Mississippi State University

Resource Efficiency Plan

Current Status and
Committee Recommendations

August 28, 2006

Mississippi State
UNIVERSITY

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1. Resource Efficiency Plan

Due to the rising cost of energy, budget issues and the further expansion of University interests, it has become necessary to establish a plan for dealing with energy related issues. A committee was assembled to address the energy issues facing the University and has met at regularly scheduled intervals to review individual group findings. This document presents the *initial findings, actions, and recommendations* from the Energy Committee and its subgroups.

1.1. Savings Estimates (Defined)

The savings that are presented in this document are based on the current level of resource usage and subsequent price at that associated level during the period in which the actions were taken. The savings presented should be considered a deferred cost and not actual cash flow. These values do not take into account other economic conditions such as energy cost and demand fluctuations and economic inflationary pressures. Although these values are represented by actual dollar amounts, they should be used as a reference to the progress being made to alleviate the current financial strain caused by external factors and the continuing need for external sources of energy.

1.2. Background

With the increase in energy costs and budget constraints, energy has become a central focus of University personnel. The economics of energy cost require Mississippi State University (The University) to take the necessary steps to curtail energy spending. The primary focus was placed on electrical and natural gas consumption. Other areas, which include petroleum, water, and other natural resources, are a concern as well but are not fully addressed within this document. These sources of energy use will be addressed in more detail in subsequent reports when more information is available.

Measures to reduce the amount of energy consumed by the University are necessary to keep operational costs to a minimum. Some measures were first implemented by Facilities Management (FM) in late 2005 and were instrumental in controlling the utility usage (and overuse) within facilities on the University campus, primarily during the winter intermission. These measures saved approximately $137,000 with the bulk of the savings from reducing minimum heating requirements within campus facilities.

To further investigate the energy use within campus facilities, FM partnered with The Department of Industrial and Systems Engineering (ISE) to perform a study of the energy use within campus facilities. McCain Engineering Building was selected for the five month study. Three areas within the pilot building were defined and examined. Those areas included 1) Lighting, 2) Equipment, and 3) Heating, Ventilation, and Air Conditioning (HVAC). This study revealed areas of potential energy savings within the building and helped to develop policy and standards that would capitalize on these

savings. The knowledge gained from this study has proven beneficial and is being applied to other buildings on campus.

Additionally, FM hired an Energy Manager to provide expertise and support in the area of energy systems to discover ways to control the cost of utilities through current technologies as well as developing new energy practices to lessen the energy consumption and demand. It is estimated that a deferred cost of $150,000 has been created by the addition of this position.

2. Focus Areas

Several areas were examined based on the expertise and involvement of members of the Energy Committee (EC). These areas include both cultural and technical aspects. Although the details are brief, they represent the work performed by the EC to date. The following represents the current actions and recommendations of members of the committee. The committee members associated with the areas can be found at the end of this document.

2.1. Energy Supply and Rate Structure

2.1.1. Electricity

University personnel entered negotiations with the primary electrical energy provider, Tennessee Valley Authority (TVA), and the local distributor Starkville Electric Department (SED). The results from the negotiations included a new contract that reduced the per kilo-watt cost associated with electricity provided by TVA/SED. The new rate, at $0.055/KWh, is $0.018/KWh lower than the previous rate of $0.073/KWh. The new rate should produce an estimated cost difference (savings) of $1.5 million annually.

This new interruptible rate was negotiated with certain conditions that the University is obligated to meet. Those conditions required the University to, at TVA authority, disconnect from the TVA network within five minutes of notification. The previous contract allowed a period of one hour to disconnect from the TVA network.

Further negotiations with TVA may provide a means for producing revenue by utilizing the University's power generation capabilities as an energy supplier to TVA when requested. An investment of approximately $150,000 will be required to fully implement this measure. Both TVA and the University are moving forward in this area.

2.1.2. Natural Gas

Currently negotiations have concluded to establish a new, lower rate for the consumption of natural gas. This new rate expires at the end of October and does not include the Generation Plant's supply. This new rate is set at $7.74 /MMBTU. Although this rate is

currently higher than the market average, it is substantially lower than the previous year's average rate of $8.52. This average was taken between May and August 2005. Further savings could be realized in the event of a natural disaster or other incident that disrupts the natural gas supply network. This savings would only occur if the current rate was to exceed the contract rate.

Committee Recommendations:

The University must continue to utilize Energy consultants when necessary to further the knowledge and goals of our energy reduction requirements.
The University must continuously examine the current energy market to maintain the best energy rate per unit of measure.

2.2. Operations and Maintenance Systems

2.2.1. Central Plant

In order to be successful in the area of energy management and the reduction of energy waste, proper management and control of the systems that influence energy use is essential. The Central Plant (CP) is a key center for energy use within the University campus. The CP is responsible for a significant portion of the energy consumed by the University. Since it is a vital system, it is necessary to continuously monitor and control the systems contained therein. The two primary elements produced by the CP systems are steam and chilled water. These two elements are used in 40+ buildings across the University campus. These elements help to maintain the proper climate control within these buildings and are essential to normal operations. The following sections detail the work completed and underway in these areas.

2.2.1.1. Steam

One of the elements that the CP produces is steam. The steam is necessary in the air reheating process within the facilities that the CP supports. The CP is equipped with four boilers capable of producing 130,000± pounds per hour of steam. Currently the CP is producing steam on the smallest of the four boilers, a 15,000 lb/hr boiler. Due to modifications made to the facilities supported by the CP, the 15,000 lb/hr boiler is sufficient to meet the needs for the University at this time. Some of those modifications to the external facilities that the CP supports are listed here:

- Reduced air flow in Variable Air Volume (VAV) air conditioning terminal devices to zero whenever the room thermostat is satisfied, reducing the need for reheat (previously, a nonzero quantity of 55 degree air flowing into a satisfied space would require reheat to avoid overcooling the space).
- Implementation of a wider dead band between cooling and heating set points, which further reduces the use of reheat.

In the past, the CP has been unable to reduce the need for steam such that the CP could utilize the 15,000 lb/hr boiler only. The external modifications listed above have allowed CP to not require the services of the higher capacity boilers. As the seasons change, however, it will become necessary to bring those boilers online as the outside temperatures fall. The modifications above are not a comprehensive list of what has been accomplished, rather a set of key items that provide the greatest impact on steam requirements.

As the steam requirements are reduced, so is the requirements for natural gas to convert the water into steam. By implementing these modifications, the CP has seen a 60%+ reduction in natural gas consumption. This reduction should be realized through the cooling season and is estimated to be $500,000 per year.

Much more could be done to dramatically reduce the costs of producing steam for space heating and reheating. Currently, the CP produces all steam at 120 psi, 350 ^{o}F because one building, the Laundry, requires steam at that pressure. Most of the steam produced is then throttled to 60 psi (307 ^{o}F) and distributed to the 6 remaining buildings on campus which still utilize steam for heating, while the remainder is used to make hot water at 110-180 ^{o}F. Because of years of neglecting to allocate money for maintenance and repair of the steam distribution system, approximately $500,000 per year is lost in steam leaks (conservatively estimated at 10% of average produced) and another $300,000 per year in lost steam condensate. Furthermore, utilizing a 95% efficiency hot water boiler in lieu of the present 80% efficient steam boilers for our hot water needs would save an additional $500,000 per year. In total, the current steam production and distribution system is costing the University $1,300,000 per year in wasted energy.

2.2.1.2. Chilled Water

The other element necessary for maintaining proper climate control within campus buildings is chilled water. Chilled water is necessary to reduce the temperature and humidity levels within an occupied space. The CP possesses four chillers capable of maintaining the 40+ buildings that the CP services. Currently the CP is operating on three chillers as opposed to four this time last year. The reason for the reduction can be found in the modifications performed on the external facilities that were listed in the previous section. This 25% reduction in the cooling load on the CP should produce a significant cost avoidance compared to the previous year's operational requirements of $200,000.

Further reduction in chilled water requirements can be seen during the evening and overnight hours. When the outside air temperature falls, the chilled water requirements also decrease. At present, the CP is running two chillers at night. By bringing one chiller down at night, the CP can realize an estimated savings of 1MW on the current electrical load.

The modifications made to facilities external to the CP have reduced the overall energy requirements on the CP. As external systems are examined and optimized to reduce load requirements, the energy requirements of the CP will be reduced further.

2.2.2. Generation Plant

The University possesses the ability to produce electrical energy through the Generation Plant. This plant was completed in 2005/2006 and can generate a maximum of 26MW of electrical power with two 13MW generators. The system is capable of operating on natural gas or diesel. When the plant was conceptualized and constructed no plan was developed to operate and maintain it. There are currently no operation and maintenance funds available for this system. Resources are redirected from other campus requirements to support the minimal needs of the plant.

Currently the power generation plant operates in a standby mode. This mode allows for testing of the plant's equipment to ensure operational status when required. This testing is scheduled every two weeks to reduce the use of fuel and excessive wear to the system's components.

The generation plant has seen, and is currently undergoing, warranty work to improve system performance. This will help to reduce consumables and maintain a higher level of efficiency from the system.

Given the nature of the new contract between the University and TVA /SED, the University must vacate the TVA network within five minutes. The current method to disconnect from the network requires user intervention by manual switching. This method is scheduled for replacement to a fully automated system with remote control capabilities, thus reducing the time to bring the generation plant online and, subsequently, "black-out" conditions across the University campus. Even with the automatic switching, the generation plant requires a period of roughly 20 minutes to initialize. During this initialization period, the campus will experience a loss of power for at least 15 minutes in the event of a forced TVA disconnect. Moreover, given the recent track record of generation plant reliability, there is a good possibility that both turbines will not come online. If this should happen, one turbine cannot handle the entire campus load and parts of the campus will have to be isolated, remaining "black" for the duration of the TVA disconnect period. For this reason, any buildings with critical equipment and/or experiments, which would be damaged or compromised in the event of a campus outage, should have local, redundant power generation capability.

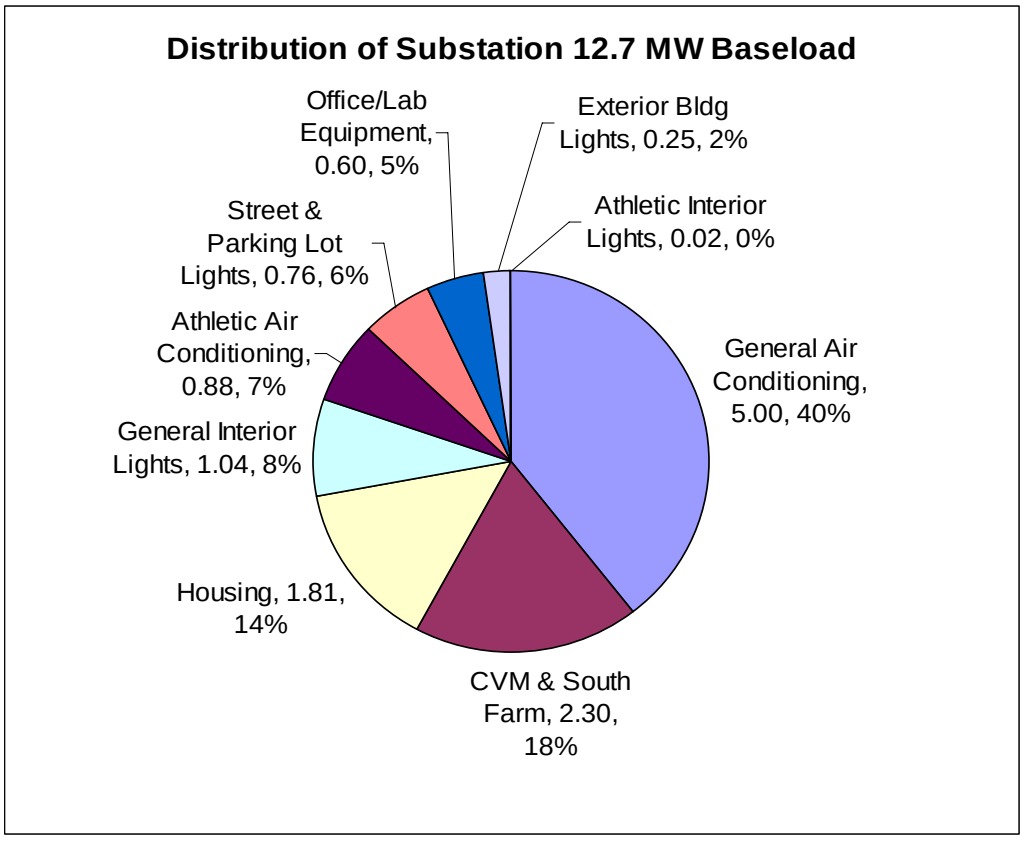
2.2.3. Electrical Distribution and Usage

Understanding the distribution and usage of electricity within the campus is of extreme importance to determine what areas of campus (Academics, Athletics, Research, etc) demand the most of the electrical network. It is also vital to determine the usage per facility to determine the operational baseline for each facility.

By understanding the distribution and usage levels within campus areas and facilities, FM personnel can better plan and design energy resources to satisfy the University's growing demand. With this in mind, measures are being taken to identify electrical consumption within high occupancy and high volume buildings. These measures include visual inspection of electrical systems and, where possible, digital metering to monitor power usage at requested intervals. This information will prove vital to discovering those systems that require the highest electrical demand and the periods at which that demand is necessary. This information can be used to adjust the high demand systems to reduce the peak demand during the operational period under examination.

A recent examination of nighttime electrical use has revealed valuable data concerning energy consumption for key systems across the University campus. On June 28, 2006, FM personnel conducted a test to confirm the suspected effect of air conditioning on the base load demand. During this time, all air conditioning systems within the main campus buildings and the main chiller plant were shut down while a trend log recorded electrical demand through the campus substation. The results indicated a 3.2 MW load reduction. This reduction did not include the effects of numerous split system air conditioning systems, window units, and a few small air handling units that could not be shut down within the limited time frame of the test.

From the tests an energy consumption baseline of 12.7 MW was established for the University. The figure below shows this baseline divided into the primary components that make up the overall consumption.



The data presented above was calculated by taking direct readings from the energy supply system and by estimating energy usage based on physical dynamics of each system shown (i.e. building size, estimated active lighting per square foot area, historical data).

With this data, FM personnel can take the appropriate actions to alleviate some of the nighttime demand and will provide insight into those areas that can be adjusted based on user need in order to reduce overnight energy consumption.

By far, the largest portion (roughly 47%) of the 12.7 MW nighttime base load is due to air conditioning campus buildings. This nighttime total could be reduced by 1/3 or more by investing in control systems necessary to control and/or schedule the HVAC operations of the many buildings on campus which are currently running "wild." While, the details of control system recommendations are deferred to Section 2.6, the results of the study presented in this section provide overwhelming credibility and urgency to the recommendations presented in Section 2.6.

Although campus lighting is a small contributor to the overall base load, we cannot ignore the perception that excess lighting wastes energy nor can we ignore the "every-little-bit-counts" concept where obvious and easily attainable savings exist. Further examination of campus lighting and investigation into lighting technologies that automatically activate lighting and provide the ability to schedule lighting on the campus may prove useful in reducing energy expenditures. Other measures to reduce unnecessary lighting during nighttime hours may also provide beneficial cost savings.

Committee Recommendations:

The University should develop and provide immediate funding for the operation and maintenance of the Electrical Generation plant.
The Electric Generation plant should be activated on a bi-weekly schedule and loaded to ensure reliability of the system and subcomponents.
The University should continue to develop a new contract with TVA to export power to TVA via SED. Any revenues generated from this action should be reinvested in the Generation plant for operation and maintenance needs.
The University should examine all parking areas to determine if lighting can be deactivated during the night (12AM – 5AM).
The University should examine other pedestrian use areas of campus to determine if lighting can be deactivated during the night (12AM – 5AM).
The University should explore the use of technology to manage the lighting needs of certain pedestrian use areas on campus such as bike and walk paths.
The University should develop and implement a plan to phase out the use of the general purpose central plant steam boilers and the aging, decrepit team tunnel distribution system as recommended in Section 2.2.1.1.
The University should complete the central CHW/HW loop as originally planned.

The University should allocate resources to investigate the economics of implementing new energy saving, central plant energy savings technologies such as

- Free heat utilizing condenser heat recovery
- Variable condenser water flow and/or temperature utilizing variable speed drives on condenser pumps and cooling tower fans
- Variable frequency drives on chillers
- Chilled water storage systems to accomplish load leveling (and thus peak demand reduction)
- Conversion of central HW loop to centralized variable speed pumping.

The University should develop a financial plan to implement those energy savings technologies which demonstrate economic payback over the lifetime of the proposed systems.

2.3. User Awareness (Faculty/Staff/Student)

User awareness and involvement is critical to further reduce unnecessary energy use. Conveying the efforts of FM to the University's faculty, staff, and students is a key component in the effort to reduce energy consumption. The development of a campus awareness program that promotes the sharing of information between FM and users (faculty, staff, and students) is necessary to successfully implement the changes within campus facilities that will help reduce energy use. By inviting user comments and involving others outside FM, the effort to reduce energy consumption will be extended to those who directly impact the level of energy consumed. The user's awareness of the energy issues facing the University should have a positive effect on the energy consumption level. To date the efforts have received exceptional support by the University faculty and staff.

The development of a promotional icon and catch phrase to promote energy awareness has been initiated. The promotional icon is a rendering of the University Bully Icon with an adapted message. The catch phrase to promote energy awareness is as follows:

"One State, One Team – Conserving Energy Together"

To further user awareness, media outlets should be utilized. Such media outlets should include (but are not limited to): Campus and local television, radio, and newspapers. The combination of multiple media outlets will help to ensure wide area exposure to the energy issues facing the University and will help promote action by members of the faculty, staff, students, and surrounding communities by making them aware of the energy issue facing the University.

Further exposure of users to the energy issue can be achieved by implementing an Internet web page committed to the promotion of information related to University energy issues. This energy web page will focus on user awareness by promoting energy saving techniques and presenting up-to-date information concerning energy and resource

management efforts by FM. This energy web page will also provide a link between users and FM to discuss energy related issues and promote dialogue to improve operations related to energy systems.

Another outlet proposed includes the use of an "Energy Savings Indicator" (ESI). This outlet would be a variation of the United Way® fundraising thermometer. This ESI would be strategically placed on the University campus to provide insight to users on the accumulated savings from energy conservation and management efforts.

The promotion of the idea of energy awareness by utilizing icons and phrases, combined with external points of reference (Media and Internet outlets) will further user awareness, which will promote action by those affected. It is essential that users (faculty, staff, and students) be aware of the issues by communicating directives and establishing appropriate policies towards energy conservation and management.

2.3.1. Student Energy Committee

The Student Association (SA) President is currently developing a student oriented committee that will focus on the student aspect of energy awareness and conservation. The primary goals of this committee will be as follows:

- To inform and educate the student body about current energy recommendations.
- To develop ways that students can assist in the conservation of energy.
- To foster an energy conservation program developed by students that is directed toward students.

Committee Recommendations:

The University should continue to encourage its members (Faculty/Staff/Students) to conserve energy whenever possible.
The University Student Association President should continue to develop and promote the ideas for student participation in the University's energy program.
The University should utilize all available media outlets to transmit the "*One State, One Team – Conserving Energy Together"* message.

2.4. Facility/Building Management Programs

With the data collected from the McCain Engineering Building study performed by ISE personnel, several areas have been defined for improvement within campus facilities. The primary focus has been placed on the scheduling of HVAC needs according to the occupancy of specified areas within particular facilities. Although not all facilities on the campus allow for occupancy scheduling, those that do should be utilized to the full extent of the systems capabilities.

Of the 150+ buildings on campus, 44 are currently equipped with some form of HVAC control that can be scheduled. With this capability and the assistance of Facility/Building Representatives, the opportunity for savings is vast. The ISE study revealed that the current operational state of the HVAC system for McCain Engineering building was underutilized. The HVAC system was set to maintain specific temperature levels whether or not the space was occupied. With the help of the Facility/Building manager and FM personnel, schedules were formed based on the occupancy needs for space within the building. These schedules were derived from data collected from various sources and were implemented during the summer 2006 terms. Further scheduling for special events, such as Orientation, Registration, and summer camps, were successfully implemented on a need basis.

In order to successfully schedule the HVAC systems to meet occupant requirements, it is necessary to involve all parties that have authority to schedule areas within campus facilities. This includes the Registrars Office, Dean's Offices, Facility/Building Representatives, Building/Laboratory Supervisors, and any other supporting department or faculty/staff member that has the authority to schedule areas within University facilities. The sharing of information relative to the successful scheduling of areas within campus facilities is critical to the success of the program. The establishment of a common system for scheduling campus facilities is necessary to mitigate any issues that may arise from the use of multiple systems.

To meet the need for occupancy scheduling of HVAC systems, a communications channel between the Facility/Building Representatives and the users (faculty/staff/students) is also required. This communications channel should be standard for all users and should include all information necessary to appropriately schedule facility events.

To further the progress, it is vital to gain the support of members within the facilities for which the changes are being implemented. To do this, the recommendation has been made to create a point of contact (POC) within each facility that is responsible for maintaining the proper scheduling for their particular facility. This POC would interact with FM personnel to ensure their knowledge of the capabilities and implementation parameters of the particular systems within the facility. This POC should be a member of the staff who is responsible for the day to day operations of the facility and should not be one who is disjoint from the operation of that facility.

The promotion of policies directed towards curtailing unnecessary energy use within campus facilities by Facility Mangers is as important as scheduling HVAC and other building control systems. These policies should include the systematic shutdown of non-critical equipment and lighting systems at the end of the day. Obviously, user awareness will play a critical part in the support of these policies; therefore, the ideas outlined in the previous section will prove useful in this area.

Committee Recommendations:

The University should facilitate a building representative meeting to disseminate information related to the energy program.
The University should stress the importance of energy conservation measures to individual building representatives and/or department heads and/or business managers, as appropriate, to become responsible for the energy program within their respective areas.
The University should promote policies towards reducing unnecessary energy use within facilities. The policies should be jointly developed by the local building representatives in coordination with the Energy Manager.
The University should encourage all departments to schedule operations considering the energy needs of the facility occupants.
The University should establish a common medium for communicating HVAC scheduling among building representatives, the established offices responsible for facilities scheduling, and the Energy Manager.
The University should continue to enhance the communication channels for energy issues to the Energy Manager and other FM personnel.

2.5. Information Technology Services

Since the advent of computers, the demand for electrical resources has increased dramatically. The number of computers and other computer related equipment available to the University has steadily increased over the years. With this increase, a greater demand for electrical resources and a greater demand on facility systems are required. These demands translate into expenditures that, on an individual basis, are small, but when all computers, monitors, printers, fax machines, copiers, etc. are examined jointly, the demand is enormous.

With this in mind, Information Technology Services (ITS) is developing policies for the operation of the University's IT equipment. These Energy Efficiency Standards include requiring University personnel to check energy-related settings on IT equipment that they use and adjust them according to specified operational parameters. The full extent of the possible savings is unknown but has been estimated at over $150,000 per year based on the 8,000+ computers in use on campus. This savings estimate is derived from a 25% reduction in energy use by these devices that could potentially be realized by proper utilization of the energy settings of the devices and by switching them off when not in use.

Recommendations are also being developed for these settings to mitigate negative impact to any automated systems currently in place and to maintain the integrity and security of the Universities network and computing services. Exemptions to these standards will likely be necessary for some users and should be addressed on an individual basis; however, they should be allowed only after fully evaluating the need and not be based on the status-quo.

Further examination of IT equipment is necessary to determine if some can be deactivated at the end of day (EOD) or during times when it is not necessary for their operation. This examination would require user participation and acceptance of ITS standards for IT equipment operation.

Further examination of older, less energy efficient IT equipment is needed to determine its usefulness and whether or not replacement measures should be implemented due to the equipment's age and energy inefficiencies. It may be necessary to request of users to replace aging equipment to satisfy new requirements of IT energy efficiency standards. As for replacement equipment or new equipment acquisitions, these actions should be brought to ITS attention and recommendations on this equipment should be made by ITS personnel.

Committee Recommendations:

The University should continue to pursue the acquisition of energy efficient IT equipment in all areas.
The University should promote the establishment of energy related protocols on all IT equipment connected to the University IT network and energy distribution systems.
The University should consider the development of contingency plans in the event of power loss to IT systems in critical areas of the campus such as research and event/time critical systems.
The University should promote the use of energy savings measures on all computing equipment, both University-owned and personally-owned, including Personal Computers, Computer peripherals, and other computing related equipment.

2.6. Facilities Operations

2.6.1. Current Building Controls

The need for maintaining effective and efficient Energy Management and Control Systems (EMCS) for facilities on the campus is critical to the interests of the University and its long term objectives. Without an EMCS system that promotes energy efficiency and controls uniformity, the ability of FM personnel to manage energy usage is quite limited. The need to continue to standardize and conform to a single EMCS for University facilities is critical to maintaining operational effectiveness. With multiple EMCS, the ability of FM personnel to respond to compatibility and maintenance issues is hampered greatly. By supporting a standard EMCS, the control of energy usage can be centralized and monitored to increase system efficiency and help reduce (and possibly eliminate) unnecessary energy use.

2.6.2. Building Efficiency Strategy

Since many of the University's buildings vary in architectural design, it is necessary to promote and further develop our energy management strategy that will accommodate the various facilities across the University campus. This energy strategy should be one that is uniform for all buildings under the common EMCS system with the ability to accommodate certain needs and conditions based on the operational capabilities and requirements of the specific facilities under its control. The energy management strategy allows only control systems to be installed in any campus facility that has a specific demonstrated compatibility with the campus Energy Management Strategy.

Additionally, the following are recommended policies/strategies for HVAC control and occupant responsibility. These standards are designed to assist Facility/Building representatives whose buildings do not have automatic controls installed and those buildings where HVAC controls exist but do not operate according to the overall EMCS strategy.

2.6.2.1. Building Climate Control

1. Indoor facility temperature settings for HVAC systems for spaces during occupied periods will be 70°F while heating and 76°F while cooling.
2. Where available, occupants will be given the means to adjust their personal preference from the set temperature by ±2°F.
3. Indoor facility temperature settings for HVAC systems for spaces during unoccupied periods will be 55°F while heating and 85°F while cooling.
4. Indoor facilities that require more stringent temperature settings due to research critical systems will be regulated more closely to the predefined set points.
5. Set points are established by FM and are maintained at the Central Plant Control Center (CPCC).
6. Facilities that are not controlled under the common EMCS will be required to adhere to common set points set forth in 1 and 3 above.
7. Where EMCS systems are available, thermostats will provide users with the ability to place areas into temporary occupancy when the area is required outside the normal operational day (06:00 to 16:30).

Further policies towards HVAC EMCS are under development as FM personnel make necessary adjustments to minimize energy misuse and overuse. These polices will be addressed at a later date.

2.6.2.2. Building Occupant Requirements

1. Occupants (specifically Faculty and Staff) are required to report excessive energy use and misuse to FM personnel.
2. Occupants are requested to turn off unnecessary lighting and lighting in areas that are no longer occupied.

3. Occupants are requested to conserve energy where possible.
4. Occupants are requested to notify FM personnel of areas within buildings that are not used so that appropriate measures can be taken to reduce energy consumption within those areas.
5. Occupants are requested to report any issues with HVAC, lighting, and other energy systems to FM personnel in a timely manner.
6. Occupants are encouraged to communicate with FM personnel to make changes to the operational state of the building as convenient as possible for both parties.

Further policies towards occupancy requirements are under development as FM personnel make necessary adjustments to minimize energy misuse and overuse.

2.6.3. Facility Improvement Requirements

2.6.3.1. Measurement Systems

In order to determine the level of operation for campus facilities and whether or not adjustments to EMCS are promoting savings, it is essential to monitor the progress by recording energy usage within campus facilities. In order to accomplish this, it is necessary to implement measurement systems that can record specific building functions. These functions include, but are not limited to, chilled water usage, steam usage, electrical usage, water usage and air quality. These systems are a vital element to managing the energy consumption within campus facilities. These systems should be implemented at the earliest possible time so that an operational baseline can be determined and improvements to systems can be implemented based on the data collected.

2.6.3.2. Control System Maintenance

A preliminary examination of University facilities which primarily focus on academics has yielded a list of top energy users that contribute to over 26% of the total electrical consumption for the University. These buildings are listed below along their current energy consumption contribution (out of the 26+ %).

1. Institute for Clean Energy Technology (Formerly DIAL) – 5.3%
2. Hand Chemical Laboratory – 3.7%
3. Center for Advanced Vehicular Systems (CAVS) – 2.7%
4. Engineering Research Center (ERC) – 2.5%
5. Allen Hall – 2.4%
6. Sanderson Recreational Center – 2.4%
7. Agri-Center 2.2%
8. Library – 2.0%
9. McComas Hall – 1.8%
10. Bost Extension – 1.6%

Other buildings that did not make this list but should be examined include: Simrall, Thompson, and Humphrey Coliseum. These facilities have known energy issues and should be resolved.

The list presented above represents a large portion of the energy use among academic centers across the University campus. Measures can be taken to reduce this amount, some with minimal effort which includes adjusting operational modes and procedures as well as general maintenance (i.e. filter replacements, coil cleaning, etc). Other facilities will require investment capital to produce the desired outcome. The initial estimates provided by FM personnel an approximate cost to retrofit the existing systems roughly $510,000. Please note that this is an *initial estimate* and may vary from the actual costs associated with systems retrofits. In order to produce an accurate estimate, the systems within these facilities would require a thorough examination to determine the necessary components. If these actions were implemented, FM personnel estimate a 20% reduction in the energy use for these buildings. This translates into a $24,000/month savings in energy expenditures. With these savings, the initial investment could be reclaimed in 22 months (based on the initial cost estimate).

Further examination of existing facilities, as indicated above, is necessary to determine operational effectiveness and required system improvements. These facility 'surveys' will be performed in the coming weeks and months and should yield valuable information that will help FM personnel plan system improvements and upgrades.

The continual examination of system facilities will help ensure effective and efficient operation is vital to effective energy management. Building commissioning and re-commissioning is necessary to verify that facility systems are operating at the highest level of efficiency. Commissioning allows for new energy strategies to be developed that will provide savings and aid in the identification of areas in which attention is required. University facilities should be re-commissioned at a specified interval to ensure operational effectiveness.

Committee Recommendations:

Continue to refine the development of performance standards for future EMCS system implementation in University facilities.
Implement the building climate control and operating procedures for HVAC systems outlined in section 2.6.2.1.
Implement the building occupant requirements outlined in section 2.6.2.2.
Develop and fund an aggressive preventive maintenance program for all HVAC and related systems.
Develop and fund a program for systematic replacement of aging, inoperable, and inefficient control systems (HVAC, lighting, etc) within University facilities.

2.7. Energy Vision and Master Planning

The University has an obligation to lead, in the protection of the environment, improving quality of life, and promoting sustainability. Conventional design and construction methods often produce buildings that can negatively impact the environment as well as occupant health and productivity. These buildings are expensive to operate and contribute to excessive resource consumption, waste generation, and pollution. To help reduce these impacts and meet the goals of sustainable design, the University should adopt a set of requirements and recommendations to encourage the development of "green" buildings without forcing excessive costs or other burdens upon the University and the tax payers of Mississippi.

Climate-responsive design rediscovers the powerful relationship of buildings to place. Buildings that respond to local topography, microclimate, vegetation and water resources are typically more comfortable and efficient than conventional designs that rely on technological fixes to ignore their surroundings. Taking advantage of free natural resources, and conserving scarce high-priced commodities are two of the best ways to reduce costs and connect occupants to their surroundings.

On sites where optimal orientation and massing are difficult, the building envelope provides the greatest opportunity to conserve energy. The envelope should maximize daylight, natural ventilation and views to the exterior, and control solar heat gain and traffic noise. The building envelope may also be designed to integrate systems for collecting solar energy and rainwater.

It should be the leadership of the University to utilize natural resources whenever possible in every facility on campus. A reduction in the cost of maintaining campus facilities can be achieved by utilizing sunlight, rainwater, landscaping, and other natural resources. By using these given resources, the University can free resources so they can be applied to other energy issues.

It should also be the leadership of the University to promote ways to obtain renewable sources of energy for campus functions. These renewable sources of energy should allow for sustainable buildings (i.e. buildings that produce their own energy) and should provide for transportation needs. Obviously capital investment would be required to attain the infrastructure necessary to accomplish this, but it is an investment that would lead to unforeseen payoff capabilities. The University should sponsor further research into this area by utilizing on-campus resources as a source for information and possible energy systems acquisition and testing.

It should be the leadership of the University to pursue the highest possible level of Leadership in Energy and Environmental Design (LEED) standards for all facilities on the University campus. The LEED Green Building Rating System® is a national standard for the development of high-performance, sustainable buildings. The University should further examine the possibility of LEED certification for all campus facilities and

expect any architect and contractor charged with campus construction to be aware of LEED standards, if not LEED certified.

The University should promote the development of facilities with the entire life cycle of that facility in question during the initial stages of development. By examining the life-cycle costs associated with a particular facility design, issues may be resolved prior to implementation and life-cycle costs could be reduced prior to construction.

Committee Recommendations:

Include energy planning as a central focus in the facilities planning process
Require design agents who work with the University be LEED certified
Develop, promote and require LEED design standards for all THE UNIVERSITY facilities (academics, athletics, administration, housing, support services, research, etc)
Require life-cycle cost analysis of each new facility development. All costs associated with facility ownership should be examined prior to implementation.
Develop a panel of University experts for advice and counsel in the facilities planning process.
Require from all design agents a LEED design plan to be developed and submitted for review and approval in the initial stages of the project design.

2.8. New Technology and Alternative Fuels

With the current energy issues facing the University, it has become necessary to examine other sources of energy and new technologies for those energy sources. The exploration of new technologies and alternative fuels should be pursued by the University to increase the range of useful energy sources and promote research opportunities within the educational arena.

Listed below are a few examples of how new energy technology and alternative fuels might be utilized:

Use of bio-diesel in backup generators, central plant boilers, power generation plant.
Combined cooling, heating and power (CHP) systems: fuel cells, gas turbine generators, or other engine generators coupled with waste heat recovery and thermally driven cooling technologies.
Agricultural waste products – direct combustion or conversion to gaseous or liquid bio-fuels.

Additional indirect savings (perhaps even income) could result in combining the use of alternative fuels and new energy technologies with research projects. Using alternative energy systems as an integral part of campus operations adds value to research proposals by demonstrating to funding agencies the University's commitment to alternative energy,

adding real-world credibility to the research, enhancing the educational and outreach functions of the research. Furthermore, it provides a possible "free" source of matching funds for research projects.

One example of utilizing alternative energy sources can be found at the Mississippi Horse Park. Many alternative fuels technologies (especially direct combustion of waste products) can be easily implemented on agricultural facilities to not only save energy but enhance the normal function/operation of the facility. The facilities design is not conducive to energy savings. The building is oriented the wrong direction, it is poorly insulated, the ceilings are high, ventilation requirements are high, etc. To combat some of these issues quickly and with initial cost effectiveness the current electric resistance heaters would need to be replaced with equivalent propane or oil fired heaters (natural gas is not available). While the energy cost per Btu or kW-hr for propane is not much cheaper than electricity, the high electrical demand charges (about $9,000 just to turn the electric heaters on for 30 minutes) would be eliminated.

Further examination reveals a 'free' source of fuel at the facility. At a major equine event, all 315 stalls (and sometimes a few extra portable stalls) are rented. For each stall, two to five bags (50 lb each) of horse bedding (wood shavings) are used. Assuming an average value of 3.5 bags, 27 tons of free fuel is generated per major event. With a heating value of 8000 Btu/lb, that's equivalent to about $6,000 worth of propane generated at a single event. Last year, the Horse Park generated 222,900 lb of horse bedding (wood shavings). With a heating value of 8000 Btu/lb, that's equivalent to 1,783,200,000 Btu, which is enough to heat the facility throughout the heating season. That's the equivalent of 19,448 gallons of propane, or $24,310 worth of free fuel. Wood-pellet-fired boilers and pelletizers of the size needed are currently available to make use of this fuel without increasing the labor required to handle the material. Moreover, using hot-water for heating opens the door for low-intensity radiant floor heating and radiant panel heating—the most effective form of heating in terms of occupant comfort and energy efficiency. A feasibility investigation is, thus, underway.

Alternative fuels and new energy technology will not provide the short-term, emergency solution to our current energy issues. It is a long-term strategy to reduce dependence on current, limited energy sources and provide a diversity of energy options. With that in mind, the following actions should be investigated:

1. Ask and answer the question, "What can we (on the *operations* side of campus) do to enhance *research*, *teaching*, and *service* functions of the university (and vice versa)?"
2. Inform the University President, VP Research, Provost, Extension Director, and other necessary officials of the need and gather their support
3. Promote faculty/staff/students awareness and input in the new technology area. Capitalize on the expertise available to the University.

Committee Recommendations:

The University should research opportunities to develop emerging energy technologies and promote feasibility studies for alternative fuel use in campus facilities.
The University should publish internally what new energy technology research and alternative fuels are being pursued to promote cross-discipline interaction.
The University should implement, where possible, new sources of energy that will provide sustainability in University facilities.

3. Concluding Remarks

As with any endeavor, the cooperation of all parties involved is necessary for success. It is imperative that the full support of the University President, Vice Presidents, and Administrators throughout the University be entrusted to individuals within Facilities Management to implement the necessary changes to improve the energy infrastructure and reduce unnecessary energy use. It is also necessary to inform and seek the support of the Board of Trustees of State Institutions of Higher Learning and the Bureau of Building, Grounds and Real Property Management.

As many are aware, it is necessary to take steps to control and conserve the energy consumed by University facilities due to the rising cost of energy. The emphasis on Energy Management should embody all of the areas mentioned in this document and those not yet encountered. By taking a proactive approach to Energy Management, the University can plan for energy needs by establishing policies and procedures that will help today, tomorrow, and beyond.

Along with policies and procedures, the University should utilize the expertise it possesses (faculty, staff, and students) in the areas of Energy and Facilities management, planning, resources, and technology. The University should make use of the years of experience that current (and past) faculty and staff possess.

The University should strive to promote Energy Awareness and interaction among all those affected (faculty, staff, and students). By making individuals more conscious of the issue, new ideas towards energy consumption, efficiency, and management can be brought forth and promoted across the University.

The University should make a concerted effort to investigate and implement new energy technologies as well as the update of current energy systems. This effort should be in concert with the University's Master Plan. As seen in the past few months, updating the current systems can produce a limited savings, but this savings can only go so far. In order to further the savings potential it will become necessary to investigate new sources of energy and implement them to realize further benefit.

In order to continue the progress that has been made in the area of Energy Management, capital investment is necessary. Obviously, funding for most areas is severely limited due to the current energy budget deficit, but the means to implement change should not overshadow the end result. The implementation of Energy Efficient systems should be approached with the life cycle benefit/cost concept. By examining the entire benefit/cost of the systems over its intended life, the end result of system implementation can be examined and compared to the initial outlay necessary to implement the systems. This approach will allow for a more accurate representation of the investment potential and requirements.

4. Committee Members and Contributions

The following is a list of the focus areas and the Energy Committee members that contributed to those areas:

Energy Supply and Rate Structure –

Jim Jones
Ralph Nobles

Operations and Maintenance Systems –

Ralph Nobles
Dave Lanouette
Carl James
Jim Parrish
Lee Collins
Glen Flurry

User Awareness (Faculty/Staff/Student) –

Bill Broyles
Carl Brown
Nancy Reichert

Facility/Building Management Programs –

Dick Johnston
Carl Brown
Dave Lanouette

Information Technology Services –

Tim Griffin

Facilities Operations –

Dave Lanouette
Jim Parrish
Lee Collins

Energy Vision and Master Planning –

Tim Muzzi
Michael Berk
Larry Barrow
Dave Lanouette
Carl James

New Technology and Alternative Fuels –

Carl James
Dave Lanouette
David Howell
Eugene Columbus

Student Energy Committee –

J.R. Love
T.C. Rollins
Lauren Hood
Leanne Thornton
Alan Gay