Feasibility of Deep Direct Use Geothermal on the WVU Campus-Morgantown, WV

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The Morgantown campus of West Virginia University (WVU) is uniquely positioned to host the first geothermal DDU heating and cooling system in the eastern United States, demonstrating that geothermal is a national resource not limited to the western states. While much of the eastern United States is not blessed with extremely high heat flow and elevated temperatures, the northeastern part of West Virginia is unique in having a basin that is expected to support the achievable flowrate of geofluid through target formations in the Appalachian Sedimentary Basin, and sufficient temperatures in those target formations. These two factors were identified by the PI in the 2006 MIT Future of Geothermal Energy Report to be the two most critical factors in minimizing cost of geothermal energy.

In this work feasibility analysis of developing a Geothermal District Heating and Cooling (GDHC) system for the WVU campus in Morgantown, WV, to replace the current coal-fired steam heating and cooling system will be performed. This system is unique as it will allow for utilization of the geothermal heat, and thus amortization of the costs of the system, across a full 12-month year. The overall project objectives are to 1) decrease the uncertainty and risk associated with developing the geothermal resource for use on campus at WVU and 2) complete an optimized design for the geothermal system, minimizing the delivered Levelized Cost of Heat (LCOH).

Our first goal to minimize the risk of project development will be achieved by decreasing the uncertainty in both the subsurface geothermal system as well the surface distribution system. The subsurface uncertainty is dominated by the uncertainty in the project team’s projections of geofluid flowrate in our target formation, the Tuscarora Sandstone. The project’s second overarching goal of minimizing the delivered LCOH will be achieved by performing an integrated surface-to-subsurface optimization of the full GDHC system as well as engineering design and analysis of the retrofit potential of each segment of the campus.

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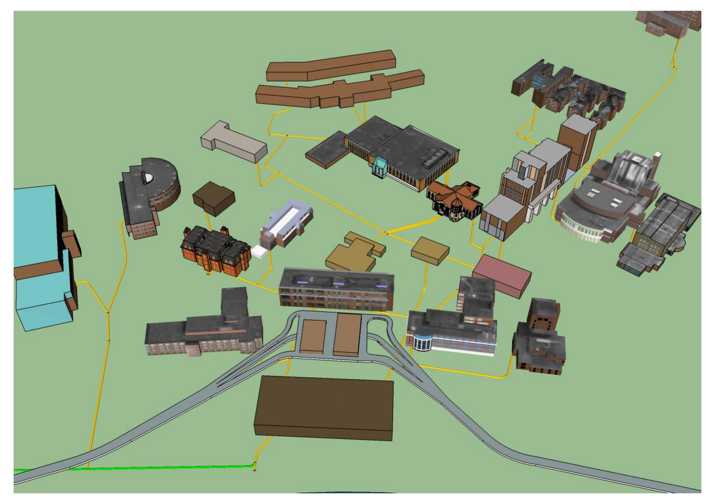
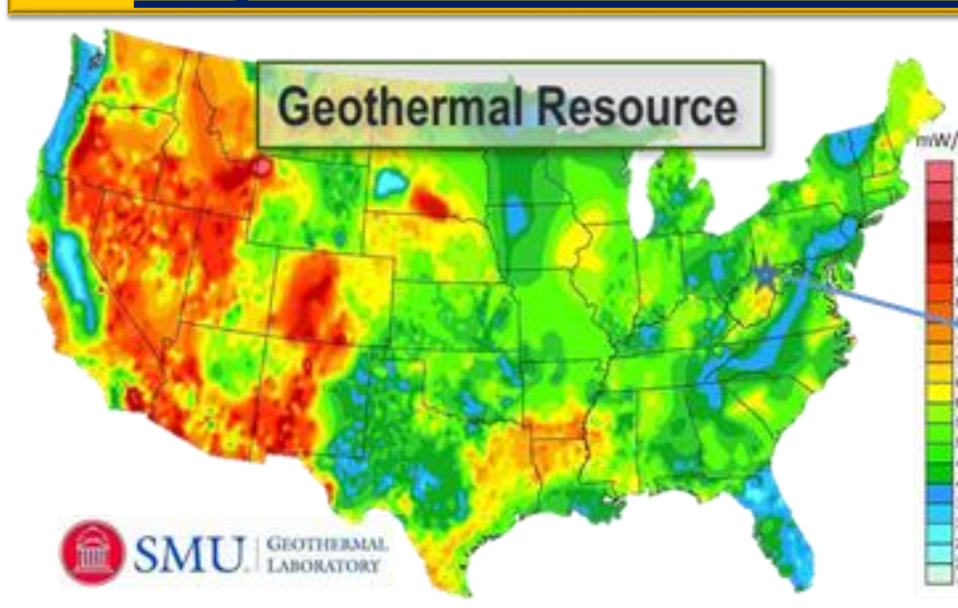
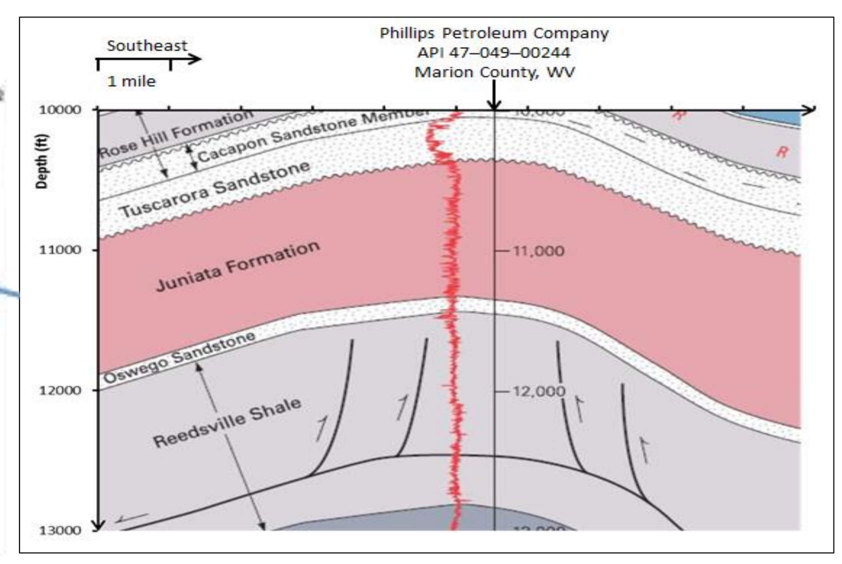
Goal

- Design of a Geothermal District Heating and Cooling (GDHC) system providing heat to the WVU campus and replacing the current coal-fired system.

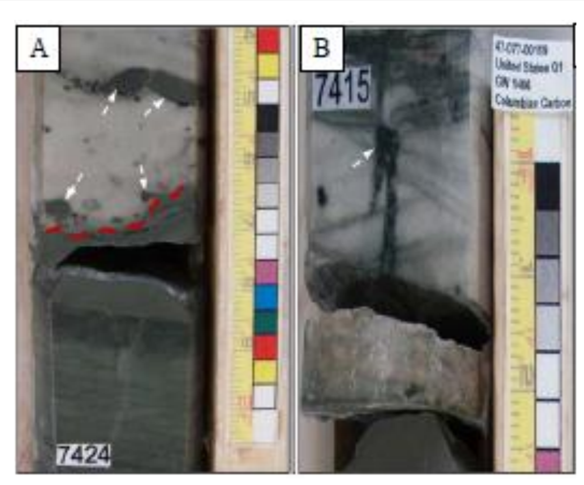


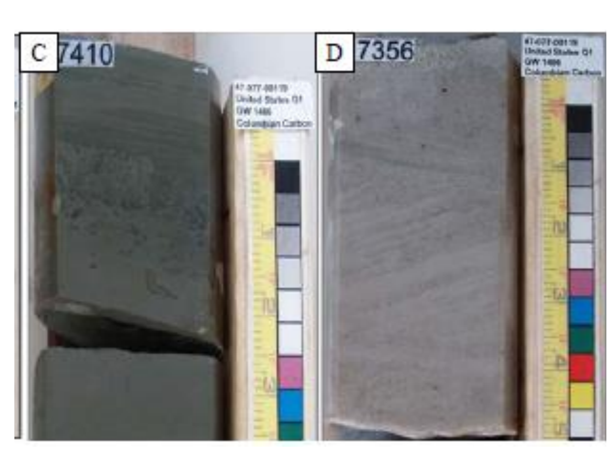
Objective 1 – Characterize the Geothermal Site





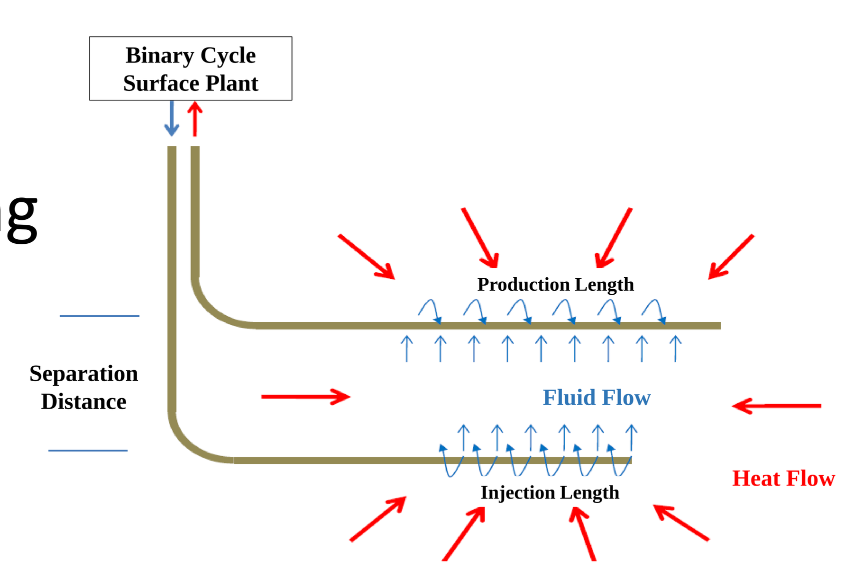
- Core analysis for reservoir property measurements.
- Mini-permeameter measurements for matrix, fracture, & overall permeability
- The background geothermal temperature data is available through distributed temperature fiber optic cable.
- The uncertainty in the subsurface reservoir parameters is reduced by performing uncertainty analysis using iTOUGH2.





Objective 3 – Create Subsurface Model & Design

- We will design the subsurface geothermal system incorporating the current state-of-the-art in unconventional hydrocarbon development.



- Optimizing a geothermal well field incorporating multiple horizontal lateral wells.
- Sedimentary fracture dominated geothermal systems will be assessed which are currently under-explored.

Impacts

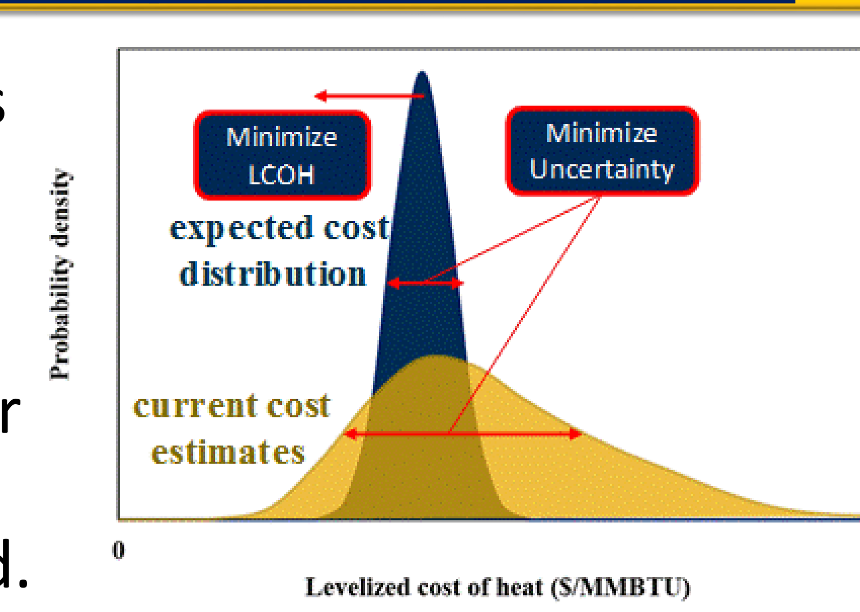
- Advancement of WVU's efforts to achieve a reliable and clean energy source for its central steam generation system, as part of its ***Sustainability Plan*** managed under the Office of Sustainability and the WVU Energy Institute.
- Year-round utilization of the DDU system, significantly lowering the annually levelized cost of heat, thus providing ***the first demonstration in the eastern U.S.*** of the practical feasibility and effectiveness of geothermal technologies and systems.

Objective 2 – Characterize Existing Infrastructure

- The year-round energy consumption data of the proposed market for multiple years will be investigated to characterize the energy demand.
- Particularly, the fluid stream temperatures and flow rates at the entry and exit of distribution points, energy losses during transmission, average and peak heating & cooling demand of the campus will be determined over a year.
- The current piping system and the equipment for district heating and cooling across the campus will be analyzed.
- Simulations of Aspen Plus heating and cooling model will help to estimate the preliminary district heat supply and thereby levelized cost of heat (LCOH).

Objective 4 – Develop and Optimize the System

- The proposed surface plant is the retrofit of the existing heating and cooling system with replacement of the current steam heat exchanger with a new heat exchanger designed for geothermal fluid.



- An economic analysis for the GDHC will be performed using GEOPHIRES.
- The feasibility of the GDHC system will be determined by comparing costs and benefits with the existing system.

WVU GDHC System Development Timeline

Start Date	June 2017	June 2019	Spring 2020	Spring 2021	Summer 2022	Summer 2023	Summer 2025	September 2026	March 2027
Task	Feasibility Project Start	Exploratory Well Planning	Exploratory Well Drilling and Evaluation	Injection Well Drilling and Formation Evaluation	Production Well Drilling and Flow Testing	Distribution System Upgrading	Building Integration	Commission-ing	New System Start

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