STUDENT SUSTAINABILITY COMMITTEE

Funding Application – Student-Led Projects (Under $10K)

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 funding application should include this application and any letters of support.

Please submit this completed application and any relevant supporting documentation by the deadline listed on the SSC website 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: Energy shaft for geothermal exchange at the UIUC Energy Farm
Total Amount Requested from SSC: $10,000

Project Topic Areas: ☒ Land & Water ☒ Education ☒ Energy
☐ Transportation ☐ Food & Waste

Applicant Name: Zhaowang LIN
Campus Affiliation (Unit/Department or RSO/Organization): University of Illinois at Urbana-Champaign (UIUC)/Department of Civil & Environmental Engineering
Email Address: zhaowang@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.): Deparment of Civil & Environmental Engineering and Prairie Research Institute (Illinois State Geological Survey)

Project Team Members

Name	Department	Email
Zhaowang LIN	UIUC/Civil & Environmental Eng.	zhaowang@illinois.edu
Timothy D. Stark	UIUC/Civil & Environmental Eng.	tstark@illinois.edu
Andrew J. Stumpf	PRI/ISGS	astumpf@illinois.edu
Yu-Feng Lin	PRI/ISGS, UIUC/Civil & Environmental Engineering, and UIUC/Illinois Water Resources Center	yflin@illinois.edu

Student-Led Projects (Mandatory):
Name of Faculty or Staff Project Advisor: Timothy D. Stark
Advisor's Email Address: tstark@illinois.edu

Financial Contact *(Must be a full-time University of Illinois staff member)*
Contact Name: Timothy D. Stark
Unit/Department: UIUC/Department of Civil & Environmental Engineering
Email Address: tstark@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:

We want to know: What is your project? What does it concretely produce, accomplish, or solve? Why is this project needed on campus?

The proposed project will involve the design, construction, and installation of an energy geo-structure (energy shaft with a diameter of 2 feet and a length of 30 feet) for heating the UIUC Energy Farm on the University of Illinois at Urbana-Champaign campus, located near the southeast corner of Race Street and Curtis Road on the South Farms. There is great potential in exploring and utilizing geothermal energy, a renewable energy alternative to fossil fuels. An energy shaft is a new technology designed to access the shallow geothermal energy (relatively constant ground temperature in the upper 30 m of the subsurface). The objective of the project is to determine the feasiblity of using drilled shafts that are already being used to support structures on campus also as a geothermal heat-exchange element. Geothermal heat exchangers (closed absorber pipes) can be incorporated into underground infrastructure, e.g., drilled shafts, through which water is circulated to withdraw shallow geothermal heat (~55 °F) and transport it to the surface for structure heating or cooling.

In this project, Illini Drilled Foundations, Inc. in Danville, IL, a leading member of the Association of Drilled Shaft Contractors (ADSC), will construct the energy shaft. To construct an energy shaft, a borehole is drilled, then a reinforcement cage comprised of various shaped steel bars is lowered into the borehole, and finally the borehole is backfilled with concrete. In the proposed shaft, the reinforcement cage will be augmented with coil-shaped and/or U-shaped geothermal pipes for heat exchange purposes. The material of the geothermal pipes will be PEX (cross-linked high density polyethylene) and/or HPGX (a fiberglass material provided by the Rygan Corporation in Tulsa, OK), which have high strength and low thermal resistance to facilitate heat exchange. Fiber optic cables will be attached to the geothermal pipes to measure temperature variations during system operation. Finally, thermally-enhanced concrete will be used to backfill the borehole. Thermally-enhanced concrete could be made with thermally-enhanced cement paste (e.g., using silane and silica fume as chemical admixtures) and metallic additives (powders, fibres and shavings). Vibration and densification of the concrete also increase the thermal performance of concrete by reducing the porosity of the concrete.

In summary, energy shafts could serve as both structural and heat-exchange elements for buildings, leading to reduced costs and reduced usage of space because another borehole will not have to be drilled for a heat exchange system. The unique aspect of this project is the effectiveness of an energy shaft in Central Illinois is not known but all high rise structures in the area are supported on drilled shafts because of the subsurface conditions. As a result, this project will allow the cost/benefits of an energy shaft to be quantified to determine whether or not future U of I buildings should be founded on energy shafts. The usage of renewable shallow geothermal energy will lower fossil fuel usage, costs, and greenhouse gas emissions. The results of this project will enhance the future development of geothermal exchange systems on the U of I campus, which will aid in achieving the goals outlined in the Illinois Climate Action Plan (iCAP).

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. SSC cannot fund projects without prior location approval.

The project will be located at an available workspace at the UIUC Energy Farm, 4110 S Race St, Urbana, IL 61802 (N40.066909°,W88.205433°). No special permission is required and this is beneficial because the infrastructure for assessing and monitoring the energy shaft are already in place (i.e., a control room was

built for the geoexchange borehole project that SSC funded), therefore the asscoiated project costs are minimized.

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 could benefit any unit on the U of I campus and the local community that is interested in supporting structures on drilled shafts because these shafts could be modified to also serve as an energy shaft as well as a foundation support element. This geothermal heat exchange system could be used to heat and cool the overlying building. The Department of Civil and Environmental Engineering (CEE) and the Prairie Research Institute (PRI) are already engaged in geothermal exchange projects on campus. The UIUC Energy Farm is a partner in some of this work. The results of this project will further investigate the use of this "green" renewable energy source on the U of I campus.

How will this project involve and/or benefit students?
This includes both direct and indirect impact.
Graduate students will be involved in the design, installation, and monitoring of the energy shaft. The students will have access to the latest inter-disciplinary technology (Structure and Energy) about energy shafts, U of I professors, and engineers/scientists at the PRI and UIUC Energy Farm. The students will analyze the resulting data to observe and assess the performance of the energy shaft.

On one advanced workstation in the technology laboratory at PRI, the advanced geothermal modeling software 'COMSOL Multiphysics version 5.3a' is installed and available for use by the students. The students will use the software to simulate the hydro-thermo-mechanical response of the energy shaft, and these simulation results will assist with the design of energy shafts for new construction on the UIUC campus.

What are your specific outreach goals? How will this project inspire change at UIUC?
Our outreach goal is to study the potential and feasibility of using energy shafts to support future buildings on the U of I campus. If it is cost effective, energy shafts will be recommended to the campus and the local commmunity for reducing HVAC costs, decreasing greenhouse gases emissions, and maximizing the use of campus' built land.

How will the project improve environmental sustainability at the Urbana-Champaign campus?
The project could help reduce the usage of conventional HVAC systems, increasing energy usage efficiency, and lowering greenhouse gas emissions. The combination of structural support and heat-exchange exchange systems is a drilled shaft also reduces the installation and land space costs required for a geothermal system. The outcomes of this project will enhance our understanding and utilization of geothermal systems on campus.

If applicable, how does this project impact environmental injustice or social injustice?
Not applicable.

Scope, Schedule, and Budget verification

What is the plan for project implementation? Describe the key steps of the project including the start date, target completion date, target date for submitting a final report, and any significant tasks or milestones.
Please be as detailed as possible.

Task	Timeframe (# of weeks to completion)	Estimated Completion Date
Start date	---	October 22nd 2018
Design of energy pile	5 weeks	November 26th 2018
Source and purchase components	4 weeks	December 24th 2018
Construct the energy pile	6 weeks	February 4th 2019
Experiment design and implement	8 weeks	April 1st 2019
Writing report and paper	5 weeks	May 6th 2019

List all budget items for which funding is being requested. Include cost and total amount for each item requested.
Please be as detailed as possible.

24-inch diameter and 30-foot length bored cast-in-place pile (See the attached support material)	*$8,400*
Geothermal pipe (PEX or HPGX, inner diameter = ~1 inch, 100 feet long)	*$700*
Fiber optic cable (200 feet) and installation	*$900*
Total	*$10,000*

If the project is implemented, will you require ongoing funding? What is the strategy for supporting the project in order to cover replacement, operation, or renewal costs?
SSC provides funding on a case by case basis and should not be considered as an ongoing source of funding
No ongoing funding is required.

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.
We have not applied for other sources of funding.

Have you applied for funding from SSC before? If so, for what project?
No.

How will you bring awareness and publicize the project on campus? In addition to SSC, where will information about this project be reported?
We will introduce our project to students through seminars in the CEE. We hope to arouse interest of researchers and members from other departments or communities on campus, such as the energy and sustainability communities. We plan to publish papers on scientific journals or conferences, and related information and results will be reported on the iSEE/SSC and CEE/PRI websites.

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August 30, 2018

U of I Civil & Env. Eng. Dept.
Attn: Zhaowang LIN

RE: Energy Shaft Research Project
4110 S Race St., Urbana, IL

We propose to construct the drilled shaft on the above referenced project according to the information you emailed on 8-17-18 and this proposal. We will be utilizing a truck mounted drill rig with a reach of 6' from tracks to center of hole.

Base Bid Inclusions:

- Machine drilling 1 shaft: 24"Ø x 30' deep
- Furnishing temporary casing as required
- Removal of spoil to an off site location
- Requesting utility locate to be performed by appropriate agencies
- State and Federal payroll taxes
- Workmen's Compensation Insurance
- One (1) Mobilization/Demobilization

Base Bid Exclusions:

- Any premium time labor
- Any soil borings
- Furnishing or placing any permanent
- Furnishing layout, off sets, cutoff elevations or other engineering services.
- All permits, fees, easements and permission of adjacent property owners that may be required for this work, except for those required for the transportation of our equipment
- Any traffic controls
- Any excavation, dewatering, erosion control or dust control of site
- Any laboratory field testing services for material, concrete or soil
- Access to the shaft location capable of supporting our drill rig and support truck. Working grade will be dry, firm, stable and level per OSHA 29 CFR 1926.1402(a)(b)
- Rig requires 55' of working height clearance, weighing approximately 100,000 lbs
- Responsibility for damaging, exposing, removing or relocating any utilities in the area that after the locate are deemed by us to be too close (within 3') to the proposed excavation. Anything within 3' of excavation must be exposed by others before we will drill.
- Protection of top of completed shaft for safety or weather reasons
- Furnishing or placing any anchor bolts
- Forming above grade
- Performance or Payment bonds unless expressly included in Illini's bid and reimbursed to Illini
- Removal of contaminated or hazardous waste if encountered. We shall be reimbursed for any additional cost due to delays, excavation or other associated work
- ***Drilling rock, removal of boulders or obstructions of any kind

Means and Method of Performance. All construction work and services shall be performed in the means and manner selected by Illini Drilled Foundations, Inc. (Illini) provided that such means permit Illini to comply with the architects specifications, industry custom, and does the same in a workmanlike manner. Illini shall not be required to employ any particular means or methods, without additional compensation, not otherwise required to perform its scope of work under conditions of good weather and reasonable access.

The Illini bid is expressly based upon its being provided with sufficient access to the project site, release-for-construction drawings and necessary layout and engineering such that it can perform the entire scope of work in a continuous and uninterrupted operation with no waiting/down-time and no more than one mobilization. Work shall be completed in each area before moving to the next, most adjacent area of work for reasons other than correcting defective work.

Access. Customer shall provide at its cost, continuous access to the project site. "Access" shall be defined as providing a reasonably level and water-free work site with all necessary ramps and benches for Illini to gain ingress and egress and to efficiently operate our equipment, including drill rigs, concrete trucks and pickup trucks, in our work area. All excavation required for our work operations must meet all current local, state and federal codes and standards prior to our working in such areas. Rig requires at least 55' of working height clearance. Illini shall not be required to alter its means and method of performance as a result of access limitations. If access is unstable or inaccessible such that Illini cannot ingress or egress via the access created by Customer or cannot perform its work, Customer shall provide a stone bed or such other conditions to allow for ingress, egress and/or performance of work. Illini is not responsible for ensuring, creating or maintaining access to any portion of the project to perform its scope of work and shall be reasonably compensated by Customer for delays, additional costs (including but not limited to additional mobilization and demobilization costs) incurred due to a lack of access, regardless of the cause or origin thereof. In the event Customer is a general contractor, Customer's obligation for such compensation is not dependent upon payment by the project owner for same.

Layout. Illini is not responsible for surveys, layout, as-built drawings or other engineering services for the project. Customer shall provide adequate layout, including but not limited to cut-off elevations, field locations and off-sets for each shaft on the project.

Differing Site Conditions. Illini has expressly relied upon any site and subsurface condition representations identified in the bid documents in preparing and submitting this proposal. Unless Illini has been paid, or has been expressly and specifically promised payment, for performing its own pre-proposal subsurface inspections, it shall be entitled to rely upon the site and subsurface condition representations contained in the bid documents, including but not limited to boring samples, and shall be entitled to additional time and payment in the event the site or subsurface conditions materially differ from that which was disclosed in the bid documents.

Utilities and Obstructions. Illini shall contact the appropriate utilities in advance of performing its work if required by its contract or subcontract on the project. However, Illini shall not be responsible for, and shall be compensated for, any delays or costs incurred due to striking underground utilities either not identified or incorrectly located in the bid documents or plans or by the utility company. Illini is not responsible for exposure, relocation and/or protection of utilities or other underground obstructions not identified in the bid documents.

Contract Documents. In the event any documents are incorporated by reference into the contract presented to Illini, Customer shall provide copies or make such documents available for inspection and copying (at Customer's expense) to Illini prior to requiring Illini to execute such contract.

Interest If Illini is a subcontractor under a pay-if-paid or pay-when paid prime contract project, Customer shall pay Illini within seven (7) days from receipt of any funds from the project owner that were obtained based upon the labor or materials provided by Illini. Interest at the rate of 8% shall accrue thereafter.

Warranty. Illini shall warrant its labor and materials for a period of one(1) year beginning from the date on which Illini substantially completes its scope of work.

Inspection and Approval of Work. Notwithstanding any warranty obligations which may be assumed, Customer shall timely inspect and approve the work performed by Illini,which inspection and approval shall be completed and communicated to Illini not longer than (60) days after completion of the specific work being inspected.

Payment Illini shall be paid for the contract value of its work billed and performed within thirty (30) days from the date on which such work was billed, with the exception of retainage not to exceed ten percent (10%) which may be withheld until the earlier of (1) inspection and approval of Illini's work or (2) construction upon or utilizing all of the work performed by Illini, but in any event not to exceed sixty (60) days.

Attorneys Fees. The prevailing party in any dispute relating to the Proposal, the project or any contract or subcontract entered into between Illini and Customer relating to the project shall be entitled to recover its reasonable attorney fees and costs incurred through litigation, negotiation, mediation or correspondence.

Definition of Rock. Rock, boulders or obstructions are defined as material which cannot be removed with normal earth auger drilling equipment-requiring instead the use of rock augers, core barrels, or other specialized rock removal equipment or procedures.

Force Majeure. Any extra work, overtime or lost time resulting from issues beyond the control of Illini on the project, including but not limited to: access problems, onsite conditions, design changes, improper layout, lack of readiness, inspection delays, weather, etc., will be invoiced and paid by Customer without retention.

INDEMNIFICATION & HOLD HARMLESS PROVISION Illini as subcontractor agrees to hold harmless and indemnify the contractor for any claims made for personal injury, death, or property damage against contractor providing that Illini's negligence was the sole proximate cause of the personal injury, death or property damage. If Illini was or is found to be only partly negligent, Illini will hold harmless and indemnify the contractor only to the extent that Illini's partial negligence bears to the total amount of damages awarded to any complainant by settlement or otherwise.

Survival and Superiority. This proposal and all terms herein shall form a material part of any contract or subcontract entered into between Customer and Illini relating to the project and shall supersede all conflicting subsequent agreements, whether verbal or in writing. Said proposal shall be attached thereto and incorporated by reference, though the failure to do so shall not invalidate in any manner the terms of this proposal. The parties agree that this proposal shall expressly survive any merger clause or exclusion contained in any subsequent agreement and shall not in any manner be diminished or waived by any subsequent writing unless the parties expressly reference this proposal by name and date in the merger clause or waiver section of any subsequent writing.

Upon acceptance of this bid and scope, please sign below and fax back to 217-442-0418. Your signature and date at the bottom of this sheet will serve as written notice to proceed.

Our bid shall be valid for a period of 30 days from bid date.

Our base bid is: $ **8,400.00**

Unit Prices:

Add $ 20.00 per cu. ft. additional depth in earth

Deduct $ 4.00 per cu ft lesser depth in earth

Add $ 850.00 per hour for drilling rock, removing boulders or man made obstructions or for delay time caused by others.

Respectfully,

Illini Drilled Foundations, Inc.

Julie Hines
V.P. / Estimating

Signature and Title:_____

Date:_____