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Cornell University Borehole to Reveal Potential of Geothermal Heating

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Professor Lynden Archer, Ph.D., is the Joseph Silbert Dean of Engineering at Cornell University and the James A. Friend Family Distinguished Professor in Engineering. He has served as Director of the School of Chemical and Biomolecular Engineering at Cornell and Director of the Cornell Energy Systems Institute. His research of polymer-nanoparticle hybrid materials, including applications for energy storage and carbon-capture, led to his co-founding of lithium battery company NOHMs Technologies. Archer is a member of the National Academy of Engineering and a fellow of the American Physical Society.

Cornell University is moving forward, and underground, with plans to drill an observatory borehole to explore the viability – and ensure the safety – of using geothermal energy to heat its Ithaca, New York, campus.

At a virtual community forum hosted earlier this year, a Cornell faculty and staff panel outlined the next steps for testing Earth Source Heat (ESH), the process by which water would be extracted from the Earth's crust, its heat transferred to a separate supply of water flowing within Cornell's heating distribution pipeline to heat most of the Ithaca campus buildings, and the original geothermal water returned to the subsurface.

"One of the many benefits of this project is that it will help us to achieve our goal of carbon neutrality on the Ithaca campus by 2035," said Joel Malina, vice president for university relations, who moderated the forum. "So we anticipate significant – capital letters, significant – emissions savings."

The mechanics of ESH are relatively straightforward. Hot geothermal water is extracted by pumping from a production well and then through a heat exchanger. The water is reinjected into a second well so that it can circulate through the naturally hot rocks via a network of underground pores and crevices, and the water's temperature rises again as it is drawn back to the production well. At the heat exchanger, heat is transferred to a secondary loop that runs through campus and connects to individual buildings. The geothermal water and the campus heating water do not mix.

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"Not only would Earth Source Heat enable Cornell to heat our campus without burning fossil fuels," said Rick Burgess, vice president for facilities and campus services and co-chair of the Sustainable Cornell Council. "It also brings an exciting opportunity for scientific discovery."

Cornell first began exploring ESH in 2009, when the university created its Climate Action Plan, and has refined the concept in recent years through a series of studies and workshops. A $7.7 million grant from the U.S. Department of Energy (DOE) announced in August 2020 effectively established Cornell as the national test case for the technology.

Based on preliminary estimates, buildings on Cornell's 745-acre campus could be heated by three or four pairs of wells, Burgess said, but additional research and analysis are needed to determine if the project is feasible and to mitigate potential adverse consequences. Therefore, the university is set to construct a 10,000-foot-deep observatory borehole to be located on a small facilities parking lot on the

outskirts of campus. The gravel lot is currently used as a contractor staging area and is owned by the university.

The Cornell University Borehole Observatory (CUBO) will enable researchers to study how much heat can be produced by geothermal energy, if it will be sufficient for the campus's needs and for how long, and what, if any, are the unintended effects.

The CUBO team has already identified three distinctly different geological zones to target.

"Knowing the precise depths and corresponding temperature, sustainable fluid flow rate, fluid character and rock type of each target helps us to quantify the benefits, costs and risks of any future project," said Steve Beyers, the lead ESH engineer with Facilities and Campus Services. "We anticipate our systems approach will be very different for each targeted zone. Each presents different challenges, technically, environmentally and physically. Reaching these goals will help us decide if a project here in Ithaca is feasible and safe."

The diameter of the hole will be 36 inches at the surface and will contain progressively smaller casings in progressively thinner holes, all narrowing around a central 8-inch casing that extends the full length of the borehole, along with fiber-optic cables to collect and transmit data.

CUBO's planning and design is underway, and regional law firm Bowles Rice is assisting with the project's contracting. The drilling and "logging" – in which special tools are sent down the borehole to collect data and test the subsurface – will last about eight months, Beyers said.

"The (DOE) grant itself will run for three years," Beyers said. "During the remainder of that time, we will continue to gather data, analyze data, refine estimates, and help the DOE determine the feasibility of this type of technology in this general geological region – not just for Cornell, but for others who may have similar hopes for a future of renewable sustainable heat."

For more information about the Cornell University Borehole Observatory and Earth Source Heat, visit: **EarthSourceHeat.Cornell.edu**.

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