U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Overview of Testing Infrastructure Program

2019 Wind Program Peer Review

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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

Technology Innovation– Background

Motivation:

Provide facility cross-cutting support for key office programmatic research, development and testing; and serve external wind stakeholder utilization through industry-supported Work-for-Others agreements and Cooperative Research and Development Agreements (CRADAs).

Support research and development at national laboratories across the nation that offer unique facility assets and capabilities for conducting wind energy R&D

- **Background- Funding to support O&M of testing facilities**
- **Key projects: NREL's NWTC; and SNL's SWiFT facility**
- **Team: Gary Nowakowski and Mike Derby**

Motivation Enabling Wind Nationwide: Enable World-Class Wind R&D

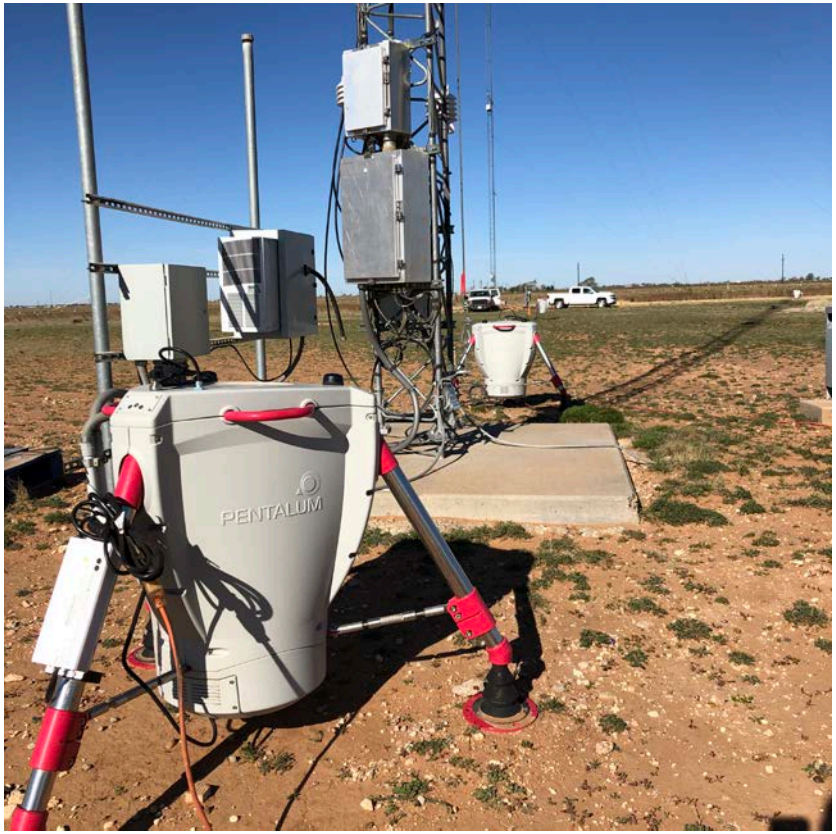
- Gearbox reliability improvement
- Controls development
- Environmental R&D science
- Grid Integration R&D and certification

Motivation Enabling Wind Nationwide: Enable World-Class Wind R&D

- Aerodynamic blade research
- Drivetrain and generator testing and certification

Motivation Enabling Wind Nationwide: Enable World-Class Wind R&D

- Wind Plant performance optimization
- Leveraging instrumentation packages to conduct remote wind farm optimization and A2E



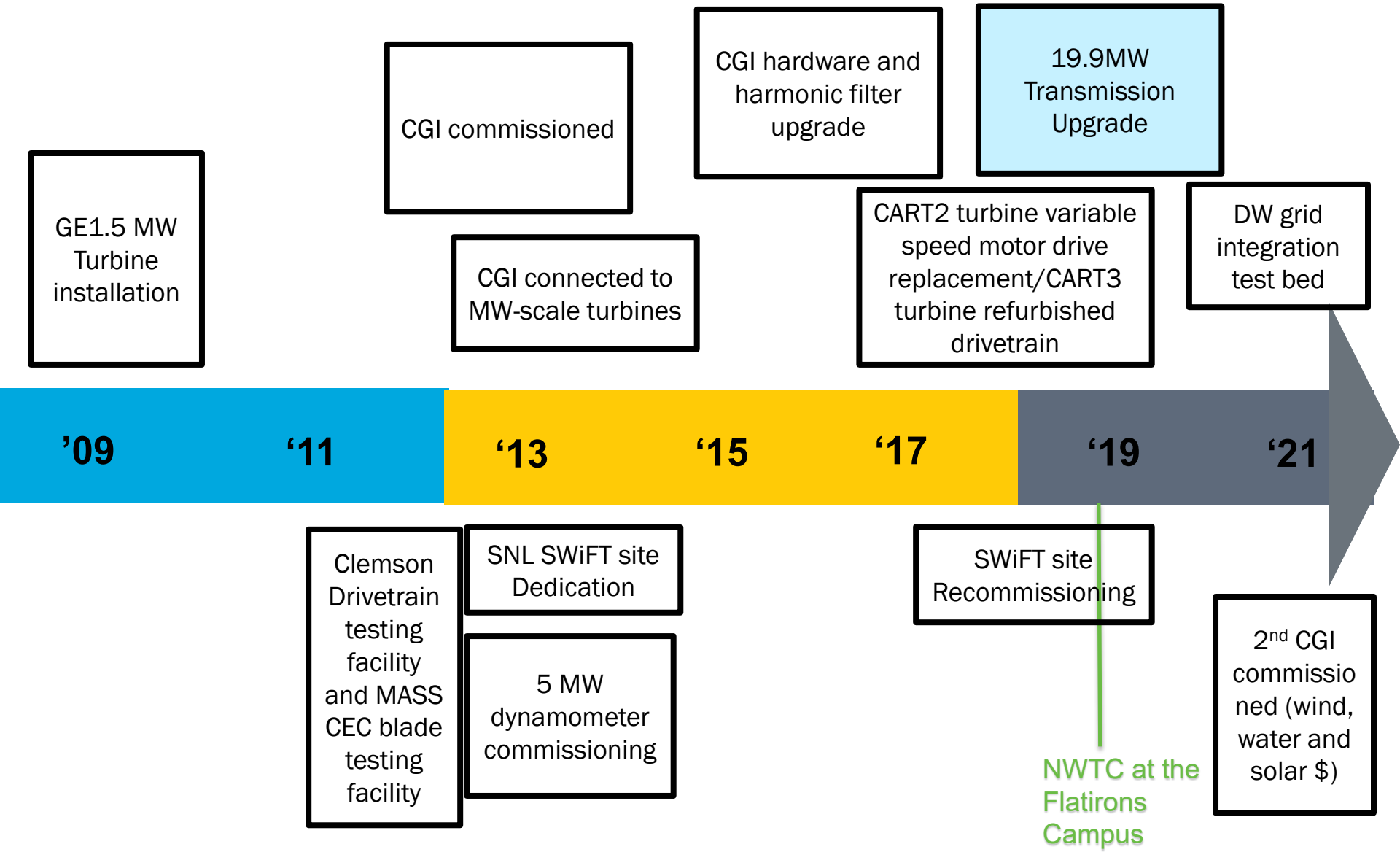
Motivation Enabling Wind Nationwide: Enable World-Class Wind R&D

- High-performance computing and simulation work (NREL, Lawrence Livermore National Laboratory, Pacific Northwest National Laboratory, and SNL)
- Manufacturing-related R&D (Oak Ridge National Laboratory at the Manufacturing Demonstration Facility (MDF) and Carbon Fiber Test Facility (CFTF); as well as NREL's Composites Manufacturing Education and Technology (CoMET) facility)
- Research related to extending the life and reliability of drivetrain bearings and gears (known as tribology) (Argonne National Laboratory's Advanced Photon Source facility to perform high-brightness X-ray analysis)
- Grid integration and transmission research (Idaho National Laboratory and NREL)
- Wind resource science R&D (National Oceanic and Atmospheric Administration (NOAA) and various national laboratories including Pacific Northwest National Laboratory)

Technology Innovation: Challenges, Goals, & Approach

Strategic Area	Challenges	Goals	Approach
Blade Testing	Turbine components have continued to grow in size, often beyond existing facility testing capabilities	**Testing of Critical Components as proxy for full scale component/system testing**	• Investigate ways to complete critical component testing as a means of component certification (i.e. blade spar testing, leading and trailing edges, root and segmented joints, and validation of metal components including rotor and drivetrain bearings • Continued involvement in IEC standards development and IEA development
Field Testing	Need for future field testing at existing wind plant locales around the country	**Develop ability to efficiently conduct field campaigns from a central location**	• Evaluate the potential to conduct future field campaigns from a central remote location
Grid Integration	Need to seamlessly integrate large amounts of wind power onto the grid	**Ensure equipment and facilities are available to conduct grid integration R&D**	• WETO and NREL investments in test pads, load banks and controllable grid interface equipment to conduct wind grid integration R&D including micro-grid R&D

Key Projects Over Time



Activities & Accomplishments (FY17-18)

Strategic Area	Accomplishments	Collaborators
Field Testing	• GE Drivetrain reliability testing	• Drivetrain reliability collaborative
Large Dynamometer Testing	• Wind Generator Testing • Columbia Power Technologies MHK generator testing • MHI Vestas 9.5 MW generator testing at Clemson	• GE, CPT, MHI-Vestas
Turbine to turbine wake interactions	• Completed wake steering R&D and testing in FY17 at the SWiFT and Peetz wind farm (NREL)	• Texas Tech Univ
Grid Integration R&D	• Grid fault research on DOE and industry full-scale wind turbines utilizing CGI • Grid Modernization Lab Call (GMLC) projects utilizing CGI, MW/ MWh battery, DOE 1.5 turbine	• Siemens/Gamesa, GE, PG&E
Facilities	• Progress toward construction of the 19.9MW transmission line upgrade • CGI harmonic filter upgrade • Grid simulator load bank design/order	• WAPA • DOE M&O contracts team

Future Priorities (FY19 and beyond)

Strategic Area	Future Priorities	Collaborators
Grid Integration	• Installation of a load bank • Investment and installation of a 2nd CGI • Distributed wind grid integration/micro-grid testing • Wind Battery testing	• SETO and WPTO
Environmental R&D	• Utilize the site for bird and bat detection and deterrence R&D	• Multiple financial assistance awardees
Generator and Drivetrain Testing	• Drivetrain testing and R&D • Linear generator testing	• GE • Dehlsen • VA Tech
Blade aerodynamic R&D	• ARPA-E SUMR blade testing (segmented ultra-light two bladed morphing rotor) • Smart Blades II project – Bend twist-coupled blades for passive load control	DLR, Fraunhofer IWES, Univ of VA
SWiFT Recommissioning	• Fully recommission three Vestas turbines • Complete NRT Rotor Testing	• NREL • Vestas • TPI
Transition to Flatirons campus	• Continue to prioritize NWTC R&D needs (central control center facility)	• NREL • EERE Tech offices