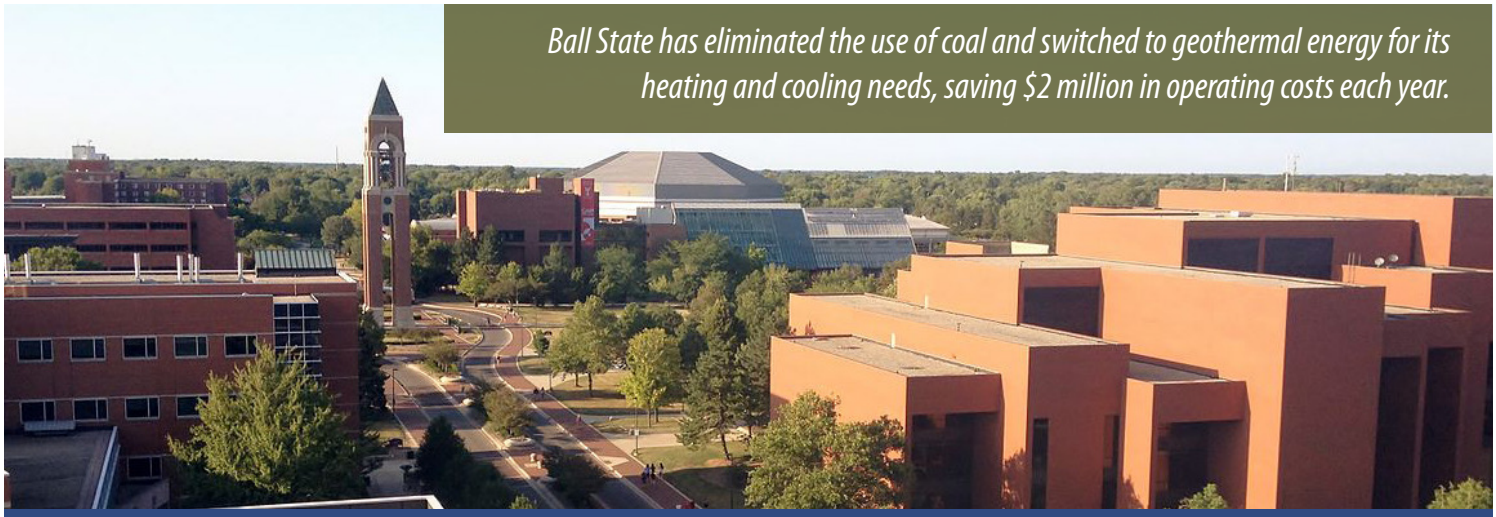

Ball State has eliminated the use of coal and switched to geothermal energy for its heating and cooling needs, saving $2 million in operating costs each year.

Geothermal Heating and Cooling

Moving Toward 100% Clean, Renewable Energy on Campus

In addition to electrification and solar heat and hot water, geothermal heating and cooling systems on campus can help America's colleges and universities use 100 percent clean, renewable energy. Campuses throughout the country are installing geothermal systems to save energy, educate students, and achieve their sustainability goals.

Geothermal Energy Is a Key Building Block of a Clean Energy Future

Virtually pollution-free, inexhaustible, safe and efficient, geothermal energy is a truly clean means of heating and cooling that is also dependably constant. Geothermal energy is a key piece of the puzzle to help our society shift away from today's energy system built on polluting fossil fuels.

How Do Geothermal Heating and Cooling Work?

According to a 2011 report by the National Wildlife Federation, 160 campuses in 42 states use geothermal energy for heating and cooling. Thanks to geothermal technologies like heat pumps, campuses can use the heat of the earth to:

- Provide space heating or cooling across a network of buildings,
- Save energy by situating new buildings partially underground, and
- Store thermal energy in aquifers for later use.

This factsheet is one of an 11-piece series.
For citations, and to read the other factsheets, please visit
EnvironmentAmericaCenter.org/Campus101

Geothermal Heating and Cooling Present Challenges and Opportunities

Geothermal technologies can benefit colleges in different ways:

- **Low Operational Costs:** Geothermal energy systems have lower operating and maintenance costs than some other conventional heating systems, enabling colleges to recoup the cost of installation.
- **Scaling:** Geothermal technology may also be scaled to work in individual buildings or whole campuses.
- **Educational Tools:** Energy dashboards have proliferated to help students and faculty monitor the performance of geothermal installations.

Colleges and universities are reducing barriers to geothermal energy:

- **Installation disturbance:** Creating a geothermal heat network may require tearing up streets to lay down piping. Universities can often have more flexibility to handle these disruptions than other institutions. For example, Lake Land College in Illinois is taking it one building at a time, and performing major projects during the summer break or at night, to avoid affecting normal campus operation.
- **Innovation:** Universities can research and test innovative geothermal energy applications. For example, Cornell University's research has alleviated concerns about the ecosystem impact of heat exchanges with aquifers and lakes, based on studies of its own "lake source cooling" system.

Ball State Replaces Coal-Fired Boilers with One of Nation's Largest Geothermal Systems

At Ball State, a public university in Indiana with more than 20,000 students, heating historically came from four coal-fired boilers that emitted carbon dioxide, sulfur dioxide and particulate matter pollution, contaminants linked to global warming, acid rain and respiratory problems, respectively.

In 2012, those boilers were replaced by one of the nation's largest geothermal energy systems. Water travels through pipes underground, where the stable temperature heats water in the winter and cools it in the summer, and throughout the campus, where heat exchangers and fans regulate indoor air temperature in more than 5 million square feet of space in 47 buildings. The system improves air quality and saves the school $2 million each year.

To pay for the initial phase of the project, Ball State repurposed $40 million in funds for replacement boilers, along with $5 million in federal grants and additional savings generated by the first completed section of the geothermal system. They are also selling their carbon offsets to help provide revenue through Second Nature's C2P2 program, using the revenue to further invest in energy reduction programs. When sales end in 2021, Ball State can claim the emissions reductions towards its clean energy goals, and move closer to its goal of achieving carbon neutrality by 2030.

List of Resources

To start your campus' push to adopt geothermal energy:

- Understand the principles underlying geothermal heating and cooling: https://www.energy.gov/energysaver/heat-and-cool/heat-pump-systems/geothermal-heat-pumps
- Read the National Wildlife Federation's geothermal energy guide, Going Underground on Campus: Tapping the Earth for Clean, Efficient Heating and Cooling (2011): https://www.nwf.org/EcoLeaders/Campus-Ecology-Resource-Center/Reports/Going-Underground-on-Campus
- A 10 percent federal tax credit is available for commercial ground-source heat pumps. Learn about that incentive and others for clean energy technologies at: http://programs.dsireusa.org/system/program/detail/658

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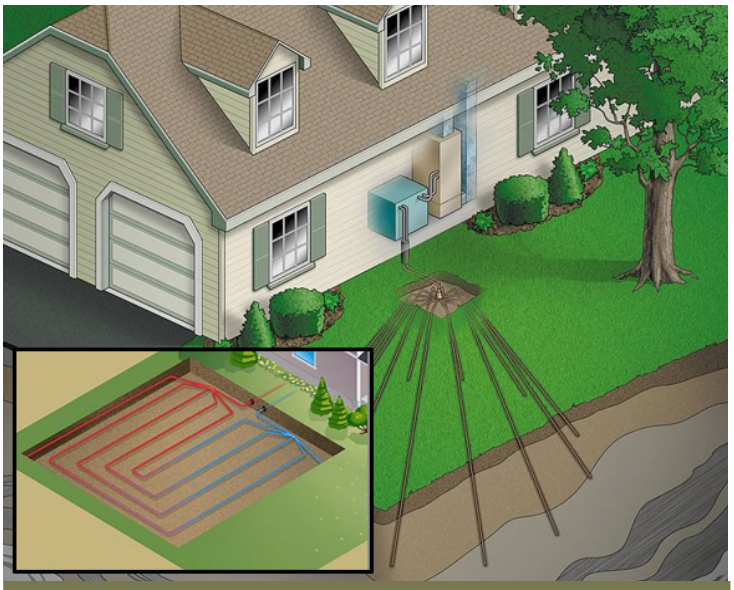

Ground source heat pumps use the earth as a heat source in the winter or as a heat sink in the summer, benefiting from the earth's stable temperature.

North Shore Community College Uses Geothermal to Create Zero Net Energy Building

In 2011, North Shore Community College built Massachusetts' first state-owned, zero-net-energy building – one that produces as much or more energy than it consumes each year. A key component of the Health Professions & Student Services Building's design is the use of ground source heat pumps to heat and cool the building efficiently.

This system consists of 50 geothermal wells drilled beneath the building's parking lot, connected to the building through pipes. Heat pumps are used to circulate fluid through distribution systems in the building – including chilled beams – to provide heating and cooling.

In the summer, excess heat from the building is circulated into the wells where it cools and is re-circulated to provide cooling. Likewise, in the winter, cooled fluid is pumped into the wells where it is warmed by the ground and re-circulated to heat the building with the help of heat pumps.

This geothermal system is critical to the design of the building, which consumes 40 percent less electricity than a traditionally-designed building and reduces carbon dioxide emissions equivalent to taking 780 cars off the road. These achievements and other design elements of the building, including a solar PV system, earned it a LEED Gold certification.