

IOWA STATE UNIVERSITY

College of Engineering

Wind Energy Initiative

Advancing Wind Energy Research, Education and Outreach

U.S. Department of Energy's Wind Vision*

10% of electricity by 2020

20% by 2030

35% by 2050

Iowa State's Wind Energy Initiative brings together the knowledge and resources necessary for the nation to meet these goals.

* Study Scenario

WEI at ISU

Researchers at Iowa State University make the most of the abundant wind resource available in the state of Iowa. Their work covers the entire spectrum of the engineering and science necessary to produce wind energy—from atmospheric studies to blade manufacturing and tower construction to grid integration—and makes the renewable energy source more affordable and accessible.

The Wind Energy Initiative (WEI) in ISU's College of Engineering formally began in 2008, building on several successful research and educational programs within the college. Since then, wind energy-related research expenditures passed the \$1M mark in FY14, and WEI established a federally funded Ph.D. training program, undergraduate wind energy minor and a federally funded research experience for undergraduates program.

Vision

Establish a center of excellence in wind energy research education and outreach to reduce the cost of wind energy production, delivery and its adoption.

Mission

WEI will make wind energy increasingly competitive through: 1) reducing capital costs; 2) increasing energy capture; 3) decreasing costs associated with addressing variability and uncertainty in power production; 4) minimizing operation and maintenance costs; 5) enhancing energy delivery; and 6) improving the environmental impacts of wind energy.

WEI will lead in developing the talent to meet industrial and academic workforce needs related to wind energy. WEI will provide expertise to regulatory bodies and will seek to engage the general public.

Research

WEI collaborates with academia, government agencies, industry and non-profit associations to strengthen its impact on the wind energy sector. The group engages undergraduate students through dedicated coursework, REU opportunities, field trips, seminars and national competitions. Additionally, WEI maintains a research-focused Ph.D. degree in wind energy science, engineering and policy.

Active Research Areas

Wind farm and turbine aeromechanics and wake interference

Sponsors: National Science Foundation, EPSCoR, Iowa Energy Center, IAWIND and Industry

Wind resource characterization, measurement and modeling of turbine-crop and turbine-turbine interactions

Partners: University of Colorado and Anemometry Specialists, Inc.
Sponsors: National Science Foundation, Industry and IAWIND

Design, testing and levelized cost of energy analysis of tall concrete towers and foundations

Partners: Siemens Corp. and Coreslab Structures (OMAHA), BergerABAM, Lafarge North America and National Renewable Energy Laboratory
Sponsors: DOE, Iowa Energy Center and Industry

Blade manufacturing

Partners: TPI Composites, Sandia National Laboratory, National Renewable Energy Laboratory
Sponsors: DOE, Industry and IAWIND

Grid integration

Sponsors: DOE, ISU Electric Power Research Center, Power System Engineering Research Center, Bonneville Power Administration, Southern California Edison Company



Wind turbines in the aeronautic and atmospheric boundary layer wind tunnel aligned to simulate a wind farm in complex terrain.



Fabric layup equipment for studying advanced manufacturing techniques

IOWA

as a resource

Facilities

Wind Energy Manufacturing Laboratory

A high-bay laboratory space dedicated to advancing the manufacturing processes for utility-scale wind turbines. Research in the lab focuses on developing methods for cost-effective manufacturing methods, including advanced manufacturing processes, automation technologies, metrology and nondestructive evaluation (NDE).

Wind Simulation Testing Laboratory

Home to the aeronautic and atmospheric boundary layer wind tunnel that can generate winds up to 110 mph. With an 8'x8'x55', adjustable ceiling height test section, this tunnel is ideal for studying scaled model wind farms in various terrains.

Structure Engineering Research Laboratory

This facility enables load and fatigue testing of large components and wind energy systems, e.g., concrete tower segments.

Wind Energy Systems Laboratory (WESL)

This lab has experimental lab-scale wind turbines and various electric machines, including doubly-fed induction and permanent magnet synchronous generators. Power electronics, controllers, and measurement systems add to the available resources ensuring WESL provides an environment of interdisciplinary system-level research.

Center for Nondestructive Evaluation

The premier U.S. research organization for the development and application of inspection and sensing technologies for structural health monitoring and other applications.

Iowa is the second-leading state in wind energy production, and it is one of only two states to manufacture all three major components of wind turbines: nacelles, blades and towers. Iowa clearly exhibits several distinct advantages in the development of wind energy as a domestic power source:

- Through 2014, Iowa led the nation by generating 28.5% of its electricity from wind.
- Iowa wind farms today power the equivalent of more than 1.4 million homes.
- Worldwide, Denmark is the only country to have achieved > 25% wind power. Did you know Iowa produces 2.5 times more wind energy per capita than Denmark? Think of the possibilities.



IOWA EPSCoR

The Wind Energy platform of Iowa's Experimental Program to Stimulate Competitive Research (EPSCoR) investigates technologies to improve the reliability of wind energy systems.

Platform Leader:

Patrick Barry Butler, University of Iowa

Iowa State University faculty:

Resource Characterization

Gene Takle (Plank Leader)

Baskar Ganapathysubramanian

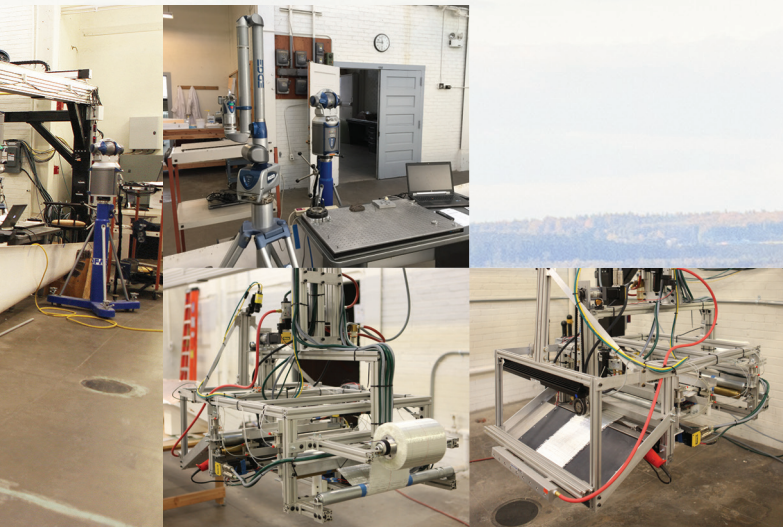
Anupam Sharma

Blade Performance and Reliability

Ganesh Rajagopalan (Plank Leader)

Wind Farm Outdoor Laboratory

This lab will combine data from two 120m meteorological towers with surface observations. Erection begins spring 2015.



for wind turbine blades located in the Wind Energy Manufacturing Lab.

<http://iowaepscor.org/research/energy/wind>

Wind Energy Initiative Research Thrust Area Leads

A diverse group of research faculty from multiple colleges and departments at Iowa State have research funding from multiple sources.



Dr. Leonard Bond
Nondestructive Evaluation



Dr. Hui Hu
Wind farm aeromechanics



Dr. James McCalley
Grid integration



Dr. Frank Peters
Blade manufacturing



Dr. Sri Sritharan
Tall turbine towers and foundations



Dr. Eugene Takle
Wind resource characterization

Industry Collaboration Program

Collaborative projects between industry affiliates and Iowa State University improve how technology to produce wind energy is developed, and both sides of the partnership see the benefits. Researchers gain access to real-world data and expertise from experienced practitioners who can validate models and research, while affiliate companies engage in advanced discoveries.

In these partnerships, affiliates use their research dollars to address a specific technical need in their company and can request research proposals addressing particular problems of interest. As researchers respond and work alongside the companies to develop creative solutions for these projects, the science itself advances, making the impact of these partnerships even greater.

Membership Levels

Large Business \$40,000

Small Business \$15,000

Affiliate benefits

- Access to expertise across the value chain of the wind energy sector
- Sponsored research
 - Customized research projects tailored to your needs
 - Exploit inventions that may lead to new innovative products
- Networking opportunities with industry and government leaders
- Use of unique facilities
- Partner with ISU faculty to obtain federal research funds

For more information:

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www.engineering.iastate.edu/wei

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