**Project Summary**

Geothermal growth is limited by a lack of geographically dispersed high-temperature thermal resources and high initial upfront investment in characterization and well construction. This project intended to address the challenges of energy supply intermittency and enhance grid resilience, reliability, and energy security by storing energy provided from currently available renewable resources in the subsurface to harvest it a later time during at-peak energy demand.

This project intended to improve geothermal adoption, reduce initial project risk, and improve price competitiveness through utilizing existing oil and gas infrastructure such as non-productive wells, non-economic fields, dry holes, and orphaned wells. The project also intended to address the lack of geographically dispersed thermal resources and enhance grid resilience, reliability, and energy security by introducing an economical method for storing energy from currently available renewable resources in the subsurface for usage during at-peak energy demand.

During this research, the project furthered the understanding of the feasibility of utilizing abandoned oil and gas wells as geothermal heat storage wells. The project team investigated the heat storage and hydrogeological characteristics of subsurface reservoirs in the Illinois Basin to evaluate their response to heat injection for determining the evolution of temperature profiles and heat losses over time using existing and available data sets. The project team then performed modeling and simulation to evaluate the heat losses of returning fluids during heat extraction. The outputs were used to select an optimal candidate reservoir and location in Southern Illinois. The team designed and performed a small-scale field test in an existing oil well to refine the model and to demonstrate the permitting and regulatory pathways necessary for the conversion of oil and gas assets to geothermal use. The field test also serves as a proof of concept and can guide the procedures for future research and implementation.

Additionally, the project team, conducted initial market research and customer discovery to develop a go to market strategy for an Advanced Geothermal Energy Storage (AGES) system. The project team in this research also identified the parameters to be refined in future research, to improve the current go to market strategy economic model. To this end several subject matter experts were also identified to assist in future research with geothermal infrastructure setup, energy storage policy and law, energy storage market demand, potential siting based on demand etc. Future research will involve further sophistication of the site commercial modeling, implementing a larger-scale test, and further refinement of the thermodynamic modeling/simulation process. The output will be lifecycle costs and economics suitable for comparison to alternative approaches from a validated full-scale demonstration for venture capital investment into this technology.

The project successfully demonstrated the ability to leverage existing oilfield infrastructure, permits, and land access and leasing agreements, to enable geothermal storage projects to come online faster and cheaper than a greenfield development could. This technology could allow for greater energy independence and security through long-term energy storage solutions. The longer duration allows for greater storage for renewables currently limited by hours-long storage durations of lithium-ion. The AGES system would support the growth of renewable energy farms, and provide greater opportunities for a cleaner energy infrastructure.