U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

2021 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
WIND ENERGY TECHNOLOGIES OFFICE

BERKELEY LAB

A01 - Modeling & Analysis to Inform WETO R&D

Analysis & Modeling – Analysis & Modeling

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FY21 Peer Review - Project Overview

Project Summary:

- Help DOE and other stakeholders stay abreast of latest wind technology and market developments and future possibilities
- Fill critical knowledge gaps by conducting analysis on the cost, performance, and value of, as well as barriers to, wind power
  - ✓ Synthesize and analyze foundational data
  - ✓ Conduct innovative and targeted analyses
  - ✓ Provide analytical support to WETO and its partners
- Key project partners include NREL, IEA Wind Task 26, University of Massachusetts, and Paulos Analysis

Project Objectives:

- Inform WETO's R&D planning approaches, investment decisions
- Help WETO evaluate potential opportunities for, and then prioritize, major technology development initiatives
- Provide external stakeholders and WETO data and analysis of cost, performance, value, and barriers to wind power

Project Start Year: FY19
Expected Completion Year: FY20 + ongoing
Total expected duration: 2 years + ongoing

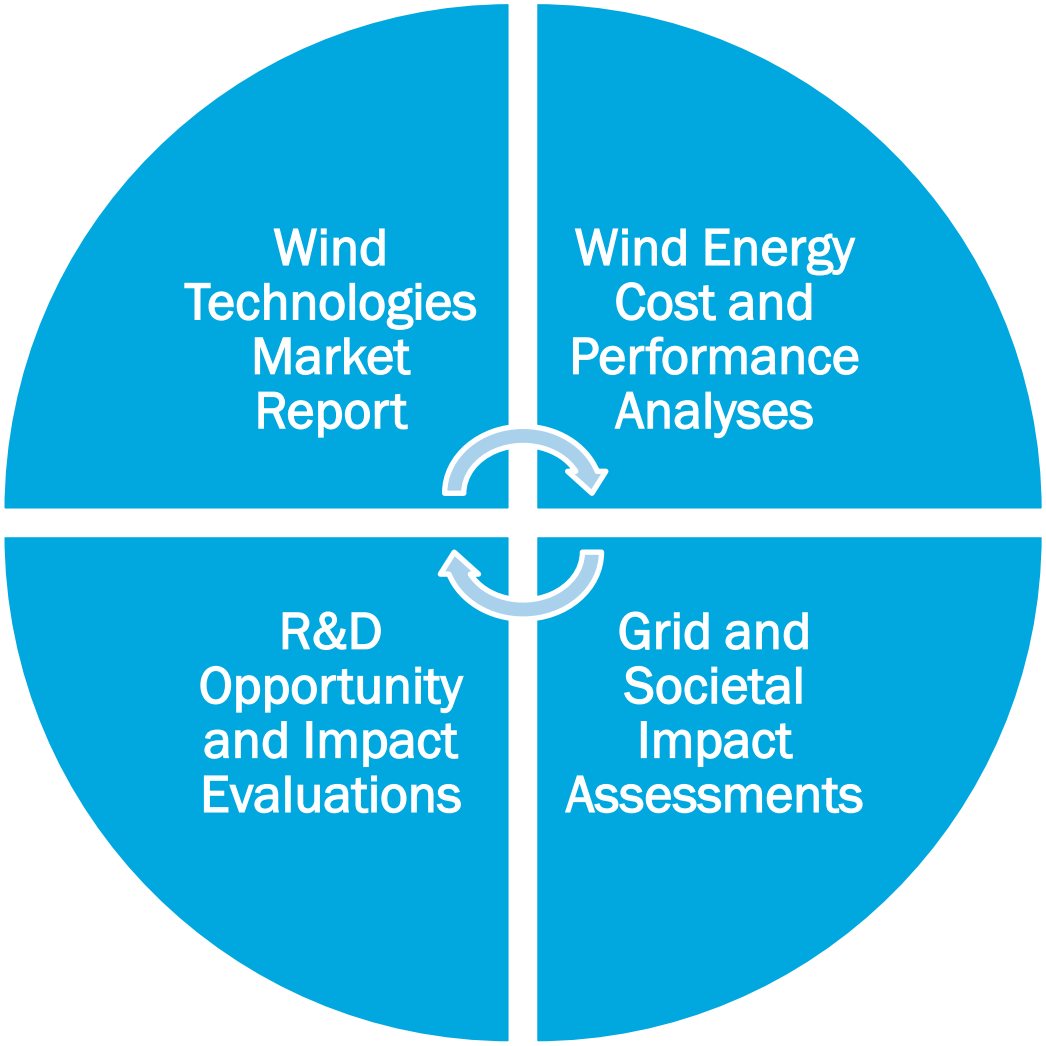
FY19-FY20 Budget: $2,793,103

Key Project Personnel: Ryan Wiser (PI), Mark Bolinger, Dev Millstein, Andrew Mills, Ben Hoen, Joseph Rand, Ben Paulos

Key DOE Personnel: Patrick Gilman (PM)

Project Scope and Impact

Four Areas of LBNL Engagement



WETO

- Helps WETO understand current market status and serves as empirical foundation for R&D assessments
- Enhances WETO's ability to discern and prioritize future technology improvement options, and assess impacts
- Supports a wide range of R&D investment and other decisions with real-time analysis

EXTERNAL

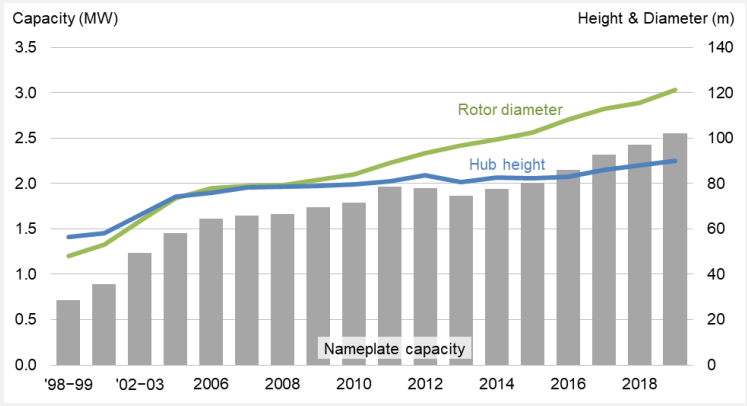
- Provides stakeholders with a trusted source of data on and analysis of cost, performance, value, barriers
- Advances understanding of wind's impact, role, and value within electric system

Project Performance: Accomplishments, Progress, Impact

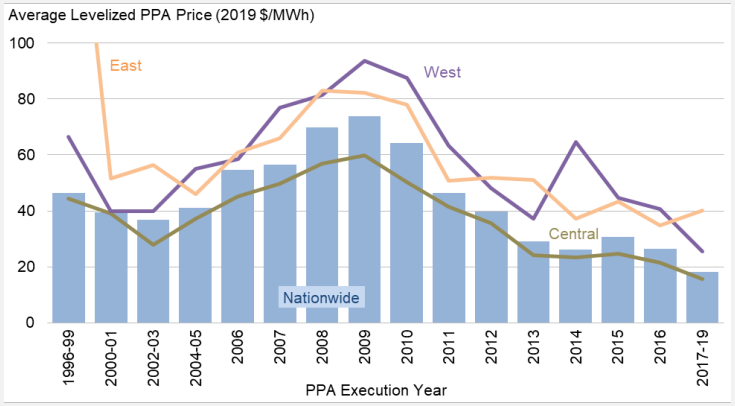
Wind Technologies Market Report

- Goal: Publish annual 'flagship' DOE report that presents data on key trends in the land-based wind market, and covering deployment, manufacturing, technology, performance, cost, and value.
- A 'go to' guide for diverse stakeholders; helps DOE benchmark its R&D progress, and provides empirical foundation for other analyses.

Technology advancement…



…enables rock-bottom PPA prices



New and Notable

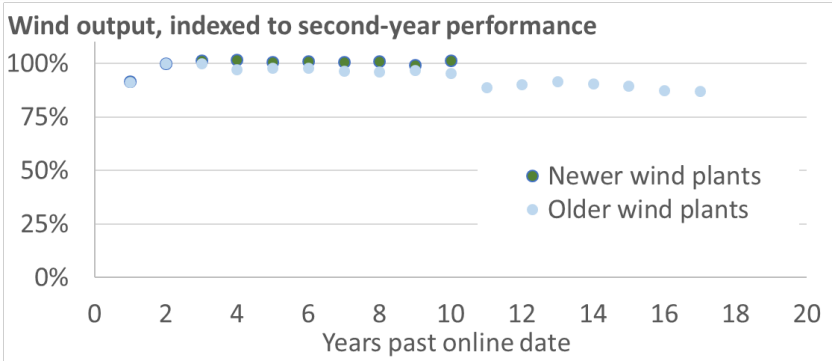
- Hybrid plants: wind+storage, wind+PV
- Transmission interconnection queues
- LCOE estimation and tracking
- Refinement of grid-value analysis
- Data access and visualizations
- U.S. Wind Turbine Database

Project Performance: Accomplishments, Progress, Impact

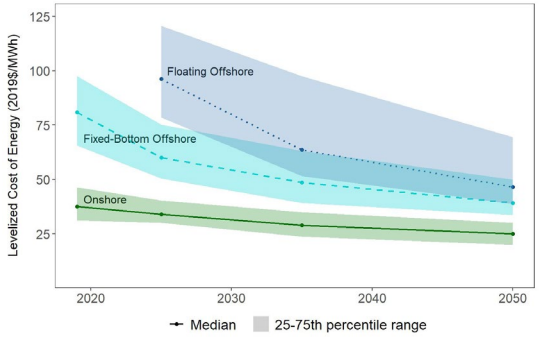
Wind Energy Cost and Performance Analyses

Goal: Analyze cost and performance trends and drivers to help prioritize R&D, and estimate and illuminate pathways to reduce the levelized cost of energy (LCOE).

Performance Change with Age



Expert Elicitation Survey



- 140 global experts
- LCOE-focused
- Also covered:
  - ✓technology
  - ✓constraints
  - ✓grid value

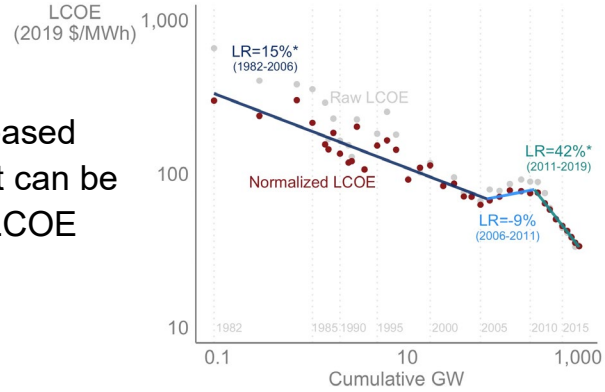
Operating Cost & Project Life Surveys…

Recent projects expect **OpEx** of ~$40/kW-year—a 50% reduction over the last two decades

Recent projects expect a **useful life** of ~30 years—a 50% increase over last two decades

…building up to LCOE-Based Learning

Establish LCOE-based learning rates that can be used to forecast LCOE

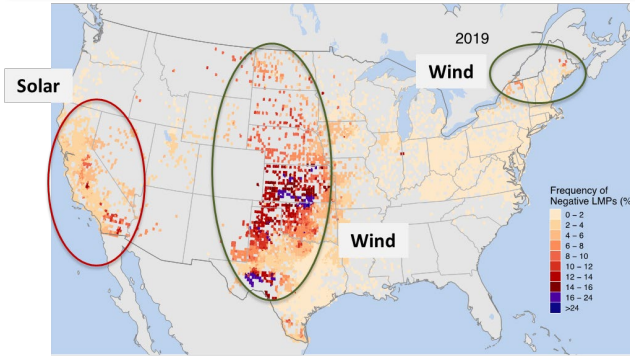


Project Performance: Accomplishments, Progress, Impact

Grid and Societal Impact Assessments

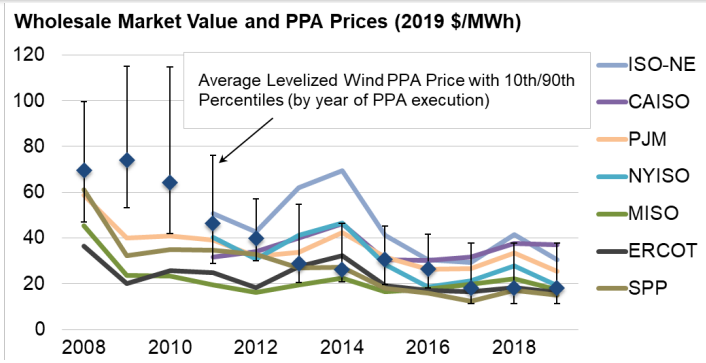
Goal: Advance understanding of wind's grid integration needs and system value, and ways to boost value. Inform R&D targets and prioritization beyond LCOE.

Wind & PV Wholesale Price Impacts



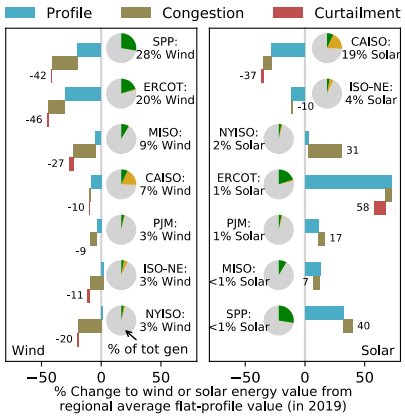
- Impacts on annual average prices are modest
- Impacts of temporal and geographic profiles more significant

Annual Tracking of Market Value



Disentangling Value Drivers…

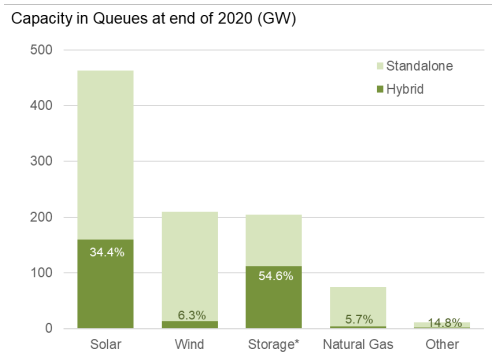
- Above work seeded article that measures impact of output profile, congestion, and curtailment on wind's value
- Informs mitigation options at both system and plant level



…to Inform Methods to Boost Value

Explore ways to boost the grid value of wind:

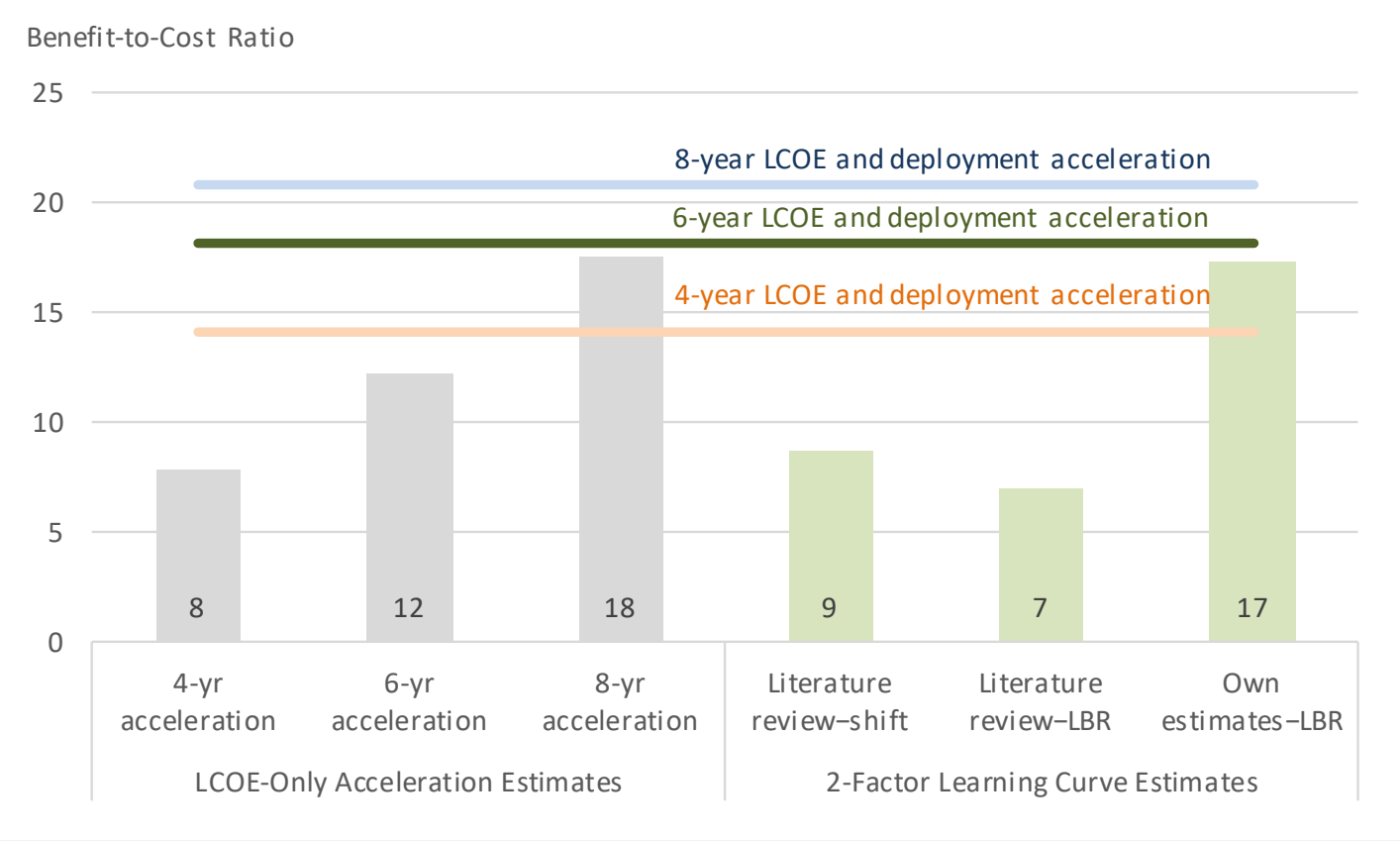
- ✓ Hybridization
- ✓ Large rotors
- ✓ Transmission
- ✓ Ancillary Services
- ✓ Transmission rights



Evaluating the Economic Return to Public Wind R&D in the United States

Assessed economic return on WETO's $3 billion in wind R&D since 1976

Benefit-to-cost ratio of ***18-to-1*** under core case (***30-to-1*** if including carbon)



Project Performance: Accomplishments, Progress, Impact

Other Activities and Accomplishments

IEA Wind, including Task 26 on cost of wind energy

- *Science* article, with NREL and many others through IEA Wind
- *WIRES* article with NREL and IEA Wind Task 26 on wind LCOE
- *Applied Energy* article with IEA Wind on cross-country cost and value trends
- IEA Wind Task 26 cross-country report on technology and costs
- IEA Wind Task 26 ongoing data visualizations on technology and costs

Other collaborative publications with partners

- Land-based wind learning-curve book chapter, with several academics
- Modeling and simulation book chapter, with NREL and others

Technical assistance

- Extensive technical assistance to numerous parties, including state and federal decision-makers, and wide variety of wind and energy stakeholders

Project Performance - Upcoming Activities

FY21 Current and Ongoing Work

- 2021 edition of *Wind Technologies Market Report* and related products
- **Expanded data:** interconnection queues, wholesale prices, hybrid generators
- **Expert elicitation:** *Nature Energy* article, article #2 to be submitted to *Wind Energy*
- **LCOE-based learning:** historical LCOE-based learning, and drivers therein
- **Technology advancement:** impact of turbine advancement on capacity factors
- **IEA Wind:** update visualization data, participate in cross-country report, and more
- **Wind value assessment:** decomposing profile, congestion, curtailment impacts
- **Ancillary services:** exploring possible value enhancement from wind and wind+storage
- **Financial transmission rights:** analyze designs & propose new ones aligned with wind
- **Colorado School of Mines:** census-based local economic and jobs impacts analyses

Work will evolve to more-fully reflect new WETO priorities, and may include:

- Evaluating wind's role and needs within the context of *deep decarbonization*
- Further analysis of approaches to *enhance value* of wind under deep penetrations
- Assessing the *local community* impacts and *social benefits* of wind deployment

Stakeholder Engagement & Information Sharing

Diverse Stakeholders Benefit From This Work

- **All:** Help reveal wind's position in power sector; current or upcoming issues impacting sector
- **Analysts:** Used to benchmark technology and cost assumptions, and modeling inputs
- **Planners:** Often feeds into utility resource planning and procurement decisions
- **R&D:** Used to identify opportunities to reduce costs and/or enhance performance
- **Developers:** Helps developers and offtakers enhance the grid-system value of wind
- **Grid Operators:** Facilitates better understanding of how wind influences power markets
- **Policymakers:** Enhances understanding of how societal value of wind compares to its costs

6	9	3	2
Technical reports	Journal articles	Conf. posters	Book chapters

Press uptake	Presentations	Tech. Assistance	Data Vizes
146	45	126	11