View results

Respondent
7 Arijit Banerjee

46:22
Time to complete

Instructions

Please adhere to the session word counts. Project leads must present their project at a SSC Working Group meeting prior to the submitting their application. The Working Group meeting schedule can be found on the SSC website.

NOTE: This document will be shared publicly on our SSC Illinois Climate Action Plan (iCAP) portal so that others can learn from your project.

If you have any questions about Working Groups and/or the SSC application process, please contact the SSC at Sustainability-Committee@illinois.edu.

1

Has someone from the project's team presented their Step 2 project at an SSC Working Group meeting? *

- (●) YES
- ( ) NO

2

Select the Working Group meeting you attended. *

- (●) Energy + Transportation & Infrastructure Working Group Meeting
- ( ) Food & Waste + Land, Air, & Water Working Group Meeting
- ( ) Education & Justice Working Group Meeting

3

Date of the Working Group meeting you attended. *

9/17/2024

4

Project's Name *

UIUC Campus Wind Turbine Project

5

Amount of funding requested from the SSC for this project *

$160,000

6

Project Category *

- ○ Education & Justice
- ◉ Energy
- ○ Food & Waste
- ○ Land, Air & Water
- ○ Transportation & Infrastructure

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Project Abstract *

In less than 100 words, briefly describe the project.

We are installing a 20-kW wind turbine on campus, primarily funded by a $6 million U.S. Department of Energy grant. However, this grant doesn't cover three essential components: fencing for safety, a gravel road for access, and an electrical connection to the nearest power line. Additionally, we aim to restore the environmental ecosystem affected by the installation. We request funding from the Student Sustainability Committee to support these elements. This project will serve as a living testbed for sustainability, advance renewable energy research, promote environmental responsibility, and empower our students as future energy leaders.

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What key changes are reflected in your Step 2 application compared to your Step 1 application, if any, and why? *

Initially, our main focus was on securing funding for the infrastructure. In the next phase, following feedback from the Chair of the Land, Air, and Water Working Group, we made significant changes by allocating $10,000. This amount is dedicated to planning, strategizing, evaluating options, and implementing the most effective and cost-efficient methods to ensure the installation minimally disrupts the surrounding ecosystem. We will collaborate with Jamie Ellis, the Natural Areas Manager for the University of Illinois and a local expert in prairie restoration. Our goal is to restore as much of the property as possible with native prairie plants, following guidelines from the Xerces Society for Invertebrate Conservation.

Project Lead

9

Project Lead's Full Name *

Arijit Banerjee

10

Project Lead's Department/Campus Affiliation *

Department of Electrical and Computer Engineering/Grainger College of Engineering

11

Project Lead's University Email Address *

arijit@illinois.edu

12

All student-led projects require a faculty/staff advisor. Is this proposed project a student-led project? *

NOTE: Only currently enrolled Illinois students are eligible to be a Project Lead.

- ○ YES (by selecting YES, you affirm that the Project Lead is a currently enrolled Illinois student)
- ◉ NO

Project's Financial Contact

The project's Financial Contact must be a full-time Illinois employee who has the authority to manage the project's financials and generate financial reports on behalf of the project.

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Financial Contact's Full Name *

Beverly A Curtis

14

Financial Contact's Department *

Department of Electrical and Computer Engineering/Grainger College of Engineering

15

Financial Contact's University Email Address *

bcurtis@illinois.edu

16

Are there additional members of your project team? *

- ○ YES
- ◉ NO

Project Questionnaire

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List your proposed project's timeline and major milestones. *

NOTE: SSC funding agreements remain active for two years. Thus, your timeline should reflect your activities over a two year period or less.

Year 1 Q1 and Q2 (October 2024-Mar 2025) - Layout design, construction of the foundation, fencing, and gravel road
Year 1 Q3 and Q4 (April 2025-September 2025) - Installation of 20 kW Wind Turbine along with necessary electrical infrastructure to connect to the power grid
Year 1 Q3 and Q4 (April 2025-September 2025) - Evaluate options to balance the local ecosystem.
Year 2 Q1 and Q2 (October 2025-Mar 2025) - Monitoring of energy capture and measurement of Levelized cost of electricity (LCOE)
Year 2 Q3 and Q4 (April 2025-September 2026) - Installation of a new drive train to capture LCOE
Year 1 Q3 and Q4 (April 2025-September 2025) - Implement one option to balance the local ecosystem.

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Describe your project in detail. *

Be sure to address the following:
-What are your project's goals and how do you intend to accomplish them?
-What are your project's deliverables?

We aim to develop the world's most efficient, reliable, and compact wind turbine drive train. We are applying control co-design principles instead of following the traditional approach—where the electrical generator and power electronics converter are built separately and then connected to convert mechanical power into electrical power. This strategy significantly reduces the system's size and weight, substantially reducing the cost of crucial turbine components, such as the tower, nacelle, and foundation, while improving efficiency and reliability. Our innovation will allow wind energy systems to extend farther offshore, tapping into several petawatt-hours (one billion megawatt-hours) of untapped energy within exclusive economic zones that stretch up to 230 miles from the U.S. coastline.
To achieve this objective, we partnered with the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) in June 2019, beginning with an initial $3M grant ([1]). During Phase I, we successfully demonstrated our technology on a laboratory testbed. Building on that success, ARPA-E awarded us an additional $3M to validate the concept in an actual wind turbine, allowing us to install a turbine on our campus. Over the next three years, we plan to achieve three key milestones: first, install a 20-kW wind turbine and use it to establish the baseline levelized cost of electricity (LCOE); second, design and build a 20-kW drive train based on our innovative concept; and third, retrofit the turbine with our drive train and compare the new LCOE against the baseline.
Although ARPA-E is funding most of the project, there is still a need for more support for the infrastructure development due to the specific characteristics of the land where the turbine will be installed. The site, which belongs to the university (located at coordinates 40.017114233960065, -88.32766389784068), has already been approved for wind turbine construction by the University Facilities and Services team.
Three critical infrastructure developments are necessary: first, a gravel road must be built from the existing silo to the wind turbine site, as the area becomes muddy and inaccessible during rain due to poor soil conditions. Second, a fence must be installed around the turbine to ensure the safety of students, personnel, and equipment. This safety mechanism will provide a secure environment for those conducting research or tours. Third, the turbine is some distance from the nearest electrical pole, so an underground conduit carrying three-phase electrical cables must be installed to connect the turbine to the grid and transmit the harvested power.
We are also partnering with Ryse Energy LLC, who is providing the wind turbine with a tip height of 120 feet. A unique feature of this turbine is its tilt-up tower, which allows us to bring down the nacelle whenever needed for research, inspections, or student tours. More details about this turbine can be found in reference [2]. We will also actively work on understanding the environmental impact of such an installation and how to mitigate the imbalance it creates from the ecological standpoint.
[1] https://arpa-e.energy.gov/technologies/projects/megawatt-scale-power-electronic-integrated-generator-controlled-dc-output
[2] https://www.ryse.energy/20kw-wind-turbines/

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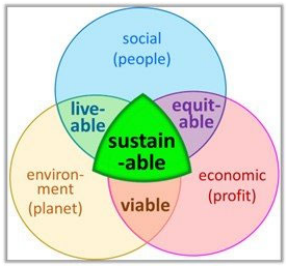
Authentic sustainability consists of the overlapping area of 3 spheres: Environment, Society, and Economy.

Describe how your project addresses sustainability. *



Our project targets all three pillars of sustainability: environmental, societal, and economic.
Environmentally, this wind turbine enhances our campus's renewable energy mix. While we already have significant solar power infrastructure, including the solar panels on the ECE building and Solar Farm 2.0, adding wind energy will diversify our renewable resources. This diversification is particularly valuable when solar panels are less effective on cloudy days. The wind turbine will directly reduce approximately 100 metric tons of carbon emissions annually, making a meaningful contribution to lowering our campus's carbon footprint for at least the next 20 years.
Socially, the project extends beyond our university community, raising awareness of renewable energy among students, faculty, and local residents. The wind turbine will serve as a showcase to neighboring communities, inspiring discussions on sustainability and the role of renewable energy in everyday life. Being located near farmland, the project could encourage sustainable agricultural practices by highlighting wind energy as a viable resource for local farmers. Furthermore, having a wind turbine on campus creates a living testbed for students and researchers, offering unique opportunities for hands-on learning and innovation. Our campus will become one of only seven universities in the U.S. (to the best of my knowledge) with a dedicated wind turbine for educational and research purposes, cementing our leadership in renewable energy education.
Economically, the project will reduce energy costs by feeding power into the grid. With an expected capacity factor of 0.5 and an electricity rate of $0.1219 per kWh, the turbine is projected to generate 105 MWh/year of electricity, resulting in an estimated energy cost offset of $10,678 annually. This economic benefit, combined with the reduction in carbon emissions, makes the project a sustainable energy solution and a financially sound investment for our campus. In addition, we will place measures in place to restore any disruption this installation creates to the local ecosystem.

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How does your project promote and increase environmental stewardship at UIUC? *

If applicable, also address what the carbon, water, waste, and/or energy savings is associated with your project.

Our project promotes and enhances environmental stewardship at UIUC by actively engaging the campus community in renewable energy practices, reducing our carbon footprint, and creating educational opportunities that foster a deeper understanding of sustainability.
1. Reducing Carbon Footprint and Diversifying Renewable Energy:
The installation of the wind turbine directly aligns with UIUC's goals to reduce carbon emissions and transition toward a cleaner energy portfolio. By complementing our existing solar infrastructure, such as Solar Farm 2.0 and the ECE building's solar panels, the wind turbine adds a new dimension to our renewable energy capabilities. This diversification ensures that, even on days with limited solar power production, we can still harness renewable energy, thereby reducing reliance on fossil fuels. The turbine is expected to reduce our campus carbon emissions by approximately 100 metric tons annually, reinforcing UIUC's commitment to environmental responsibility. We will have an energy savings of 105 MWh annually for the next 20 years.
2. Hands-On Learning and Research Opportunities:
A major aspect of promoting environmental stewardship is education. The wind turbine serves as a living testbed for students, researchers, and faculty, providing real-world, hands-on experiences in renewable energy. By giving students access to a functioning wind turbine, we enhance learning across engineering, environmental sciences, and other disciplines related to energy and sustainability. These experiences not only foster technical skills but also cultivate a deep appreciation for sustainable practices. Through research and development, students and researchers will have the opportunity to improve and innovate upon existing turbine technologies, encouraging a culture of innovation in renewable energy at UIUC.
3. Community Awareness and Inspiration:
The visibility and accessibility of the wind turbine, located in an open field near farmland, allows the broader community to witness and learn about renewable energy in action. This project serves as a public demonstration of UIUC's commitment to sustainability, promoting awareness and inspiring action beyond campus boundaries. Neighbors, local farmers, and visitors will have the chance to observe how renewable energy can be integrated into different sectors, potentially motivating them to adopt sustainable practices in their own lives and businesses. As an educational tool, the turbine can be used to engage the community through tours, workshops, and sustainability events, making UIUC a regional leader in environmental stewardship.
4. Aligning with UIUC Sustainability Goals:
This project directly supports UIUC's Illinois Climate Action Plan (iCAP), which outlines the university's long-term sustainability goals, including achieving carbon neutrality by 2050. By reducing emissions, promoting renewable energy, and providing an educational platform, the wind turbine helps the university make tangible progress toward these ambitious goals. It also reflects the university's role as a leader in sustainability research and action, demonstrating our commitment to environmental stewardship at both the institutional and community levels.
In conclusion, this wind turbine project promotes environmental stewardship at UIUC by reducing emissions, fostering hands-on learning and innovation, raising community awareness, and aligning with the university's sustainability objectives. It represents a comprehensive approach to sustainability that will have lasting benefits for the campus and the surrounding community.

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Does your project aim to advance one or more of the Illinois Climate Action Plan's (iCAP) objectives? If so, how?

A full list can be found here:
https://icap.sustainability.illinois.edu/objectives

Yes, our project directly aims to advance several objectives of the Illinois Climate Action Plan (iCAP). By installing a wind turbine on campus, we contribute to multiple facets of iCAP's sustainability goals. Here's how our project aligns with specific iCAP objectives:
1. Objective 1.0: Total Campus GHG Emissions
One of iCAP's primary goals is to reduce campus energy consumption. While our project is not focused on energy conservation per se, it directly complements efforts to reduce the reliance on non-renewable energy sources. By generating approximately 105 MWh of clean, renewable energy annually, the wind turbine helps offset the university's energy demands, thereby contributing to the broader objective of reducing energy use on campus. The turbine is expected to reduce our campus carbon emissions by approximately 100 metric tons annually.
2. Objective 2.3: Use Clean Energy Sources
Our project aligns perfectly with iCAP's objective of using clean energy sources to meet campus energy needs. By introducing wind energy to UIUC's existing renewable energy mix, which already includes solar panels, the project supports the goal of increasing the proportion of energy sourced from renewables. This diversification ensures that UIUC continues to reduce its reliance on fossil fuels, particularly on days when solar energy production is low, thereby advancing the clean energy agenda.
3. Objective 6.1: Broaden Sustainability Principles into Education and Research
The installation of a wind turbine on campus provides invaluable hands-on learning and research opportunities, which is a core focus of this iCAP objective. Students and researchers across multiple disciplines will have access to a functioning wind energy system, allowing them to study its operation, maintenance, and performance. This will enhance educational outcomes and provide opportunities for innovation in renewable energy, aligning with the goal of incorporating sustainability principles into the university's educational and research activities. The testbed itself will provide a resource for future multidisciplinary research including electrical, mechanical, aerospace, robotics, environmental, wind energy forecasting, and other aspects of sustainability. It will provide an excellent opportunity to engage students through field visit from course such as ECE 330, ECE 333, ECE 464, ECE 431, ECE 469, AE 311, AE 321, AE 323, AE 353, AE 410, NPRE 201, NPRE 475, ME 310, ME 370, ME 460, and IE411.
3. Objective 2.1: Energy planning document
While this objective specifically mentions solar energy, the broader goal of increasing on-campus renewable energy generation is met through our wind turbine project. The turbine provides a unique opportunity to integrate another renewable resource into the campus energy portfolio, thereby contributing to the expansion of on-campus renewable energy infrastructure. The project outcome will help us in making more knowledgeable decisions for planning resources involved with renewable energy sources.
In summary, our project aligns with and actively advances several key objectives of the Illinois Climate Action Plan. By expanding on-campus renewable energy generation, promoting sustainability education, and reducing emissions, our wind turbine project plays a vital role in helping UIUC meet its long-term sustainability and carbon neutrality goals.

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How many students will be directly impacted by this project? *

Over the next three years, we expect at least 45 students would be directly involved with this project. Already, this year we have around 15 graduate and undergraduate students working on this project.

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How many students will be indirectly impacted by this project? *

Around 400 students per year are expected to be indirectly impacted by this project through tours of the facility deepening their understanding about renewable energy resources. In addition, we plan to augment our ECE building lobby display with this wind turbine information, which could impact an additional 3000-4000 students who pass by the lobby daily (including 10000 from Engineering Open House).

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What is the intended student impact? *

Be sure to address the following:
-How will this project benefit students?
-How will students be involved with this project?
-What educational components are in your project?

The intended student impact of our wind turbine project is multifaceted, providing educational, research, and experiential learning opportunities that will directly benefit students across various disciplines at UIUC.
How will this project benefit students?
Hands-on Learning Opportunities: The wind turbine will serve as a "living lab" on campus, offering students hands-on experience with a fully operational renewable energy system. Students will have the opportunity to observe, study, and interact with the wind turbine, gaining practical knowledge about its construction, operation, and maintenance. This will enhance their understanding of renewable energy technologies, preparing them for careers in the rapidly growing field of clean energy.
Research and Innovation: By giving students direct access to the turbine, the project provides a unique platform for research and innovation. This will promote student-led research on topics such as energy efficiency, wind turbine performance optimization, and environmental impact analysis, fostering a culture of innovation and problem-solving.
Increased Awareness of Sustainability: The wind turbine's presence on campus will raise awareness about renewable energy and sustainability among the broader student body. It will serve as a visible symbol of the university's commitment to sustainability, inspiring students from all disciplines to think more critically about environmental responsibility. Additionally, the turbine will create opportunities for interdisciplinary learning, linking fields like environmental studies, economics, and policy with engineering and technology.
How will students be involved with this project?
Direct Involvement in Research and Development: Students will be actively involved in the ongoing research and development of the turbine's technology. Engineering students, in particular, will have the chance to contribute to the design, testing, and improvement of the turbine's drive train as part of coursework or research projects. Graduate students can work on more in-depth studies involving turbine performance analysis, while undergraduate students may participate through capstone projects, internships, or volunteer opportunities.
Educational Tours and Workshops: The turbine will be used as a teaching tool for courses related to renewable energy, sustainability, and environmental science. Professors can organize field trips and tours to the wind turbine site, allowing students to learn firsthand about its operation. Additionally, workshops on topics like renewable energy, environmental stewardship, and energy policy can be organized, helping students gain broader insights into the practical applications of sustainable technologies.
Interdisciplinary Collaboration: The project will encourage collaboration between students from different academic backgrounds. For example, engineering students may collaborate with environmental science students to study the turbine's impact on the environment, while economics students may evaluate the financial aspects, such as energy cost savings and the turbine's contribution to carbon neutrality. This interdisciplinary approach will give students a well-rounded understanding of how technical, environmental, and economic factors intersect in the real world.
What educational components are in your project?
The wind turbine can be integrated into several courses and academic programs at UIUC. Engineering courses related to energy systems, renewable energy, and mechanical design will use the turbine as a case study, providing real-world data and examples to complement classroom learning.
The turbine will be an educational resource not only for UIUC students but also for the surrounding community. Students involved in outreach programs will have opportunities to conduct tours for K-12 students, organize sustainability workshops, and engage the public in discussions about renewable energy.

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Have you spoken with anyone in UIUC's Facilities & Services (F&S) department regarding the feasibility of your project? *

- (●) YES
- ( ) NO

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With whom in the Facilities & Services department did you speak? *

Stacey DeLorenzo (sdeloren@illinois.edu) Qu Kim (qkim@illinois.edu) and Morgan White (mbwhite@illinois.edu)

Project Finances

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Has your project team or department previously been awarded funding from the SSC for the same or a similar project? *

- ( ) YES
- (●) NO

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OPTIONAL: Attach any letters of commitment or support here along with any supplemental media that will support your application (presentations, photos, etc.).

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Download, complete, and submit the **SSC-Budget-Timeline-NEW APPLICATION-template** file linked below. Please be very detailed so that the SSC can fully evaluate the merit of your funding request.

https://studentengagement.illinois.edu/sites/default/files/2024-09/SSC-Budget-Timeline-NEW-APPLICATION-template.xlsx
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SSC-Budget-Timeline-Campus_Wind_Turbine_Proje_Arijit Banerjee.xlsx