



University of Missouri

66-MW District Energy CHP System

Project Overview

The University of Missouri (MU), located in Columbia half way between Kansas City and St. Louis, is Missouri's largest university with an enrollment of more than 30,000 students. MU has been producing energy using various forms of CHP since 1892. Today's system provides district heating and cooling and a microgrid with 66 MW of electric capacity. 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%.

MU generates electricity with two 13 MW gas combustion turbines and four backpressure steam turbines ranging in capacity between 6MW and 19MW. The system produces steam through a series of boilers—two chain-grate boilers, two spreader-stoker boilers, a fluidized-bed boiler, and a gas/oil fired boiler – and by capturing the exhaust heat of the gas-turbine generators using heat recovery steam generators (HRSGs). Up to 1.1 million pounds of steam can be produced for campus thermal needs, not only for heating and power generation, but also 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.

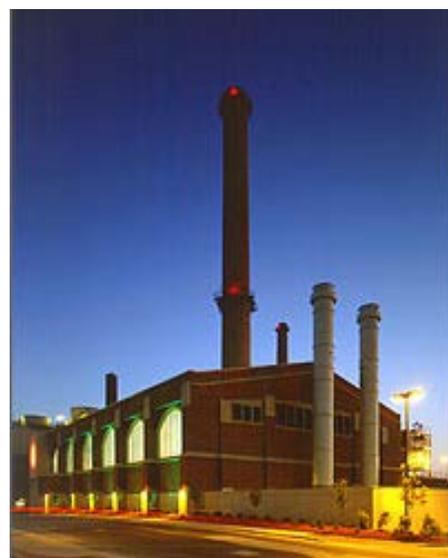
The plant has fuel flexibility which adds to its resiliency and cost effectiveness. Sustainable biomass and natural gas make up the majority of MU's fuel supply, with coal necessary in the winter to meet fuel demand.

Heat, Power and Cooling

Because the system provides not only heat and power but also cooling throughout the campus in part through steam driven 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 air condition campus buildings and provide process cooling for research. The system has 32,000 tons of cooling capacity with about a third of the 37 chillers powered by steam. Various satellite chiller plants, strategically located throughout campus, are connected together by 23 miles of underground chilled water piping. Chillers are controlled and metered centrally by a process control system which optimizes the campus cooling load by operating the most efficient chillers first, reducing the energy to cool the campus.

Quick Facts

LOCATION: Columbia, Missouri
MARKET SECTOR: Colleges/Universities
STUDENT ENROLLMENT: 35,000
CHP GENERATION CAPACITY: 66 MW
CHP PRIME MOVERS: Two 13 MW gas turbines and four (6MW to 19MW) steam turbines
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 ft²
ENVIRONMENTAL BENEFITS: CHP and renewable energy have lowered MU GHG's by >50%
BEGAN CHP AT CURRENT LOCATION: 1923



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

Energy Efficiency and Conservation

MU's CHP operation is nearly twice as efficient as a typical "electric only" power plant. 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, saving the university \$9.5 million annually in avoided utility costs and \$85 million in cumulative.



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. In the future the plant could also use locally sourced biomass like corn stovers, switchgrass, miscanthus or woody crops. The University has reduced its consumption of coal by 73% 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 51% from a 2008 baseline.

"The service we receive from the campus system is extremely reliable. We removed aging chillers here at the hospital a few years ago when the campus-wide chiller system was installed. Our standby generators rarely run, beyond the weekly tests that we perform."

Roger Higginbotham, Exec. Director for Support Services, MU Health Care

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 all critical facilities receive adequate electricity supplies at proper frequency. In addition to the 66 MW available from the CHP system, MU has a 40 MW transmission connection to the grid through the Midwest Independent Operating System (MISO), connecting through the transmission system operated by Columbia Water and Light. MU's microgrid has a demonstrated reliability greater than 99.995%.

"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

Accolades

MU has received numerous accolades for their district energy system and 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 4 universities to receive this prestigious award and the only university to be recognized twice by IDEA, in 2004 and then again in 2017. US EPA has also twice recognized MU as Energy Star Partner of the Year for its energy efficiency efforts and in 2010 presented the University with its Energy Star Combined Heat and Power Award. MU is ranked 5th in the nation for onsite generation of "green" renewable electricity in EPA's Green Energy Partnership and leads in on-site generation among universities in the program.

For More Information

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