Ten Carter Wind Model 300 wind turbines installed at the Great Orton Wind Farm in 1993 near Cumbria England. *Photo courtesy of Carter Wind Turbines.*

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

2020 Component Innovation Awardee: Carter Wind Turbines

Project Dates: December 14, 2020 – September 13, 2022

Project Overview

Midsize Wind Turbine Modifications Could Increase Energy Production 86%, Reduce Cost of Energy 41%

Carter Wind Turbines aims to address the need for lower-cost, more-reliable distributed wind energy generation. The company plans to increase efficiency and improve the energy capture of its two-bladed Carter Model 300 midsize, self-erecting wind turbine. To achieve this, Carter Wind will:

- Enlarge the rotor diameter from 23 meters (m) to 36 m
- Use new airfoil shapes for the blade designed specifically for stall-regulated rotors, which automatically slow blades as winds increase to extreme speeds
- Incorporate lightweight, fiber-reinforced composite materials into the blades.

In addition, a simplified manufacturing process will decrease the cost of production and improve performance and reliability. Along with rapid deployment, this could make the wind turbine more economically viable for industrial and municipal customers who have unique grid situations and site conditions like those found in remote or island locations.

> "Carter Wind is excited to partner with the U.S. Department of Energy and the National Renewable Energy Laboratory to develop new 36-m rotor blade molds for our Model 300 wind turbine. The partnership will help accelerate blade production and significantly lower distributed wind levelized cost of energy."
>
> Matt Carter, President and CEO of Carter Wind Turbines

Project Outcomes and Deliverables

Carter Wind's new 36-m rotor may enable 86% more energy production (795 megawatt-hours per year projected compared to the 427 that comes with a 23-m rotor). This increase will result in an expected 41% levelized cost of energy reduction to 4.7¢ per kilowatt-hour, which will also allow locations with lower wind energy resources to adopt the technology and increase the number of economically viable projects nationwide.

The longer blades will also incorporate new airfoils that will:

- Improve blade aerodynamic performance and structural efficiency, resulting in lower blade weight and cost
- Increase annual energy production by ensuring dirt, bugs, or other surface irregularities minimally impact blade performance
- Reduce noise.

Plus, designing and engineering new manufacturing equipment—called blade tooling—will:

- Reduce the number of parts to manufacture and steps in the production process, which lowers blade costs, improves quality control, and reduces production time
- Allow use of modern design tools to predict loads more accurately, which will increase reliability while reducing weight and corresponding cost
- Improve manufacturing quality to increase structural performance.

Lastly, a new single passthrough flexible blade design (called Flex Beam) attached to both blades with a single, pinned joint will reduce the number of parts that must be manufactured and improve serviceability of the blades and Flex Beam.

Project Approach

To achieve the goals of this award, Carter Wind Turbines will:

- Evaluate, confirm, and verify rotor design and loads for certification
- Design new manufacturing molds to produce Flex Beams and blades
- Evaluate different blade mold manufacturing processes for more efficient construction
- Fabricate the molds for Flex Beams and blades
- Fabricate the first Flex Beam and first blade for testing
- Prepare for Flex Beam and blade testing
- Complete progress reports, incorporating National Renewable Energy Laboratory (NREL) review and feedback.

Project Collaborators

Current and future project partners include:

- *Cascadia Consulting Group*—Research and analysis support
- *DNV-GL*—Blade design and modeling support
- *Janicki Industries*—Proposed blade mold producer

Project Financial Information

Award Amount: $400,000
Awardee Share: $100,000
Total: $500,000

> "The larger rotor developed through this Competitiveness Improvement Project subcontract will allow Carter Wind to deploy its medium-sized wind systems in new markets and ensure the systems are not only cost competitive with conventional energy sources but reduce overall carbon emissions, too." s
>
> Dave Snowberg, National Renewable Energy Laboratory Technical Monitor

Component Innovation Award

One of eight types of Competitiveness Improvement Project awards, Component Innovation Awards are designed to support innovation in existing components. For example, awards support:

- New commercial turbines that lower costs or improve production with longer blades or innovative tower concepts
- Novel wind generator designs, which can reduce levelized cost of energy.

About the Competitiveness Improvement Project

The U.S. Department of Energy's (DOE) 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*

Download the *DOE fact sheet*.

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