

Contact: Diana Gonzalez

**REQUEST FOR A NEW PROGRAM AT IOWA STATE UNIVERSITY:
PH.D. PROGRAM IN WIND ENERGY SCIENCE, ENGINEERING, AND POLICY**

Action Requested: Consider approval of the request by Iowa State University to establish a new Ph.D. Program in Wind Energy Science, Engineering, and Policy (WESEP) in the College of Engineering.

Executive Summary: The proposed program is an interdisciplinary program that will offer new opportunities for students in wind energy related careers in industry, academia, and government. This proposal was reviewed by the Board Office and the Council of Provosts and is recommended for approval. No concerns were raised when it was presented to the Iowa Coordinating Council for Post-High School Education. The proposed program addresses the Board of Regents Strategic Plan priorities to “provide educational excellence and impact as well as economic development and vitality” and Goal #8 – “Iowa’s public universities and special schools shall be increasingly efficient and productive.”

Background:

- ◇ **Description of program.** The proposed program is an interdisciplinary program of study that will develop students’ capability to conduct research on problems that occur in wind energy. This will be achieved through a unique integration of engineering, science, and policy-related disciplines including education and research activities.

Upon completion of the program, graduates will be able to (1) use their expertise in wind energy to formulate research problems and develop and execute research plans that address significant issues in wind energy; (2) manage the research process; including mentoring research staff; (3) analyze and interpret research results using context relevant methods; (4) write well-reasoned and competitive research proposals; and (5) communicate results at technical and non-technical levels through journal publications, conference proceedings, popular and scientific publications, and public presentations.

- ◇ **Relationship to existing programs at ISU.** Given the high degree of collaboration between departments and colleges, it is expected that the proposed program will foster further interdisciplinary research in wind energy and cultivate a stimulating research environment that will enhance ISU’s research capabilities. It will help to provide interdisciplinary bridges between the activities of the Colleges of Agriculture and Life Sciences, Engineering, and Liberal Arts and Sciences.

- ◇ **Duplication.** The proposed program does not exist elsewhere in the state of Iowa. The University of Iowa has a Master of Science program in Industrial Engineering with a focus on wind power management. While a few courses in the Master of Science program may have similarities with those in the proposed program, the Master of Science program does not have as much emphasis on wind energy. SUI only has two graduate courses related to wind energy – Contemporary Topics: Fundamentals of Wind Turbines and Wind Power Management. SUI’s program will likely be complementary to the proposed program at ISU. In 2007, Texas Tech University implemented a Ph.D. program in Wind Science and Engineering as the first in the country.

- ◇ Student demand. Potential demand for the proposed program is based on the interest demonstrated by enrollments in wind energy dedicated courses.
 - More than 130 students have enrolled in the undergraduate course, Introduction to Wind Energy, since 2010.
 - Approximately 30 students enrolled in the undergraduate course, Introduction to Wind Energy, System Design and Delivery, in Fall 2011.
 - Approximately 40 students enrolled in the graduate course, Electromechanical Wind Energy Conversion and Grid Integration, in 2009-2010.
 - More than 20 students enrolled in the graduate course, Wind Energy Manufacturing, in Spring 2010.
 - In 2011, ISU received a \$400,000 grant from the National Science Foundation Research Experience for Undergraduates (REU) program to conduct a summer research program in wind energy from 2011-2013. The program admits only undergraduate students interested in pursuing graduate studies. There were 270 applications for 11 positions funded by the grant indicating strong student interest in research and graduate study in wind energy.
 - Currently, there are approximately 40 graduate students working wind energy-related projects who may be attracted to the proposed program.

- ◇ Unique features. The proposed program leverages the strengths of three colleges at ISU – Engineering, Agriculture and Life Sciences, and Liberal Arts and Sciences – along with multiple centers and laboratories that conduct wind energy related research, including the Center for Nondestructive Evaluation (CNDE), Power Systems Research Center (PSERC), Electric Power Research Center (EPRC), Iowa Energy Center (IEC), Institute for Transportation (InTrans), Wind Energy Manufacturing Laboratory (WEML), Wind Engineering and Experimental Aerodynamics Lab, Climate Science Program (CSP), and Iowa Environment Mesonet. The proposed program will use the campus strengths in engineering and climate science (CNDE, PSERC, EPRC, IEC, InTrans, CSP) and blend it with ISU's expertise in agriculture, rural life, economics, legal, regulatory, and policy in the Center for Agricultural and Rural Development (CARD).

- ◇ Resources. The proposed program will be supported by faculty from the Colleges of Engineering, Agriculture and Life Sciences, and Liberal Arts and Sciences. In September 2011, ISU received a \$3.15 million five-year "IGERT¹" award from the National Science Foundation to support a Ph.D. program in Wind Energy Science, Engineering, and Policy. The program funds will be used for course development and support of 28 domestic students. In 2016, the grant can be renewed for an additional five years. There are 18 ISU faculty members involved in the proposal.

¹ The National Science Foundation acronym for the "Integrative Graduate Education and Research Traineeship Program." See http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12759 for information on this program. The announcement for the IGERT award to ISU on wind energy can be found at http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1069283&WT.z_pims_id=12759.

The ISU Wind Energy Initiative was established by the College of Engineering in 2011 to promote research collaborations in wind energy and currently includes 36 faculty members. The College allocated \$500,000 over three years to support the development of major research proposals and has recruited a new faculty member in 2011 to support the initiative.

Facilities and equipment for the proposed program include the Wind Energy Manufacturing Laboratory, Wind Simulation and Testing (WiST) Laboratory, mesoscale and regional climate models of the CSP, Iowa Environmental Mesonet archives, Alternate Energy Grid Infrastructure and Systems Laboratory, and ISU CNDE.

- ◇ Facilities and equipment. Existing laboratory facilities will be used for the proposed program, including the following:
 - The Wind Energy Manufacturing Laboratory (WEML) is the newest and largest laboratory space in the Industrial and Manufacturing Systems Engineering department. It includes more than 2500 sq. ft. of space with high-bay space and climate control. Smaller scale wind turbine blades can be easily accommodated in the facility.
 - The Wind Simulation and Testing (WiST) Laboratory occupies 11,000 sq. ft. in the Department of Aerospace Engineering. It is a state-of-the-art experimental facility for conducting research, education, consulting, and outreach in wind-structure interaction. It is a one-of-a-kind facility for applications in wind engineering, aeronautics, and industrial aerodynamics. It includes a wind tunnel with two test sections, aerodynamic and atmospheric boundary layer with gust generation capability. It also includes two other wind tunnels and a large tornado-microburst simulation facility with translation capability.
 - The Climate Science Program (CSP) provides access to four mesoscale models and four regional climate models for short-term wind forecasting and wind climate change analysis.
 - The Alternate Energy Grid Infrastructure and Systems (AEGIS) Laboratory is equipped with a real time digital simulator, state-of-the-art computing platform capable of simulating power systems in real-time with high fidelity. It also has several dynamometers, which provide the capability to test and validate a range of electric motors and power electronics systems.
 - The ISU Center for Nondestructive Engineering (CNDE) equipment can perform ultrasonic, x-rays, and vibrothermonic testing to facilitate health monitoring of wind turbines.
 - The recent NSF EPSCoR award to ISU, SUI, and UNI for renewable energy includes a wind farm testbed that can serve as a research facility for the proposed program and support validation of high resolution wind farm simulation models.

- ◇ Cost. The University projects that the cost for the proposed program will be \$159,600 in Year 1. This includes a one-time cost for curriculum development of \$83,000 which will be supported by the NSF IGERT grant. The annual costs will increase from \$76,600 in Year 1 to \$85,500 by Year 5. The costs include \$15,000 per course to staff courses; \$5,000 per year to staff the Director of Graduate Education; and administrative costs of \$43,000 per year. The NSF IGERT grant and College of Engineering reallocations will provide sufficient funds to cover the costs. ISU anticipates that the NSF IGERT grant will be renewed for years 6-10.

- ◇ Projected enrollment. The projected enrollment is six student majors in Year 1, increasing to 40 student majors by Year 7. The projected enrollment of non-majors is an annual average of 15 students. The college anticipates recruiting students at the Master of Science level and at the undergraduate level and will rely heavily, but not exclusively, on the NSF \$3.1 million IGERT grant to recruit students because the grant provides significant financial incentives. There are four distinct mechanism to recruit IGERT fellows:
 - Recruit through an in-place agreement with the University of Puerto Rico at Mayaguez (UPRM) to support four UPRM M.S. students as IGERT fellows in the second year of their M.S. program and in the first year in the proposed program.
 - Recruit from targeted schools such as historically black colleges and Midwestern schools with high quality science and/or engineering programs that do not offer Ph.D. programs.
 - Recruit from a WESEP summer REU site. The 2011 offering was highly successful and is likely to lead to graduate applications.
 - Recruit from the ISU campus, including McNair Scholars which prepares underrepresented students for doctoral studies. A proposed undergraduate minor in wind energy is also likely to identify interested students.

- ◇ Workforce Need/Demand. U.S. wind power has grown from 3 GW to 42 GW since 2000, which is the second largest growth of any generation technology nationally. During this same period, Iowa wind power has grown from 0.25 GW to 4 GW, which far outstrips the growth of any other Iowa generation technology. The Department of Energy (DOE) indicated in a recent report² that U.S. wind power will reach 300 GW by 2030, with Iowa remaining a significant contributor. The same report identified a long-term national need for graduate programs in wind energy, stating that "...the level of U.S. graduate programs is well below similar graduate programs in Europe (Denmark, Germany, etc.). At this rate, the United States will be unable to provide the necessary trained talent and manufacturing expertise. Unless this trend is reversed, even with major new wind installations in the United States, most of the technology will be imported, and a significant portion of the economic gains will be foreign rather than domestic." Another recent report³ indicated that smart-grid technologies, which include wind energy, would create 140,000 permanent high value jobs.

- ◇ Link to institutional strategic plan. The proposed program is consistent with ISU's mission – "Iowa State will lead in developing more sustainable ways to produce and deliver safe and nutritious food, water, materials, and energy; integrate the protection of plant, animal, and human health; and care for our environment." It also addresses ISU's strategic plan priority – "Iowa State will be internationally known for faculty, staff, and students who address the challenges of the 21st century." The proposed program is integral to the College of Engineering's strategic plan – "We will improve the human condition through research that addresses grand challenges and builds upon our core competencies in energy, health, computing, green technology, and infrastructure."

² U.S. Department of Energy, "20% Wind Energy by 2030 Increasing Wind Energy's Contribution to U.S. Electricity Supply," May 2008.

³ The U.S. Smart Grid Revolution: KEMA's Perspectives for Job Creation," 2008, available at http://www.smartgridnews.com/artman/uploads/1/KEMA_s_Perspectives_for_Job_Creation.pdf.