**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:** Campus Instructional Facility (College of Engineering)

**Total Amount Requested from SSC:** $375,000

**Project Topic Areas:** [ ]  Land & Water [x]  Education [x]  Energy

[ ]  Transportation [ ]  Food & Waste

**Applicant Name:** Associate Professor Liang Liu

**Campus Affiliation (Unit/Department or RSO/Organization):** College of Engineering

**Email Address:** lliu1@illinois.edu

**Check one:**

 [ ]  This project is solely my own ***OR***

 [x]  This project is proposed on behalf of (name of student org., campus dept., etc.): College of Engineering

**Project Team Members**

|  |  |  |
| --- | --- | --- |
| **Name** | **Department** | **Email** |
| Liang Liu | College of Enigneering (COE) | lliu1@illinois.edu |
| Qu Kim | College of Enigneering (COE) | qkim@illinois.edu |
| Andy Stumpf | Prairie Research Institute (PRI) | astumpf@illinois.edu |
| Yu‐Feng Lin | Prairie Research Institute (PRI) | yflin@illinois.edu |

**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: Associate Professor Liang Liu

Unit/Department: College of Engineering

Email Address: lliu1@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.*

When built, the University of Illinois Campus Instructional Facility will be a four-story building (with a total of five levels when you include the lower level) dedicated to academic and classroom uses on a site bounded by Talbot Laboratory (south), Grainger Engineering Library (east), Wright Street (west), and Springfield Avenue (north). The College of Engineering facility will become a major academic building (serving thousands of students at any time and staying open well into the evening for group projects and studying), satisfying classroom demand for both the College and the broader campus. The Campus Instructional Facility will be the first public-private partnership of its kind on the Urbana-Champaign campus, as well as the first geothermal system (a concept noted for its potential in the University's iCAP goals), providing the Student Sustainability Committee (SSC) an opportunity to participate in a series of notable firsts for the institution.

For your review and consideration and to contribute to the University's goal of being carbon-neutral by 2050, we propose a geothermal exchange project that focuses on advancing engineering systems and significantly lowers greenhouse gas emissions from operational energy for this new Campus Instructional Facility. The concept is scalable, allowing for expansion to other buildings on the John Bardeen Quad and beyond. The geoexchange system will reduce overall usage of other energy sources (i.e., electricity and natural gas); and provides a form of resiliency when parts of the campus energy system go offline.

The goal is to deliver an exceptional high performance building with the lowest entropy possible to exhibit the fundamental second law of thermodynamics. We believe the facility should demonstrate the power of thoughtful and innovative engineering to deliver performance that provides a high-quality learning environment, while respecting the quality of life of not only students, faculty, and staff but also all those affected by the environmental impacts of the building. By providing an abundance of fresh air through optimized air ventilation, displacement supply air, daylighting, and night flush we intent to enhance the indoor microbial biome, etc., with the intent of maintaining a superb learning environment. In addition, the building will use radiant heat transfer as the mechanism for creating thermal comfort, mimicking the method by which we most naturally like to experience warmth and comfort.

Our proposal is also to reduce dependence on the Abbott Power Plant (including adding to the campus resiliency); while the existing plant has an efficient combined heat and power system, it also relies on fossil fuel to generate energy that has a large carbon footprint. As early as 1997, the U.S. Environmental Protection Agency already estimated that geothermal exchange could reduce energy consumption by up to 44% compared with air-source heat pumps and up to 72% compared with conventional electrical heating and air conditioning. With a geothermal exchange system, the total energy load required from the central heating and cooling systems will be reduced for this facility. Our design involves using a condenser water loop to draw energy from different elements. In 2012, the U.S. Department of Energy estimated that more than two-thirds of the nation’s electrical energy and more than 40% of natural gas is consumed in a building’s utilities. In residential and commercial buildings, space heating and cooling and water heating consume more than 40% of the electrical power. Within the building sector, space heating and cooling are the predominant demands, accounting for 47% of site-delivered energy, and water heating accounts for an additional 12%. We know that an installation of this scale will attract attention from the public and other universities; it will be an inspiration for others to follow.

We would like the operation of the Campus Instructional Building to be responsive and to exceed what is proposed in the iCAP plan and its overarching sustainability goals. Specific to emissions reduction, we are striving to reduce our energy use intensity (EUI) with a suite of energy efficiency measures, including a radiant heating and cooling system, high efficiency lighting and equipment, and passive desiccant humidity control. However, we will be able to realize the highest possible emissions savings by reducing the dependency on the Abbott Power Plant, and we ask for your support to do so. The estimated load of the radiant system for heating and cooling requires 210 tons (2,520,000 Btu/hour) of cooling capacity. With the proposed grant, the geothermal exchange system will meet approximately 30% of that load (about 63 tons) utilizing the ground-source system to provide the heating and cooling needed through a combination of the stored thermal energy and electrical energy. The implementation of efficient design will reduce carbon emissions from the source of energy by 35%. and the introduction of a portion of the ground-source system will reduce overall source energy and carbon emissions by another 8%. If the project can achieve a full-sized ground-source system, the savings could reach 55% when compared against a typical building.

By significantly altering the carbon curve for the University of Illinois College of Engineering, we propose a new paradigm for campus construction that can inspire future campus improvement projects using geothermal exchange, thermal storage, and optimized building designs. You can imagine that similar geothermal systems could be installed on other campus greenspaces, creating a network of district-scale systems that collectively would significantly reduce energy reliance on the Abbott Power Plant

The project team proposes to seek publicity and coverage in trade and scientific publications, in the media, in conferences and workshops (talks, posters, flyers), and in communications with campus administrators, public officials and regulatory agencies.

In the future, the system could be expanded to provide renewable energy sharing with other buildings. The ground-source heat exchange system will not impede the pedestrian and civic amenities that the students enjoy on and around the John Bardeen quad. The borefield and piping will be buried below the ground. Once the system is installed, the impacted land will be restored to its original condition.

This project will be a milestone for the University's goal of being carbon-neutral by 2050 and will be the first to include this forward looking design. Unlike other buildings connected to the central heating and cooling plant, which is powered by fossil fuels, introducing a thermal borehole energy system will enable buildings on the Bardeen Quad to have an opportunity to share thermal resources in a cooperative way, fed instead by renewable resources. This project proposes a forward-looking design to transition the campus towards a cleaner tomorrow. Several universities, e.g. Stanford and public institutions in California, are already transitioning to predominantly electric campuses and towards zero emissions and zero carbon, while others, e.g. Boston University, have committed to 100% renewable energy.

We are asking the SSC to support this effort with approximately 20% of the cost of the geothermal system. The balance will be funded in part by developing a project that far exceeds the University's baseline (and therefore, energy savings will be monetized) and the balance will be funded by the project's construction, the College of Engineering or other grant programs. Concurrently, we are pursuing a $65,000 grant from the Carbon Credit Sale Fund to support initial drilling, testing and monitoring that will inform the project's design.

**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 ground source heat exchange system will consist of approximately 60 wells arrayed in a field approximately 200' x 200' in plan (dimensions currently under review). The well field is proposed to be located under the John Bardeen quad. It will be designed to be expandable, with the ability to be connected to other buildings, allowing for multiple phases. This strategy and approach could also be leveraged at other campus areas adjacent to similar green spaces and quads.**

**The University of Illinois Facilities & Services has reviewed this request and is actively engaged as a participant with the Campus Instructional Facility project team.**

**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.*

The project is leveraging a novel "Public Private Partnership" structure. In simplistic terms, this means that the University is working with several private sector entities (both for profit and not-for-profit) that will assist in delivering the project. As part of the transaction, the University will sign a 30-year lease for the improvements. The geothermal solution will be on University land outside of the proposed ground lease area. The benefit, resulting in reduced utility costs, accrues directly to the College of Engineering.

**How will this project involve and/or benefit students?**

*This includes both direct and indirect impact.*

**This concept was originally conceived and developed by university students and faculty, so student involvement has been key since its infancy. Dr. Lin was funded by the SSC in 2016 to pilot a new method for designing and monitoring geothermal exchange system in order to reducing the cost of installation and optimizing the operation for future campus projects like this one. Dr. Andy Stumpf assisted the team by conducting geothermal property analysis, and in 2018 SSC funded his new project for installing a geothermal exchange system for greenhouses at the Woody Poly Perennial site. Both Drs. Lin and Stumpf will assist the design team for the Campus Instructional Facility to create the most cost-efficient installation possible, through the innovative techniques developed with SSC's previous support. The project also proposes to work with Dr. Tim Stark. He and his students will run a borehole simulation that will return information on optimizing the well spacing. He also has experience helping design geoexchange systems, specifically at O'Hare International Airport.**

**The project team envisions deep collaboration with the faculty and staff in the Departments of Civil and Environmental Engineering, Mechanical Engineering and Geology, and Energy Systems Program, iSEE, and Facilities and Services. Additionally, we propose that students be involved in the project at several stages, including in the design phase, during construction, and operation of the geothermal system. During design phase, students can review the modeling processes and tools that allow the system to achieve optimal performance. During construction, we would like to arrange times to observe the installation of borefield from a "safe distance" to allow the students the opportunity to see the drilling process and understand the volume of earth that is displaced. We also would want to show the students the interface between the geo-exchange system and distribution of the heating and cooling from the digital monitoring and control room. Real time energy and emissions savings will be displayed that further engage the students post-occupancy. Operationally, the students will benefit from the comfort of the radiant system in their learning environment.**

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

The project team wishes to collaborate with the SSC to publicize the project and its results on campus, in the surrounding communities, across the state and nationally. In the budget, several concepts are included, though there is the potential for further expansion with SSC collaboration.

Embedded throughout the project, there will be opportunities for potential student engagement and interaction with high performance, healthy features — all visible and tangible to the students. However, we are well aware that invisible engineering strategies can have the highest impact on emission reductions. Our aim is to make as many of these "behind-the-scene" engineering operations visible for teaching and instruction opportunities.

# Financial Information

*In addition to the below questions, please submit the supplemental budget spreadsheet available on the Student Sustainability Committee* [*website*](http://ssc.sustainability.illinois.edu/?page_id=2087)*. 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?**

N/A, though the research and knowledge gained through past geothermal projects is being incorporated into this context.

**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 is being requested. Replacement and operating costs will be covered by the College of Engineering. The monitoring well will be maintained by the Prairie Research Institute.

**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.*

The SSC grant would fund approximately 20% of the cost of the geothermal system. Based on the high levels of energy efficiency the project is pursuing, in part with this geothermal system and a radiant system, the University anticipates saving $685,000 against the baseline assumptions for the connection to the campus utility infrastructure that was previously budgeted. Those dollars would be monetized and directed towards the geothermal system. An additional $65,000 is concurrently being pursued from a Carbon Credit Sale Fund request. When you add the proposed grants and anticipated savings tied to increased efficiency, it brings total prospective funding sources to $1,125,000.

The remaining funding gap is being reviewed by project stakeholders, where additional grant sources are being engaged while the project team and the College of Engineering evaluate budget options. The geothermal proposal is anticipated to save the College of Engineering $118,540 per year in utilities against the project baseline (which was utilized for initial operating estimates), so there is a compelling payback period and an opportunity for the College of Engineering to pursue this option with the proposed funding sources noted above. The team is committed to identifying a pathway forward, with a combination of monetized efficiency savings, grant dollars, operational savings and as a part of the project budget.

# 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**](https://icap.sustainability.illinois.edu/) **(iCAP) goals?**

The Illinois Climate Action Plan (iCAP) outlines a path for the University of Illinois at Urbana-Champaign to achieve carbon neutrality as soon as possible, and no later than 2050. Our proposal is to reduce dependance on the Abbott Power Plant as the University transitions to a zero emission and zero carbon campus. While the existing plant has an efficient combined heat and power system, it also relies on fossil fuel to generate energy at a high carbon footprint. With the geothermal system, the total energy needed from the central heating and cooling systems will be significantly reduced, while also setting the stage for expansion of this to the rest of the John Bardeen Quad and beyond. This portion of campus will create a template that can be replicated in other areas as the University works towards a cleaner future.

Eliminating emissions from Abbott and purchased electricity is a central vision outlined in the iCAP. The methods cited include a combination of reducing energy demands and shifting energy generation toward clean energy sources. The project will participate with the University in the purchase of green power purchase agreements, while the geothermal system will vastly reduce demand on Abbott. In addition, the project will use high-efficiency heat pumps, so a significant portion of the heating can be met by non-fossil-fuel electricity rather than by combustion of fossil fuels. The iCAP specifically references our proposed geothermal project concept:

"One very promising technology for this involves the use of geothermal heat pumps. As an example of what can be accomplished with current technology, we consider Ball State University, which commissioned a large-scale district geothermal heating and cooling system in 2012. It uses large heat pump chillers to simultaneously produce chilled and hot water. The system has a design coefficient of performance of 3.8 for heating and 2.9 for cooling, meaning that for each unit of electric energy consumed 6.7 units of heat are moved. Ball State University is at almost the same latitude as our university, so similar systems could be evaluated for use on this campus. […] An additional attraction of geothermal is the use of a hot water distribution system. A study of the benefits of a possible transition from steam to hot water thermal distribution was recommended by the 2010 iCAP, which suggested that this transition, either central or distributed, can yield considerable energy savings."

The iCAP conclusion cites this strategy (and others being deployed as a part of this project) as the most viable technologies to achieve the campus goals: "At present, the most viable technologies and markets that appear promising for clean energy are: (1) electrification of our heating needs, through the use of geothermal and/or air-source heat pumps […] [and] (4) power purchase agreements for zero-carbon electricity from off-campus sources […]."

**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.*

**The project is anticipated to commence next spring. The geothermal system will be actively monitored. The system performance will be integrated into learning opportunities with the College of Engineering and other University departments.**

**The primary environmental impacts, energy savings and a reduction in carbon emissions, will be tracked and made available via the outreach goals cited below.**

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

**The project also proposes to develop and deploy a student-focused digital application ("app") to monitor the geothermal exchange system and building consumption. This application could be scaled as other buildings deploy similar measures on campus. In addition, the project team welcomes the opportunity to engage directly with the SSC, incorporating digital communications on the SSC's involvement and contribution, real time data on the geothermal exchange system, and other sustainability metrics on the digital displays throughout the Campus Instructional Facility.**

**In terms of inspiring change at the University of Illinois, the goal is to develop a strategy and approach so that this concept can be incorporated to other new construction and renovation projects. The project team envisions a future where many of the green spaces and quads at the University could serve a similar purpose, all without impacting these beautiful spaces for the enjoyment of students, faculty, staff and visitors. This would make for a very compelling story and one we feel will resonate with a wide audience.**

**Lastly, the project team is receptive to teaming with the SSC, Energy and Sustainability Engineering (EaSE), and other campus groups to create opportuinties for the geothermal system and the Campus Instructional Facility to become a laboratory, both during construction and following completion.**

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

**N/A**