U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
GEOTHERMAL TECHNOLOGIES OFFICE

GEOTHERMAL HEAT PUMP CASE STUDY:

University of North Carolina Asheville

High-efficiency. Low-maintenance.
A better occupant experience.

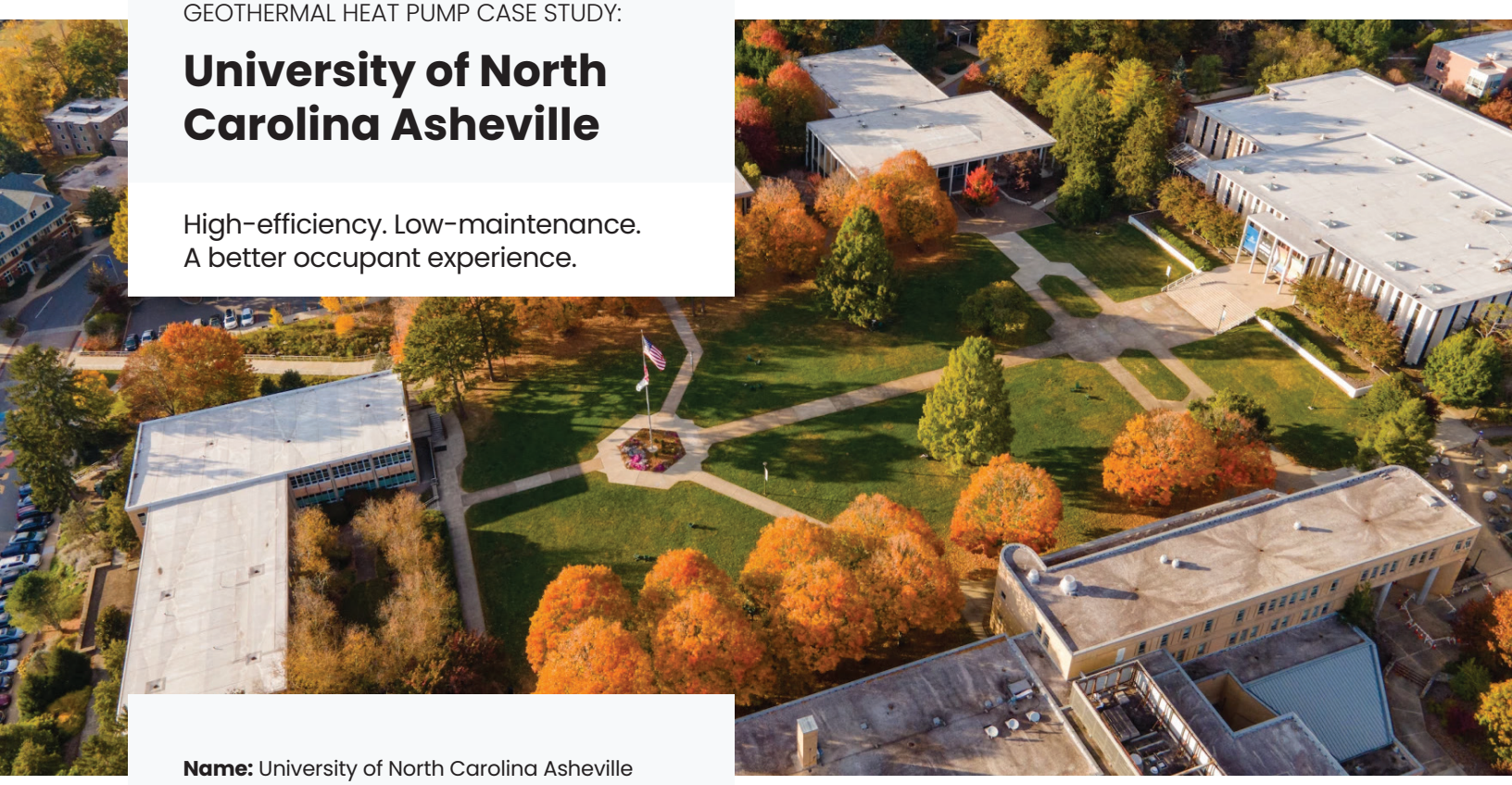

Photo from University of North Carolina Asheville

Name: University of North Carolina Asheville

Location: Asheville, North Carolina

Year Construction Started: 2003

Size:

- Five geothermal well fields with boreholes drilled 400–500 feet deep
- 200,000 square feet of building space
- Five buildings served
- 567 tons of heating and cooling capacity

Unique Features:

- Ponder Hall combines its geothermal heat pump system with a chilled beam system, which uses convection and radiant heat transfer to regulate the temperature of the space, further improving the building's energy efficiency.

Energy Use:

- 30,000–50,000 Btu per square foot, or 8.79–14.65 kWh per square foot

Reduction in UNC Asheville's Carbon Footprint:

- 4,200 metric tons of CO_2 annually
- 56,300 metric tons of CO_2 to date

Cost Savings:

- $46,000 annually
- $783,000 to date

Geothermal Systems Advance Campus Energy Goals

Over the past 20 years, the University of North Carolina at Asheville (UNC Asheville) has constructed five newer campus buildings and retrofitted one older building with vertical closed-loop geothermal heat pump (GHP) systems. These systems use the constant ground temperature, which is about 58°F, to keep the buildings warm in the winter and cool in the summer. Thanks in part to these systems, UNC Asheville has consistently had the lowest energy use rates per floor space among all campuses in the UNC system.

Pioneering Efficiency Advantages

Whitesides Hall, constructed in 2006, was the first new build on campus to include a geothermal heat pump system, with 15 boreholes installed to a depth of 500 feet underground. Whitesides Hall uses 20% of the energy used by next-door Carmichael Hall, which was constructed in 1966 and is a similar size. Streamlining the building's heating and cooling technologies from a chiller, boiler, and cooling tower to just the geothermal heat pump system also cut maintenance costs and bolstered system

Whitesides Hall, built in 2006, was the first building on the UNC Asheville campus to include a geothermal heat pump system. *Photo from University of North Carolina Asheville*

resiliency. With the cooling towers removed and most of the infrastructure underground, the new system also saves water, reduces noise, and improves the campus viewshed, creating a better experience for the campus community.

Four Campus Buildings Follow Suit

Inspired by these advantages, over the next eight years UNC Asheville constructed four more buildings with geothermal heat pump systems: the Sam Millar Facilities Complex, Pisgah House, Ponder Hall, and the Chancellor's Residence. The university also renovated an older building, Rhoades Hall and Tower, which included installing a geothermal heat pump system under the campus's Main Quad to serve as the building's new source of heating and cooling. UNC Asheville's geothermal heat pump systems now serve 200,000 square feet of building space, which is just over 12% of the campus's total building area.

A Portfolio of Sustainable Practices

UNC Asheville's geothermal heat pumps are part of an impressive portfolio of sustainable campus building practices. For example, the Sam Millar Facilities Complex also features a solar thermal system for hot water, a rainwater catchment system that supplies water for the building's toilets, and bioretention ponds that clean the wastewater before it enters the local watershed. The university considers geothermal heat pumps for every renovation or new build and has identified several areas that are good candidates for upcoming systems.

> A geothermal heat pump system is one of the most energy-efficient systems on the market. It's reliable and resilient—regardless of the outdoor conditions. For our (first) system, we already got the investment paid back through annual energy savings by now. Especially for government facilities or university buildings like ours, when you look at a building's 50-year lifespan, this is a great investment.
>
> Dan Croisant, Facilities Mechanical Engineer, UNC Asheville

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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:
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