



CHP  
TECHNICAL ASSISTANCE  
PARTNERSHIPS

# University of Missouri

## 66-MW District Energy CHP System

### Project Overview

The University of Missouri (MU) in Columbia is Missouri's largest university with an enrollment of more than 30,000 students. MU has been meeting its energy needs using various forms of CHP since 1892, when it built its first central power plant. The capacity of the current system is 66 MW. It serves more than 15 million square feet of facilities – including hospitals and clinics, a nuclear research reactor, research laboratories, academic buildings, residential halls, dining facilities, athletic facilities, computing center and administrative buildings – with an electric reliability >99.995%.



Photo Courtesy of University of Missouri

The system consists of two gas turbines with heat recovery steam generators (HRSGs) and duct firing capability, four steam turbines, one backpressure steam turbine, as well as a series of six boilers. The

system can produce up to 1.1 million pounds of steam for meeting the needs for electric power generation and the campus thermal loads that include sterilization, production of chilled water, cleaning, and humidification. The campus's energy distribution system consists of 31 miles of 13.8 kV electric lines, 27 miles of steam and condensate return pipe, and 23 miles of chilled water pipe. Some of the chilled water is also used for cooling the gas turbine inlet air to 60°F to prevent the loss of gas turbine generation capacity when the ambient air temperature rises above 59°F, the temperature used for rating all gas turbines. The plant has fuel flexibility which adds to its resiliency and cost effectiveness. Biomass and natural gas make up the majority of MU's fuel supply, with some coal in the winter to meet fuel demand.

### Quick Facts

**LOCATION:** Columbia, Missouri

**MARKET SECTOR:** Colleges/Universities

**STUDENT ENROLLMENT:** 30,000

**CHP GENERATION CAPACITY:** 66 MW

**CHP PRIME MOVERS:** Two gas turbines (13 MW each) with HRSGs and duct firing  
4 steam turbines (6 MW to 19 MW each)  
1 backpressure steam turbine (300 kW)

**PRIMARY FUELS:** Natural gas, biomass, coal

**USE OF RECOVERED THERMAL ENERGY:** Space heating, space cooling, domestic hot water, equipment sterilization

**AREA SERVED:** ~275 buildings, >15 million ft<sup>2</sup>

**ENVIRONMENTAL BENEFITS:** CHP and renewables have lowered MU GHG's by >50%

**BEGAN CHP AT CURRENT LOCATION:** 1923, most recent addition 2017



MU District Energy CHP Power Plant  
Photo Courtesy of University of Missouri

### Heat, Power and Cooling

Because the system provides not only heat and power but also cooling throughout the campus in part through both steam turbine driven centrifugal and absorption chillers, MU refers to its system as a Combined Cooling Heat and Power system. The campus district cooling system produces and distributes chilled water to cool campus buildings and provide process cooling

for research. The system includes 32 chillers with total cooling capacity of 32,000 tons of which 8,900 tons of chillers are powered by steam: 5,000 tons by steam turbine-driven chillers and 3,900 tons by double-effect absorption chillers. The chiller plants are strategically located throughout the campus. The chillers are controlled and metered centrally by a control system that optimizes the campus cooling load by operating the most efficient chillers first, reducing the energy to cool the campus.

## Energy Efficiency and Conservation

MU's CHP operation is nearly twice as efficient as a typical conventional system: electricity from grid and on-site boilers. The Energy Management team has long taken a leadership role in improving energy efficiency across the campus, providing building automation controls and optimization, HVAC commissioning, energy conservation, and insulation services. All utilities are fully metered at campus buildings, with consumption data automatically collected and transmitted back to Energy Management for verification, funding allocation, and identification of potential efficiency improvements. Energy efficiency measures have reduced energy use per square foot in academic buildings by 21% since 1990. The savings are \$92.8 in cumulative terms and are now up to \$10.4 million on an annual basis.



**Gas Turbine Generator**  
Photo Courtesy of University of Missouri

## Renewable Fuels and Sustainability

MU's CHP plant has been developing and using renewable biomass fuels since 2006. In 2013, the plant replaced an aging coal-fired boiler with a 100% biomass-fired boiler that's consuming more than 120,000 tons of sustainably sourced biomass (mill residue, ground pallets, tree trimmings) from Mid-Missouri companies, increasing its reliance on renewable fuels and helping the local economy. The University has reduced its consumption of coal by 93% from its base year of 2008 through a combination of renewables, fuel switching, and energy efficiency, and is well on its way towards its climate goals, having reduced emissions of greenhouse gases by 54% from a 2008 baseline.

## System Resiliency

With a major hospital and other critical medical and research facilities in its system, MU Energy Management places a major focus on reliability. The district energy system has N-1 operational availability and full black start capability. All critical facilities have electric system looping and automatic switching if power supply is disrupted. The University has an automated load shedding system that ensures critical facilities retain service during an electrical upset condition. The 66 MW from the CHP system is backed up with

a 40 MW transmission connection to the grid through the Midwest Independent Operating System (MISO), connecting through the transmission system operated by Columbia Water & Light.

*"It is extremely rewarding for our campus district energy system to be recognized by IDEA as one of the best of the best. I'm very proud of our staff's contribution in helping us win this prestigious award by delivering highly reliable, cost-effective and sustainable utility services to the Mizzou campus."*  
**Gregg Coffin, Campus Facilities Energy Mgt. Director**

*"The service we receive from the campus system is extremely reliable. Our standby generators rarely run, beyond the weekly tests that we perform."*  
**Roger Higginbotham, Exec. Director for Support Services, MU Health Care**

## Accolades

MU has received numerous accolades for its energy efficiency efforts. In 2017, the International District Energy Association (IDEA) presented MU with its "System of the Year Award." MU is one of only 5 universities to receive this prestigious award and the only university to be recognized twice by IDEA, in 2004 and 2017. US EPA has also twice recognized MU as an "Energy Star Partner of the Year" for its energy efficiency efforts and in 2010 presented it its "Energy Star Combined Heat and Power Award."

## For More Information

### U.S. DOE CENTRAL CHP TECHNICAL ASSISTANCE PARTNERSHIP

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