Geothermal Energy Potential of University of Michigan Campus

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1. What is Geothermal Energy?

Geothermal energy is a passive source of renewable energy that utilizes the natural temperature of the Earth’s crust for the heating and cooling of buildings.

- The average temperature of the Earth’s crust is 55 degrees Celsius, whereas the air temperature on Earth’s surface is higher in the summer and lower in the winter.
- By running fluids through an underground geothermal loop, this temperature differential can be exploited to provide energy for heating and cooling.

The biggest advantages of geothermal are that it is highly efficient, there are no fuel costs, and systems have a long lifetime. The biggest disadvantage of geothermal is the upfront installation cost.

2. Comparing Geothermal with other Heating and Cooling Systems

- While geothermal systems may cost more initially to install, the lower operations and maintenance costs, and longer lifetime allow for competitive system payback.
- Geothermal systems can be installed in any location.
- Geothermal systems have a higher capital cost than air-source heat pumps and rooftop systems.
- Geothermal system energy and maintenance costs are 55% less than those associated with rooftop units.
- The net present value (NPV) of a geothermal system is 18% lower than rooftop units over a 30 year lifetime.


The University of Michigan receives its heating and cooling energy today from DTE and the Central Campus Natural Gas Plant. U-M Central Campus is heated and cooled by the Central Natural Gas Power Plant, while U-M North Campus receives 100 percent of its energy from DTE.

We recommend alternative replacement with geothermal for U-M North Campus buildings, once their heating and cooling systems are due to be replaced.

U-M North Campus is large and spread out across 800 acres. We recommend that campus buildings immediately surrounding the North Diag be converted first. This excludes Northwood Apartments V, North Apartments VI, the North Campus Research Complex, Child Care Center and Property Disposition building. Thirty-seven buildings make up the remaining core of North Campus, and add up to 3,715 square feet.

The July 2015 Greenhouse Gas Reduction Committee report recommended geothermal for U-M North Campus, quoting the installation at $22 million capital cost.

Michigan State Capitol Geothermal Project (2017)

In 2017, the utility systems of the Michigan State Capitol building were due to be replaced as a part of the Capitol restoration project. Due to its long term economic and sustainability benefits, the state decided to install a 224 well system to heat and cool the 114,660 sq. ft. building.

- The system cost $4 million to install, but will result in $300,000 in savings every year on the capitol building’s energy bills.
- 10 year payback for the geothermal system.

4. Geothermal in Michigan

While it is sometimes considered feasible only in places with surficial geothermal activity such as Iceland and Yellowstone National Park, geothermal heating and cooling is economically feasible in most places, including Michigan. Geothermal is being used in Michigan right now to help governments and businesses save money on their monthly energy bills, decrease their greenhouse gas footprint, and provide a more environmentally friendly way to heat and cool their buildings.

Kerrytown Market Geothermal System

The Kerrytown Marketplace building at 303 Detroit Street was retrofitted with a 150,000 BTU geothermal system in 2011 by MAV Development, proving that geothermal is viable in Ann Arbor.

- The system cost approximately $81,000, and powers the 13,000 sq. ft. building.
- Each well cost $6,000 to install.

5. Other Universities Lead the Way

Ball State University, Muncie, Indiana

Ball State University installed a passive geothermal heat pump system that now provides heating and cooling to their entire campus. They chose to make this investment because the age and condition of their heating and cooling system was in jeopardy and the campus was growing. When going through this process, Ball State looked into three options: a fossil fuel boiler system, an all natural gas boiler and a ground source geothermal heat pump. They chose the ground source geothermal heat pump because, despite its high capital cost, it has lower maintenance costs, decreases the campus CO₂ emissions by 50% and saves significant money over the life of the system. Their campus is 5.8 square miles of building space, not including parking lots or structures. The project cost was $82.9 million, and was entirely funded by the Department of Energy and the State of Indiana.

Ball State University chose to install vertical geothermal, meaning the boreholes extended 500 feet into the ground and used less space. They installed 1,000 miles of piping between the borehole installation and hot water piping.

Cornell University, Ithaca, New York

Cornell University is heating and cooling their entire campus by using a combination of a low temperature geothermal system and lake source cooling. This means that their heating needs will come from passive geothermal technologies and their cooling needs come from Cayuga Lake.

They estimate the cost will be between $100 - $150 million for the low temperature geothermal system itself. They hope that a combination of grants and donors fund this large scale renovation project.

6. Conclusions

Through our exploration of geothermal energy and the different ways it can be utilized to heat and cool buildings, we recommend that the University of Michigan install passive geothermal heat pumps in existing campus buildings when they are ready for renovation and all new buildings across the campus. Passive geothermal heating and cooling will save U-M money, reducing student tuition increases, and decrease emissions relative to traditional heating and cooling systems. We urge the university to consider alternative replacement of heating and cooling systems with geothermal as a means of making significant progress towards its sustainability goals.

References:
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