U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

2021 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
WIND ENERGY TECHNOLOGIES OFFICE

Program Area Presentation: Analysis and Modeling

Patrick Gilman, Program Manager

August 2-5, 2021

FY21 Peer Review - Program Overview

Program Summary and Long-Term Objectives:

- Ensure WETO sets robust goals and makes decisions based on a solid analytical foundation to maximize taxpayer return on investment .
- Advance the state of the art in wind energy technoeconomic and scenario analysis
- Provide deep insight on wind energy's roles today and in a decarbonizing future

FY19 - FY20 Budget Under Review: $15,959,667

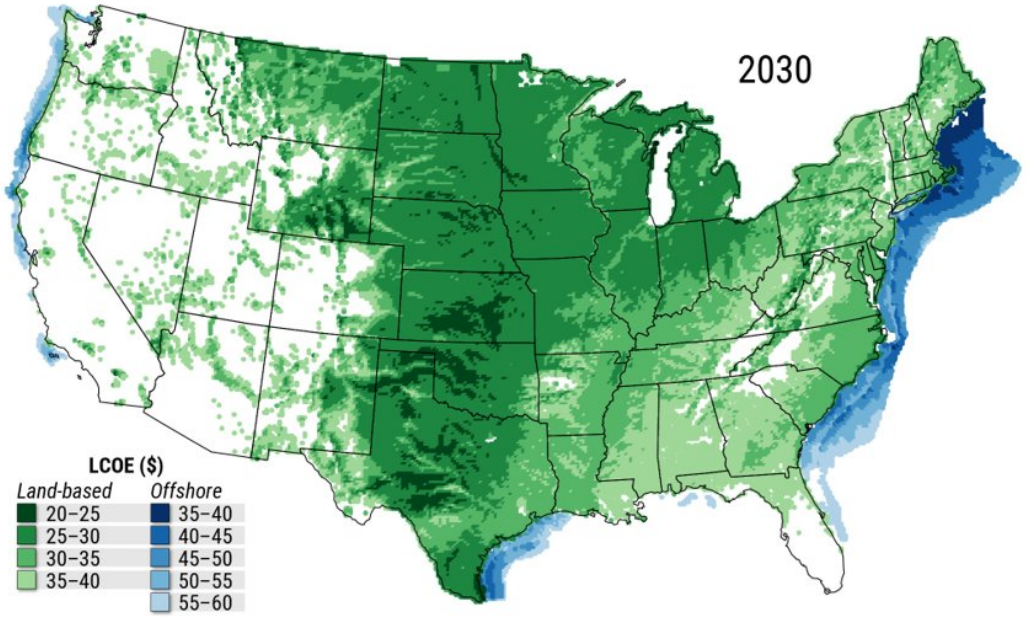
Current budget (FY21): $9,157,095

Number of projects under peer review: 7

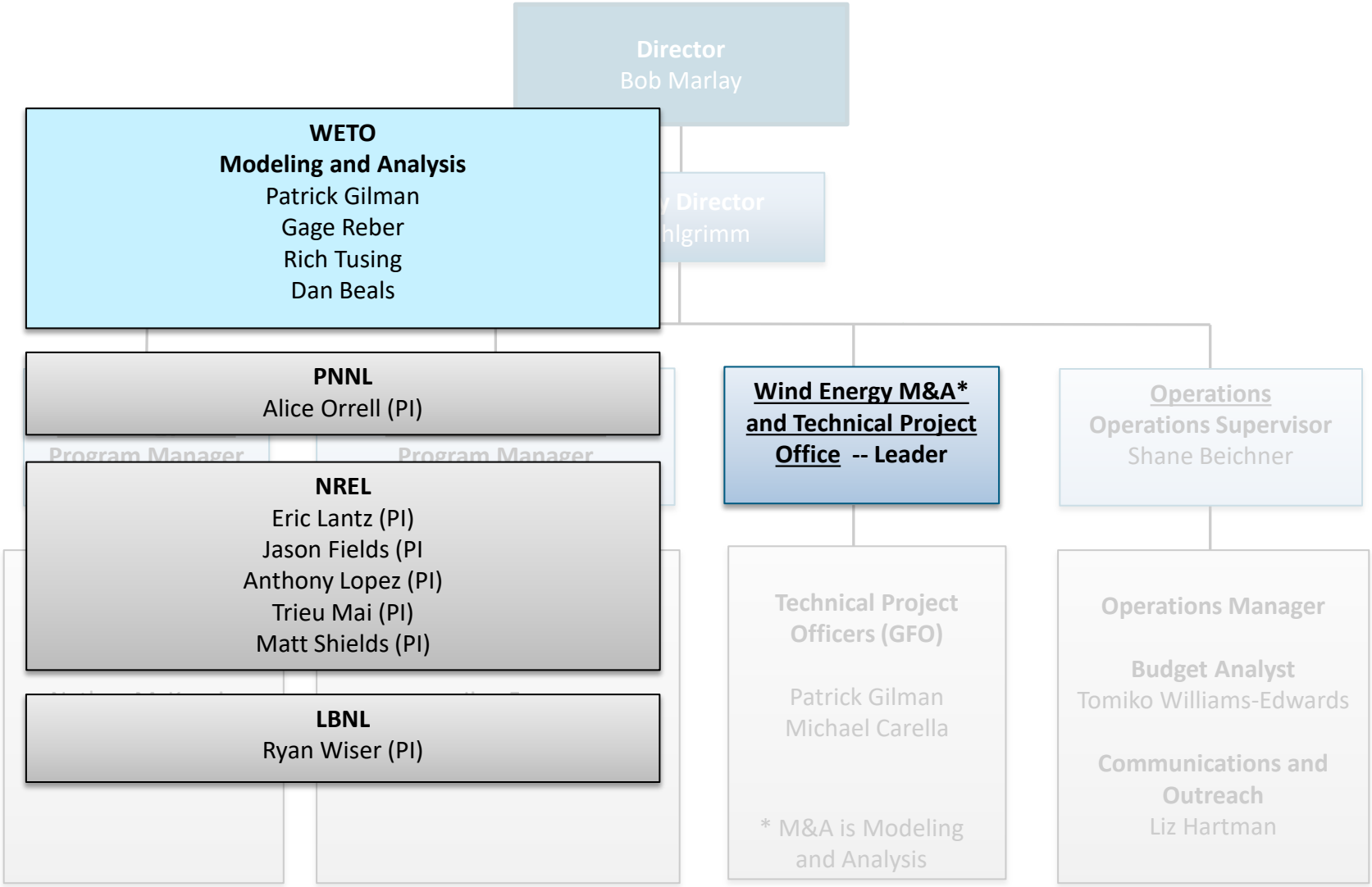
Total number of current projects: 7

Program Objective(s) 2019-2020:

- Process-based balance of system and O&M cost models
- Represent siting, technology, and other issues in wind supply curve
- Wind plant performance benchmark
- Wind market data and reports
- NREL ATB and standard scenarios
- Wind grid value



WETO Modeling and Analysis – the Team

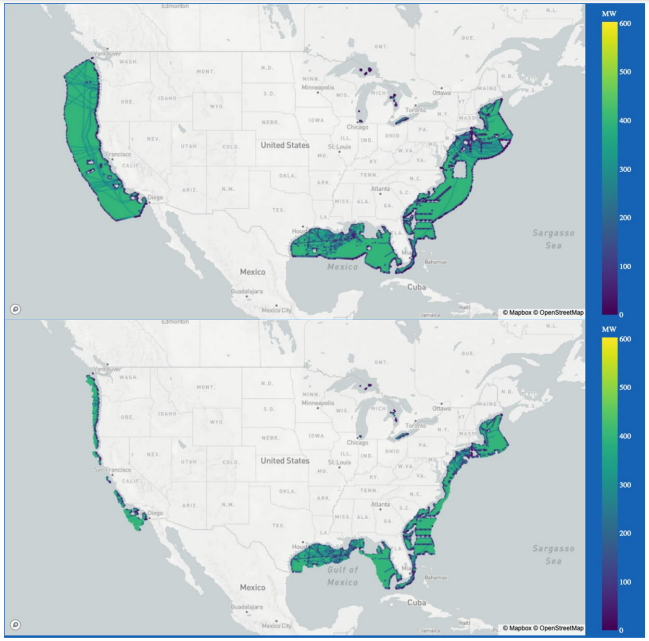


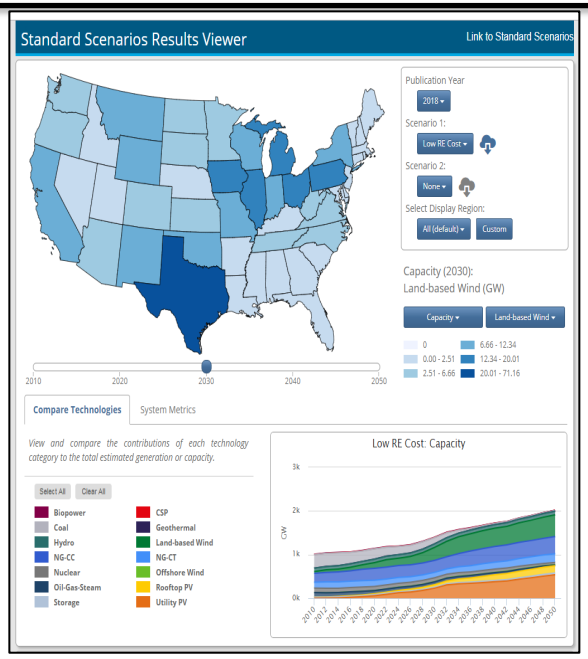
Session Schedule

Project	PI	Lab	Start Time	End Time
Program Overview: Analysis & Modeling	Patrick Gilman	DOE - WETO	10:05 AM	10:30 AM
Modeling and Analysis to inform WETO R&D	Ryan Wiser	LBNL	10:30 AM	10:55 AM
Distributed Wind R&D Analysis Support	Alice Orrell	PNNL	10:55 AM	11:20 AM
Break 1: 15-min			11:20 AM	11:35 AM
Wind Plant Technology Characterization	Matt Shields	NREL	11:35 AM	12:00 PM
Spatial Analysis for Wind Technology Development	Anthony Lopez	NREL	12:00 PM	12:25 PM
Break 2: Lunch, 60-min			12:25 PM	1:25 PM
Energy Sector Modeling and Impacts Analysis	Trieu Mai	NREL	1:25 PM	1:50 PM
Wind Analysis for Priority Needs	Eric Lantz	NREL	1:50 PM	2:15 PM
PRUF- Wind Plant Performance Benchmarking	Michael (Jason) Fields	NREL	2:15 PM	2:40 PM

Analysis and modeling: why and how?

Goals: 1) Ensure WETO sets robust goals and makes decisions based on a solid analytical foundation to maximize taxpayer return on investment; 2) advance the state of the art in wind energy technoeconomic and scenario analysis, and 3) provide deep insight on wind energy's roles today and in a decarbonizing future





Market data collection, analysis, and reporting

- Establish technology baselines and industry benchmarks
- Set goals, track progress, evaluate return on investment
- Retrospective cost/benefits analysis

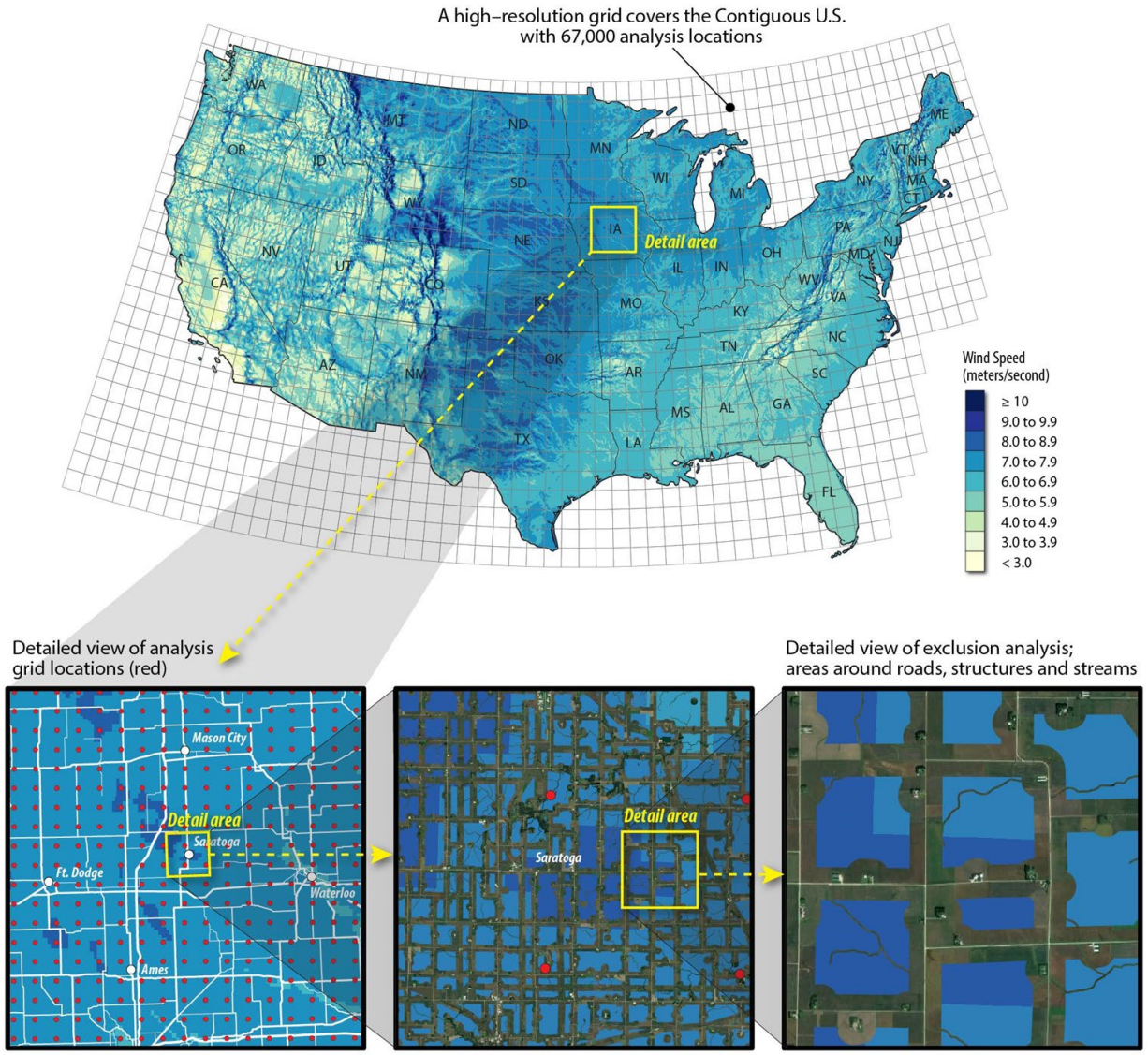
Techno-economic analysis

- Evaluation of wind innovations
- Cost and performance modeling
- Spatial and temporal supply curve analysis
- Electricity sector modeling
- Cost and spatial model development, validation, and maintenance

Strategic wind energy futures analysis

- Electricity sector scenario modeling
- Assess wind costs, value to the grid and other benefits
- Capacity expansion model development and maintenance
- Deep collaboration across DOE/gov't

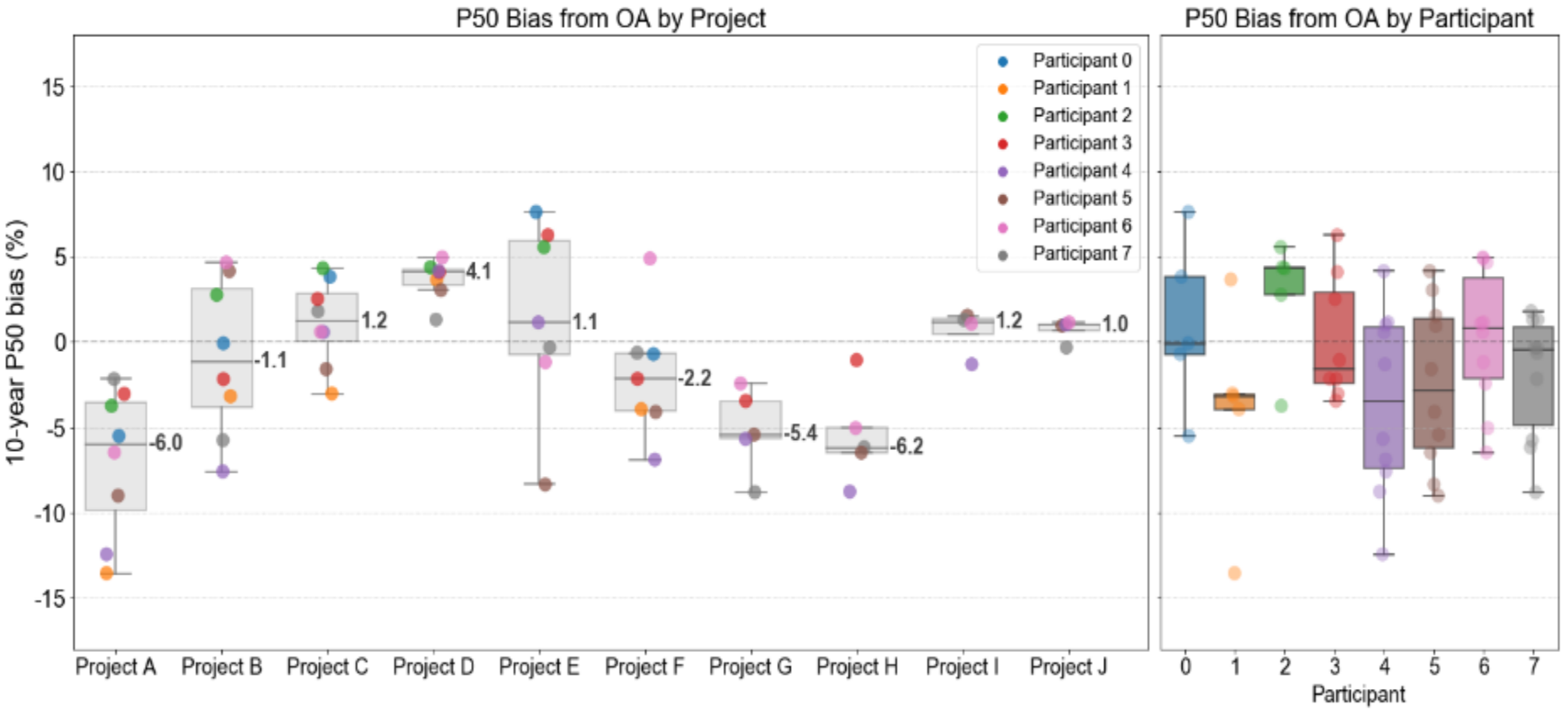
Built on constantly improving, world-class analytical and modeling capabilities



A few examples :

- Cost modeling (SAM, LandBOSSE, ORBIT, WOMBAT, NARWAL)
- Grid planning/Capacity expansion modeling (ReEDS, RPM, PRAS)
- Agent based technology diffusion (dGen/dWind)
- Multidisciplinary Design and Optimization/systems engineering (WISDEM)
- Grid operation modeling (PLEXOS, REFlex)
- Spatial modeling (reV)

Market data collection, analysis, and reporting



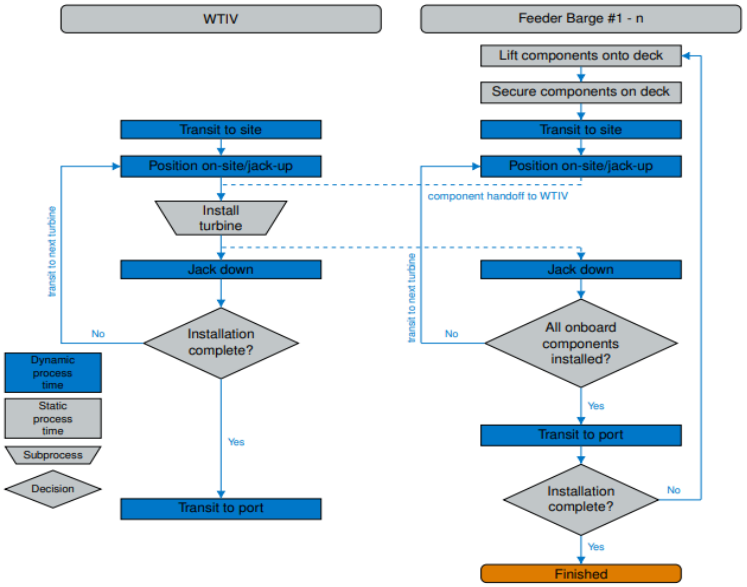
Wind Technologies Market Report, Offshore Wind Market Report, Distributed Wind Market Report and associated data establish cost and technology trends, help us set baselines, targets and measure progress against them.

Performance, Risk, Uncertainty and Finance (PRUF) benchmark has collected and analyzed 10s GW of operational data to assess bias in pre-construction performance assessment (above) and helped consultants and owner-operators improve their assessments

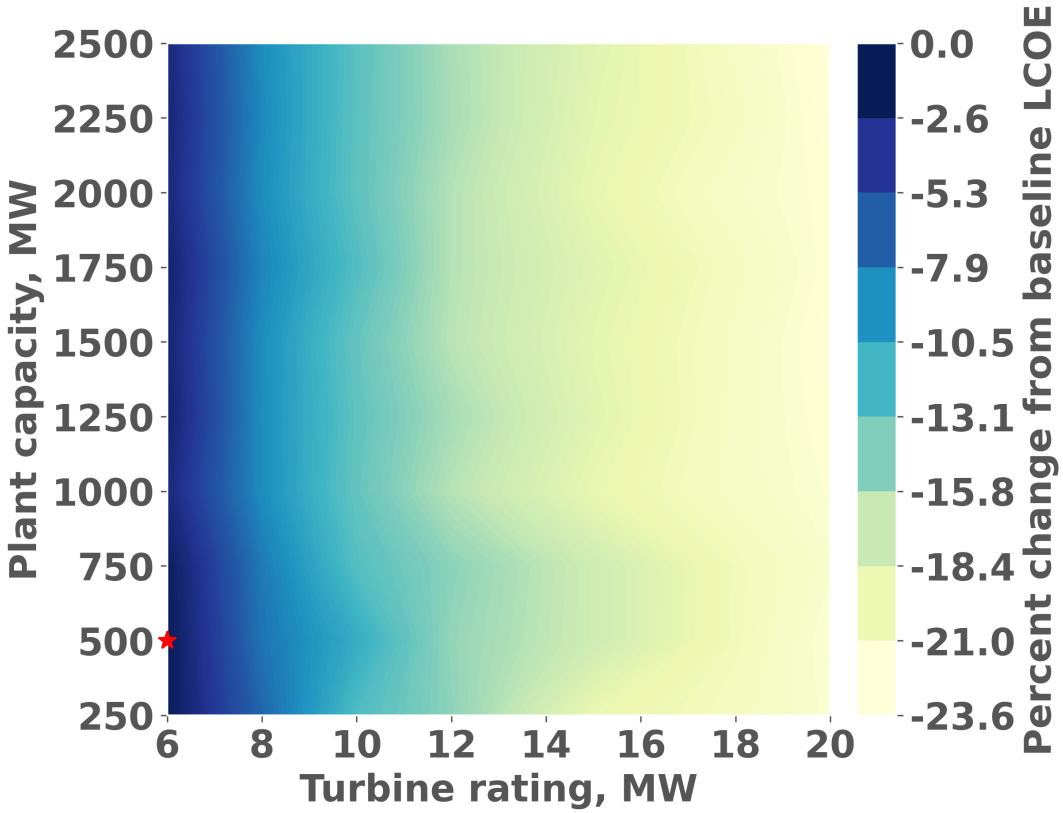
Techno-economic analysis

ORBIT:
Offshore
Renewables
Balance-of-system
Installation Tool

LandBOSSE:
Land-based
Balance-of-System
Systems
Engineering



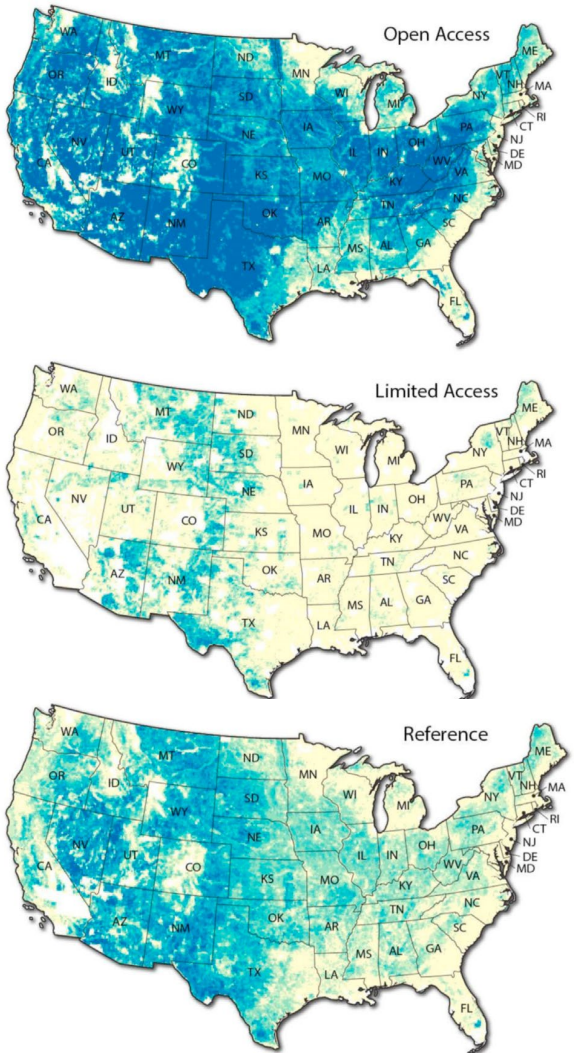
Process diagram showing the turbine installation process used in ORBIT (Nunemaker, et al., 2020)



Impacts of plant size, and turbine rating on the levelized cost of energy of offshore projects (Shields, et al, (2021), *Applied Energy*)

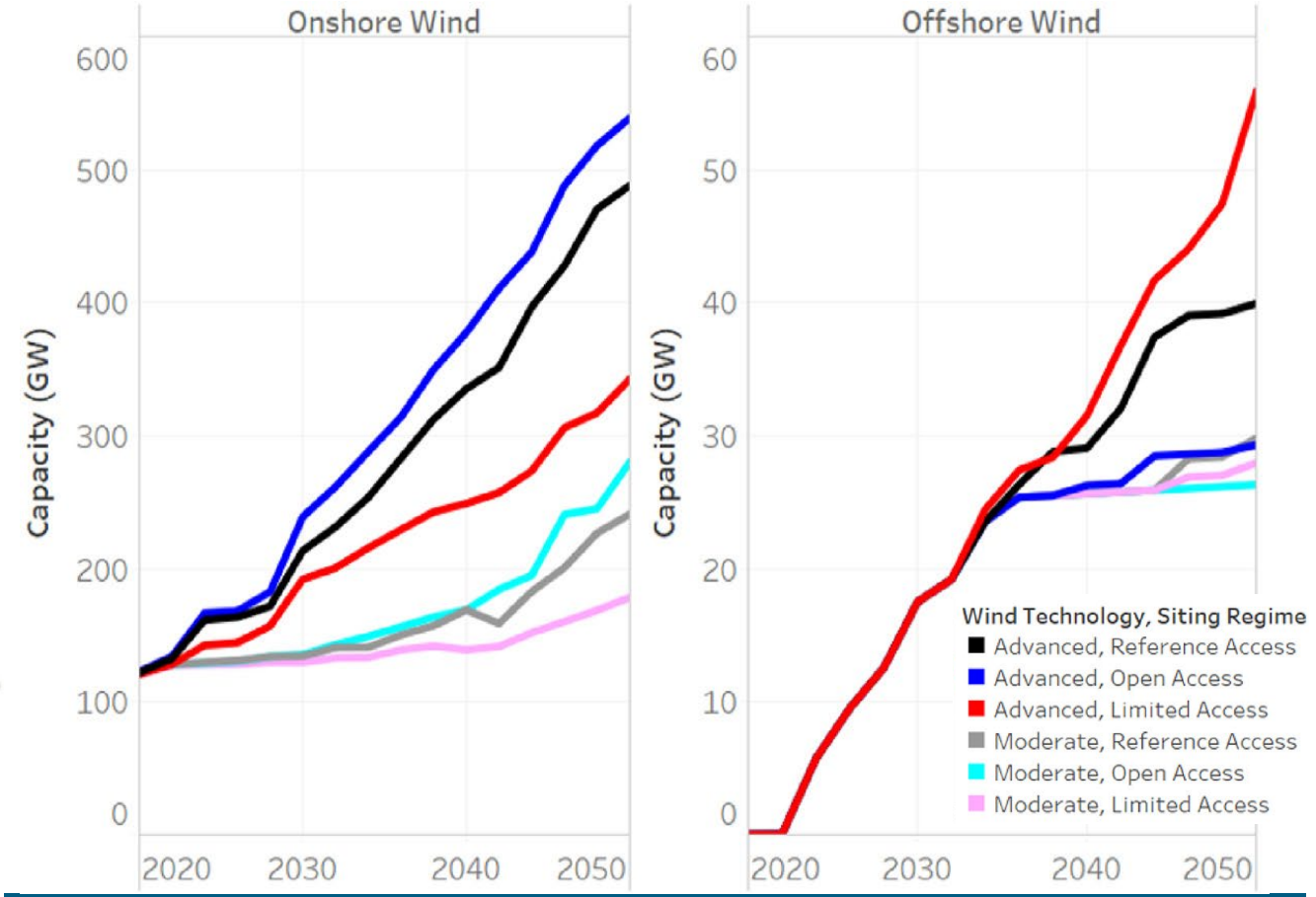
Bottom up cost model development – Developed state-of-the-art, open-source process-based cost models LandBOSSE and ORBIT to assess balance of system and installation innovations on total system costs

Wind Energy Futures Analysis



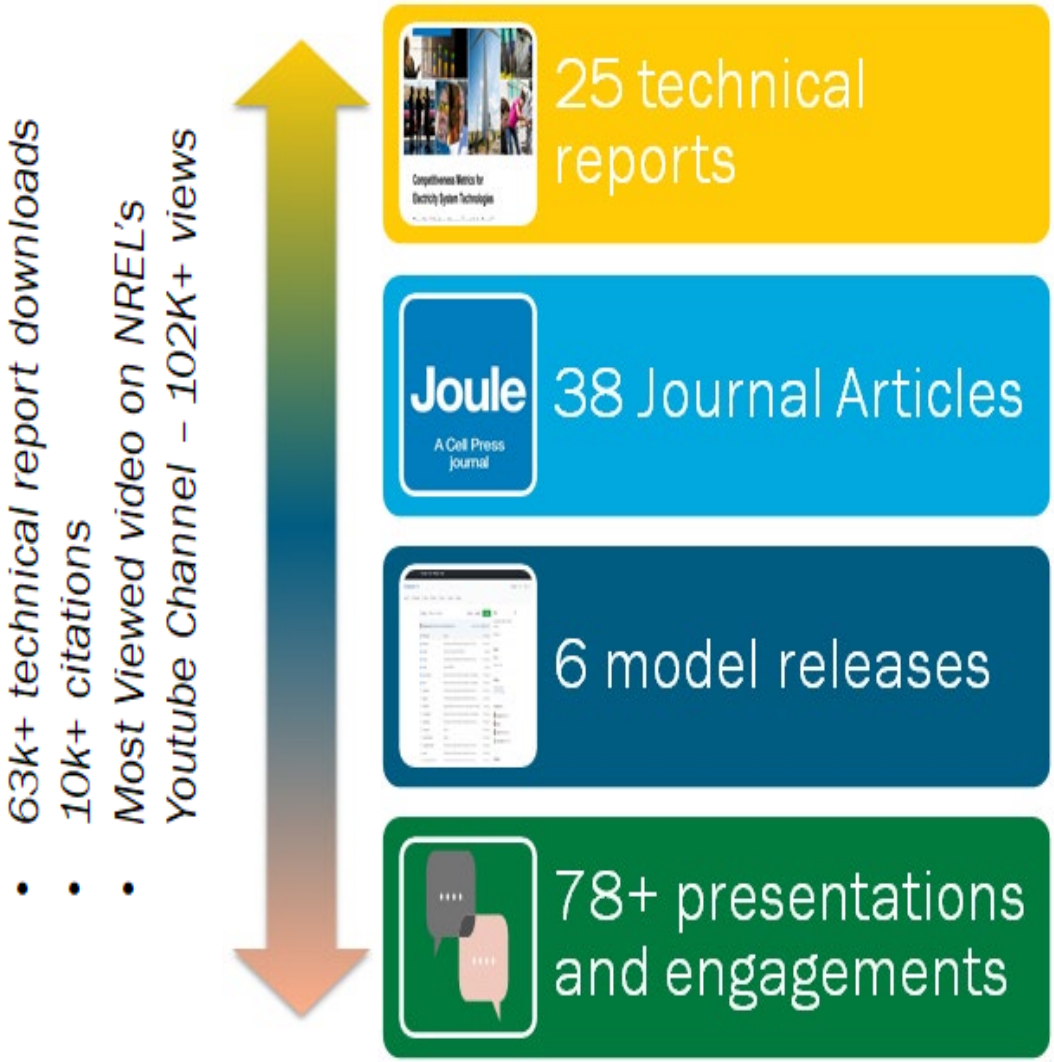
Potential wind energy capacity given siting constraints (dark = more)

Lopez et al. 2021, Mai et al. 2021



The impact of wind siting constraints on wind energy potential and power system evolution- Groundbreaking study on effects of different siting constraints on wind's technical potential and deployment in various electricity sector future scenarios

Program Impact



Notable Accomplishments

Overview of Offshore Floating Wind Webinar: Most watched video on NREL's Youtube channel – 102K+ views added over 500 new subscribers

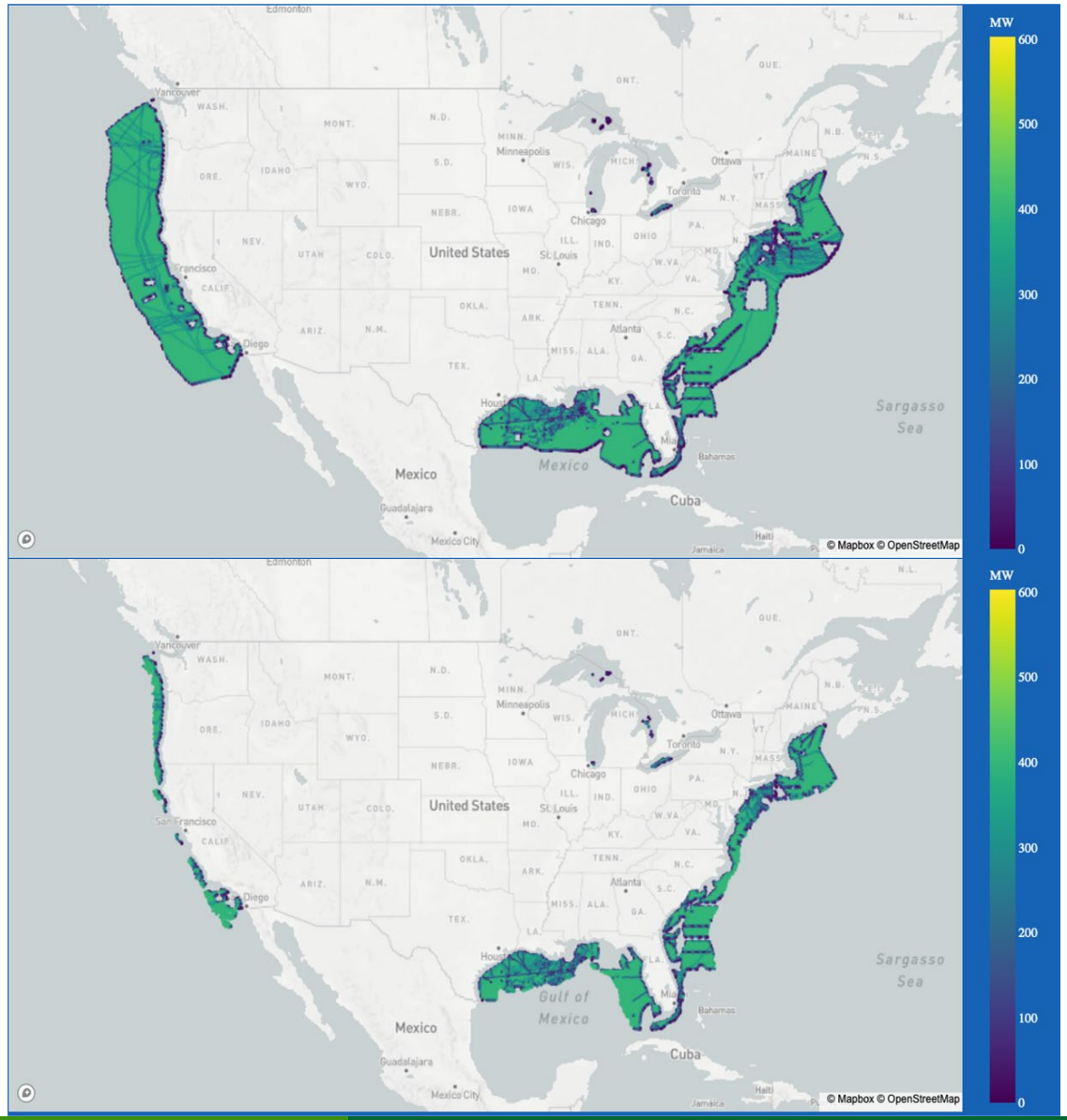
Development of BOS Cost Models ORBIT and LandBOSSE: Up to date open-source balance of system cost models that can model impact of individual innovations

Development of Spatially Explicit Wind Siting Regimes: reV supply curves have been updated to better represent wind turbine siting constraints like setback requirements

15 MW Offshore Reference Turbine: Created open-design and model, which serves as a baseline for offshore wind industry and research community. Has over 12K+ report downloads

Expert Elicitation Survey: 140+ of world's wind energy experts were surveyed to gain insights on future cost reductions and drives of wind technology. Expert findings anctipate cost to be 45-53% lower than predicted in 2015. Resulted in an article in Nature Energy

Coming Attractions



- Complete process-based cost models
- Wind in deep decarbonization
- Offshore wind supply curves
- Spatially-explicit capacity expansion modeling
- Manufacturing and supply chain
- Net economic impacts
- Energy and environmental justice