

Comparing Geothermal Systems Between Colleges



Julia Braulick, Nasra Mohamed, Chenoa Schatzki-McClain, Allison Palmbach
Introduction to Environmental Geology 120
Carleton College

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Case Studies: Colleges Powered by Geothermal Energy

Ball State University

- Has cut carbon footprint nearly in half!
- Realized the importance of geothermal in moderation when the system was used too heavily, the ground was heated 17.5 degrees celsius.

Oregon Institute of Technology

- Implemented geothermal in the 1990s
- Wells are 2-3 times deeper than wells found on other campus
- Campus was moved to better utilize geothermal

Carleton College

What makes Carleton's geothermal design unique?

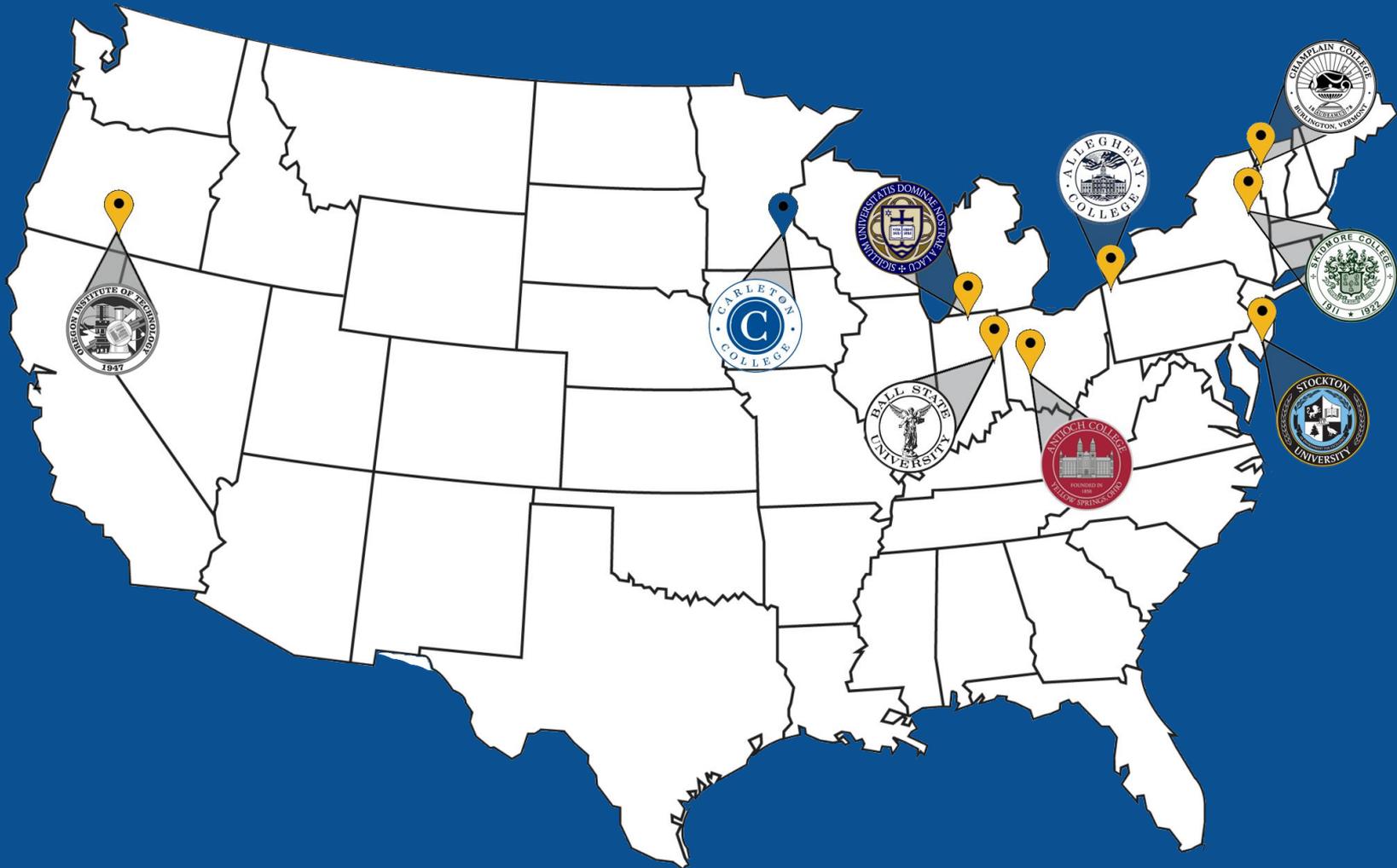
- Carleton is using horizontal bores in one of its fields to avoid contact with the water table.
- Unlike many schools, Carleton's geothermal system will supply the entire campus rather than just a few select buildings.

Location	Location	Temperature Number of wells	Size Number of public buildings	Energy Number of MW per year	Number of Buildings	Number of Buildings Served	Cost/yr \$K/yr	Project Start Date	Project Completion Date
Oregon Institute of Technology	Seaside, OR, USA	25/1	6000	8	1	1	1000-2000	1990	1992
Ball State University	Muncie, IN	20/2	11	6000	1	1	1000	1971	1973
Carleton College	Northfield, MN	20/20	14	10	1	1	1000	2000	2002
Ball State University	Muncie, IN	20/20	14	10	1	1	1000	1971	1973
Ball State University	Muncie, IN	20/20	14	10	1	1	1000	1971	1973
Carleton College	Northfield, MN	20/20	14	10	1	1	1000	2000	2002
University of Utah State	Logan, Utah, US	20/20	14	10	1	1	1000	1971	1973
Carleton College	Northfield, MN	20/20	14	10	1	1	1000	2000	2002

Learn More!

<https://docs.google.com/presentation/d/1NPFjjsK00G8E84M-JW62nLHULK6Ttk>

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Overview of Collected Data

Institution	Location	Campus Size (number of students)	Cost (million USD)	Savings (million USD per year)	Number of fields	Number of Boreholes	Well Depth (in ft)	Project Start Date	Project Completion Date
Oregon Institute of Technology	Kamath Falls, OR	5154	0.035	0.5	2	-	1300-1800	1964	-
Stockton College	Galloway, NJ	7854	1.2	0.33	1	400	435	1994	1995
Allegheny College	Meadville, PA	2100	-	-	-	50	500	2005	2006
Skidmore College	Saratoga Springs, NY	2680	1.4	-	3	670	400-500	2007	2014
Ball State University	Muncie, IN	1140	82.9	2.2	4	3383	400-500	2010	2009
Champlain College	Burlington, VT	2000	-	-	1	-	300	2010	projected 2020
Antioch College	Yellow Springs, OH	270	8.8	0.4	2	300	300	2013	-
University of Notre Dame	Notre Dame, IN	8530	40	2.5	3	1303	300	2017	partially completed
Carleton College	Northfield, MN	2014	38	1.4	3	304	520	2017	projected 2019

Geothermal Case Studies

Our research was not thorough enough research to be generalized. Instead, our project focuses on case studies. A future project could solidify the exact scale and nature of each project in order to compare directly between schools.

Oregon Institute of Technology (Klamath Falls, Oregon)

OIT implemented geothermal heating in the 1960s, far ahead of its time. The campus was actually moved specifically to take advantage of geothermal resources, since that part of Oregon has a fault system that produces an unusual amount of geothermal energy. Today 12 buildings are heated by geothermal on campus, saving around a million dollars a year in heating costs. Further expansions are in the works that, when implemented, will make OIT the first campus in the world to supply all its heating and electrical energy from a geothermal resource directly under campus.



<https://sustainablerace.com/oregon-institute-technology-recognized-increasing-use-geothermal-solar-energy/>

Stockton College (Galloway, New Jersey)



Planned geothermal systems will include 600,000 square feet of building space. Once all of the proposed geothermal projects are completed, 35% of campus will be heated and cooled with geothermal, but the college aims to reach 50% by 2050. Stockton requests other schools looking to invest in geothermal do not take the easy way out, but should be very involved from the onset.

Allegheny College (Meadville, Pennsylvania)

In 2006, Allegheny College completed the construction of their first geothermal system which included 30 boreholes with a depth 500 feet, supplying heat to three buildings and reducing fossil fuel use for heating by 80 percent for those buildings (Snelling et al.). Subsequently, two additional systems have been installed, with 65 additional bores. It has been estimated that the school will recover the costs of the installation within 4-6 years from natural gas savings (Snelling et al.).



<https://www.go-gba.org/projects/allegheny-college-north-village-phase-one/>

Skidmore College (Saratoga Springs, New York)



Skidmore installed its first geothermal heating system in 2007 in conjunction with the construction of new student housing. Skidmore has since completed two additional geothermal projects that supply heat to several other buildings on campus. Together, these systems supply 40 percent of the campuses' heat. The boreholes were drilled to between 400 and 500 feet and cost the college approximately 1.4 million.

<https://www.skidmore.edu/sustainability/renewable-energy/geothermal.php>

Ball State University (Muncie Indiana)



<https://energy.gov/articles/ball-state-building-massive-geothermal-system>

Ball State's goal is to shut down their four aging coal-fired boilers, thereby cutting campus carbon footprint nearly in half. The Ball State project is an important model for other schools' projects due to its large scale. Ball State has dealt with some challenges, such as an electrical fire on the Heat and Chill plant in July 2013, and raising the temperature of the ground from 55 to 85 degrees due to putting heat into the ground.

Champlain College (Burlington, Vermont)

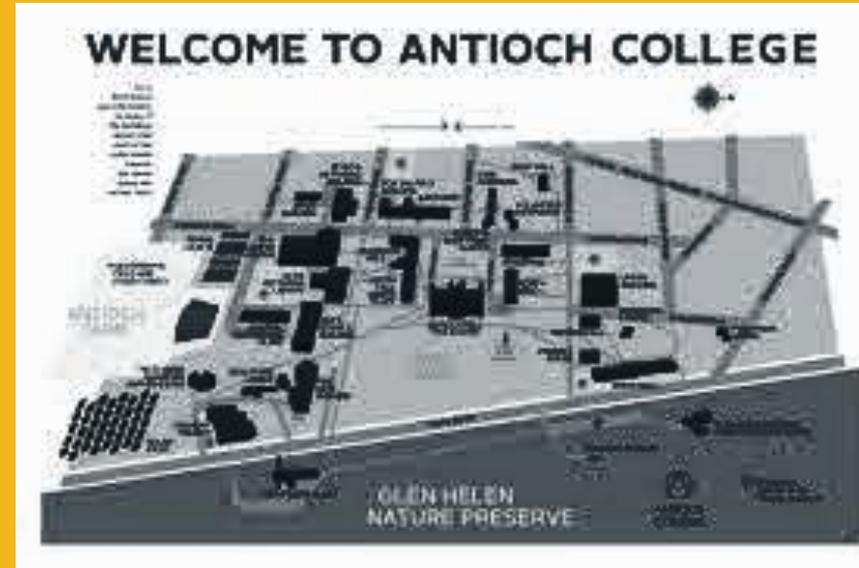


Champlain College received one of the official LEED Platinum Awards for their new Admissions Center. The building (originally built in 1859) was restored in 2010. Champlain's President, David F. Finney said "We embrace the future... [the building] models the highest levels of modern sustainability and environmentally sound development in Vermont" (Hedman)

<https://www.pcconstruction.com/champlain-college/>

Antioch College (Yellow Springs, Ohio)

Antioch College's goal is to source 90% of their electricity from renewable energy by 2018. This energy will come from the college solar array, the town of Yellow Springs' hydroelectric and wind contracts, and the college Central Geothermal Plant. The geothermal plant, when completed, Antioch the only college in the country to be almost exclusively heated and cooled by geothermal and solar power. The date of completion of the plant is currently TBD.



http://www.antiochcollege.org/sites/default/files/060415_AntiochMap_P01.jpg

Notre Dame University (Notre Dame, Indiana)

Notre Dame is installing 3 geothermal systems on campus. These systems will have the capacity to reduce Notre Dame's carbon dioxide emissions by 11,803 tons ~ the equivalent of taking almost 1,000 cars off the road yearly. The campus is also looking to create a hydroelectric project on the St. Joseph River, as well as several solar projects that are still in being conceptualized.



<https://www.nd.edu/features/going-geothermal/>

Carleton College (Northfield, Minnesota)

What makes Carleton's geothermal design unique?

- Carleton is using horizontal bores in one of its fields to avoid contact with the water table.
- Unlike many schools, Carleton's geothermal system will supply the entire campus rather than just a few select buildings.



https://apps.carleton.edu/geothermal/updates/?story_id=1611362

What Can We Learn?

There are more geothermal projects on other campuses than was previously recognized.

These projects serve as useful resources for geothermal design at other colleges. They may also help schools to estimate the costs of project construction, energy use reduction, and potential savings.

Limitations?

There is not a conclusive data source that accurately compares different geothermal systems at different colleges, so the data collected was compiled from various sources.

Some institutions did not have all the data available that we were looking for, and many institutions measured aspects of their geothermal systems with different numerical values.

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