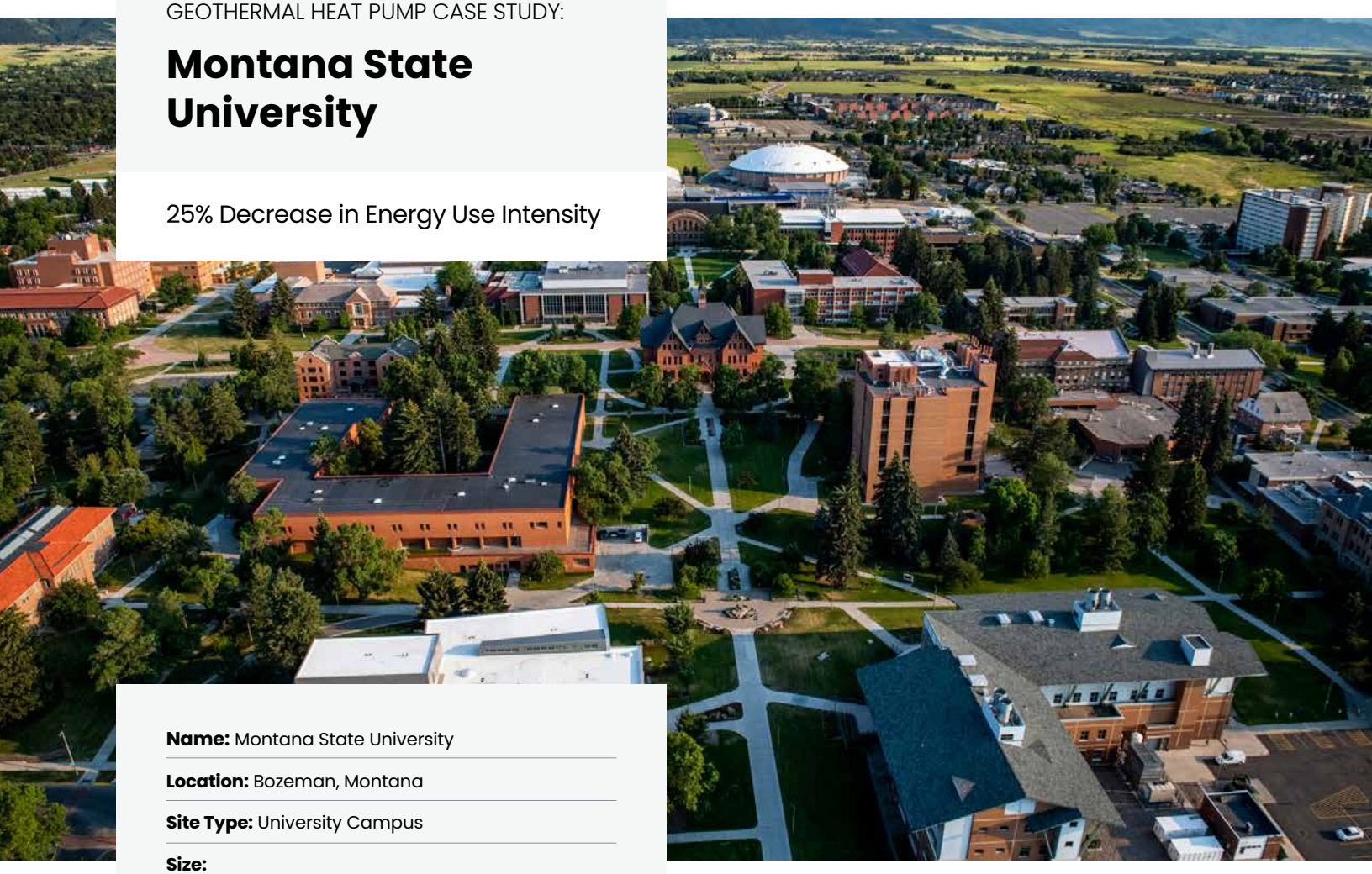
U.S. DEPARTMENT of ENERGY | Office of Energy Efficiency and Renewable Energy
Geothermal Technologies Office

GEOTHERMAL HEAT PUMP CASE STUDY:

Montana State University

25% Decrease in Energy Use Intensity



Name: Montana State University

Location: Bozeman, Montana

Site Type: University Campus

Size:

- 650,000 square feet (8 buildings) heated and cooled by geothermal systems
- 264 boreholes drilled 500–700 feet deep
- 100 boreholes and two new buildings planned for 2024–2025

Unique Features:

- 8,000 heating degree days per year
- Geothermal systems utilize 2.5 miles of existing utility tunnel system
- Includes fifth-generation ambient loop for energy sharing

Energy Savings:

- Building energy use intensity decreased by 25% from 2007 to 2023

Cost Savings:

- The first campus energy district installed in 2011, including four buildings connected to a central heat pump plant and 52 geothermal boreholes, saves an average of $130,000 annually

The foundation of Montana State University's energy strategy includes several energy districts with connected buildings and geothermal borefields. This concept is deployed across 650,000 square feet to provide efficient heating and cooling. In combination with other building energy-efficiency systems, the geothermal heat pump system reduced campus building energy use intensity by 25% from 2007 to 2023. *Photo from Montana State University*

Geothermal Is a Piece of the Energy Puzzle

Montana State University (MSU) started to rethink heating and cooling on campus in 2007 by retrofitting Leon Johnson Hall, a laboratory building built in 1976, with the university's first geothermal heat pump (GHP). This retrofit allowed MSU to leverage energy that would otherwise be untapped.

In 2011, the university began to construct Jabs Hall on an adjacent site, eventually connecting four buildings and utilizing 52 geothermal boreholes—creating the first campus energy district. In 2017, another energy district was implemented in the

Montana State University's district energy system acts as a living laboratory for campus facilities professionals, engineers, and students—a hands-on learning opportunity to study and improve energy-efficient building design, right beneath their feet. *Photo from Montana State University*

south area of campus and connects two new classroom buildings as well as a new student wellness center. This south campus energy district has the potential to connect 10 buildings using existing utility tunnel infrastructure.

A Growing Network

MSU's campus energy district systems have a total of 264 boreholes and 56 miles of piping installed, with another 100 boreholes planned for 2024-2025. One of the energy district systems uses a fifth-generation ambient loop to allow energy sharing between buildings and geothermal borefields. Excess heat from busy classroom buildings will be used to warm up other spaces, such as the pool in the new wellness center. This transfer of energy is a key benefit of a district heating and cooling system.

Campus-Wide Benefits

MSU uses the geothermal heat pump systems not just for heating and cooling, but as a learning opportunity. Every year, 1,000 students tour the MSU utility tunnels and building mechanical spaces to learn about campus energy systems. Graduate students frequently wrestle with "real-world" campus problems as part of their degree programs, subsequently informing campus-wide engineering and building decisions.

As a state-funded institution, MSU navigates a complex process to identify and seek funding for cost-effective, resilient, and energy-efficient building and infrastructure systems. MSU's systems-oriented approach and integration of the geothermal energy district into campus activities is a model for a resilient system that benefits everyone on campus.

> A geothermal heat pump system achieves many goals through deployment of a proven technology. We are pleased to see how the building- and utility-level approaches being implemented today will reshape the campus, commercial buildings, and neighborhoods throughout Montana.
>
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Visit the Case Studies page to see more examples of geothermal heat pumps in action.

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For more information, visit:
www.energy.gov/eere/geothermal/geothermal-heat-pumps

DOE/GO-102025-6437 • July 2025