Overview of Illinois Geothermal Projects

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Key Topics

- Climate Leadership Commitments
- Illinois Geothermal Coalition
- Illinois Geothermal Projects

Climate Leadership Commitments

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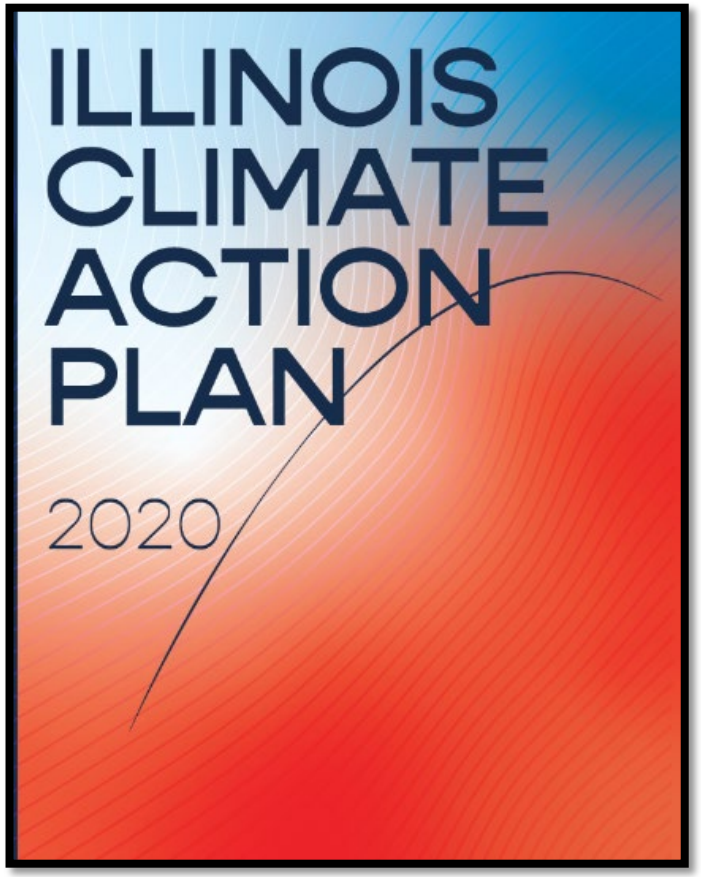
Facilities & Services (F&S) provides all physical plant, operational, and essential services for sustaining an environment that fosters the research, teaching, and public engagement activities at Illinois.

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

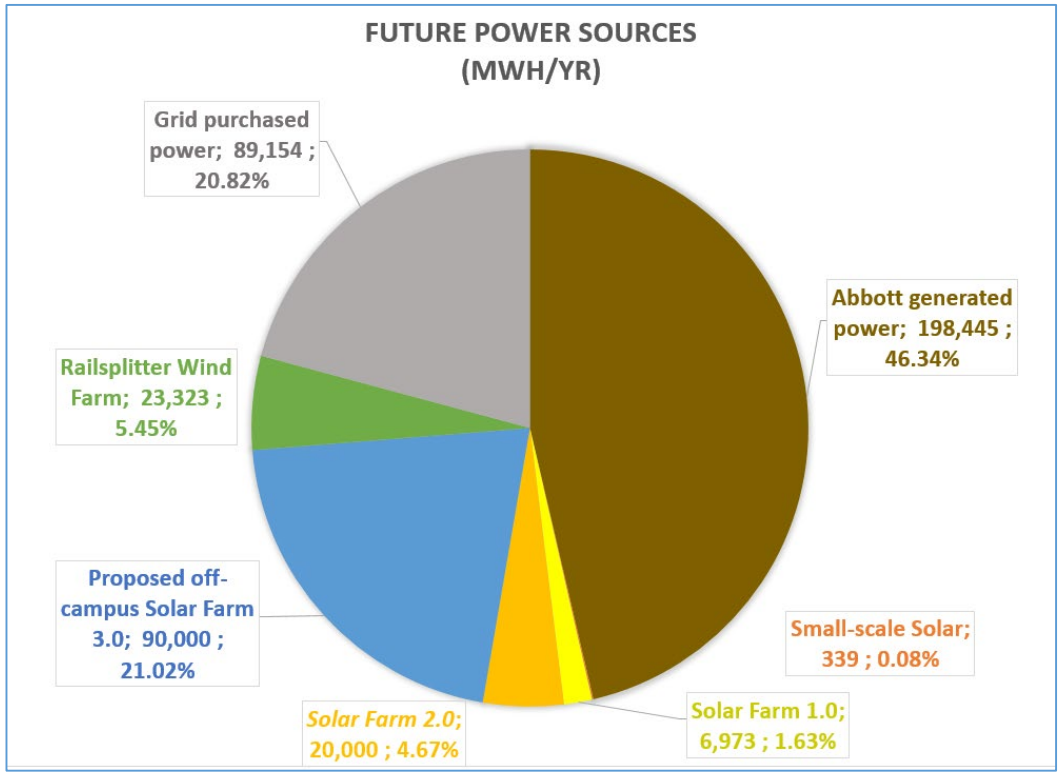
Illinois Climate Action Plan (iCAP) 2020

- 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!



Illinois Geothermal Coalition

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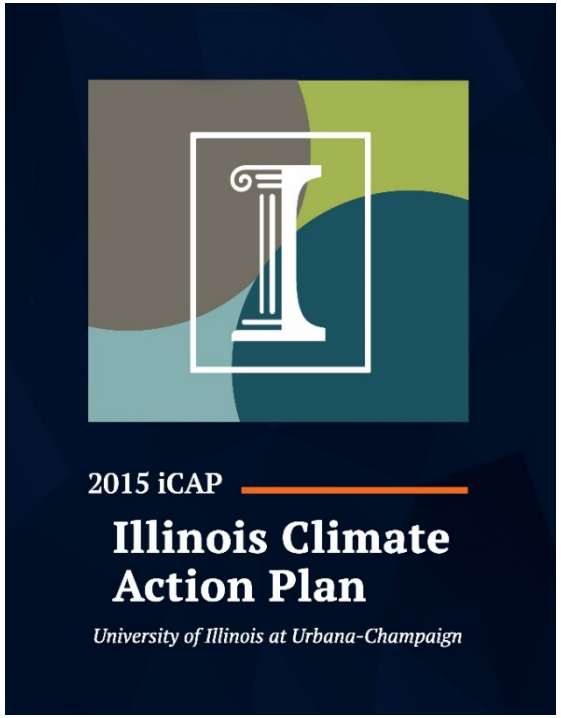
How did we get here?



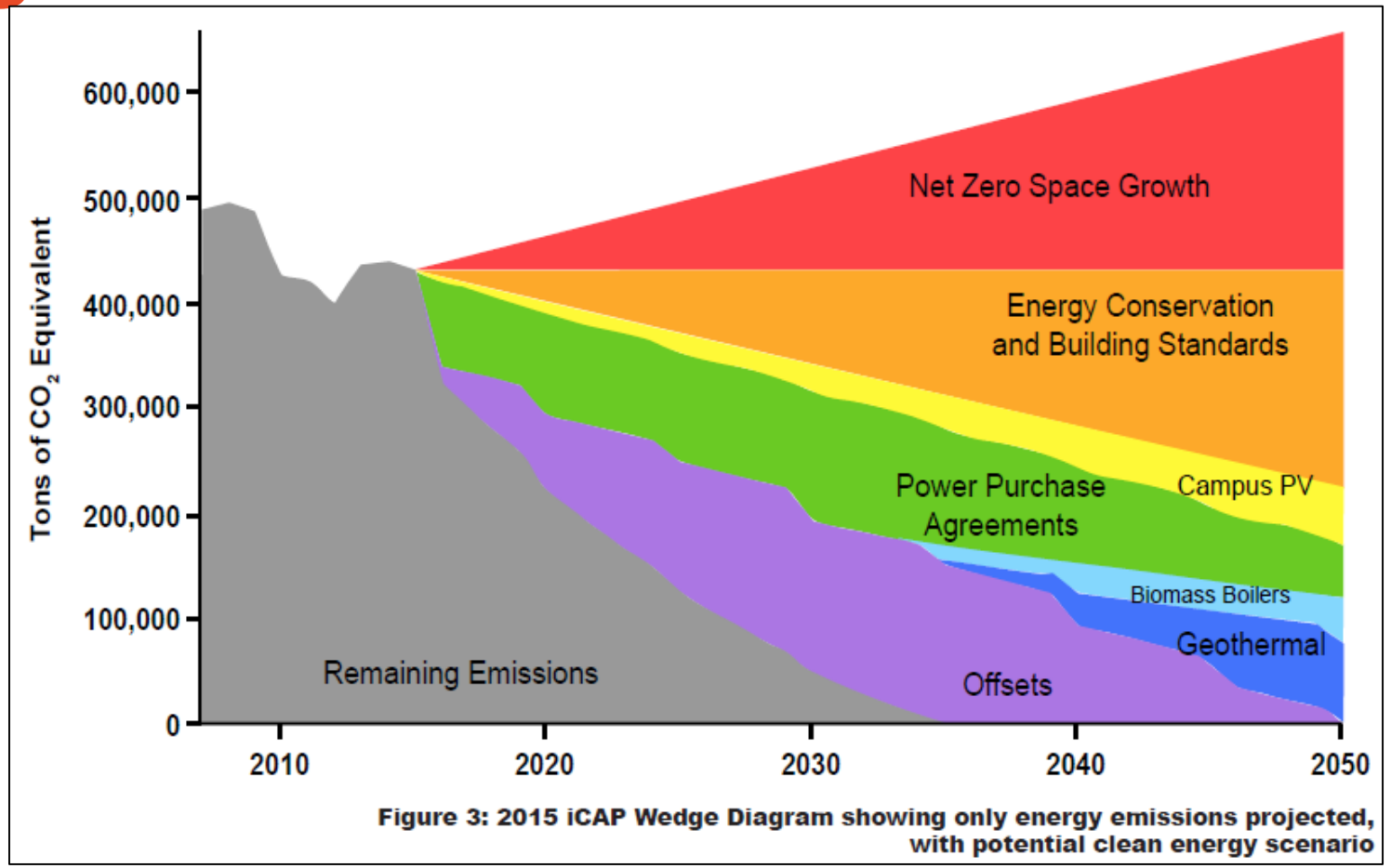


Figure 3: 2015 iCAP Wedge Diagram showing only energy emissions projected, with potential clean energy scenario

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.

Illinois Geothermal Projects

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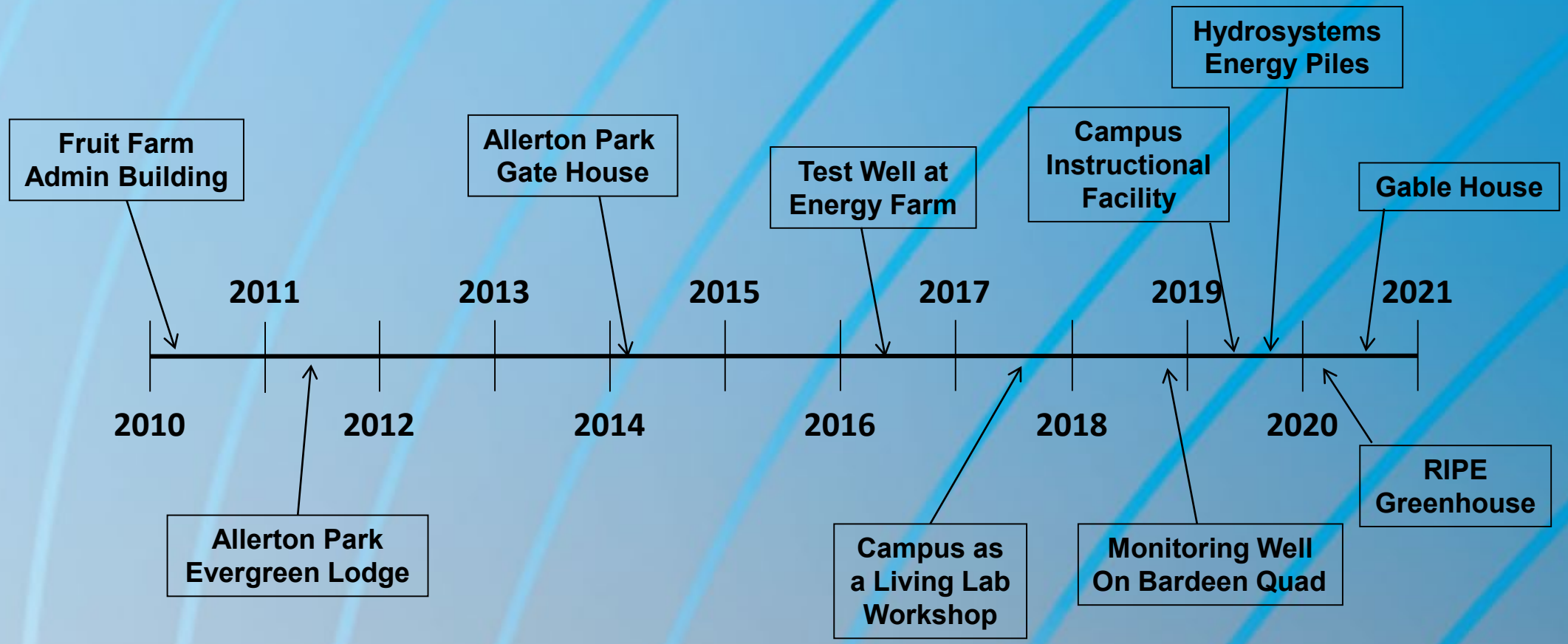
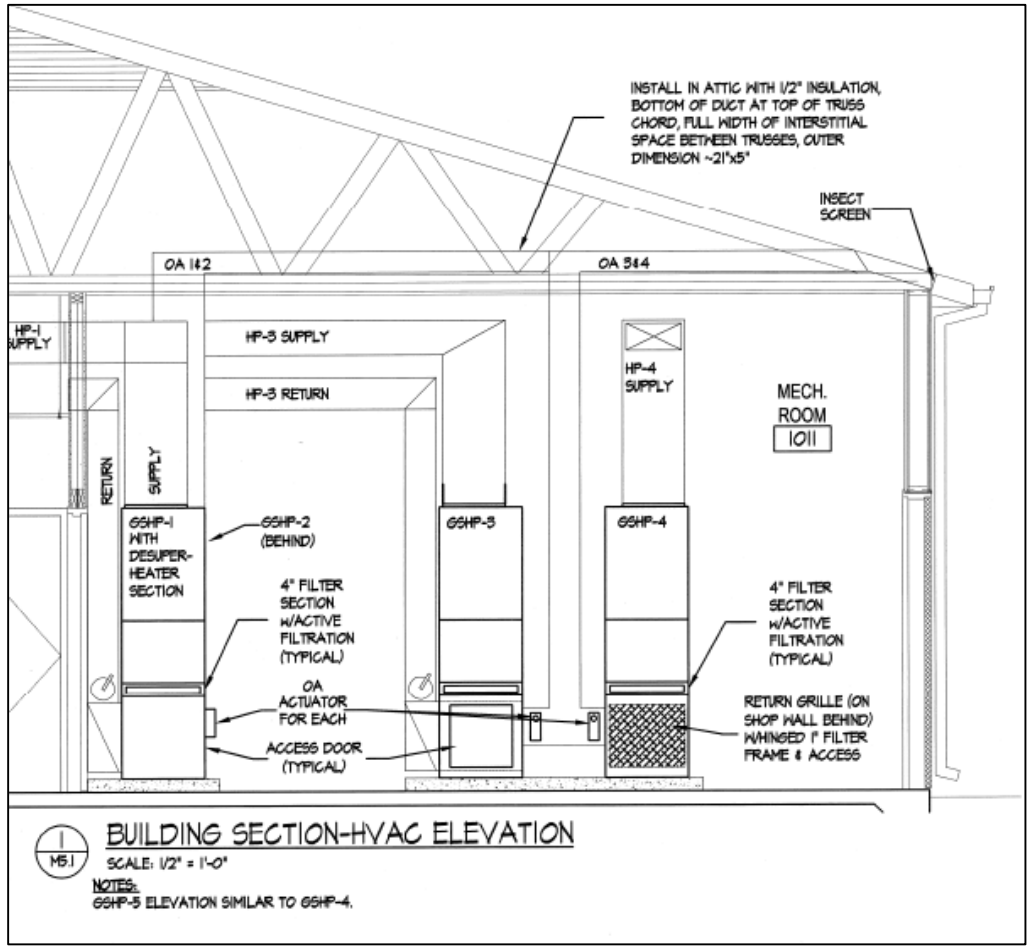
Geothermal Timeline



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



2011 Evergreen Lodge at Allerton

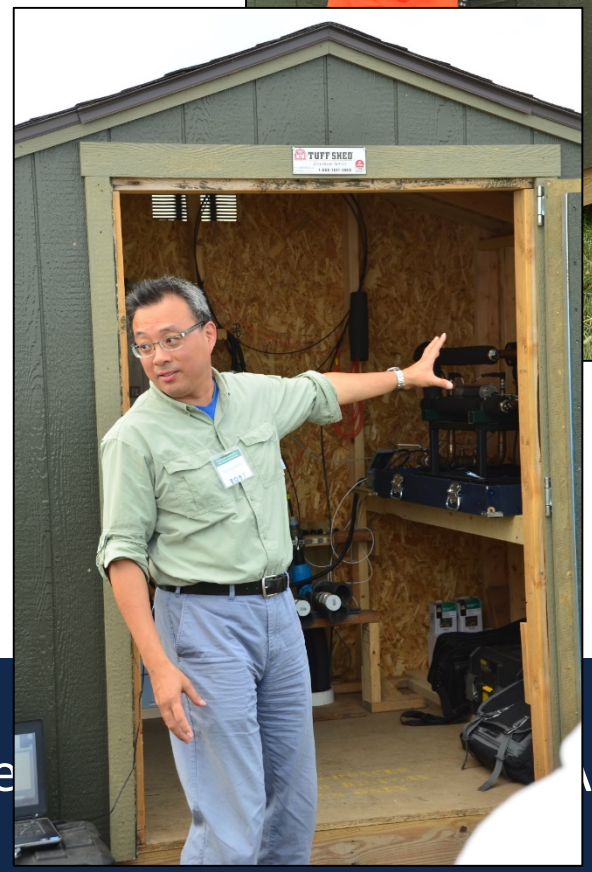
- This 2011 project replaced an inefficient HVAC system in the 2,828 GSF Evergreen Lodge (originally built in 1955).
- Project included a 6 ton geothermal with a hot water generator, Geothermal Loop included 200’ deep boreholes with a 1” x 410’ vertical loop in each borehole, grouted with bentonite
- 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

2019 Campus Instructional Facility

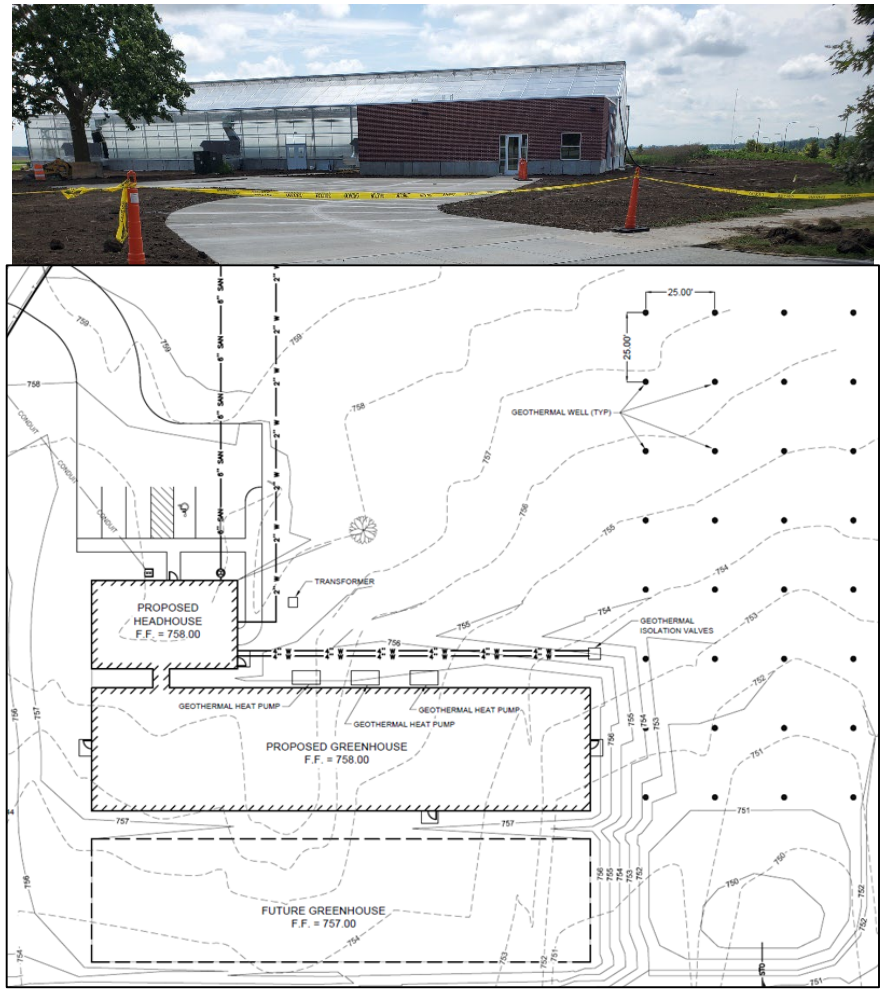
- Adding geothermal system will save $45,000/year (projected over 30 years to be a savings of $1.35 million).
- Measuring ground thermal properties and installing the temperature monitoring system reduced the bore holes needed from 60 to 40 450 ft deep.
- Monetary savings for drilling only 40 has reduced 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

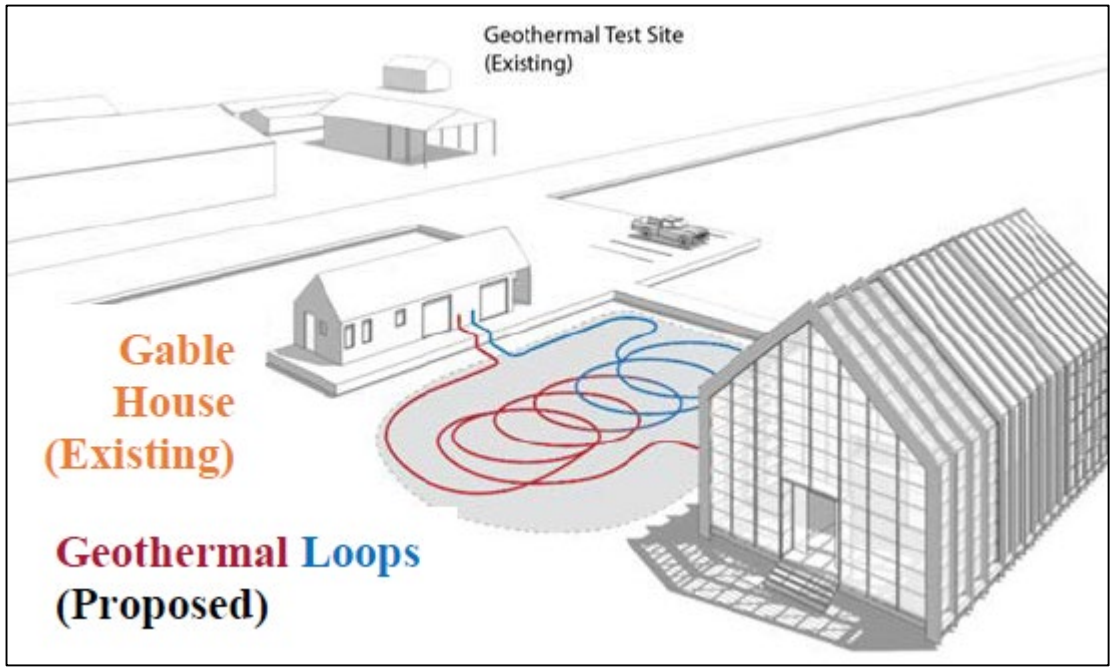
- The geothermal system is designed to maintain constant environmental conditions of 83 F° for the RIPE Greenhouse and 75 F° for the Headhouse Building.
- Includes three heat pumps and thirty-two vertical heat exchangers (VHE) in 300’ deep boreholes filled with bentonite grout.
- Each heat pump has a 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

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Thank you