

University of Missouri
Energy Conservation, Efficiency and Renewable Energy
December 2018

Energy Conservation Success

The University of Missouri is a long-time leader in the application of energy conservation technologies which has yielded notable reductions in energy use and cost avoidance for its Columbia campus. ***MU's campus education and general (E&G) space has grown by 49% since 1990, yet energy use has been reduced by 17% and greenhouse gas emissions have been reduced by 70% on a square foot basis. The annual cost avoidance of MU's energy conservation efforts are now \$10.4 million, cumulative cost avoidance has reached \$92.8 million since 1990.***

Key features of MU's conservation program include:

- **Lighting** – Early efforts converted most all facilities to high efficiency lighting. We're now focused on another phase of light saving opportunities with LED lighting technologies providing both energy and maintenance savings. LED has become the campus lighting standard for new and renovation projects. Where also re-lamping existing campus facilities including: exterior lights, parking structures, classrooms, offices and labs. Recent parking garage conversions to LED have resulted in overall better lighting, much lower maintenance, and over 60% in energy savings.
- **Daylight Harvesting** – Controls are used to automatically turn off or dim interior lights in areas that receive adequate sunlight. Some LED technologies we're applying include this as an integral feature.
- **Motion Sensors** – Motion sensors have been installed in thousands of classrooms, offices, conference rooms, and laboratories to turn off lights and set-back thermostats when spaces are unoccupied.
- **Efficiency Upgrades of Building Heating, Ventilating and Air Conditioning (HVAC) Systems** – HVAC systems have been retrofitted to higher efficiency systems. These upgrades consists of upgrading the controls, motors, variable speed control of motors, variable air volume systems, use of energy recovery devices, and use of occupancy sensors/schedules to reduce building energy consumption.
- **Design and Commissioning Standards for HVAC Systems** – Energy efficiency design standards for HVAC systems are implemented on all campus projects to meet or exceed federal and state guidelines. ***All new buildings and renovations are designed to meet ASHRAE 90.1*** (American Society of Heating, Refrigeration, and Air Conditioning Engineers) to establish minimum energy efficiency design requirements. These design features include:
 - Building envelope insulation, walls, roof, and thermal efficient windows
 - Energy Management Control Systems
 - Variable volume air and water circulation systems
 - Heat recovery on 100% outside air systems
 - Occupancy sensors for lighting control and temperature setback
 - High efficiency motors
 - High efficiency lighting systems

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- **Energy Management Control System (EMCS)** – The EMCS is an automated digital control system for HVAC systems, which monitors, controls, and reports energy use while maintaining comfort in campus buildings. MU’s EMCS system has expanded to over 150 buildings, approximately 80% of the campus.
- **Local Energy Controls Expertise** - The Campus Facilities - Energy Management staff install, program, test, and commission controls and HVAC systems to achieve design requirements and ensure maximum energy efficiency and occupant comfort. This on-campus resource saves cost on the control system and provides a high degree of ownership.
- **HVAC Controls Fault Detection** – We’ve applied a computerized monitoring system which constantly monitors the health of the building automation systems in campus buildings. It sends exceptions when early indications of inefficiencies occur. Technicians can then make corrections or repairs to keep the HVAC system optimized.
- **Reduced Building Energy Use and Analysis** – All buildings are fully metered for energy consumption. Metering data is analyzed each month and energy consumption patterns are identified. Buildings showing potential energy saving opportunities are audited and energy conservation projects are implemented.
- **Water Reduction** – Since 1990, even though space has increased by 49%, water use has decreased by 53%. This is a result of implementing projects to eliminate waste water cooling, using sensors in lavatories on sinks and fixtures, and other water conservation efforts.
- **Campus-wide Energy Conservation Awareness** – Presentations and advertisements are used to encourage MU faculty, staff, and students to conserve energy. In addition, engineers in the Campus Facilities - Energy Management Department assist professors with tours and presentations for academic classes. Campus Facilities also educates the public on our energy conservation program and success.

Current focus areas for the energy conservation program include:

- LED Lighting Conversions
- Continue to update fume hoods with more energy efficient technology during renovation projects
- Upgrade HVAC controls in additional campus buildings using more energy efficient technologies
- Further apply and optimize the HVAC controls fault detection system
- Assist with applying the latest ASHRAE efficiency standards on building campus projects
- Continue to promote energy conservation awareness across campus
- Develop a retro-commissioning effort to restore building efficiencies as necessary

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High Utility Production Efficiency and Reliability

MU has a full capacity micro-grid which delivers steam, electricity, chilled water for cooling, and drinking water for its Columbia campus. A variety of production technologies are used which provide reliability, resiliency, and cost efficiency. A few key features of MU's utility production systems are:

- **Generation Efficiencies** – MU's uses Combined Cooling, Heat, and Power (CCHP) technologies to produce steam, chilled water for cooling, and electricity for the campus. The efficiency of this process is nearly twice that of conventional "electric only" power plants, reducing fuel use and emissions.
- **Efficient District Cooling** – In 1990 air conditioned buildings had their own stand-alone system. Since then, we've incrementally replaced this less efficient technology with a highly efficient and reliable district cooling system. Today, highly efficient chillers are connected together with 25 miles of underground chilled water piping to supply cold water to campus buildings for cooling and de-humidification. Today's system takes advantage of the efficiencies inherent in the chilled water loop system due to diversity, and by using the campus EMCS to schedule chiller operation based on efficiency, the energy used to provide cooling to campus has been reduced significantly.
- **Free Cooling** – There are campus facilities and processes requiring cooling year round. During the winter months we take advantage of cold outside air to produce chilled water from "free cooling" heat exchangers to provide this cooling. Prior to installing this free cooling system, electric chillers were run year-round to provide for this need.
- **Energy Conservation in Utility Production** – MU's CCHP system efficiently provides reliable utilities to the campus. To enhance the energy production efficiency the production operations have: employed economic/efficiency equipment dispatch, optimized digital process controls, increased the use of variable speed drives, installed high efficiency motors, converted to LED lighting, collected process waste water for reuse, capture waste heat, and applied other efficiency techniques.
- **Safe and Consistent Drinking Water** – MU's local fully regulated drinking water system consistently provides a quality water supply for its campus. The system is fully automated to safely, reliably and efficiently deliver water to the campus for drinking and process.

Renewable Energy

Renewable energy at MU now exceeds 40% of the total campus energy supply. The renewable energy portfolio includes: biomass, wind, solar photovoltaic, and solar thermal. These systems provide MU with a significant amount of sustainable energy. These technologies also serve as an educational and research resource for students and faculty. ***MU is currently the #2 generator of green energy when compared to all college and university participants in EPA's Green Power Partnership. MU is currently ranked #6 for on-site green energy production compared to all industrial, governmental, and academic partners in the program!***

MU's renewable energy portfolio includes the following.

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- **Biomass CHP Energy** - Most of MU's renewable energy is sourced from regional biomass fuel (residue wood) which is used to produce steam and electricity for the MU campus. The biomass boiler annually uses over 120,000 tons of regionally sourced biomass, mostly using wood residues from Missouri saw mills and wood product companies. The benefits associated with the use of biomass at MU include:
 - Improving our environment through reduced emissions, including greenhouse gases
 - Supporting MU's goal to become more sustainable in its use of energy
 - Creating "Green Energy Jobs" in Missouri to harvest, prepare, and transport biomass
 - Helping MU researchers develop new ways to grow, prepare, and transport biomass feed stocks
- **Wind Energy** – A significant portion of the electricity MU purchases from the grid, 74% in FY18, was purchased from an off-site wind farm within the Mid-continent Independent System Operator (MISO) system. MU also locally demonstrates wind energy on its campus with a 20 kw wind turbine generator located near the General Services building at the intersection of Stadium Blvd. and Champions Drive. This wind turbine uses similar technology to a utility scale turbine and is used as a teaching resource for MU class groups and organizations.
- **Solar Energy** – MU has several solar energy systems located on campus. At the campus power plant, a 34kw photovoltaic (PV) solar which makes electricity for campus using an array of 144 poly-crystalline PV panels, another 2.4 kw system is located at the Research Reactor. There is a solar thermal heating system which uses evacuated tube technology to collect thermal energy from the sun to heat make up water for the plant's boilers at the power plant. A solar thermal heating system was also recently added at Gateway Hall to supplement domestic hot water heating. These solar energy systems are available as a teaching resource for MU class groups and organizations.

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CAMPUS FACILITIES - ENERGY MANAGEMENT AWARDS

- **1995 US EPA Green Lights University Partner of the Year Award** for progress in upgrading lighting, and promoting energy efficiency.
- **1996 National Association of College and University Business Officers Award** for the implementation of an innovative wholesale electricity purchasing program.
- **1997 MU was selected from among 1,400 participants for the first US EPA's and US Department of Energy's Energy Star Buildings Partner of the Year Award**, an honor for excellence in using energy more efficiently, saving money and improving the environment.
- **1998 Missouri Governor's Award for Quality and Productivity** recognizing the teamwork between the MU Campus Facilities - Energy Management Department, Missouri Department of Corrections, and the Missouri Department of Natural Resources with the Tire Derived Fuel Program.

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- **1998 Governor's Pollution Prevention Award** for MU's overall approach to the production, use, and conservation of energy.
- **1998 National Council of State Governments' Award for Innovation** for innovative use of tire derived fuel.
- **1999 EPA's Energy Star Label Buildings** awarded for University Hall and the General Services Building. These buildings are the first office buildings on any university campus to earn this recognition.
- **1999 top member of the EPA's Honor Society** of Energy Star Buildings Partners for our success in the program.
- **2000 Missouri Waste Coalition Achievement Award** for MU's contributions towards improved waste management practices and wise use of natural resources in our state with the Tire Derived Fuel Program.
- **2001 EPA's Energy Star Partner of the Year Award** received for the second time by MU for commitment to energy management practices in using efficient lighting and HVAC systems across campus and for its dedication to stringent energy efficiency requirements in all new construction. MU first received the award in 1997.
- **2003 EPA's Combined Heat and Power Award** for recognition of efficiency and associated environmental benefits of MU's combined heat and power facility.
- **2004 International District Energy Association's System of the Year Award** for recognition of MU's exemplary operating performance, reliability, efficiency, and excellence in providing energy services.
- **2008 National Wildlife Federation's Energy Efficiency Award - Chill Out: Campus Solutions to Global Warming** for recognition of MU's efforts in energy conservation and efficiency.
- **2008 Missouri Waste Control Coalition's Outstanding Achievement Award** - in the Government category for its joint, "tires-to-energy" recycling program.
- **2010 EPA's Energy Star CHP Award** for efficient operation of a Combined Heat and Power Plant.
- **2017 International District Energy Association's System of the Year Award** for recognition of MU's exemplary operating performance, reliability, efficiency, and excellence in providing energy services. MU became the first University to win this award twice.
- **2017 EPA Green Power Partnership Leadership Award** for the development and use of renewable electricity to serve our Mizzou campus.
- **2018 Mayors (City of Columbia) Climate Protection Award** for pollution prevention on our campus and the surrounding community.