Data from XFlow Energy's 5-kW prototype wind turbine validation campaign in 2020 (shown here) provided key information for XFlow's 2019 CIP Prototype Design Development project, which took the turbine from early-stage concept to a thoroughly engineered, construction-ready design. *Photo by Ian Brownstein, XFlow Energy*

U.S. Department of Energy Competitiveness Improvement Project (CIP)

2021 Prototype Installation and Testing Awardee: XFlow Energy Company

Project dates: Nov. 1, 2021–July 31, 2023

Project Overview

XFlow Energy Company To Validate an Aeroelastic Model To Help Certify Its Vertical-Axis Wind Turbine Design

XFlow Energy Company (XFlow Energy) aims to reduce the cost of wind energy by designing vertical-axis wind turbines (VAWTs), which have a cheaper blade manufacturing process and a mechanically simpler design than traditional wind turbines, among other cost-saving advantages.

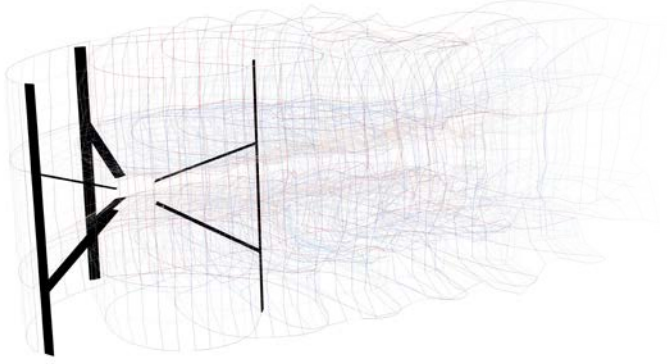
However, a lack of modeling or simulation tools that can predict the coupling between aerodynamic and structural forces poses a significant challenge to developers of VAWTs. Known as aeroelastic models, these are not just important design tools—they're critical for certifying VAWTs of 25 kilowatts (kW), which is the size of XFlow Energy's prototype wind turbine. Without certification, XFlow Energy will not be able to deliver an independently validated product to its customers, and those customers will not be eligible for state and federal incentives. An accurate aeroelastic model could provide less-conservative structural optimization tactics than are currently used, resulting in a wind turbine with lower capital costs.

Project Outcomes and Deliverable

This project will advance XFlow Energy's 25-kW wind turbine toward commercialization by demonstrating the turbine's capabilities in real-world conditions to internationally recognized standards and validating key features of the design, which can only be tested in the field.

> "This Prototype Installation and Testing award enables XFlow Energy to get one step closer to commercializing our low-cost-of-energy, vertical-axis wind turbine."
>
> *Ian Brownstein, Chief Executive Officer, XFlow Energy*

The project will also result in a validated aeroelastic model capable of capturing the physics of VAWTs—a key step to increasing commercial readiness. While additional system optimization will likely occur after this validation, the VAWT design will be ready for certification.



This visualization simulates the flow around XFlow Energy's 25-kW wind turbine. This simulation was made possible with assistance from the National Renewable Energy Laboratory during XFlow's 2019 Prototype Design Development Competitiveness Improvement Project award. *Photo Image by Ian Brownstein, XFlow Energy*

Project Approach

XFlow Energy will test a prototype of its 25-kW VAWT at the Spanish Fork Test Facility in Spanish Fork, Utah. Measurements will be collected using International Electrotechnical Commission standards. This validation will demonstrate the VAWT's power production and quantify its acoustic emissions. Furthermore, the loads-measurement campaign will be used to validate a novel aeroelastic model capable of capturing the complex physics around VAWTs, including rotor geometries. XFlow Energy will also conduct accelerated lifetime testing on the VAWT's gearbox to demonstrate its ability to operate for the intended lifespan of the wind turbine.

Project Collaborators

Current and future project partners include:

- Windward Engineering—the owners of the Spanish Fork Test Facility, which Windward Engineering leased to XFlow Energy along with measurement equipment.
- National Renewable Energy Laboratory (NREL)—the team who will review the design and provide general technical assistance.

Project Financial Information

Award Amount: $250,000

Awardee Share: $75,800

Total: $325,800

Prototype Installation and Testing Award

One of eight types of Competitiveness Improvement Project awards, Prototype Installation and Testing projects validate a prototype wind turbine to determine the commercial readiness of the turbine system. These results are intended to confirm that turbine designs or improvements are ready for certification testing.

> "XFlow Energy's VAWT prototype has the potential to lower the cost of energy from wind by harnessing the benefits of vertical-axis wind turbine designs. In addition, the company's aeroelastic model will benefit the wind industry—and its customers."
>
> *Scott Dana, NREL technical monitor*

About the Competitiveness Improvement Project

The U.S. Department of Energy's (DOE's) Competitiveness Improvement Project supports U.S. leadership in distributed wind technologies. Managed by NREL on behalf of DOE's Wind Energy Technologies Office, the Competitiveness Improvement Project supports innovation to advance wind energy as a low-cost, distributed generation technology option.

More Information

Visit NREL's website at www.nrel.gov/wind/competitiveness-improvement-project.html

XFlow Energy Company SUB-2022-10035

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National Renewable Energy Laboratory
15013 Denver West Parkway, Golden, CO 80401
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