U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

2021 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
WIND ENERGY TECHNOLOGIES OFFICE

Argonne NATIONAL LABORATORY

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NREL Transforming ENERGY

Pacific Northwest NATIONAL LABORATORY

T37 - 1.2.2.401 – Tools Assessing Performance

Technology RD&T and Resource Characterization – Distributed Wind

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FY21 Peer Review - Project Overview

Project Summary:

The Tools Assessing Performance (TAP) project aims to improve wind resource assessment so distributed wind system developers can better predict turbine performance—enabling wind turbines to become a more economically viable and reliable distributed energy resource.

The TAP portal provides access to newly available wind resource data, allows users to perform timely and accurate performance assessments, enables modeling of obstructions that may impact turbine performance, and delivers a validated methodology for developing and documenting distributed wind turbine performance assessments.

These core innovations will be brought together within a single software package accessible through a web interface and Application Programming Interface (API).

Project Objectives 2019-2020:

- Complete assessment of the existing state of the art for distributed wind resource assessment tools and data.
- Create meaningful baselines for the current state of the art and targets for improvement at the completion of the project.
- Develop ensembles to quantify uncertainty and select optimal Weather Research and Forecasting setup
- Develop methodology for evaluating and potentially correcting the bias in the national wind resource dataset.
- Develop high fidelity analysis for single obstacles and create training dataset for development of lower order models.
- Analyze methods for spatial and vertical interpolation and identify combination which produces lowest error.

Overall Project Objectives (life of project):

- Enable consistent project performance estimation across the industry.
- Lower the cost of estimating project performance.
- Reduce the wide range of actual versus estimated project performance from +/-50% to +/-5%.

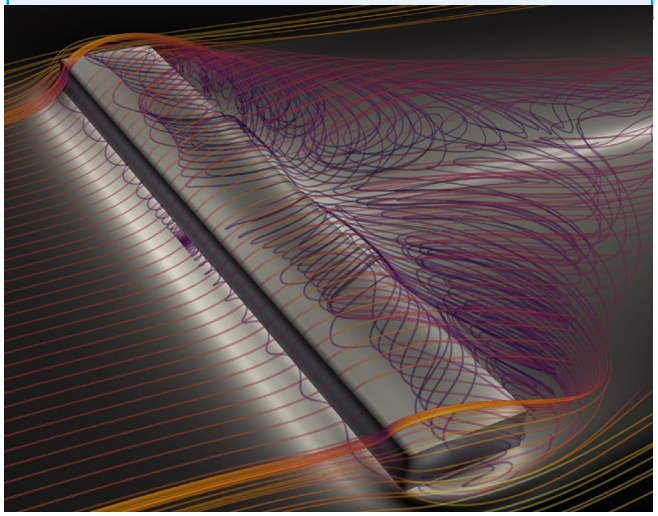
Project Start Year: 2019
Expected Completion Year: FY 2022
Total expected duration: 4 years
FY19 - FY20 Budget: $1.6 million/year

Key Project Personnel:

- Heidi Tinnesand, PI – NREL
- ANL: Rao Kotamarthi, Jiali Wang
- LANL: Rod Linn, Matt Nelson
- NREL: Caroline Draxl, Caleb Philips
- PNNL: Alice Orrell, Lindsay Sheridan

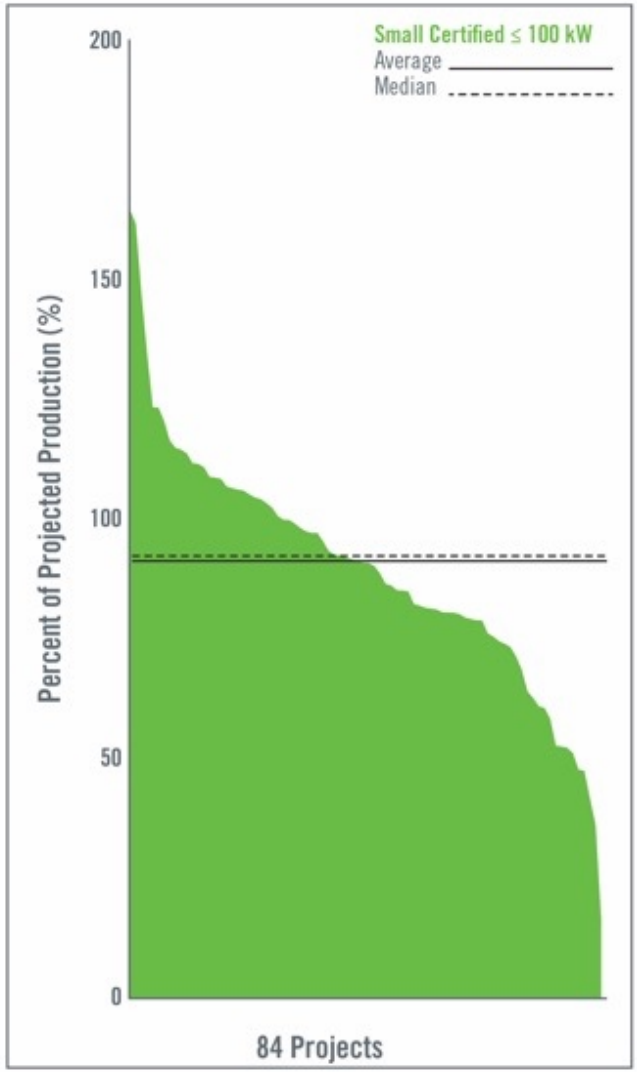
Key DOE Personnel:

- Patrick Gilman
- Bret Barker



Project Impact

Reduce the wide range of actual versus estimated project performance from approximately +/- 50% to +/- 10%.

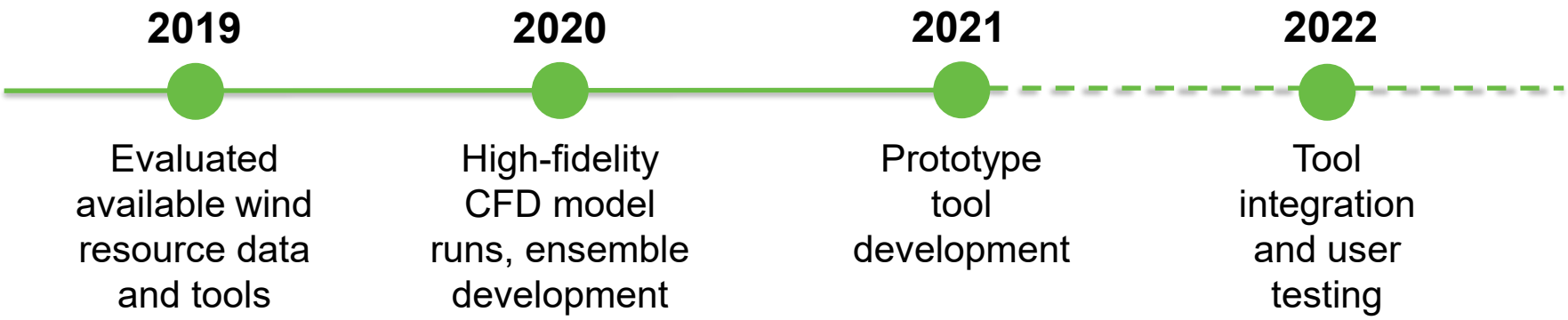


Project Impact: Example

There is a growing segment of distributed wind projects installed behind the meter for industrial customers using utility-scale wind turbines.

Profits for projects like this can be significantly increased using better wind resource capabilities.

Program Performance – Scope, Schedule, Execution

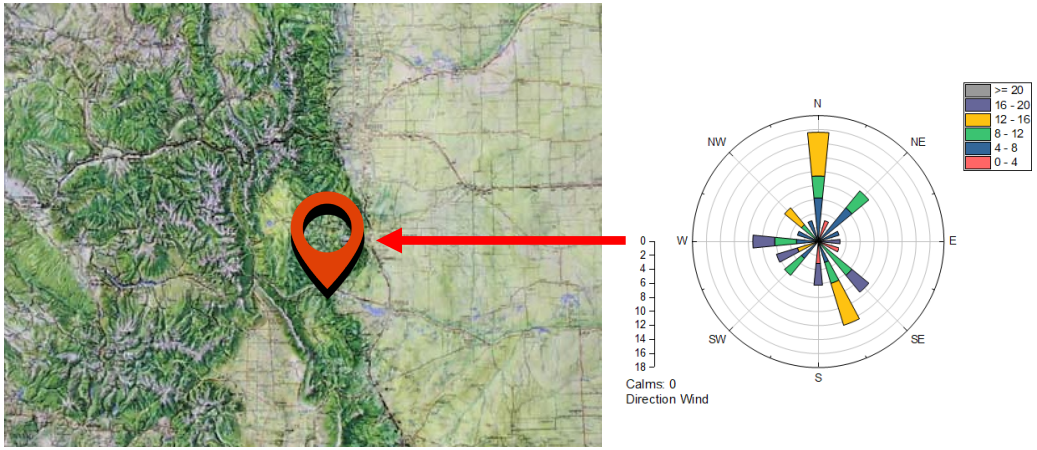


The TAP team has overcome significant challenges through:

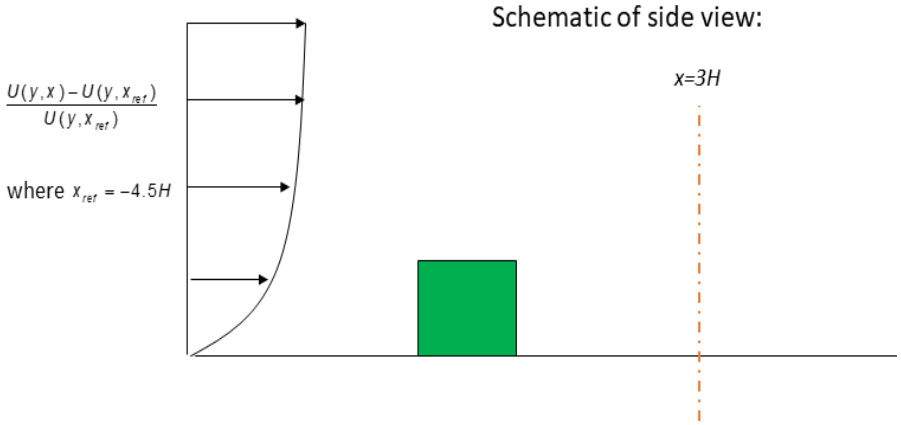
- Securing access to sufficient computational resources to run the weather research and forecasting model to create the new national wind resource dataset.
- Finding and developing the right computational fluid dynamics (CFD) tool to create the training dataset needed to develop new purpose-built low-fidelity models.

Program Performance – Accomplishments & Progress

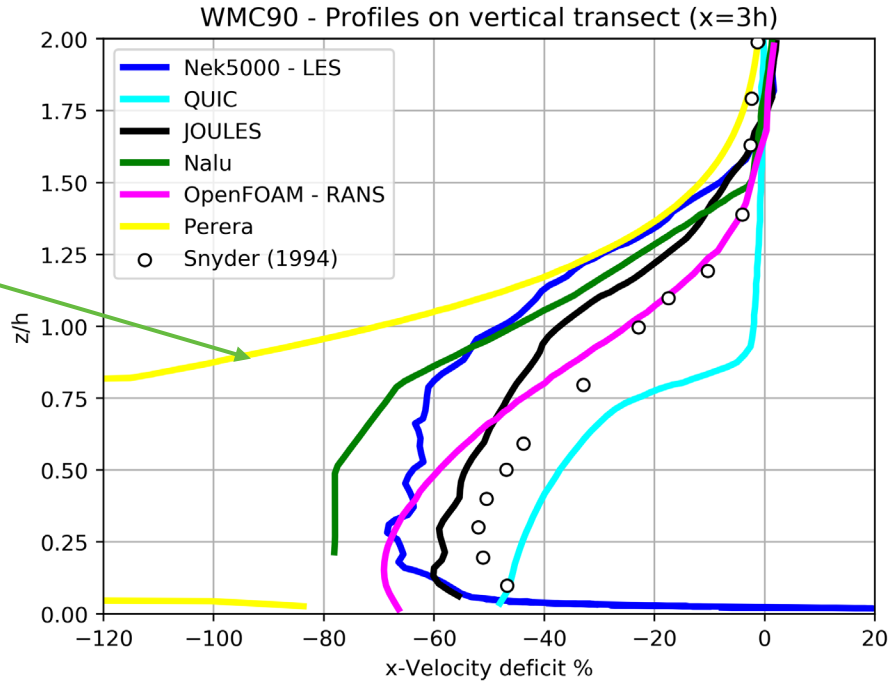
- **New, best-in-class national wind resource dataset**:
  - Completed ensemble runs in Alaska and the continental United States, began quantifying model uncertainty and determined optimal model setup.
  - Developed bias characterization and correction strategy.
- **Obstacle modeling capability**:
  - Developed library of high-fidelity CFD simulations to inform lower-order model development.
- **Computational backbone**:
  - Determined best combination of spatial and vertical interpolation. techniques.
  - Developed beta version of tool.



Program Performance – Accomplishments & Progress



Perera: commonly used simple wake model.



Project Performance - Upcoming Activities

- **New, best-in-class national wind resource dataset**:
  - Produce ensemble runs in Hawaii.
  - Run 18 years for the entire U.S. and 20 years for Alaska.
  - Quantify bias in 20-year dataset, correct bias where possible.
- **Obstacle modeling capability**:
  - Validate new models using three validation datasets: 13 sites in the Netherlands, test site in Texas, text site at ANL.
  - Refine models based on validation exercises.
- **Computational backbone**:
  - Implement obstacle models.
  - Test integration of capability with existing user-facing tools, e.g., HOMER, SAM, GridLAB-D.
  - Implement stakeholder feedback.

HOMER Energy by UL

Stakeholder Engagement & Information Sharing

Conference Venues

[Broad Dissemination and Outreach]

Stakeholder Workshops

[General Discussion and Feedback]

One-on-one Sessions

[Specific Tool Feedback]