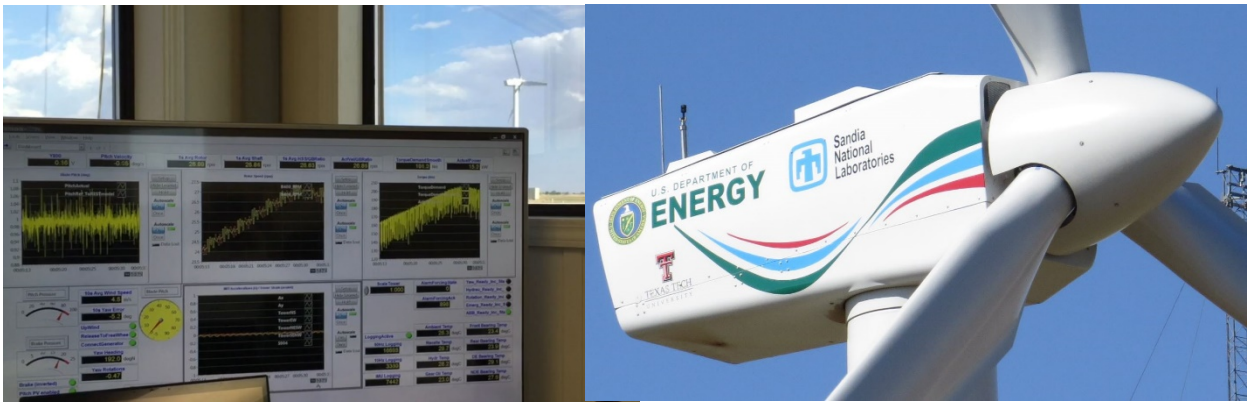
Using Large-Scale 3D Printing to Test New Wind Turbine Blade Designs

A collaboration between Sandia National Laboratories (SNL), Oak Ridge National Laboratory (ORNL), and TPI Composites began when Sandia wanted to test a new subscale wind turbine blade design at the DOE/SNL Scaled Wind Farm Technology (SWiFT) facility hosted by Texas Tech University. The Manufacturing Demonstration Facility (MDF) at ORNL has the largest polymer 3D printer in the world, capable of printing the very large blade mold segments required for this project. Blade manufacturer TPI Composites assisted with the mold design and assembled the mold sections into a complete blade mold after ORNL had printed them. TPI then manufactured the Sandia designed prototype wind turbine blades using the completed mold. National Renewable Energy Laboratory also assisted with blade structural testing. The prototype test blades, which were designed to replicate the wake of full-scale blades, but they were only one-third the size of standard full-scale blades, and they were produced at only 5 percent of cost to manufacture full-scale blades.



The DOE/SNL SWiFT facility has three research-scale, variable-speed, variable-pitch, modified wind turbines with full power conversion and an extensive sensor suite, two heavy duty instrumented anemometer towers, and site-wide time-synchronized data collection.

With conventional blade manufacturing methods, trying new wind turbine blade designs is extremely expensive due to the multimillion dollar cost of making the complex molds used in manufacturing. Since short production runs for prototypes are cost prohibitive, innovation is stifled, and it is difficult to lower the costs and increase adoption of wind energy. 3D printing, or additive manufacturing, is drastically reducing the time and cost associated with building new wind turbine blade designs. It allows blade designs to move directly from computer models to mold production, bypassing some of the expensive and time-consuming steps of more traditional manufacturing. By streamlining the mold-making process, advanced designs can be tested more quickly, accelerating the introduction of new technology and leading to lowered costs for wind energy.

The prototype blades are being flown by Sandia at the SWiFT facility as part of an effort to conduct basic science research on wind plant performance. Additionally, this initial test of using Big Area Additive Manufacturing (BAAM) for this application is being analyzed by ORNL. With

more large 3D printers becoming available in the marketplace, TPI is evaluating the feasibility of using 3D printing not only for producing molds for subscale blade prototypes, but perhaps also for larger-scale blade manufacturing. This method for creating wind blade molds is also attracting interest from companies like Ingersoll Machine Tools, Inc., which would like to build larger 3D printers to accommodate the needs of the largescale tooling industry. Together, two national laboratories, working with industry, are coming up with new ways to lower the cost of wind energy production and accelerate the deployment of wind power. Sandia and ORNL won a Federal Laboratory Consortium Regional Partnership Award in 2017 for this work.

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