

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN



**A PROPOSAL FOR THE INSTALLATION OF THREE WIND TURBINES AT THE  
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN**

submitted to the:

**Illinois Clean Energy Community Foundation**  
Renewable Energy Grant Program

submitted by:

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**BACKGROUND**

The University of Illinois at Urbana-Champaign (UIUC) is committed to incorporating the principles of sustainability into research, education, and campus operations. The administration, faculty, and staff of the UIUC are dedicated to continuing the University's tradition as a leader in the development and education of new and emerging technologies that improve and benefit society. In addition, the UIUC student body continues to demonstrate its support for applying energy efficiency practices and renewable energy technologies on campus through its "clean energy technology" fee.

In the spring of 2003, students at the UIUC voted to institute a semester fee of \$2 per student to be used to improve energy efficiency and implement renewable energy on campus. This fee was initiated and promoted by the group *Students for Environmental Concerns* with the intent of reducing the environmental impact of University operations. The students were particularly interested in funding a project that would generate a significant amount of cost-effective, renewable energy while also providing an impressive physical statement within the campus surroundings. Utility-scale wind turbines satisfied these requirements, while the UIUC Crop Sciences Research and Education Center (South Farms) area provided a viable location.

This idea was presented to campus administrators and the Committee for a Sustainable Campus Environment where it was well received with offers of support and technical assistance. A wind energy consultant was secured, using funds from the Office of the Provost, and a feasibility study was completed. The consultant investigated issues such as: turbine siting; financial modeling; wind resource potential; capital and operating costs; electrical interconnection; environmental issues; Federal Aviation Administration requirements; financing and ownership options; and, community relations. The outcome of these analyses and considerations was (is) positive, with no barriers to such a project.

## GRANT PROPOSAL AND REQUEST

The UIUC proposes to install three, 1.5 megawatt (MW) wind turbines on the campus South Farms. The University is proposing three utility-scale wind turbines in order to demonstrate a working wind farm for individual farmers or farm cooperatives considering multiple turbine installations, and for student and faculty research and education. Once completed, this facility would be one of the first (if not the only) university-owned, multi-turbine, on-campus wind farm in the United States.

The university estimates the total project capital cost will be \$5,700,000. The UIUC requests \$2,000,000 in aid from the Illinois Clean Energy Community Foundation (ICECF) Renewable Energy Grant Program to help establish this wind turbine project. This request is approximately one-quarter of the total cost (\$1.4M), plus a two-to-one (2:1) match on the student fees (\$600K). To date, the student initiated “clean energy fee” has raised and committed \$300,000 for this project. In addition, the university is investigating the possibility of an additional \$250,000 in support directed by the Illinois Department of Community and Economic Opportunity (DCEO) through Vestas Wind Systems A/S. The UIUC is prepared to fund the remaining \$3,000,000+ in capital costs.

## OWNERSHIP

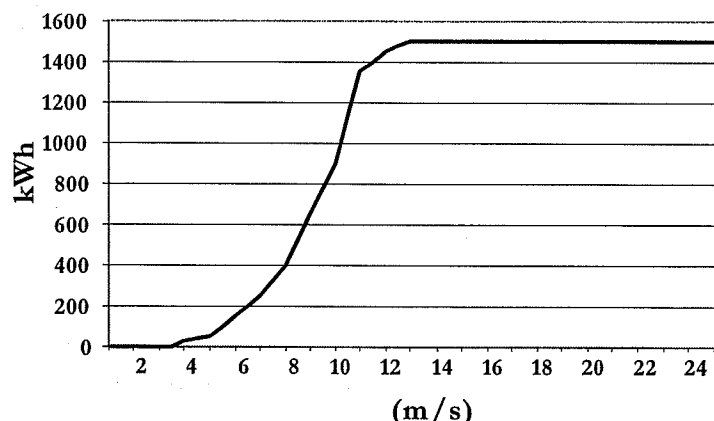
The UIUC will own, operate and maintain the turbines. Under University ownership, the Urbana-Champaign campus will have greater control of site access and an enhanced ability to incorporate educational and research programs into the wind farm operation.

## ENERGY GENERATION & DISTRIBUTION

UIUC facilities will use 100 percent of the electricity generated by the wind turbines; the energy will feed directly into the University’s electric distribution system. The electricity will be produced at 600 to 900 volts and transformed up to 13,800 volts for connection to the campus electric grid. The wind turbines will displace electricity generated by natural gas turbines at the UIUC Abbot Power Plant and purchased electricity, depending on the time of day and year.

The three turbines will produce an estimated 10,500,000 kilowatt hours of electricity, or about 2.7 percent of the total campus energy consumption. The figure below shows a performance curve for a General Electric 1.5 MW wind turbine, coupled with 10 minute wind data for the South Farms area of campus. This information was used to estimate the site’s annual energy production potential. The annual energy production figure includes a six percent (6%) total reduction of energy due to multi-turbine waking effects (2%), icing during the winter (1%) and maintenance downtime (3%).

**Figure 1: 1.5 MW Turbine Gross Power Output**

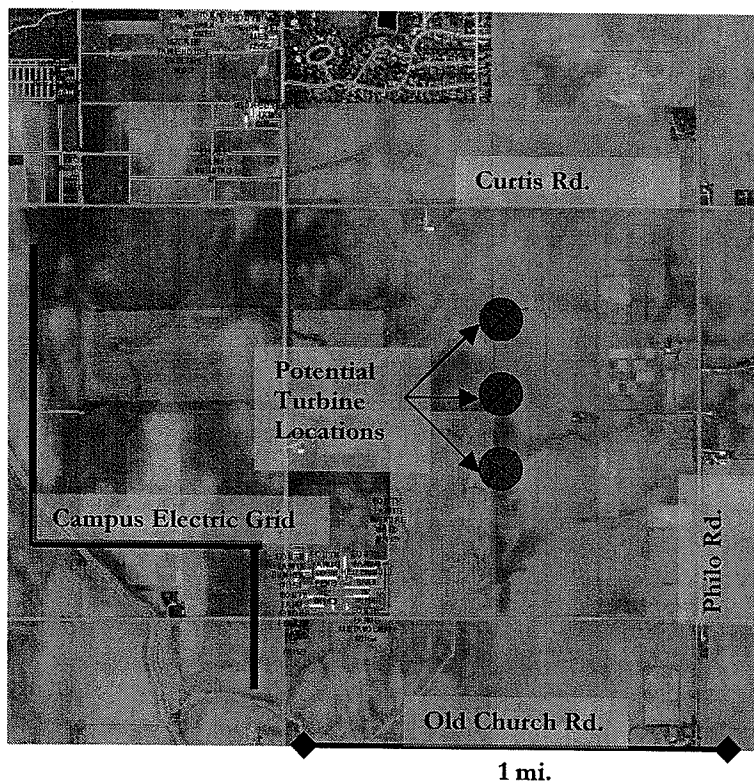


## LOCATION

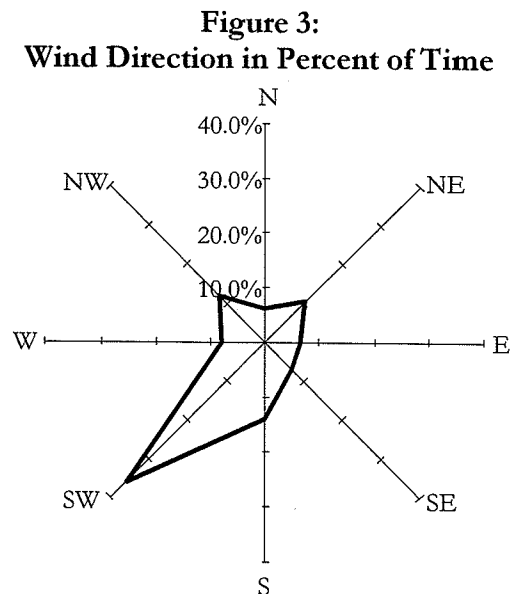
The South Farms area is roughly bound by Curtis/Windsor Roads on the north and Old Church Road on the south and by Philo Road on the east and First Street on the west. Four potential sites within this area were evaluated based on the following criteria:

- adequate distance from neighborhood developments;
- proximity to the campus electric distribution system;
- adequate distance from Willard Airport;
- maximum surface elevation; and,
- UIUC land ownership.

The most viable location for all five criteria is shown below in Figure 2. The site lies on relatively high ground, is at least one-half mile from the nearest housing development, is close to the campus electric grid, and is sufficiently far from the airport.



**Figure 2: Proposed Turbine Location**  
(Aerial view of UIUC South Farms)



This proposed site and the proposed north-south orientation of the turbines also are favorable based on the prevailing wind direction. Figure 3 above shows the wind direction (in percentage of time) is generally from the southwest for the South Farms area. (Figure 3 data provided by studies conducted by: Ralf Möller, Associate Director for Operations, UIUC College of ACES and Dirk Andreas, professional engineer, Navigant Consulting, Inc.)

## COMMUNITY OUTREACH & FEEDBACK

On June 29, 2005, this proposed project site was informally presented to officials with the cities of Champaign and Urbana, the Village of Savoy, and Champaign County. Those representatives expressed few initial concerns. The University will continue to openly communicate with these and other community stakeholders throughout the development process. The site proposal also will be presented to and reviewed by the Federal Aviation Administration and the UIUC's Willard Airport.

## **EDUCATION, RESEARCH & EXTENSION**

This project represents a unique blend of campus interests that combines the University's education and research missions with the development and incorporation of a sustainable technology into its operational infrastructure. The project will be one of the largest wind demonstration projects on a university campus in the nation, which will enhance the University's ability to educate students and the citizens of Illinois about wind power technology. Several academic disciplines will be able to make use of the wind turbines for a variety of education and research purposes.

The South Farms area is central to the field research conducted by the UIUC's College of Agriculture, Consumer, and Environmental Sciences (ACES). ACES and the UIUC Office of Extension & Outreach are interested in the operational and rural economic potential of wind energy and are eager to have a wind energy demonstration site for interested citizens – especially farmers. Such research will be important to help farmers understand the impact of wind turbines on their crops and livestock. Furthermore, the wind turbines would complement the South Farms initiatives in biomass energy, and provide an interesting study in the placement of such facilities near rural-urban interfaces. ACES faculty and staff also will be able to use the site to study the effects of wind turbines on human, wildlife and ecosystem health.

The UIUC's College of Engineering also will be able to extensively use and study wind technology. The aerospace engineering program will be able to study air foil design and aero acoustics. Civil engineering professors and students will be able to study structures and foundations. Electrical engineers will be able to study the electric grid and the power generation systems. The mechanical engineering program will be able to study air flow/turbulence, energy conversion and instrumentation and controls.

The Office of Continuing Education (OCE) offers an array of professional development courses for architects, designers, builders and planners, and will use the wind turbines as a teaching tool. The OCE also offers classes through the Smart Energy Design Assistance Center, a DCEO grant-sponsored program designed to reduce energy consumption in Illinois. The wind turbines will be instrumental in helping to demonstrate and promote sustainable methods to generate energy throughout the state.

A traditional strength of the UIUC is its interdisciplinary, collaborative approach to education and research. University facilities are unique in that they are publicly owned and generally available for activities related to classroom studies, faculty research and general public inquiry. An example of an accessible facility that was developed cooperatively by multiple functions is the University's "solar pond." Developed by the ACES and Engineering colleges, the UIUC solar pond is the largest solar energy collector/storage system (20,000 square feet) in Illinois. During its 18-year existence, the solar pond has had more than 2000 visitors. Specifically, the Nuclear, Plasma and Radiological Engineering's class on energy for non-engineering majors (NPRE 101 – "Introduction to Energy Sources") and Mechanical Engineering's energy conversion class (ME 400 – "Energy Conversion Processes") regularly tour the solar pond. And the site has hosted numerous visitors from the College of ACES and around the world.

The ACES and Engineering colleges also anticipate that the proposed wind farm will enjoy the same cooperative interaction and interest. The wind farm itself will be an attraction that will draw visitors to the UIUC campus. In addition, activities such as agriculture extension and campus conferences will bring interested viewers to the campus. And special events such as the "Engineering Open House" and "ACES Open House" annually attract 20,000+ visitors to the UIUC campus each spring; visits to the wind farm will be incorporated into their itineraries.

## ENVIRONMENTAL STEWARDSHIP

The wind turbines renewable energy production will annually eliminate the release of 6,700 tons of carbon dioxide (greenhouse gas), 32 tons of sulfur oxides and 15 tons of nitrogen oxides. In addition, the turbines generation capacity will be enough for the UIUC to voluntarily meet the State of Illinois' Renewable Portfolio Standard through December 31, 2007.

## PROJECT DETAILS & BUDGET

**Table 1a: UIUC Wind Turbine Project Details**

Number of Turbines	3
Turbine Size	1.5 megawatts (MW)
Total Capacity	4.5 MW
Estimated Capacity Factor*	27 percent (%)
Estimated Annual Electric Production*	10,564,560 kilowatt hours (kWh)
Estimated Percent of Total Campus Use	2.7 percent (%)

\* **Sources:** Wind Potential Analyses conducted by: Ralf Möller, Associate Director of Operations UIUC, College of ACES; Dirk Andreas, Professional Engineer, Navigant Consulting, Inc.

**Table 1b: UIUC Wind Turbine Project Budget**

ICECF Requested Contribution	\$2,000,000
UIUC Student Fee Contribution	\$300,000
Estimated UIUC Remaining Capital Cost	*\$3,400,000
<b>Estimated Project Capital Costs</b>	<b>\$5,700,000</b>

\* **NOTE:** The UIUC submits the above figure (\$3.4M) as our best estimate of the remaining capital cost (as of the date of publication of this proposal). We recognize that equipment and delivery costs are volatile during these times (i.e. especially in the wake of Hurricane Katrina). At this time, the UIUC has secured \$2M for this project and is pursuing the remaining \$1.4M.

**Table 1c: UIUC Wind Turbine Project Construction Budget (Estimated)**

Equipment (Nacelles, Towers)	*\$5,100,000
Installation (Site prep, Access Road, Foundations, Equipment, Labor)	\$375,000
Interconnection (Electric, fiber optic)	\$200,000
Consulting / Permitting	\$15,000
Miscellaneous	\$10,000
<b>Estimated Project Cost</b>	<b>\$5,700,000</b>

\* \$1.7M per turbine x 3 turbines = \$4.5M

**Sources consulted:** Sean Middleton, Manager of Engineering, Ill. Rural Electric Cooperative; Mark Eilers, Director of Origination, GE Wind Energy; Robert Lamppa, Sr. Project Manager, Carleton College (Facilities & Services); Mike Geier, Consultant, Snyder & Associates

**Table 1d: UIUC Wind Turbine Project Annual O&M Budget**

<b>Estimated Annual O&amp;M Costs</b>	<b>\$115,500</b>
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## PROJECT SCHEDULE (Estimated)

Project Approval	15 October 2005
Submit Turbine RFPs	14 November 2005
Select Supplier / Order Equipment	16 January 2006
Submit Sitework RFPs	16 January 2006
Select Permitting Consultant	15 February 2006
Permitting Work Complete	15 May 2006
Site Preparation Complete	31 July 2006
Equipment Installed & Operational	30 September 2006

### SUMMARY

The proposed wind farm will help the University of Illinois at Urbana-Champaign achieve multiple goals. This facility will produce a significant amount of renewable energy for the campus, and it will displace non-renewable (polluting) electric generation. In addition, the project will serve as a critical demonstration, education, and research site for students, faculty, and residents of the state. The University is committed to incorporating sustainability throughout its campus and is excited about being able to contribute to broad state, national, and global efforts in developing renewable energy sources for the benefit of all.

The University of Illinois at Urbana-Champaign looks forward to working with the Illinois Clean Energy Community Foundation to move this project from conception to completion. Thank you for your consideration.

Respectfully submitted,



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UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

College of Engineering

Office of the Dean  
306 Engineering Hall, MC-266  
1308 West Green Street  
Urbana, IL 61801



September 9, 2005

Illinois Clean Energy Community Foundation  
2 N. LaSalle St.  
Suite 950  
Chicago, IL 60602

Re: University of Illinois proposal "A Proposal for the Installation of Three Wind Turbines at the University of Illinois at Urbana-Champaign".

Dear Illinois CECF Board:

The wind turbine facility proposed for the University of Illinois campus will be a valuable asset for the people of Illinois in many ways. The College of Engineering enthusiastically supports this project and the opportunities that it will create. It is an exciting project that will gain national attention and help promote sustainable technologies on our campus and beyond.

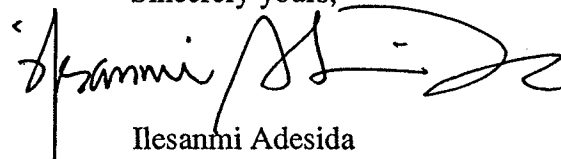
The proposed wind facility will directly affect educational activities within the College of Engineering through classes such as AE 481 (Aerospace Engineering, 'Wind Power Technology'), ME 400 (Mechanical Engineering, 'Energy Conversion Systems'), and NPRE 101 (Nuclear, Plasma and Radiological Engineering, 'Introduction to Energy Sources' for non-engineering majors). Our undergraduate students will also have opportunities to work directly with wind turbine technologies through independent study courses and senior design courses. For example, electrical engineering students may study power grid connection issues related to wind turbines. Mechanical engineering students may study air flow around and through a multi-turbine facility. Civil engineering students would be able to investigate structure topics related to the large turbine support towers.

Research activities within the College of Engineering will also benefit with the establishment of the wind farm. Our faculty members are involved in a number of projects that contribute to the advancement of scientific understanding that are important for the development of sustainable technologies. Among our faculty are leading

designers of airfoil technology, power grid systems, and composite materials that directly impact the improvement of wind turbines. In addition, several major research activities in sustainable technologies exist within the College. The WaterCAMPWS is a National Science Foundation center whose goal is to develop revolutionary materials and systems for purifying water and meeting the world's water resource demand (<http://www.watercampws.uiuc.edu/>). The Air Condition and Refrigeration Center (<http://acrc.mie.uiuc.edu/>) is a world leading research center dedicated to efficiency and environmental improvement of air conditioning and refrigeration technologies. A third example is NanoCEMMS, the Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems (<http://www.nano-cemms.uiuc.edu/>), which is creating new materials and manufacturing systems for producing nano-technology based materials. These new materials and processes will significantly expand our capabilities to develop resource efficient, sustainable technologies. It is significant to note that our research centers, such as those cited above, have strong educational components that includes graduate students, undergraduate students, and pre-college students.

The College of Engineering at the University of Illinois appreciates the Illinois Clean Energy Community Foundation's consideration of our campus proposal to establish a large scale wind turbine facility. The facility will contribute to our campus efforts to implement sustainable technologies, and to our mission to educate students and citizens about sustainable technologies.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'Ilesanmi Adesida', with a stylized flourish extending to the right.

Ilesanmi Adesida  
Interim Dean



UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

College of Agricultural, Consumer  
and Environmental Sciences

Office of the Dean  
122 Mumford Hall, MC-710  
1301 West Gregory Drive  
Urbana, IL 61801-3605



September 13, 2005

Illinois Clean Energy Community Foundation  
2 N LaSalle Street  
Suite 950  
Chicago, IL 60602

Dear Board Members:

The College of Agricultural, Consumer and Environmental Sciences (ACES) is delighted to support the proposal to install wind turbines here at the Urbana-Champaign campus. The establishment of a large scale wind turbine facility will provide tremendous educational and research opportunities for our students and faculty and provide significant opportunities for our University of Illinois Extension personnel to educate citizens throughout the state of Illinois. The College of ACES has worked with the campus administration and the campus utilities personnel to locate the proposed facility on land in the agriculture portion of the campus.

We envisage many teaching opportunities arising from this project. Wind energy is unique among electrical power generators in some interesting respects. It requires very tall, dispersed structures and the power output is variable. Questions related to the effects of a wind farm on the local environment and the economic impact of wind energy facilities are important to study and answer. The proposed facility will be unique because it allows easy access by our students and faculty.

A few examples of the ways in which the wind farm could impact our curricula are described below:

1. A course that examines the life cycle cost, operation and maintenance aspects of wind farms
2. A course (possibly co-sponsored by the Departments of Agricultural and Biological Engineering and Aerospace Engineering) focusing on wind energy technologies including wind turbine design, wind energy resources, and wind farm layout
3. An environmental course that examines landscape aesthetics, migratory bird interferences, noise, human interaction and associated wind farm issues
4. Courses that examine land use planning issues such as dispersed wind turbine farms relative to concentrated fossil fuel or nuclear power plants, air traffic considerations, investment strategies, and landowner incentives

September 13, 2005

Many research opportunities that are important for the continued development of wind turbine technology could also be established on campus. For example, the Department of Crop Sciences could design a scientific study on the long-term impact of turbines on crop production. Answering questions related to light flicker from blade rotation as well as localized changes of wind patterns on a field are important for establishing the confidence of farmers who are interested in wind turbine technology.

Our faculty members in the Department of Agricultural and Consumer Economics are actively involved in research that examines the voluntary adoption of environmental and energy standards that go beyond current governmental mandates. The wind farm would serve as a demonstration site for farmers and others who might voluntarily move to wind turbines themselves. A key research question then becomes the investigation of why some people adopt a technology while others do not. Additional research questions revolve around the type of incentives or institutions that would lead more extensive use of wind power. Faculty members in Urban and Regional Planning and our University of Illinois Extension conduct research on land use issues at the urban-rural fringe. A recent example is a project studying Urbana's recycling program. This project resulted in a national publication. Similar wind farm research projects would also have a national impact.

In summary, beyond the direct impact of developing a sustainable energy technology into our campus infrastructure, many important research and teaching opportunities would be created. Thank you for your consideration of our campus request for support of the wind turbine project. This is a great opportunity for the Illinois CECF, the University of Illinois, and the citizens of Illinois.

Sincerely,



Robert A. Easter  
Dean

RAE\*MeH

Bc -~~Matthew B. Malten~~  
Ralf Möller  
Ty A. Newell