

Funding Criteria

A. General Rules

1. Students, faculty, and staff are encouraged to submit requests for funding. Student-led projects require a faculty or staff sponsor in order to have funds awarded.
2. Funding can only go to university-affiliated projects from students, faculty, staff, and departments.
3. All SSC projects must make a substantial impact on students. This may be a direct impact or an impact through education and engagement. All SSC funding is 100% from student green fees, so the projects funded by the students must benefit them.
4. SSC encourages innovation and new technologies – creative projects are encouraged to apply.
5. Unless a type of expense is specifically listed below as having restrictions, SSC can generally fund it. The items referenced below should not be taken as comprehensive list.

B. Things SSC Can Fund, On A Case-By-Case Basis

1. SSC can fund feasibility studies and design work; however, it must work toward ultimately addressing a sustainability need on campus.
2. SSC can fund staff positions that are related to improving campus sustainability. Strong preference will be given to proposals receiving matching funding from departments and/or plans for maintaining continuity of the position after the end of the initial grant.
3. SSC can fund outreach events with a central theme of sustainability, provided their primary audience is the general campus community.
4. SSC discourages funding requests for food and prizes but will consider proposals on a case by case basis that prove significant reasoning.
5. SSC can fund repairs and improvements to existing building systems as long as it works toward the goal of improving campus sustainability; however, a preference is shown to projects utilizing new or innovative ideas.
6. SSC can provide departments with loans for projects with a distinct payback on a case by case base. Loans will require a separate memorandum of understanding between SSC and departmental leadership pledging to repay the award in full and detailing the payback plan.

C. Things SSC Will Not Fund:

1. SSC will not fund projects with a primary end goal of generating revenue for non-University entities.
2. SSC will not fund personal lodging, food, beverage, and other travel expenses.
3. SSC will not fund any travel expenses.
4. SSC will not fund tuition or other forms of personal financial assistance for students beyond standard student employee wages.

Your Step 2 funding application should include this application, the supplemental budget form, and any letters of support.

Please submit this completed application and any relevant supporting documentation to Sustainability-Committee@illinois.edu. The Working Group Chairs will be in contact with you regarding any questions about the application. If you have any questions about the application process, please contact the Student Sustainability Committee at sustainability-committee@illinois.edu.

General & Contact Information

Project Name: Bee Research Facility Sustainable Auxiliary Building

Total Amount Requested from SSC: \$220,000

Project Topic Areas: Land & Water Education Energy

Transportation Food & Waste

Applicant Name: Alison Sankey, Bee Research Facility Manager

Campus Affiliation (Unit/Department or RSO/Organization): Carl R. Woese Institute for Genomic Biology (IGB)

Email Address: asankey@illinois.edu

Check one:

This project is solely my own **OR**

This project is proposed on behalf of (name of student org., campus dept., etc.): Bee Research Facility

Project Team Members

Name	Department	Email
Alison Sankey	Carl R. Woese Institute for Genomic Biology (IGB)	asankey@illinois.edu
Dr. Gene Robinson	Department of Entomology, Director of IGB	generobi@illinois.edu
Name	Department/Organization	Email Address
Name	Department/Organization	Email Address

Student-Led Projects (Mandatory):

Name of Faculty or Staff Project Advisor:

Advisor's Email Address:

Financial Contact (*Must be a full-time University of Illinois staff member*)

Contact Name: Penny Broga

Unit/Department: School of Integrative Biology

Email Address: broga@illinois.edu

Project Information

Please review the proposal materials and online content carefully. It is highly recommended you visit a working group meeting sometime during the proposal submission process.

Please provide a brief background of the project, its goals, and the desired outcomes:

You may copy and paste your Step 1 application answer if nothing has changed.

The importance of honey bees cannot be understated; they are responsible for pollinating 1/3 of the food supply in the USA, worth \$15B annually. But bees are experiencing steep population declines, and beekeepers nationwide fight against the 4 P's: parasites, pesticides, pathogens and poor nutrition to keep their colonies alive and healthy. The Bee Research Facility requests funding to construct a Sustainable Auxiliary Building enabling expansion of a cutting-edge research system able to study the 4 P's in unprecedented level of detail. Overwintering colonies indoors will increase colony survival and the sustainability of campus resources, and provide further research opportunities.

The proposed Sustainable Auxiliary Building (~12'x30') on the Bee Research Facility property would be tied into the university electrical grid and have a 5kW rooftop solar array. The 360 sq ft roof of the building would be constructed to maximize solar exposure and the array would generate up to 6,000 kWh of energy and approximately \$475 annual savings. The building would have energy-efficient environmental controls conducive to honey bee research including: red lighting, and year-around temperature, humidity, carbon dioxide and ventilation control. This is important for the following two areas of research:

In the summer, the building would support automated behavioral monitoring of barcoded bees. Built to accommodate six tracking stations, the building would enable the study of 60 research colonies over a single summer, tracking over 60,000 barcoded bees. The optimal indoor conditions for conducting these experiments are 91° F and 60% RH. The new building could more efficiently maintain these conditions than the rooms in the Bee Research Facility, which require constant use of humidifiers and space heaters to offset the HVAC system.

In the winter, the building would overwinter full-sized colonies indoors. Recent research has indicated that indoor overwintering in a climate-controlled environment increases winter survival and might reduce the impact of pathogens and parasites. This is very promising from the perspective of the sustainability of campus bee resources. We envision eventually overwintering our entire beekeeping operation indoors (60-70 hives). The building would be maintained at 32-40° F and 30-40% RH, which are the optimal conditions for honey bees to form their winter cluster. Carbon dioxide monitoring and a well-equipped ventilation system would keep the air quality safe for both humans and honey bees.

The timing of the Sustainable Auxiliary Building is critical for two reasons. First, relocation of the automated behavioral monitoring research is already underway. We are renting a portable office space at the Bee Research Facility to meet our research needs this summer. The sooner that we can construct a Sustainable Auxiliary Building the sooner we can cease unsustainable practices to support our research. Second, the funding that supports the expansion of the automated behavioral tracking of barcoded bees is time-sensitive. For this reason, we hope that the Sustainable Auxiliary Building can be given full consideration during this spring funding cycle.

As our proposal requests a significant amount of the total allotted funding available to the Student Sustainability Committee this spring, if necessary, the funding for the installation of the solar panels, estimated at \$30,000, could be deferred to a later funding cycle. This would allow the construction of the building without delay and the addition of the solar panels on a more flexible timeline.

Where will the project be located? Are special permissions required for this project site?

If special permission is required for this location, please explain and submit any relevant letters of support with the application.

The Sustainable Auxiliary Building would be located at the Bee Research Facility, 3515 S Lincoln Ave, Urbana, IL 61802.

Support and permission granted from Don Gerard, Facilities and Services (F&S) Manager in the School of Integrative Biology.

Permission from the Architectural Review Committee in F&S was requested by Kristine Chalifoux, Management Engineer at F&S.

Other than the project team, who will have a stake in the project? Please list other individuals, groups, or departments affiliated directly or indirectly by the project. This includes any entity providing funding (immediate, future, ongoing, matching, in-kind, etc.) and any entities that benefit from this project.

Please attach letters of commitment or support at the end of the application.

Research in the Robinson lab funded by a grant to promote improved pollination from the Department of Defense – DARPA Program would directly benefit from the Sustainable Auxiliary Building. Funding from this DARPA grant is ongoing and would cover the research equipment (e.g. the automated

behavioral monitoring hives) utilized inside the building. This funding is further outlined in the Financial Information section of the application.

The following departments, programs, and laboratories have a stake in the project through past and continuing collaborations at the Bee Research Facility:

Department of Entomology

Neuroscience Program

Program in Ecology, Evolution and Conservation Biology

School of Integrative Biology

School of Molecular and Cellular Biology

Department of Animal Biology

The laboratories, students, researchers and staff of principal investigators: Dr. Gene Robinson, Dr. May Berenbaum and Dr. Adam Dolezal

Beekeeping Club RSO

WaggleNet undergraduate research project and unofficial RSO

Pollinatarium

Department of Physics

Department of Statistics

College of Engineering

How will this project involve and/or benefit students?

This includes both direct and indirect impact.

The Sustainable Auxiliary Building will support students through research both directly and indirectly. The building will directly enhance and expand educational research opportunities for undergraduate students at the Bee Research Facility. The Robinson and Berenbaum labs have provided research experiences for over 200 undergraduates over a period of several decades and the new Dolezal lab plans to continue with this practice. Research experience prepares students for their careers, helps them make connections in academia and industry and often inspires them to pursue graduate degrees. Additionally, the Sustainable Auxiliary Building's indoor overwintering capabilities could also directly support the undergraduate-led WaggleNet project, the Beekeeping Club RSO and 4H bee hives at the Pollinatarium.

Undergraduate research assistants are an invaluable part of planning, setting up, running and disassembling experiments. For example, the automated behavioral monitoring of barcoded bees requires no fewer than four research assistants per colony working hands-on to prepare the observation hive, apply barcodes to individual bees and assist with colony installation. On average one person can

barcode 50 bees/hour so each roughly 1000 bee experimental colony requires hours of preparation. Once the experiment is set-up students assist with daily maintenance of the hive. Completion of the experiment also requires student assistance in disassembly, collection of qualitative data and identification of bee behaviors in thousands of images to train the machine learning system. The expansion of the automated behavioral monitoring system from four to six stations in the Sustainable Auxiliary Building will directly translate into more opportunities for undergraduate research assistants to gain hands-on experience in experimental design, set-up and scientific beekeeping.

Indirectly, the Sustainable Auxiliary Building would increase the appeal of the Bee Research Facility and its associated laboratories, which could prospectively translate into more funding for research and provide more educational research opportunities for undergraduates.

Furthermore, to highlight the Bee Research Facility's commitment to both students and sustainability, the annual savings generated by the Sustainable Auxiliary Building solar array (an estimated \$475 a year) would be awarded to an undergraduate researcher to support a presentation at a research conference. This award would embody the pairing of education and environmentalism that the Sustainable Auxiliary Building represents.

How will you bring awareness and publicize the project on campus? In addition to SSC, where will information about this project be reported?

Honey bee research is not only important to sustaining the food supply but also attracts media and pop culture attention which we would use as a platform to discuss sustainability and pollinator health. The construction of the Sustainable Auxiliary Building would be announced in press releases from the School of Integrative Biology and the Carl R. Woese Institute for Genomic Biology. Additional media coverage of the project would also publicize the project. For example, Dr. Robinson and Dr. May Berenbaum have previously promoted their research on popular platforms such as an AskMeAnything (AMA) on Reddit.

Educational, outreach, and fundraising events are other important outlets for spreading awareness by promoting the benefits and scientific applications of renewable energy to members of the university, school groups, the local community, funding agencies and donors who participate in tours and honey tastings at the Bee Research Facility. In particular, the Sustainable Auxiliary Building would be a focal point of the biannual Bees and Beekeeping Short Course which is attended by 50 Midwestern beekeepers. We also envision a future "Bee Day" event connecting the Pollinarium, Bee Campus USA locations and the Bee Research Facility which could provide an opportunity for tours, activities and service related to sustainability and pollinator health on the UIUC campus.

Furthermore, promoting the new undergraduate research award will raise awareness of both the Sustainable Auxiliary Building's solar energy savings and the importance of pollinator health.

In addition, we are open to exploring collaborative means of spreading awareness of the project with relevant groups on campus, for example iSEE or the Pollen Power educational program through the IGB.

Financial Information

In addition to the below questions, please submit the supplemental budget spreadsheet available on the Student Sustainability Committee website. Submission of both documents by the submission deadline is required for consideration of your project.

Have you applied for funding from SSC before? If so, for what project?

No.

If this project is implemented, will you require any ongoing funding required? What is the strategy for supporting the project in order to cover replacement, operation, or renewal costs?

Please note that SSC provides funding on a case by case basis annually and should not be considered as an ongoing source of funding.

No ongoing funding from the Student Sustainability Committee is required. Upkeep and maintenance costs associated with the Sustainable Auxiliary Building will be included in future funding proposals for external grants that will utilize the facility.

Please include any other obtained sources of funding. Have you applied for funding elsewhere?

Please attach any relevant letters of support as needed in a separate document.

Funding for the following elements of the Sustainable Auxiliary Building totaling an estimated \$67,000, have already been secured through a grant from the Department of Defense - DARPA program to the Robinson Lab:

- The purchase of two additional automated behavioral monitoring hive systems including: computers, raid back-up systems, cameras, lenses, tripods, ultraviolet light rigs, custom-made observation hives and hive stands. The addition of these two stations will bring the total number to six. Total estimated cost: \$45,000.
- Renovations and modifications to large screened flight enclosures ("Bee Domes") that will be connected to the Sustainable Auxiliary Building. This spring the north Bee Dome is being renovated and we are investing in improvements to the base of the structure to increase longevity. These modifications will be made to the south Bee dome during spring of 2020, ideally in tandem with the construction of the Sustainable Auxiliary Building. Total estimated cost: \$15,000.
- Preparation for connection of the Sustainable Auxiliary Building to the university power grid including: F&S electrician surveying, trench-digging and installation of underground wiring. This work will be completed this spring in advance of field season to supply power to a rental structure and is being planned with the Sustainable Auxiliary Building electrical supply and needs in mind. Total estimated cost: \$6,000-7,000.

Recent improvements to the Bee Research Facility which continue to enhance research and provide pollinator habitat include an outdoor classroom pavilion, native prairie, educational signage and camera equipment funded by a \$100,000 grant from the Christopher Family Foundation. A grant from the Illinois State Beekeeper's Association facilitated improvements to a preliminary indoor overwintering system at the Bee Research Facility and a CO2 monitor.

Additionally, the Healthy Honey Bee Fund is a new partnership between the UIUC Department of Entomology and the Anheuser-Busch InBev Bud Analytics Lab at Research Park. The initial gift of \$5,000 and continued donation of \$1 from the sale of every case of a new alcoholic honey drink called, "b," are specifically for bee research at the university.

Environmental, Economic, and Awareness Impacts

How will the project improve environmental sustainability at the Urbana-Champaign campus? If applicable, how does this project fit within any of the Illinois Climate Action Plan (iCAP) goals?

The Sustainable Auxiliary Building promotes environmental stewardship in two main ways. First, by installing solar panels and powering research through renewable energy. Second, by facilitating year-around study of bee health. While the Bee Research Facility has most recently and prolifically studied honey bees, native bee species have been the subject of previous research and the Sustainable Auxiliary Building could be the future site of native bee research, too. Supporting the health of pollinators and understanding the factors involved in pollinator decline are hugely important to food security and the environment.

Furthermore, the Student Sustainability Committee has recognized the importance role bees play in sustainability through funding the Beekeeping Club RSO and the Bee Campus USA projects. The Sustainable Auxiliary Building would not only continue a tradition of bee research at the Bee Research Facility but would also be complementary to the two existing SSC funded bee projects.

The Sustainable Auxiliary Building will have a positive impact on many iCAP objectives in the areas of energy, transportation, education, outreach and research shown in the table below:

iCAP goals:	Sustainable Auxiliary Building impacts change by:
Engage and incentivize the campus community in energy conservation, including a comprehensive energy conservation campaign, with at least 50% of units participating by FY20.	Conserving energy in the Sustainable Auxiliary Building by switching from inefficient unit humidifiers and space heaters to an energy-efficient HVAC and humidification system.
Expand on-campus solar energy production. By FY20, produce at least 12,500 MWh/year, and by FY25 at least 25,000 MWh, from solar installations on campus property.	Expanding renewable solar energy through the solar array on the rooftop of the Sustainable Auxiliary Building.
Provide opportunities for undergraduate students to obtain research and practical experience by participating in independent study projects on sustainability topics.	Enhancing educational research opportunities for students, providing research platforms for student groups (e.g. WaggleNet), and supporting student-led beekeeping endeavors (e.g. Beekeeping Club RSO).

Support and communicate about co-curricular student sustainability programs.	Expanding existing multi-disciplinary research projects, like the automated bee tracking hive system. Creating new opportunities for collaboration through the implementation of the indoor hive overwintering system.
Build connections: to bring together scholars from across campus to encourage collaboration and to enhance research endeavors.	
Foster “actionable” research: to encourage and support research that provides real-world solutions to society’s grand challenges in sustainability, energy and the environment.	Supporting undergraduate research through the creation of the energy-offset award to sponsor a student’s presentation at a conference.
Reduce emissions from the Urbana-Champaign campus fleet by 20%.	By relocating honey bee colonies from our 12 apiary sites to the Sustainable Auxiliary Building for indoor overwintering, single-occupancy trips and vehicle emissions during the winter months will drop drastically.
Reduce the percentage of staff trips made using single-occupancy vehicles from 65% to 55% by FY20, 50% by FY25, and 45% by FY30.	

How will you monitor and evaluate the project’s progress and environmental outcomes? What short-term and long-term environmental impacts do you expect?

Some examples include carbon emissions, water conservation, green behavior, and reduced landfill waste.

In the short-term, monitoring of the project's progress and environmental outcomes can begin as early as next summer (2020). To determine energy savings, energy consumption from previous summers can be compared to the real time energy usage once the automated bee tracking research is conducted in the Sustainable Auxiliary Building. Not only will the solar panels offset energy costs, but we expect that having the system in the standalone building will also reduce the energy consumption of the experiments as the environmental conditions in the Sustainable Auxiliary Building won't have to compete with the HVAC system in the Bee Research Facility. We anticipate there will be a reduction in energy usage relative to research output as a result of transitioning to solar energy and energy-efficient environmental controls within the Sustainable Auxiliary Building.

Long-term environmental outcomes impact the Bee Truck, colony overwintering survival and longevity of beekeeping equipment. The Bee Truck is invaluable to the beekeeping operation and travels between 6,000-7,000 miles each year between the Bee Research Facility and our 12 apiaries. The Sustainable Auxiliary Building will enable us overwinter colonies indoors, eventually eliminating the need for travel to the apiaries from December-March. The Bee Truck mileage is already recorded and monitoring a change in mileage (and emissions) will be a simple metric to measure environmental impact.

Over time as we fine-tune and research the most successful configuration for overwintering colonies indoors in the Sustainable Auxiliary Building we expect an increase in colony survival. We closely track which colonies survive the winter and monitor what leads to their demise. Research indicates that overwintering colonies indoors increases survival because the environmental conditions can be closely controlled to optimize the clustering behavior of the bees. Keeping colonies indoors through the winter can also prevent the unpredictable. For example, blowing over during storms and dying from exposure-

which happened to a colony in February of this year. Increased survival will decrease need to order replacement bees from locations far from Illinois.

To illustrate the impact of overwintering survival, consider the Bee Research Facility's 70 honey bee colonies going into winter in 2018. While there is variation in the number of bees in each of these hives, we can estimate that on average each colony has 20,000 bees going into winter. 70 colonies of 20,000 bees is 1,400,000 bees. So far this winter we have lost 33% of our colonies, which means that we have lost about 460,000 bees. If indoor overwintering of our hives can reduce our losses to 20% or even 10% that would save hundreds of thousands of honey bees.

In the long-term, indoor overwintering will also reduce time and money expended on replacing and repairing beekeeping equipment. Snow, sleet, rain and wind wear and tear on hives throughout the winter, but mice, skunks and other critters are also causes of damage to equipment. Relocating hives indoors for protects them from damage and also reduces labor involved in modifying equipment for winter.

What are your specific outreach goals? How will this project inspire change at UIUC?

Our specific outreach goals involve expanding our Biannual Bees and Beekeeping Short Course and the initiation of a collaborative "Bee Day" event.

The Bees and Beekeeping Short Course is a hands-on educational course attended by 50 beekeepers from around the Midwest. The one-day program includes presentations at the IGB and the Bee Research Facility, hands-on beekeeping lessons and features an acclaimed guest speaker from the beekeeping community. The Sustainable Auxiliary Building and its indoor overwintering capabilities will certainly appeal to local beekeepers who struggle with the same winter colony losses. By adding a segment about sustainable research and beekeeping practices, indoor overwintering to prevent colony loss, and educating participants about the benefits of renewable energy we would be promoting the university's commitment to sustainability while also teaching an eager audience about how to practice environmental stewardship. This additional outreach opportunity would be free as a part of our existing and longstanding program.

While the Bees and Beekeeping Short Course reaches an important audience, local beekeepers, an additional open-house style event focused on the student body and university community would be a productive way to inspire change at the university-level. A "Bee Day" with stops at Bee Campus USA areas, the Pollinarium and the Bee Research Facility would increase visibility for pollinator health and research, showcase sustainability efforts, and provide students with an opportunity to learn about how they can get involved with bees and research on campus.

If applicable, how does this project impact environmental injustice or social injustice?

The Sustainable Auxiliary Building would be an inclusive space for students of all cultures, faiths, orientations and walks of life to connect through mutual scientific interest in honey bees and other pollinators—as is the Bee Research Facility. While this proposal does not specifically target environmental or social injustice, the Sustainable Auxiliary Building will provide opportunities in

research, education and outreach for a multitude of peoples to participate in science while engaging in sustainable practices. Like the scientific process, making a difference in environmental and social injustice requires persistent revision, reflection and dialogue and we are open to any discussions about how the Sustainable Auxiliary Building could better address injustice in the campus community, especially through educational and outreach programs.