

MU's Energy Conservation Program August 2008

MU has taken a leadership role for many years in reducing energy use on our campus with significant results. While campus education and general (E&G) space has grown by 28% since 1990, energy use has been reduced by 12% on a square foot basis. This is especially significant because much of the new space has been energy intensive research space.

The annual utility cost avoidance from energy conservation measures has now reached \$4.3 million. This is equivalent to three degree programs or \$170 reduction in tuition per student. There are environmental benefits associated with this effort as well. Since the program started MU has reduced greenhouse gas emission per square foot by 11%. Based on EPA data, the corresponding reduction of CO₂ emissions is equivalent to the removal of 18,000 cars from our roadways or the planting of 28,000 acres of trees.

MU has earned numerous awards for energy conservation success and environmental stewardship. MU is considered a leader in energy conservation by the EPA and is a member of EPA's Honor Society of Energy Star Buildings Partners.

Following is a description of our program by energy saving category.

Energy Conservation Program

- Lighting – In 1990 most lighting on campus was either incandescent or low efficiency fluorescent with magnetic ballasts. Today over 99% of the exterior lighting and over 90% of the interior lighting on campus has been converted to high efficiency lighting. Incandescent exit signs have been replaced with LED, reducing energy consumption by 80 – 90%. Daylight harvesting has also been used to automatically turn off interior lights in areas that receive sunlight.
- 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 – Major HVAC systems have been retrofitted to higher efficiency systems. These upgrades consisted of upgrading the controls, motors, regulation of air flow, use of energy recovery devices, and use of occupancy sensors/schedules to reduce building energy consumption.
- Design 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 efficient design requirements. These design features include:
 - Building envelope insulation, walls, roof, and thermally efficient glazing.
 - Use variable volume air and water circulation systems
 - Use heat recovery on 100% OA systems
 - Use occupancy sensors for lighting control as well as control system temperature setback
 - Use high efficiency motors

- Use high efficiency lighting systems
- 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. Over the past 16 years the EMCS system has been expanded from fewer than 10 buildings to over 110 buildings comprising approximately 80% of the campus.
- Reduced Building Energy Use and Analysis – All buildings are fully metered for energy consumption. Metering data is analyzed and energy consumption patterns are identified. Buildings showing a potential energy saving opportunities are audited and energy conservation projects are implemented.
- Window Film – Window film has been installed on several buildings to reduce radiant heating during the summer months.
- Water Reduction – Since 1990, even though space has increased by 28%, water use has decreased by 45%. 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. On a total gallon/gsf basis we've reduced water use 57%.
- Campus-wide Energy Conservation Awareness – Campus faculty, staff, and students are encouraged to conserve energy through the use of advertisements and presentations. In addition, engineers in the Campus Facilities Energy Management Department assist professors with tours and presentations in engineering classes. We also participate in events, such as Earth Day, to educate the public on our energy conservation efforts at MU.
- Chilled Water Loop – In 1990 each air conditioned building had its own system. Today after installing over 16 miles of underground chilled water loop piping and connecting most of the major campus buildings to the loop, the number of chillers required has been reduced by 75%. By taking advantage of the efficiencies inherent in the chilled loop system due to diversity, and by using the campus EMCS to operate the most efficient chillers first, the energy used to provide cooling to campus has been reduced significantly. Over the past five years, cooling demand has increased 45%, but the energy to produce the chilled water for cooling has been reduced by over 50%.
- Free Cooling – We have installed free cooling heat exchangers to take advantage of cold outside air to produce chilled water to cool specialized research equipment that needs cooling during winter months. Prior to installing this free cooling system, electric chillers were run year-round to provide for this need. This resulted in an 84% reduction in the cost to provide winter cooling.
- Vehicles - The University requires that 70% of vehicles purchases must be Alternative Fuel Vehicles (AFV)
- Trees – The University plants approximately 200 trees annually on the MU campus

The Campus Facilities Energy Management Department has already planned to implement the following energy conservation projects and measures as part of the ongoing energy conservation program:

- Retrofit or replace fume hoods with more energy efficient design whenever possible during renovation projects.
- Upgrade HVAC controls to a more energy saving technology in additional buildings.
- Continue to install motion sensors on lighting and HVAC systems.
- Continue to upgrade the EMCS system to increase energy savings.
- Update campus energy policies to the latest standards.
- Eliminate additional waste water cooling wherever possible.
- Increase energy conservation awareness across campus.
- Continue to investigate new lighting technologies and opportunities for new upgrades on campus.
- Continue our ongoing evaluation of utility production efficiency improvement opportunities

Energy Production Efficiency

- Generation Efficiencies – The MU power plant uses Combined Heat and Power technology to produce steam and electricity for the campus. The efficiency of this process is nearly twice that of conventional power plants. This reduces fuel consumed and emissions.
- Energy Conservation in Utility Production – Numerous energy conservation projects have been implemented in the MU power plant including use of high efficiency motors, variable speed drives, recycling of waste water, use of advanced digital process controls to optimize plant efficiency, and increased heat recovery in the generation of steam.
- Alternate Fuels
 - *Tire Derived Fuel* – The MU power plant is blending up to 10% Tire Derived Fuel with coal through a partnership with the Missouri Department of Corrections and the Missouri Department of Energy. This program results in the annual removal of up to 350,000 tires from Missouri waste tire dump sites. Since 1998, MU has burned over 3 million scrap tires. The program saves up to \$300,000 per year in fuel costs.
More information about CF — EM's TDF program is available at http://www.cf.missouri.edu/energy/em_renewable/tdf.html
 - *Corn Cobs* – We partnered with MU's College of Agriculture and Extension to burn a blend of corn cobs with coal. Preliminary testing of a 2-3% blend was completed.
 - *Wood Chips* - This year, up to 5 percent of the coal supply will be replaced with waste wood chips, saving more than 7,000 tons of greenhouse gas emissions. Waste wood chips may be a steady biomass fuel source for MU in the future. Using biomass fuel saves MU \$50,000 annually, supports the local economy, annually reduces shipping miles by 90,000, and saves approximately 16,000 gallons of diesel fuel.
 - *Bio-Diesel* – We are using a bio-diesel blend of fuel in our equipment where applicable at no additional cost. This fuel burns cleaner than pure diesel fuel and helps the local economy.

University of Missouri – Columbia
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.
- **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 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.

More information about the award is available at

http://www.cf.missouri.edu/stories/archives/em_tdf/fullarticle.html