View results

Respondent

5 Andrew Stumpf

45:02
Time to complete

Final Project Report

1. Date of this final project report submission *

2025-09-05

2. Name of project exactly as it was listed in your award letter *

Geothermal Exchange at Greenhouses at UIUC Energy Farm

3. Date (or semester/year) of original award letter *

2018-04-15

4. Expiration date of award as listed on original award letter or approved scope change letter - whichever is more recent *

2025-09-07

5. Enter the amount of the award, including any budget increases as a result of a previous scope change. *

213550

6. What is your project's 6 digit fund account number created for this project and to which the SSC allocation was transferred?

Please ask your project's financial contact for this information if unknown.

304429

7. How much (in dollars) of your award (including previous approved budget increases) is remaining? *

1057.46

8. Briefly describe the goals of your project. *

This project was developed to provide an agricultural facility on campus with renewable geothermal heating and cooling replacing the use of fossil fuels and reducing electricity usage. The Energy Farm was chosen because it is located beyond the reach of the campus' cogeneration heat and power (CHP) system. Propane is delivered by truck to meet the building's heating and cooling is by a traditional central air conditioning–propane furnace. The Energy Farm also houses demonstrations of other renewable energy technologies, and geothermal could be highlighted as an additional application. Also, there was interest to lower energy costs at the farm.

The project team also had the opportunity to collaborate with Oak Ridge National Laboratory to field test their new underground thermal battery (UTB) technology. The Energy Farm was interested in supporting this important study. The installation of the UTB was supported by external grant funding provided to the Illinois Water Resources Center at the Prairie Research Institute (PRI-IWRC). Data being collected from the geothermal heat pump (GHP) and sensors installed throughout the geothermal borefield provide benchmarking for the performance of UTB with traditional borehole heat exchangers (BHE). ORNL donated the UTB and the associated sensors.

9. Did you complete your project as it was outlined in the original award letter or in a subsequent approved scope change? *

- ○ Yes, the project was completed as originally outlined.
- ◉ No, the project was not completed as originally outlined.

10. On what date did you consider the project finished or that you stopped working on it? *

2025-09-05. The team still needs to purchase 2 informational signs, and there may be an outstanding charge for the recent repairs to the GHP. The U of I Architecture Review Committee will need to review and approve the signs the team designs.

11. Describe, in detail, the challenges / obstacles your project faced. *

The project completion was impacted by several issues. The needs of greenhouses managed by the initial faculty collaborators changed over time. F&S did not inform us until after the project started that the electrical system at WPP needed upgrading and what the cost would be. Once the project pivoted to the Energy Farm, the pandemic impacted the project's progress. For 2 years, ORNL was unable to work on their UTB prototype which delayed the field testing. Post-pandemic, the cost of equipment/supply and services rose significantly and changed daily/weekly. To complete the project, a scope change was submitted to the SSC seeking additional funding. Furthermore, this was the first geothermal project that F&S was the primary contractor, and therefore their staff had to gain knowledge and experience to ensure completion. Dove-tailing with a research component, undertaking the first field test of the UTB, also added additional complexity to the project that impacted the design workflow and completion schedule.

12. Describe, in detail, the successes your project experienced. *

The project was successful in constructing a geothermal system for heating and cooling an agricultural facility that is located beyond the campus energy system. The project also includes the first field test of an UTB prototype developed by ORNL; a technology that is expected to lower the overall cost of installing geothermal systems. The UTB technology could be used in additional applications on campus. Also, the project further demonstrated to students, faculty and staff the suitability and benefits of geothermal on campus.

13. Describe, in detail, how your implemented project addressed sustainability. *

The project installed a geothermal system that will reduce energy usage at the Energy Farm by at least 30%. The geothermal system replaces a traditional fossil fuel (propane) furnace for heating, and air conditioner for cooling; a single piece of equipment is needed. Running the geothermal system also lowers the amount of electricity required. Combined with the recent agrivoltaics demonstration at the Energy Farm, the amount of off-site energy required is greatly reduced. Furthermore, integrating the UTB into the geothermal offers the additional capacity to store thermal energy that further optimizes the operation of the GHP. A study is ongoing to quantify these benefits (Pokhrel et al., 2025).

This combined heating and cooling system also greatly lowers overall greenhouse gas (GHG) emissions. According to the U.S. Department of Energy, using geothermal for heating compared to propane reduces GHG emissions by ~65%. Furthermore, we assume the geothermal system emits zero GHG if the electricity used is from the campus' solar and wind installations. The geothermal system can run 24/7 offering a level of energy security and resiliency. With the GHP located in the mechanical equipment and borefield underground they are not impacted by atmospheric conditions. The geothermal system is expected to run for at least 30 years.

Including researchers in the project with previous knowledge about the geology and thermal capacity underground allowed the project team to more precisely size the GHP to meet the building's energy demands. Selecting a GHP with advanced controls and variable speed allowed it to be connecting to the existing duct work and utility connections. With the inclusion of the UTB, system sensors, and real-time control system (to automatically and manually control the boreholes used and fluid flow rate in the geothermal loops) provided additional capabilities to maintain operation of the geothermal system at its maximum efficiency. Including these capabilities were made possible by obtaining external grant funds and the ORNL equipment donation.

14. Describe, in detail, how your project integrated student involvement and community outreach. *

An undergraduate student in the Department of Mechanical Engineering was involved in the design and monitoring of the geothermal system. Three classes, MEng (Energy Systems) summer students, CEE 458, and GEOL 380, visited the site and integrated information about the geothermal system into coursework. The geothermal system was also showcased during field tours of the Energy Farm and the 2025 International Ground Source Heat Pump Association annual conference.

15. Describe how the project engaged individuals from underrepresented groups and/or how it promoted diversity, equity, and inclusion. *

The classes and field tours visiting the Energy Farm included a diverse group of students, faculty and staff, and members of the community. The project was also an opportunity for apprentices with F&S and the contractors to gain work experience.

16. What key takeaways should the campus community know about your project? *

The geothermal system installed at the Energy Farm demonstrates the important energy efficiency and conservation benefits that can be achieved in buildings. Combined with the UTB, the performance and efficiency of the geothermal system is improved because thermal energy can be readily stored for future use (i.e., it is easier to exchange thermal energy with water in the tank then the surrounding ground).

17. Describe the marketing material developed for promotion of your project, including but not limited to advertising (including digital) and/or signage related to this project. All marketing must include SSC's logo and/or a statement of which fee funded the project. Projects must coordinate with SSC to ensure the promotion appropriately highlights the SSC's contributions to the project. *

The signage placed provides information about the project for both the outside and interior components. One sign will be hung on the entrance door to the mechanical room to give visitors some information before they enter and view the GHP. A second (portable sign) will be made and setup outside showing the configuration of the geothermal borefield since it is underground and not readily seen.

18. Upload project marketing and/or media not previously submitted in semester progress reports. *

- 2025-Field Test&Thermal Performance Compariso_Andrew Stumpf.pdf

19. Complete and upload the semester financial documentation for your project. You should reflect all expenditures since your last semester project report. **We strongly suggest that you also upload supporting financial transaction reports from Banner for your award's CFOP. Talk to your project's financial advisor for more information on generating this report.** https://studentengagement.illinois.edu/sites/default/files/2024-09/SSC-Budget-Timeline-SEMESTER-PROGRESS-REPORT-template.xlsx *

NOTE: Any unused project funds remain the property of SSC and will be transferred back to SSC when the project has finished or when the award expires, whichever comes first.

- SSC-Budget-Timeline-FINAL-PROJECT-REPORT-temp_Andrew Stumpf.xlsx
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