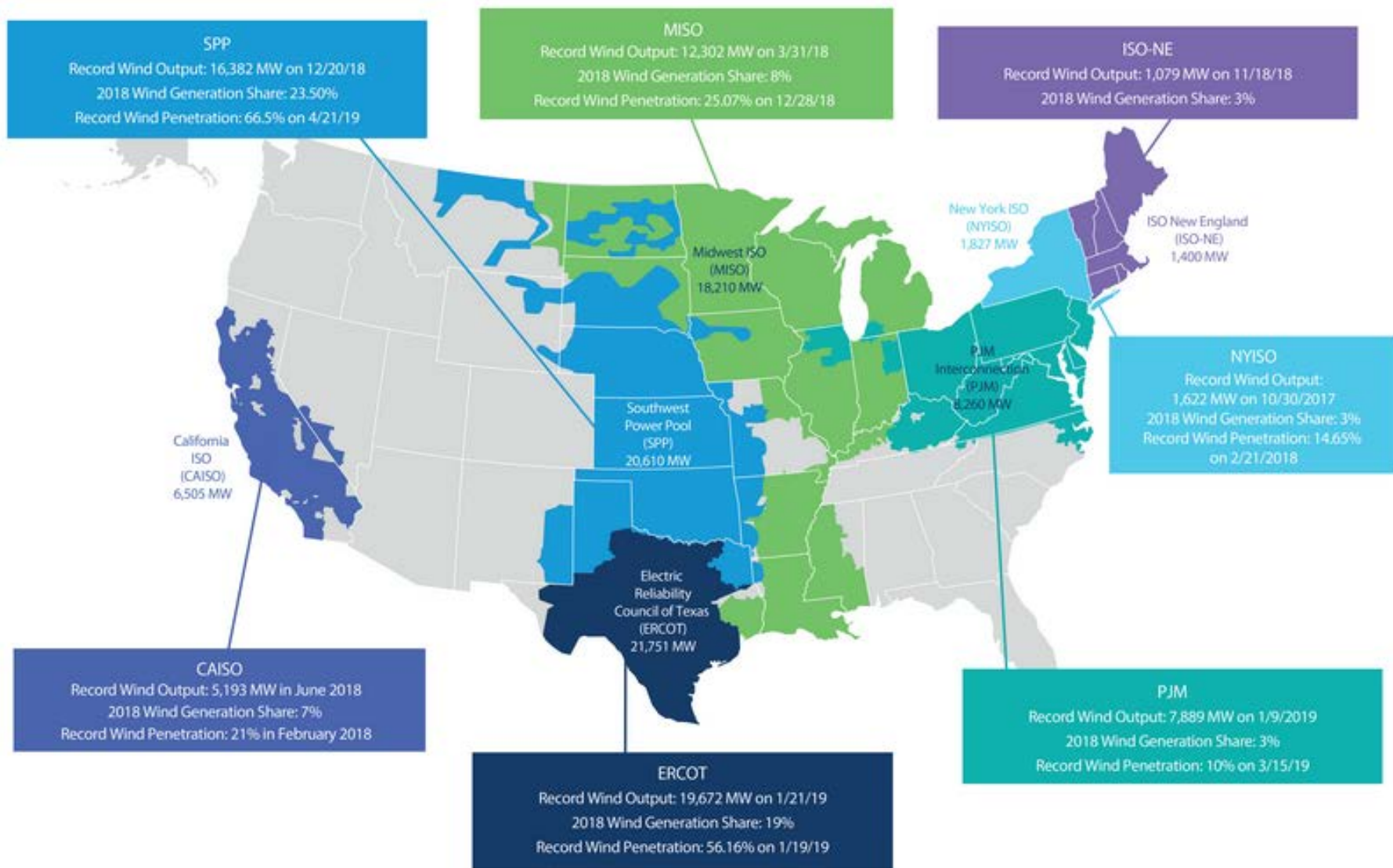
The grid operator also set a new record for wind penetration at **56.16%** on Jan. 19. The new mark came at 3:10 a.m., when wind produced 17.4 GW of energy.

The previous high for wind penetration was 54.64%, set Dec. 27.



Wind turbine locations in Texas | Matt Crawford, Texas A&M Natural Resources Institute

Grid Integration



<https://www.aweablog.org/wp-content/uploads/2019/04/Wind-in-RTOs-1.png>

Grid Integration - Motivation

Working to ensure the economic, reliable, and secure operation and planning of the power grid.



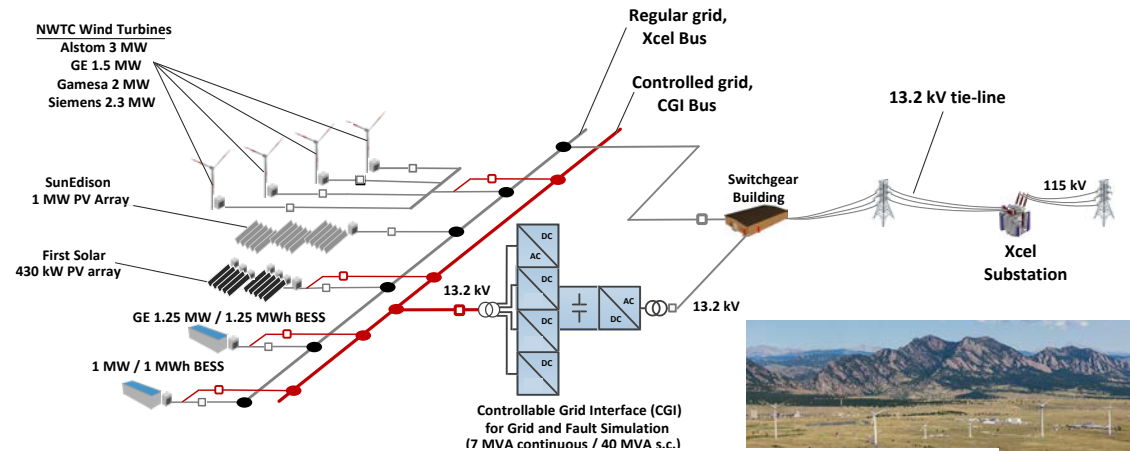
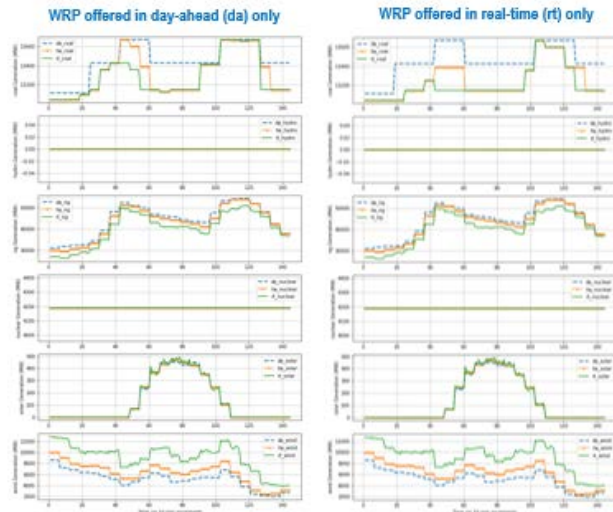
- Projects were evaluated and selected as part of the DOE Grid Modernization Initiative

Strategic Area: Reliability Service from Wind

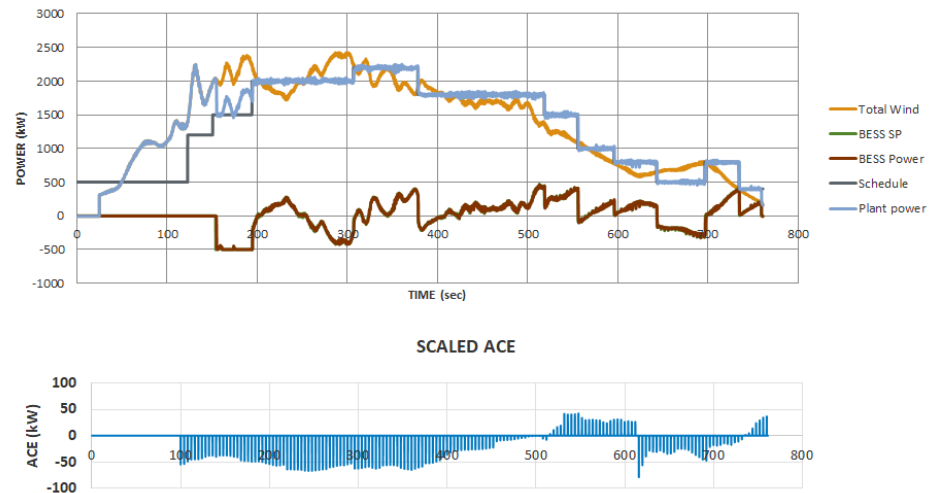
Key Challenges

- Need to better understand the services that can be provided by wind
- Lack of industry knowledge related to wind turbine capabilities

Impact of wind ramping product on system dispatch



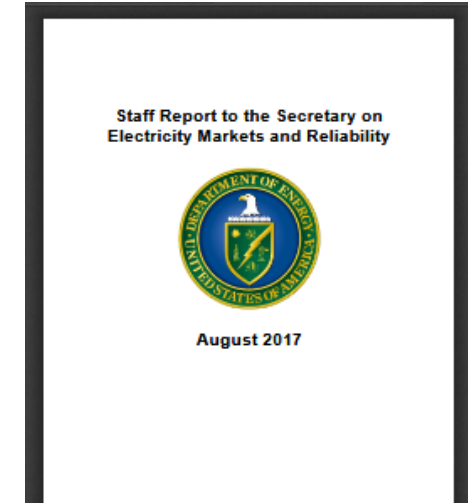
Example of stacked services: dispatchable plant + AGC



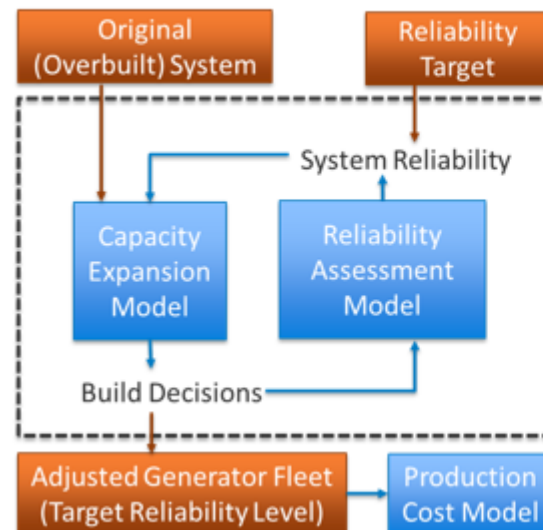
Strategic Area: Electricity Market Impact

Key Challenges

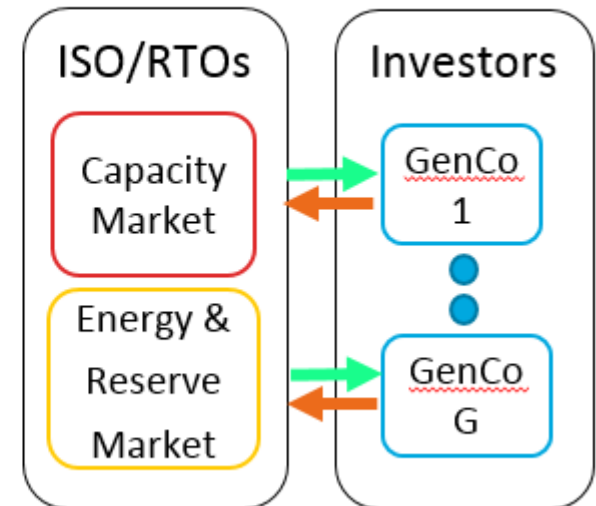
- Wind plants' low marginal costs impact electricity markets
- Current electric market designs may be compensate wind (and other generators) for all the services they provide



Assessing Energy Markets



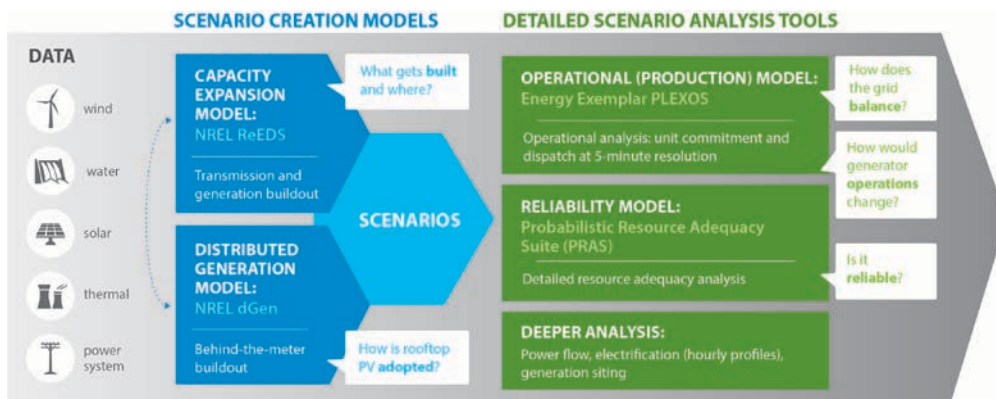
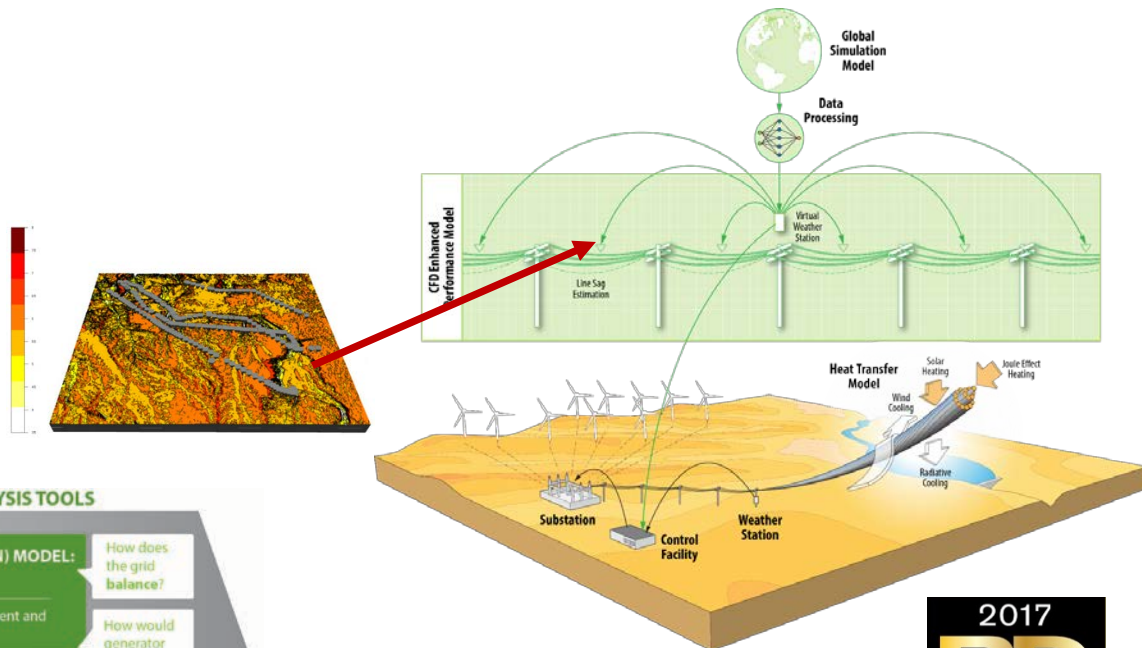
Assessing Capacity Markets



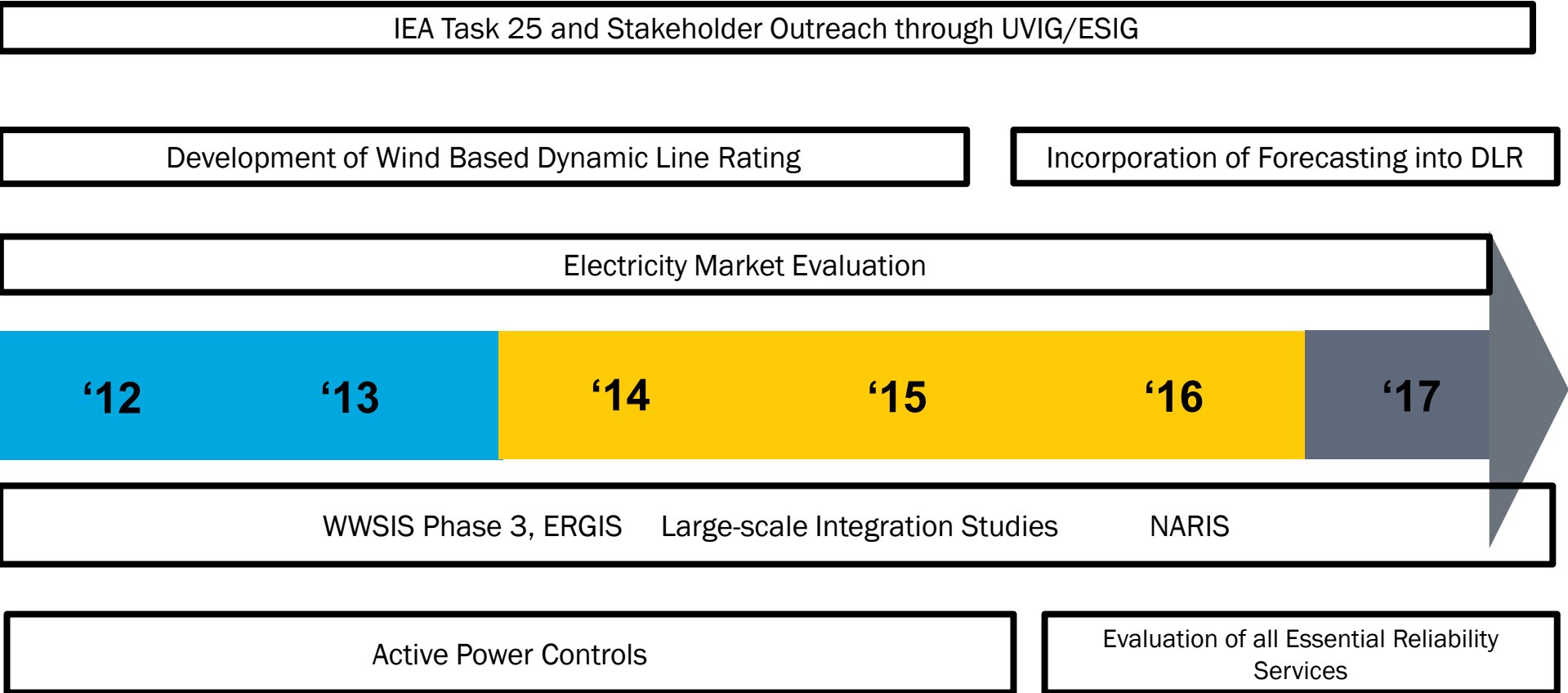
Strategic Area: Infrastructure Development and Utilization

Key Challenges

- Information is needed on where new transmission infrastructure is needed to facilitate wind development
- Large amounts of existing transmission infrastructure is currently under-utilized



Grid Integration: Key Projects Over Time



Grid Integration: Future Priorities (FY19 and beyond)

Strategic Area	Future Priorities
Beyond Batteries	• Optimize the provision of Essential Reliability Services (ERS) from wind power plants (coordinated with A2e) • Develop hybrid energy systems which combine wind with other technologies (H2, Solar, etc.) potentially utilizing the updated Flat Irons facility • Further develop and refine means to provide system flexibility
Cyber Security	• Understanding of the current state of the art in cyber security from a wind energy perspective • Develop wind energy specific cyber security strategies to identify, protect, detect, and mitigate cyber attacks
Technical Assistance/Institutional Support	• Continue sharing of technical results related to wind energy research and development with outside organizations such as utilities, ISO/RTOs, the international research community and other interested parties

Grid Integration: Strategic Approach

Strategic Area	Challenges	Goals	Approach
Reliability Services From Wind	Need to better understand the services that can be provided by wind	Improve the base level understanding of the suite of reliability services wind turbines are capable of providing	• Test the suite of commercially available reliability services • Verify that capabilities operate as advertised • Reduce operation and maintenance costs through ancillary services provided • Publish results in a public format without vendor specifics
	Lack of industry knowledge related to wind turbine capabilities	Provide publicly available information documenting capabilities	
Electricity Market Impacts	Wind plants' low marginal costs impact electricity markets	Better understand the impact of low marginal cost generation on markets	• Perform large-scale analysis of market operation with large amounts of variable generation • Compare different pricing mechanisms under different resource adequacy levels
	Current electric market designs may be compensate wind (and other generators) for all the services they provide	Evaluate how reliability services are priced	
Infrastructure development and utilization	Information is needed on where new transmission infrastructure is needed to facilitate wind development	Understand how improved transmission planning can assist wind development	• Perform large-scale integration analysis to understand where new transmission is needed • Expand on past efforts to develop dynamic line ratings and incorporate ratings forecasting
	Large amounts of existing transmission infrastructure is currently under-utilized	Improve the understanding of how wind-based dynamic line rating can unlock transmission capacity	