Energy Conservation Success

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 42% since 1990, energy use has been reduced by 19% and greenhouse gas emissions have been reduced by 57% on a square foot basis.

The annual utility cost avoidance from energy conservation measures has reached $6.3 million. Additionally, energy conservation savings reduce the need to generate additional energy, lowering long-term investment costs for new production equipment by another $2.1 million annually. This total annual cost avoidance of nearly $8.4 million is equivalent to a $243 annual reduction in tuition per student. Since the program started in 1990 the total cumulative cost avoidance has reached $66.7 million.

MU has been recognized as a leader in energy conservation by the EPA and others. A list of awards is included at the end of this document.

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

- **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 technology, reducing energy consumption by 80 – 90%. LED lighting has also been installed in several outdoor locations such as Speakers Circle and the area around Switzler Hall. LED interior lights were installed as part of the recent Gwynn Hall renovation and in the power plant as part of the Combined Heat and Power Upgrade Project. Daylight harvesting is also used to automatically turn off interior lights in areas that receive adequate 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 consist 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 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

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.

- **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 20 years the EMCS system has been expanded from fewer than 10 buildings to over 135 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 potential energy saving opportunities are audited and energy conservation projects are implemented.

- **Window Film** – Window film is used on several buildings to reduce excess radiant heating during the summer months.

- **Water Reduction** – Since 1990, even though space has increased by 42%, water use has decreased by 48%. 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. Water use has been reduced by 63% on a gallon/gsf basis.

- **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.

- **Chilled Water Loop** – In 1990 each air conditioned building had its own system. Today after installing 24 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 60%. By taking 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** – During the winter months we take advantage of cold outside air to produce chilled water from “free cooling” heat exchangers to cool research equipment. Prior to installing this free cooling system, electric chillers were run year-round to provide for this need.
The Campus Facilities - Energy Management Department plans 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 technology during renovation projects
- Upgrade HVAC controls in additional campus buildings using more energy efficient technologies
- 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
- Increase energy conservation awareness across campus
- Continue investigating and implement the use of new lighting technologies such as LED and identify additional opportunities for upgrades on campus
- Continue evaluation of utility production efficiency improvement opportunities

**Energy Production Efficiency**

- **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.

- **Energy Conservation in Energy Production** – MU’s CCHP plant efficiently provides reliable utilities to the campus. To enhance the energy production efficiency the plant increased the use of variable speed drives, high efficiency motors, lighting, digital process controls, re-use of process waste water, waste heat recovery, and other efficiency techniques. The new biomass boiler includes several efficiency improvements including: premium high efficiency motors, motor and drive speed control, recycling of process water, use of advanced digital process controls, LED lighting, and a unique heat recovery system within the biomass boiler to increase plant efficiency and advance sustainability.

**Renewable Energy**

Renewable energy at MU now exceeds 35% 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 #1 generator of green energy when compared to all college and university participants in EPA’s Green Power Partnership.** MU is currently ranked #8 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.

- **Biomass Energy** - Most of MU’s renewable energy is sourced from regional biomass fuel which is used to produce steam and electricity for the MU campus. MU’s CCHP plant has co-fired wood chips in its boilers since 2006 and a recently installed 100% biomass boiler further expanded the utilization of renewable biomass energy for the MU campus. The new biomass boiler, placed into service in late 2013, is serving MU’s energy needs with clean sustainable energy. The biomass boiler uses over 100,000 tons annually of biomass from regionally sourced biomass, mostly using wood residues from sawmills and wood product companies.
The biomass boiler technology supports the use of other possible regional biomass sources such as; corn stover, switchgrass, miscanthus, and other available types of biomass. MU leads the way in the sustainable sourcing of biomass fuels for the plant. Through partnering the MU Forestry Department, we included stringent sustainability requirements in our fuel supply contract to ensure that the biomass sourced for MU’s plant does not harm Missouri’s forests or natural resources.

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 grow, prepare, and transport sustainable biomass
➢ Helping MU researchers develop new ways to grow, prepare, and transport biomass feed stocks

• **Wind Energy** – MU locally demonstrates the use of wind energy on its campus with a 20 kw wind turbine generator. The wind turbine is located near the General Services building at the intersection of Stadium Blvd. and Champions Drive and uses similar technology to a utility scale turbine. It is also used as a teaching resource for MU class groups and organizations.

MU purchases a portion of its electrical energy off an open access wholesale grid system called the Mid-continent Independent System Operator or MISO. A significant portion of the electricity MU purchases, 47% in FY14, comes from an off-site wind farm.

• **Solar Energy** – MU has two solar energy demonstration systems located at the campus power plant, a 34kw photovoltaic (PV) solar which makes electricity for campus using an array of 144 poly-crystalline PV panels and 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. Both solar energy systems are available as a teaching resource for MU class groups and organizations.
University of Missouri

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 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.