

Program Proposal for Wind Energy Minor

- **Name of the proposed minor.**

Wind Energy

- **Name of the departments involved.**

Aerospace Engineering
Agricultural and Biosystems Engineering
Agronomy
Chemical and Biological Systems Engineering
Civil, Construction and Environmental Engineering
Electrical and Computer Engineering
Geological and Atmospheric Science
Industrial and Manufacturing Systems Engineering
Material Science and Engineering
Mechanical Engineering

- **Name of contact persons.**

Frank Peters; fpeters@iastate.edu
Gene Takle; gstakle@iastate.edu

- **General description of the minor.**

The Wind Energy minor is primarily intended for students majoring in engineering or meteorology, but will be available to all that meet the prerequisites. The minor is comprised of 15 credits, of which 6 are required of all students obtaining the minor. As per the *University Catalog*, at least 9 credits cannot be used to satisfy any other degree, program or University requirement.

Required Courses:

- ENGR 340x: Introduction to Wind Energy: System Design and Delivery
- AER E 381: Introduction to Wind Energy

Electives Courses: Take 9 credits from the list of electives

- AER E 422: Aeroelasticity
- AER E 423: Composite Flight Structures
- AER E 470: Wind Engineering
- AER E 481: Advanced Wind Energy- Technology and Design
- C E 460: Foundation Design
- C E 541: Dynamic Analysis of Structures
- I E 443x: Wind Energy Manufacturing
- MAT E 362: Non Destructive Evaluation
- MAT E 363x: Materials for Wind Energy
- E E 451x: Electromechanical Wind Energy Conversion and Grid Integration
- E E 452: Electrical Machines and Power Electronic Devices
- E E 457: Power System Analysis II
- M E 325: Machine Design
- M E 411: Automatic Controls
- M E 417: Advanced Machine Design
- M E 421: System Dynamics and Controls
- MTEOR 405/AGRON 405/ENVSCI 405: Environmental Biophysics
- MTEOR 407/AGRON 407/ENVSCI 407: Mesoscale Meteorology
- MTEOR 411: Synoptic Meteorology
- MTEOR 417: Mesoscale Forecasting Laboratory
- MTEOR432: Instrumentation and Measurements
- MTEOR 454: Dynamic Meteorology II

- **Need for the proposed minor.**

Wind energy is a pivotal component of our nation's future energy portfolio, particularly given the desire to reduce the carbon footprint through the use of renewables. The Midwest region is among the richest wind regions in the nation, with Iowa being the second leading state in the nation as measured by installed wind capacity of 3675 MW, after Texas. The proximity of Iowa to other wind-rich states has influenced many manufacturers to locate here, including Clipper Windpower, TPI Composites, Trinity Towers, Acciona, Siemens, Heartland Energy, NextEra, Availon, and Goian. This minor will help provide this industry (planners, manufacturers, developers, utilities, and maintenance providers) with technical students with the knowledge and understanding of the science, engineering and policy of wind energy.

- **Objectives of the proposed minor including the student learning outcomes and how the learning outcomes will be assessed.**

The objectives of the proposed Minor are to provide a broad understanding of the wind energy industry from component design and manufacturing, electric generation, transmission, and grid operations, to policy.

- Communicate objectives of a long-term national energy portfolio and how wind energy will contribute to meeting those objectives
- Understand the wind energy systems and design tradeoffs for the large components (e.g., blade, turbine, tower and foundation)
- Manufacturing and supply chain considerations for economic production
- Identify problems and potential solutions associated with integrating high wind penetrations into the electric grid
- Communicate most significant reliability problems for wind turbines and be conversant with related monitoring technologies and maintenance methods to address them
- Identify effect of existing and potential policies on wind energy growth

Learning outcomes will be assessed using tests, quizzes, homework and term papers

- **Relationship of the Minor to other programs at Iowa State University.**

Wind energy is interdisciplinary. There are pieces of wind energy in several departments. This minor will pull these pieces together in a recognized minor for the benefit of the students.

An Energy Systems minor is also being proposed. There were discussions for a semester between the two faculty groups developing the minors about the best approach. It was mutually agreed upon that it would best serve the students with only a minimal increase in resources to offer both a Wind Energy Minor and an Energy Systems Minor. The Energy Systems Minor is much broader in its coverage of energy systems. There will inherently be some overlap of the courses contained within the minors, but the Wind Energy Minor will continue to be more focused in this area.

- **Relationship of the minor to the strategic plans of the university, of the college, and of department or program.**

The strategic plans of the university consider the education and training of tomorrow's workforce to be of primary importance. Wind energy is playing an increasingly important role in our nation's energy independence, and this minor supports students working in and supporting this field. Furthermore, the College and ISU have identified energy sector as one of the primary area needing advancements and education as part of the 2050 challenge initiative.

- **Comparison of the proposed minor with similar programs at other universities, including the Regent's universities.**

University of Iowa offers a single undergraduate course specific to wind energy.

Outside of the state of Iowa, Texas Tech offers a minor and a BS in wind energy.

Other schools have wind energy as part of a broader renewable energy program.

- **Program requirements and procedures, including:**

- a. **prerequisites for prospective students;**

- Math 166 and Physics 222 or permission of minor committee

- b. **application and selection process;**

- Complete and submit the official ISU "Request for Minor" form. The selection process is based on approval by the admissions subcommittee of the Wind Energy Minor Committee. (See governance document for details of the Committee.)

- c. **language requirements;**

- None

- d. **related courses and seminars presently available for credit toward the program;**

- AER E 381: Introduction to Wind Energy
 - AER E 422: Aeroelasticity
 - AER E 423: Composite Flight Structures
 - AER E 470: Wind Engineering
 - currently offered as 570; dual listing to be requested
 - AER E 481: Advanced Wind Energy- Technology and Design
 - C E 460: Foundation Design
 - C E 541: Dynamic Analysis of Structures
 - I E 443x: Wind Energy Manufacturing;
 - currently offered as 543x; dual listing to be requested
 - MAT E 362: Non Destructive Evaluation
 - E E 451x: Electromechanical Wind Energy Conversion and Grid Integration
 - currently offered as 551x; dual listing to be requested
 - E E 452: Electrical Machines and Power Electronic Devices
 - E E 457: Power System Analysis II
 - M E 325: Machine Design
 - M E 411: Automatic Controls
 - M E 417: Advanced Machine Design
 - M E 421: System Dynamics and Controls
 - MTEOR 405/AGRON 405/ENVSCI 405: Environmental Biophysics
 - MTEOR 407/AGRON 407/ENVSCI 407: Mesoscale Meteorology
 - MTEOR 411: Synoptic Meteorology
 - MTEOR 417: Mesoscale Forecasting Laboratory
 - MTEOR 432: Instrumentation and Measurements
 - MTEOR 454: Dynamic Meteorology II

- e. **proposed new courses or modifications of existing courses;**

- ENGR 340x: Introduction to Wind Energy: System Design and Delivery
 - First offering in Fall 2011
 - MAT E 363x: Materials for Wind Energy
 - proposed; planned for Spring 2012

- f. **advising of students;**

- Advising of students will be by their advisors within their major department. The minor committee will provide support to the advisors and meet with students as needed for additional questions.

- g. **implications for related areas within the university;**

- none identified

- **General description of the resources currently available and future resource needs, in terms of:**
 - a. **faculty members;**
Courses can be taught by existing faculty.
 - b. **computers, laboratories, and other facilities;**
Current computer and laboratory facilities are sufficient for this minor. No future resource needs are projected.
 - c. **library facilities (journals, documents, etc.) in the proposed area;**
Current library facilities are sufficient for this minor. No future resource needs are projected.
 - d. **supplies, field work, student recruitment, etc.**
No additional supplies, field work activities or student recruitment efforts will be required beyond that which is currently performed in the department.
- **Describe the needs for new resources and/or reallocated resources. Attach to the program proposal memos from the department chair(s), the college dean(s), and other appropriate persons, agreeing to the allocation of new resources and/or the reallocation of resources.**
Existing faculty can be reallocated to teach the ENGR 340x and MAT E 363x. The other courses are already being taught. Letter attached.
- **Attach to the program proposal, letters of support, recommendations, and statements when appropriate, from programs and departments at ISU which are associated with the proposed program or have an interest in the proposed program.**

A letter from the department chairs of the following departments is attached:

- | | |
|--------|-------|
| • ABE | AerE |
| • CBE | CCEE |
| • ECpE | GE AT |
| • IMSE | ME |
| • MSE | |

And a letter from Agronomy Department chair

- **If the new program is interdisciplinary, a governance document should be created and submitted to the Associate Provost for Academic Programs. Indicate here that it has been completed.**

Wind Energy Minor Governance Document

There will be Wind Energy Minor Committee responsible for the content and administration of the undergraduate Wind Energy Minor. The curriculum committee of each of the following departments will choose a faculty member to represent their department on this committee, or elect not to be represented on the committee.

Aerospace Engineering
Agricultural and Biosystems Engineering
Agronomy
Chemical and Biological Systems Engineering
Civil, Construction and Environmental Engineering
Electrical and Computer Engineering
Geological and Atmospheric Science
Industrial and Manufacturing Systems Engineering
Material Science and Engineering
Mechanical Engineering

The committee can choose to allow representation from other departments if warranted via simple majority of the committee. The chair of the committee will be chosen annually by a vote of the committee. The vote is to be held at the first regular meeting of the Fall semester. Any votes on changes to the curriculum or admission requirements will require a majority of the members assigned to the committee. Email votes may be taken by the chair to facilitate changes, however, any member can require an actual meeting to discuss any issue that has been sent out for an email vote by the chair. To ease the workload and reduce the administrative burden, an admissions subcommittee will be formed from the Wind Energy Committee made up of the committee chair and two other members. The subcommittee will be chosen via voting by the committee. Routine admission decisions and modifications of program of study will be handled by this subcommittee.

Elective courses to be included in the minor must have the majority of their content on topics which are directly related to meteorological forecasting, planning and policy for wind energy; design, manufacturing, and operations of wind energy components and/or systems; and transmission of wind energy.

The Wind Energy Minor Committee will report to the College of Engineering Curriculum Committee, which will have final ruling on any issues regarding the Wind Energy Minor.

Approvals Were Made by the Following Bodies, per that Body's Governance Document:

- Aerospace Engineering: approved by CC
- Agricultural and Biosystems Engineering approved by CC
- Agronomy approved by faculty
- Chemical and Biological Systems Engr. dept. determined it doesn't need their approval
- Civil, Construction and Environmental Engr. approved by both CC's and faculty
- Electrical and Computer Engineering approved by CC
- Geological and Atmospheric Science approved by CC and faculty
- Industrial and Manufacturing Systems Engr. approved by CC and faculty
- Material Science and Engineering approved by CC and faculty
- Mechanical Engineering approved by CC and faculty

- College of Engineering approved by CC
11/4/2011: approved by faculty: 85% for 8% against 7% abstain
(169 total votes)

- College of LAS approved by CC
11/2/2011: unanimous approval by Representative Assembly

- College of ALS approved by CC
2/10/2012: approved by faculty: 92% for (59 total votes)

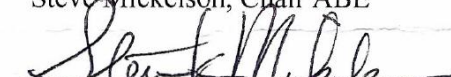
- Faculty Senate approved by CC 2/13/2012

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Engineering
Office of the Dean
104 Marston Hall
Ames, Iowa 50011-2151 USA
515 294-5933
FAX 515-294-9273
College: <http://www.eng.iastate.edu>

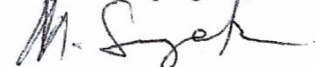
DATE August 29, 2011
TO Vern Schaefer
College of Engineering Curriculum Committee
488 Town Engineering

FROM Steve Mickelson, Chair ABE

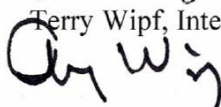

Richard Wlezien, Chair AERE



Surya Mallapragada, Chair CBE




Terry Wipf, Interim Chair CCEE

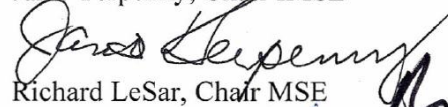


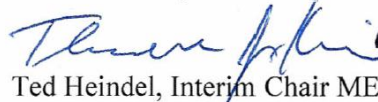
David Jiles, Chair ECpE



Neal Iverson, Chair Geog & Atm Sci


Janis Terpenney, Chair IMSE


Richard LeSar, Chair MSE


Ted Heindel, Interim Chair ME

SUBJECT Wind Energy Minor

Wind Energy is truly an interdisciplinary field that has increasing importance locally and globally. We recognize this need and support the establishment of a Wind Energy Minor at ISU.

The governance document for this interdisciplinary program clearly spells out how this minor will be administered. To this end, we will support a faculty member from our respective departments to serve on this committee at the direction of our respective curriculum committees.

This minor will require additional teaching load from some of our departments including the offering of Engr 340, MSE 363X, and the already existing courses of AerE 381 and AerE 481. We will support our respective faculty members teaching these courses as laid out in the individual course descriptions. Granted, however, that some of the faculty involved are teaching the courses as an 'overload' above their normal teaching responsibilities. But, we feel this is appropriate, as it is tightly aligned with their research interests. This minor will result in increased enrollment in some of the other courses offered by our departments, but we feel this is a very manageable level.

Our advisors will be able to advise our students regarding this minor, with the support of the Wind Energy Minor committee.

This minor will enhance the learning opportunities available to our students, and help establish Iowa State University as a leader in the Wind Energy field.

IOWA STATE UNIVERSITY
Department of Agronomy
Crop, Soil, and Environmental Sciences

2101 Agronomy Hall
Ames, Iowa 50011-1010
515 294-1360
FAX 515 294-3163


Interoffice Communication

DATE: October 20, 2011

TO: Frank Peters
Industrial & Manufacturing Systems Engineering
3004 Black Engineering

FROM: Kendall Lamkey
Chair, Department of Agronomy

RE: Wind Energy Minor



The Department of Agronomy is supportive of university efforts to advance the development of wind energy in the state of Iowa and Midwest. Dual use of our agricultural lands as well as the energy needs of our rural communities call for agriculturists to work with engineers and other scientists to develop a future of our region that includes novel and sustainable production of food and energy.

The Department of Agronomy supports the involvement of Gene Takle to provide a few lectures (3-5) and assistance to engineering leadership in the newly proposed wind energy undergraduate minor being developed in the College of Engineering. We look forward to seeking ways this effort will provide new opportunities for learning, discover and outreach in agriculture as well as engineering.

Cc: Joe Colletti
Richard Wlezien

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Interoffice Communication

DATE: October 10, 2011

TO: Interested Curriculum Committees

FROM: Ted Heindel, primary contact for the Energy Systems Minor
Frank Peters, primary contact for the Wind Energy Minor

SUBJECT: Need for minors in Energy Systems *and* Wind Energy



The purpose of this memo is to describe the motivation and need for developing minors in both Energy Systems and Wind Energy, and to specifically address the "Relationship of the Minor to other programs at Iowa State University" question in the minor approval form.

A minor in Energy Systems was initiated from a grant from the Iowa Office of Energy Independence in August 2010. A minor in Wind Energy has been under development for two years and recent proposal activity provided the critical mass for full development. The groups developing these minors met several times in Fall 2010 and came to the mutual conclusion that there is a need for both minors, and each group fully supports and endorses the other. While there is some commonality, the minors have different goals.

The advantages of having different minors is that they

- (i) will be individually identified on a student's transcript,
- (ii) provide increased visibility of the programs internally and externally to ISU
- (iii) can be leveraged in proposal activity (e.g., ISU's recent NSF IGERT and REU in wind energy), and
- (iv) both fill a desire from students and industry for focused content in the respective areas.

With nearly 6000 engineering undergraduate students, there are plenty of students to take advantage of either minor. In addition, the Wind Energy Minor was specifically developed to be open to students from other colleges, in particular the Meteorology program.