Overview of Illinois Geothermal Projects

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Key Topics

• Climate Leadership Commitments
• Illinois Geothermal Coalition
• Illinois Geothermal Projects
Facilities & Services

Facilities & Services (F&S) provides all physical plant, operational, and essential services for sustaining an environment that fosters the research, teaching, and public engagement activities at Illinois.
Climate Leadership Commitments

- Signed by 500+ leading American higher education presidents and chancellors
- 2008: signed the Carbon Commitment, pledging to be carbon neutral as soon as possible and no later than 2050
- 2016: signed the Resilience Commitment, pledging to build resilience to climate change with our local community
Illinois Climate Action Plan (iCAP) 2020

• The iCAP is our strategic plan for meeting the Climate Leadership Commitments
• SMART objectives for each theme, tracked on iCAP Portal (http://icap.sustainability.illinois.edu)
Solar Farm 2.0 Construction

Solar Farm 3.0 Discussions progressing!

FUTURE POWER SOURCES
(MWH/YR)

- Grid purchased power: 89,154; 20.82%
- Railspitter Wind Farm: 23,323; 5.45%
- Small-scale Solar: 339; 0.08%
- Solar Farm 1.0: 6,973; 1.63%
- Proposed off-campus Solar Farm 3.0: 90,000; 21.02%
- Abbott generated power: 198,445; 46.34%
Illinois Geothermal Coalition
How did we get here?

Figure 3: 2015 iCAP Wedge Diagram showing only energy emissions projected, with potential clean energy scenario.
Illinois Geothermal Coalition

- The University of Illinois is building a coalition of corporations, non-profits, and researchers to establish Illinois as a leader in geothermal energy.
- This coalition will work together to strengthen and advance the implementation and design of geothermal energy systems in the Midwest.
- Sign up online at: https://go.illinois.edu/geothermal_coalition

“Geoscientists don’t typically study the thermal properties of rock formations, and design and mechanical engineers don’t study geology, so you can see the gap in knowledge.”
~ Dr. Yu-Feng Forrest Lin.
Geothermal Timeline

Facilities & Services
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Inspiration • Innovation • Leadership • Perseverance • Agility
2010 Fruit Farm Admin.

- 2010 Capital Project included geothermal heat exchange and mini splits in the 6,600 GSF Fruit Farm Administration Building

- The system includes a horizontal loop supplied with glycol connected to five ground source heat pumps, a control panel, a GSHP monitor, and an air handling unit.

- In the last five years, the energy use intensity has been 20-25 kBTU/GSF, which is 3.5 times less than similar buildings
• This 2011 project replaced an inefficient HVAC system in the 2,828 GSF Evergreen Lodge (originally built in 1955).
• Project included a 6 ton geothermal with a hot water generator, Geothermal Loop included 200’ deep boreholes with a 1” x 410’ vertical loop in each borehole, grouted with bentonite
• Project installation cost was $28,400, and annual savings are $2,050/year. That is a payback period of under 14 years.
2014 Gatehouse at Allerton

- 2014 replacement of inefficient HVAC system with geothermal installation in Gate House (originally built in 1902)
- (7) 300’ ft deep boreholes with 1” u-bends grouted and terminated inside basement of Gate House, (7) water source heat pump
- Gate House geothermal project reduced Allerton’s on-site emissions by 10.4 tons of CO2/year.
2016 Energy Farm Test Well

- This project installed a geothermal loop and fiber optic cables in a 330 ft. deep borehole, instrumented with a Thermal Response Test (TRT) device.

- Main focus was on the collection of baseline subsurface thermal data for use in optimizing geothermal energy installations.

- This research highlighted the need to customize the design of geothermal systems to the actual Thermal Conductivity of the given subsurface condition.

- Led to a student project to build a mobile TRT unit which is now available for use with user guide.
2017 iSEE’s Campus as a Living Lab Workshop
2018 Monitoring Well on Bardeen Quad

- When considering geothermal for the Campus Instructional Facility, F&S encouraged the design team to utilize the new optimization process developed at the Energy Test Well.

- To provide the input data, F&S and iSEE funded the installation of a Monitoring Well on the Bardeen Quad.

- The monitoring well is instrumented with fiber-optic cable connected to a Distributed Temperature System (DTS) to detect changes in the subsurface thermal profile.

- Studies output utilized in designing and optimizing the geothermal bore-field for the geothermal system in the new CIF building.
2019 Campus Instructional Facility

- This geothermal system will supply approximately 135 tons of heating and cooling capacity (~ 65% of total building demand)
- Reduction in GHG emission by 70% compared to similar-sized facilities at the U of I
- The geothermal exchange is designed to enable a future expansion to serve other buildings
- The project has been designed to achieve LEED Gold
Adding geothermal system will save $45,000/year (projected over 30 years to be a savings of $1.35 million).

Measuring ground thermal properties and installing the temperature monitoring system reduced the bore holes needed from 60 to 40 450 ft deep.

Monetary savings for drilling only 40 has reduced the payback period from 40 to 28 years.

Research adds significant value to optimize design and enhances the efficiency of Geothermal projects.
2019 Hydrosystems Energy Piles

- Uses the 50-foot-deep concrete piles already being installed for the integration of geothermal heat exchangers within foundation of the new Hydrosystems building bridge.

- This innovative approach is 30-40% cheaper than the conventional methods of geothermal systems by drilling separate boreholes for the exchanger loops.

- The project estimated to supply Hydrosystems lab with 515 million Btu/year, annual reduction in greenhouse gas emissions (GHG) of approximately 100 metric tons of CO2 per year.

- The project cost is $240,000, provided by F&S and iSEE using the Carbon Credit Sales Fund; CEE; and the Student Sustainability Committee.
2020 RIPE Greenhouse and Headhouse

- The geothermal system is designed to maintain constant environmental conditions of 83 F° for the RIPE Greenhouse and 75 F° for the Headhouse Building.

- Includes three heat pumps and thirty-two vertical heat exchangers (VHE) in 300’ deep boreholes filled with bentonite grout.

- Each heat pump has a 20 kW electric resistance coil for supplemental heat during the extreme winter conditions.
2020 Gable House

On-going project …

• Solar Decathlon is a student design-build competition.

• Increasing energy efficiency using geothermal exchange and geopolymer material.

• The project includes fiber optic cables in geothermal loop for collection of the temperature data. 450 ft horizontal loop at a depth of 5 feet

• Analysis of the thermal efficiency of geopolymers as a substitute for concrete
Thank you