Mississippi State University Energy Management Plan

Incorporates the following Agencies:

Mississippi State University (Agency #254-00)

Mississippi Agricultural and Forestry Experiment Station (Agency #422-00)

Forest and Wildlife Research Center (Agency #448-00)

1 Introduction

The MSU Energy Management Plan has been created to provide continuity between the policies, standards, plans and initiatives that comprise the energy efficiency and sustainability efforts at the University. The scope of this plan reaches beyond the Mississippi State University's main campus and impacts the University's facilities across the state as well as the facilities of the Mississippi Agricultural and Forestry Experiment Station (MAFES) and the Forest and Wildlife Research Center (FWRC). This plan identifies the roles that various personnel play in energy management as well as the methods used to reach our efficiency goals. The management plan also describes the tools used for tracking performance as well as the methods utilized to fund numerous energy conservation measures throughout MSU, MAFES and FWRC facilities.

This document provides a brief summary of the different components relating to achieving energy efficiency. These components of the energy management plan include: Organization, Policy, Performance, Operations and Maintenance, Planning Design and Construction, Energy Conservation Measures, and Funding.

The management plan includes links to "Additional Resources" can be found at the bottom of each section. For further information on MSU's energy and sustainability initiatives please utilize the provide links or contact the MSU Division of Campus Services using the contact information provided below. You may also make inquiries to J.D. Hardy via email at jdh2@msstate.edu.

Contact Information

- Mississippi State University → http://www.msstate.edu/
- MSU Division of Campus Services → http://www.campusservices.msstate.edu/
- MAFES → http://mafes.msstate.edu/
- FWRC → http://www.fwrc.msstate.edu/

2 ORGANIZATION

Energy Management at Mississippi State University is a collaborative effort that involves a numerous individuals contributing at various levels within the organization. Stakeholders in energy efficiency include the IHL System Energy Management Council, the MSU Sustainability Committee, multiple departments within the Division of Campus Services, student groups such as the Students for a Sustainable Campus, not to mention the faculty, staff, students and administrators across the University that get engaged in energy efficiency and sustainability initiatives.

IHL System Energy Management Council

The IHL Board of Trustees established the IHL Energy Council in 2011 to provide oversight and support to our Mississippi Institutions of Higher Learning as they each carry out their own Energy Management Plans. The IHL Energy Council meets quarterly to review system wide performance and to promote networking and sharing of best practices throughout the campuses.

MSU Sustainability Committee

The MSU Sustainability Committee is comprised of faculty, staff, students and administrators from across the University. The primary mission of the Committee is to oversee sustainability and energy efficiency initiatives. The Committee reviews campus performance and ensures that the tenants of the MSU Sustainability Policy are upheld.

Division of Campus Services

The Division of Campus Services houses several departments that play a crucial role in the realm of energy efficiency. The Department of Facilities Management employs operators and technicians that are the backbone of efficient operations and maintenance on campus. In particular, this Department includes the technicians that operate and maintain the MSU Energy Management Control System. The Department of Planning, Design and Construction is responsible for the development and oversight of facility infrastructure projects that will allow MSU to achieve its efficiency and sustainability goals. This Department is also responsible for ensuring adherence to the appropriate design and construction standards. The Office of Sustainability provides oversight of MSU's adherence to the American Colleges and Universities President's Climate Commitment. Along with a host of other sustainability initiatives, this Office is involved with developing greenhouse gas inventories and promoting compliance with the MSU Climate Action Plan

Students/Faculty/Staff/Administrators

There are a number of stakeholders involved with energy efficiency efforts at MSU. The contributions of involved students, faculty, staff and administrators allows MSU to more effectively attain its energy goals. Various departments and organizations regularly lead efficiency and sustainability initiatives. Examples include awareness campaigns by the College of Veterinary Medicine as well as "green-fund" raising efforts by the Students for a Sustainable Campus.

Additional Resources

- IHL Energy Management → http://www.mississippi.edu/facilities/

- Division of Campus Services → http://www.campusservices.msstate.edu/
- Office of Sustainability → http://www.sustainability.msstate.edu/
- Students for a Sustainable Campus → http://www.ssc.org.msstate.edu/
- MSU Student Association – Energy Wars → http://www.thestudentassociation.com/#!energy-wars/c1oy1

3 POLICY

There are a number of policies, standards and plans that provide a guidance and direction to MSU's energy management activities. The most notable of these guiding documents are the MSU Sustainability Policy, the IHL Sustainability Policy, and the MSU Climate Action Plan.

MSU and IHL Sustainability Policies

In 2011, the IHL Board of Trustees adopted a system wide sustainability policy that was intended to prompt each campus to develop and adopt their own policy. The MSU Sustainability Policy was adopted in 2012 and sets forth the framework and procedure for sustainable facility development and operations, grounds development and maintenance, materials procurement and disposal, and transportation.

MSU Climate Action Plan

On Earth Day 2009, President Mark Keenum signed the American College and University President's Climate Commitment. This commitment demonstrates the Universities dedication to sustainability. Due to the commitment, the University now completes annual greenhouse gas inventories and progress reports documenting path towards the goals of our Climate Action Plan.

The goal of the Climate Action Plan is to produce a path by which Mississippi State University can reach carbon neutrality by the year 2042. The plan incorporates five focus areas including operations, grounds, transportation, materials, and education/research. To develop the plan for each focus area, a task force was assembled for each focus area. A member of the University's Sustainability Committee led each task force, facilitated the task force discussion, and reported the focus area goals back to the Sustainability Committee. The overarching goals of the four operational focus areas are to: (1) identify the carbon producing aspects of each area, (2) determine ways to either eliminate or reduce those carbon outputs, and (3) seek out potential sequestration opportunities.

Additional Resources

- IHL Sustainability Policy → http://www.mississippi.edu/facilities/downloads/sustainability_policy.pdf
- MSU Sustainability Policy → http://www.policies.msstate.edu/policypdfs/0127.pdf
- MSU Climate Action Plan → http://www.sustainability.msstate.edu/climate/

4 PERFORMANCE

Tracking performance is foundational to good energy management practice. MSU utilizes the IHL Energy Reporting Tool to monitor the effectiveness of our energy conservation measures. This excel based energy database with graphical dashboard allows the University to keep track of "whole-campus" consumption, energy usage index and cost avoidance. The IHL Energy Reports are updated quarterly and made available online.

MSU has just completed the 8th year of a 10-year 30% energy intensity reduction goal. This goal was set forth by the Institutions of Higher Learning and will end in FY16. As of FY14, MSU had reduced its energy consumption per square foot 34% when compared to FY06 and over the goal period MSU has avoided nearly $31,000,000 in utility costs. MSU will continue to strive for a minimum of 3% annual energy intensity reduction but the University will have to ensure its energy reduction goals comply with the goals set forth by the IHL in the coming years.

In addition to the IHL reports, MSU maintains an extensive database of monthly building energy consumption data. This data is compiled monthly by the Campus Services Business Operations Group and is made available in a number of formats. Engineering Services utilizes this data for building level analysis to identify the opportunity for and results of energy conservation measures.

MSU currently supplies the state-required master metered data updates to the state EMC via manual update. Over the past year, MSU has worked with Bureau of Buildings and an electrical engineering firm to develop a set of construction ready documents for the installation of a network based advanced metering system on MSU's top 100 energy consuming facilities. This system would provide real time tracking of over 90% of MSU's energy consumption and would allow for real-time performance analytics. The Bureau has withdrawn funding for this project at present.

Additional Resources

- MSU/IHL Quarterly Energy Report →
  http://www.mississippi.edu/facilities/downloads/energy_council/msu.pdf
- IHL System Quarterly Energy Report →
  http://www.mississippi.edu/facilities/downloads/energy_council/system.pdf

5 OPERATIONS AND MAINTENANCE

In order to achieve its performance goals, the University must optimize the operational performance of its facilities. The Department of Facilities Management oversees and executes daily operational and maintenance activities throughout the MSU facilities. Preventive maintenance coupled with optimized operational strategies can not only yield the highest system efficiencies but can also significantly reduce the volume of corrective maintenance. When necessary, fast and effective corrective action is also paramount to ensuring that MSU attains its energy and sustainability goals.

Operations

Operational excellence can only be achieved when the right personnel are equipped with the right resources they need to keep our facilities running with efficiency. MSU relies on the expertise of its Controls, HVAC, Plumbing and Electrical Technicians to monitor and maintain the active building systems. In particular, our Controls Technicians and Plant Operators have a wealth of experience in utilizing the campus wide Energy Management and Control System (EMCS) to execute energy efficiency strategies with HVAC equipment all throughout MSU's facilities. MSU's leadership must continue to acknowledge and promote the success of our skilled technical personnel while at the same time seeking out the additional talent that will be needed as our footprint ages and grows.

MSU's technicians can be much more effective in deploying energy efficient strategies when they have the right resources available. It is critical that the renovation of existing systems and the construction of new facilities provide our technical personnel with the tools they need to achieve operational excellence. As we pursue various operational measures over the coming years, the University must leverage the use of emerging technologies that provide efficiency solutions that are compatible with our facilities.

Maintenance

Effective preventative and corrective maintenance programs are equally important to operational strategies when it comes to achieving the University's energy efficiency goals. The Utilities Group is responsible for recurring preventative maintenance activities that span from daily rounds to annual equipment teardowns and inspections. This group is also primarily responsible for prompt corrective action when facility systems, equipment and components fail.

To manage maintenance activities throughout its facilities, the Campus Services Division utilizes the AIM work management system which facilitates planning, scheduling and tracking of all maintenance activities on campus. Not only is this system invaluable to our current maintenance programs, but the future roll-out of the preventative maintenance module will allow for a much more comprehensive, condition and time based maintenance program.

Additional Resources

- Operations and Maintenance Guidelines → Ops_Maint_Guidelines
- IHL Best Practices Guide → http://www.mississippi.edu/facilities/downloads/energy_best_practices.pdf

6 PLANNING, DESIGN AND CONSTRUCTION

The Department of Planning, Design and Construction Administration at MSU employs the engineers, architects and construction coordinators that are involved with the oversight of renovation and construction activities at MSU. During the planning and design of facility projects, this group ensures that any newly constructed or renovated spaces on campus comply with all applicable codes and standards. During the construction, MSU's construction administrators and coordinators inspect the facilities at all phases to ensure they are built in accordance with the design.

Planning and Design

Per the IHL and MSU Sustainability Policies, newly constructed facilities are to be designed to exceed the current version of the ASHRAE 90.1 Energy Standard by 30% in terms of energy efficiency when determined cost effective. The professional on each applicable project is required to submit an energy model at both the design development and the construction document phases. PDCA personnel review the results and make recommendations to the design professional for improved efficiencies where practical. Ultimately, the energy model has to be reviewed and accepted by the MSU Sustainability Committee as well as the IHL Deputy Commissioner of Real Estate and Facilities (when applicable) prior to construction. MSU design professionals strive to balance the desire for the latest in efficient technologies with the need for reliability in maintenance and operations.

In addition to the Sustainability Policies, the PDCA Department has developed the MSU Design and Construction Standards. These standards are provided to design professionals as a guide for planning facilities that meet the highest standard of efficiency and sustainability. The MSU Design and Construction Standards are reviewed regularly to ensure they are up to date with current codes, practices and available products and systems.

Construction Administration

The Department of Planning, Design and Construction has a team of construction administrators and coordinators that review projects throughout their various phases of construction. Whenever the built facilities do not comply with the design, the construction administration group ensures that the issues are properly resolved. In addition to the MSU construction administration group, there are often projects where MSU works closely with engineers, architects and commissioning agents to ensure the facilities will operate as planned.

Additional Resources

- MSU Department of PDCA → http://www.fm.msstate.edu/planning
- MSU Sustainability Policy → http://www.policies.msstate.edu/policypdfs/0127.pdf
- Energy Model Guidelines → http://www.mississippi.edu/facilities/downloads/energy_model_guidelines.pdf
- MSU Design and Construction Standards → http://www.campusservices.msstate.edu/doc/dcsm/
- IHL Best Practices Guide → http://www.mississippi.edu/facilities/downloads/energy_best_practices.pdf

7 ENERGY CONSERVATION MEASURES

In keeping with its long term energy efficiency and carbon neutral targets, the University has identified a number of focus areas in its operations. These operational objectives are set forth in the MSU Climate Action Plan but are also in harmony with the IHL energy efficiency goals. The operational focus areas are categorized as clean energy generation, education and awareness, retrofitting & innovation, policy enhancements, and operational optimization. There are a multitude of opportunities that have been identified in each of these categories. As these energy conservation measures are identified, they are captured and quantified in a spreadsheet maintained by the Division of Campus Services.

Identifying cost effective energy conservation measures is a daily activity at MSU. The personnel that work within the Division of Campus Services are regularly assessing the equipment needs and operational conditions within our facilities. As opportunities are identified, they are relayed to Engineering Services for review. Whole building audits are also a tool used to identify energy conservation measures; however, the University's success has more often been a system by system enhancement strategy. Typically, when a solution is found that produces good efficiency and operational results with a certain building system such as hydronic heating or lighting then there are a large number of similar facilities within MSU's portfolio that will benefit from the same solution.

Additional Resources

- MSU Energy Opportunities Spreadsheet → MSU_Energy_Opportunities
- MSU Climate Action Plan → http://www.sustainability.msstate.edu/climate/
- IHL Best Practices Guide → http://www.mississippi.edu/facilities/downloads/energy_best_practices.pdf

8 FUNDING

When it comes to executing an energy management program, the most common concern raised by facility manager relates to funding. For a number of years, the MSU leadership has recognized the importance of adequately funding energy efficiency projects. By approving quality energy conservation projects such as boiler conversions, controls upgrades and lighting retrofits, the leadership has allowed technicians, operators and engineers to produce significant energy reduction results. By continually tracking and demonstrating the positive economic impacts of energy efficiency projects, there continues to be a priority given to funding these efforts.

Energy Savings Account

A more formal method of funding was established by the IHL Leadership when it passed the IHL Sustainability Policy in 2011. Item "G" of the IHL Sustainability Policy reads as follows:

"No less than 25% of the expected annual recurring savings from completed energy efficiency projects shall be set aside each year in the appropriate fund and used to finance future energy efficiency projects. If the annual recurring savings are dedicated to the repayment of debt, then these funds shall be set aside in the first year after such debt is retired."

This policy statement led to the creation of an energy savings account at MSU that is replenished annually based on energy cost avoidance calculations. These funds are applied to new projects based on economic benefit among other factors.

Green Fund

The Mississippi State University Green fund is a joint effort of the Office of Sustainability, Students for a Sustainable Campus, and the Mississippi State University Sustainability Committee. The Mississippi State University Green Fund was just established as an opt-in contribution system for faculty, staff, and students. This fund is specifically used for sustainability projects, local and regional renewable energy projects, and for the payment of student interns.

Other Funding Sources

When energy efficiency opportunities are identified that have a good return on investment, MSU explores a variety of funding options. Many energy conservation measures have been addressed during projects funded by the Bureau of Buildings. Additionally, the Division of Student Affairs and the MSU Athletic Department are regularly funding facilities that meet or exceed our energy efficiency standards. A recent lighting and lighting controls upgrade project was funded by the University and is being paid back through utility savings. There is no one size fits all funding source at MSU when it comes to energy conservation measures.

Additional Resources:

- IHL Sustainability Revolving Fund Calculation Guide → Energy_Fund_Calculation
- MSU Green Fund → http://www.sustainability.msstate.edu/initiative/index.php

9 APPENDICES

9.1 OPERATIONS AND MAINTENANCE GUIDELINES

9.2 MSU ENERGY OPPORTUNITIES SPREADSHEET

9.3 IHL SUSTAINABILITY REVOLVING FUND CALCULATION GUIDE

Operational Guidelines

The following summarizes key operational guidelines.

A. Optimized BAS schedules to meet classroom and office needs, specialized equipment needs, plant or animal needs, and laboratory needs. These schedules are not altered without due and proper consideration of the criticality of the function, and the economic impact.
B. Maintain calibration on thermostats, instrumentation and controls, and proper operation of energy conservation devices such as economizer dampers/actuators.
C. Setback and Shutdown routines are implemented for unoccupied periods, with special attention for weekend and holiday periods. During holiday periods, Campus Services personnel will execute aggressive system shut-back protocols with adequate provisions made for system and equipment integrity. Deviations from shut-backs should not be altered without due and proper consideration of the criticality of the function and the economic impact.
D. Central thermostat guidelines are 73 degrees with 2 degree individual adjustment and 2 degree deadband. For Setback during unoccupied periods, the central thermostat is lowered 15 degrees in winter, and raised 15 degrees in cooling season.
E. General deck temperature guidelines: Cold deck 55°F - 65°F (Reset based on outside Air temperature), Cold deck (Humidity Control) 55°F (when zone RH is above set point), Hot deck (During heating seasons only and exempting those buildings requiring reheat for moisture control, using reset schedule) 80°F at 72°F outside dry-bulb temperature, 140°F at 20°F outside dry-bulb temperature and 65°F based on the outside air temperature.
F. Where applicable, the BAS will reset supply air temperatures 55F and 65°F) based on the return air temperature.
G. Heating is in effect when outside air temperature is below 60 degrees, and indoor air is less than 70 degrees. Cooling is in effect otherwise, with outside-air economizer in operation when outside air permits.
H. Follow established Preventive Maintenance Schedules within budget. Ensure filters are changed, coils are cleaned, and all bearings are lubricated at scheduled intervals.

I. Domestic hot water guideline is 140°F unless needed for food preparation or lab use.

J. Boilers should be operated at the lowest temperature adequate for meeting the service needs. Hydronic boilers shall be operated based on an outdoor air temperature reset scheme. Effort should be made, particularly with condensing boilers, to maintain the supply temperature below 140F and the return temperature as low as practical.

K. Monitor chiller efficiencies at part load; reconfigure operations where more efficient operation available. The Johnson control system is configure to cycle Central Plant chillers according to loop temperature/flow – with manual intervention according to previous electrical demand within the month and considering upcoming weather changes (i.e., do not turn on another chiller to correct slightly elevated loop temperature if outside air temperature is soon to decrease).

L. Units under BAS control will remain in the automatic position. Alarm summary reports will be reviewed daily to identify priority concerns.

M. Override reports will be run on a regular basis to identify devices and systems that are operating outside of guideline conditions.

Maintenance/Repair Guidelines

A. Damaged insulation on HVAC piping/duct will be repaired as required as soon as possible within schedule boundaries so as to prevent condensation, mildew, and energy loss..

B. Damaged weather stripping will be replaced as soon as discovered.

C. Broken windows will be repaired as soon as possible within schedule boundaries.

D. Motion detectors will be utilized wherever possible to control lights in class-rooms, conference rooms, hallways, and bathrooms.

E. Replace motors with energy efficient models instead of rewinding a standard-efficient motor. If an energy efficient motor has been rewound previously, evaluate replacement in lieu of rewind.

F. Replace burned out lamps with energy saving lamps; wherever possible, lamps should be replaced with a compatible LED solution. When LED is not feasible, a long life and low wattage florescent option should be selected. PDCA’s Engineering Services can provide guidance on retrofit and replacement of existing fixtures and lamps.

G. When ballast replacements are required, high-efficiency and low ballast factor ballasts should be given a priority.

H. All boilers are to be analyzed annually with respect to combustion efficiency, and tuned accordingly so as to ensure optimal performance.

Category	Goal	Description	Area of Impact	Percent of Total Source (Low)	Percent of Total Source (High)	Annual kwh Impact (Low)	Annual kwh Impact (High)	Unit	Budget Cost
Retrofit	Lighting Upgrades	retrofit over 4 million sqft from florescent to LED w/ addition of occupancy controls. Multi-phase project.	Electricity	5%	8%	6120000	9790000	kwh	$ 6,500,000
Retrofit	Controls Upgrades	Anticipate another 150,000 MMBtu reduction in annual electrical consumption from campus controls upgrades over coming years. (2014 Upgrades planned for Giles School of Architecture and ongoing work at College of Vet Med.)	Electricity	5%	7%	6120000	8570000	kwh	$ 3,000,000
Retrofit	Controls Upgrades	150000 MMBtu - 30% reduction (half gas)	Natural Gas	5%	7%	150000	200000	ccf	
Technology and Innovation	Thermal Storage	kwh reduction from thermal storage advantage of lower ambient temps at night	Electricity	1%	2%	610000	2450000	kwh	$ 6,000,000
Technology and Innovation	Central Plant Optimization	Enhanced software for enhancing the efficiency of central plant operation.	Electricity	1%	2%	1220000	2450000	kwh	$ 100,000
Operational Optimization	Online Commissioning Tool	Ongoing algorithms that compare inputs/outputs from the campus control system to identify operational issues	Electricity	1%	3%	1220000	3670000	kwh	$ 300,000
Operational Optimization	Online Commissioning Tool	Ongoing algorithms that compare inputs/outputs from the campus control system to identify operational issues	Natural Gas	1%	3%	30000	90000	ccf	$ 300,000
Operational Optimization	Operator Reviews	Operator review and optimizing of the Building Automation Systems	Electricity	3%	5%	3670000	6120000	kwh	$ 60,000
Operational Optimization	Operator Reviews	Operator review and optimizing of the Building Automation Systems	Natural Gas	3%	5%	90000	150000	ccf	$ -
Technology and Innovation	Smart Metering	Real Time Metering install w/ live dashboard and reporting	Electricity	2%	3%	2450000	3670000	kwh	$ 1,500,000
Technology and Innovation	Smart Metering	Real Time Metering install w/ live dashboard and reporting	Natural Gas	2%	3%	60000	90000	ccf	
Retrofit	Boiler Conversions	Approximatley 30 Buildings will still benefit from conversion to high efficiency condensing boilers	Natural Gas	3%	6%	90000	180000	ccf	$ 1,500,000
Retrofit	Mechanical Upgrades	Pressure Optimization, upgraded AHU's, Chillers, etc.	Electricity	5%	10%	6120000	12240000	kwh	$ 15,000,000
Technology and Innovation	Dynamic Glass	Enhance the building envelope via dynamic glass retrofits on old buildings and designed into new construction.	Electricity	3%	5%	3670000	6120000	kwh	$ 10,000,000
Technology and Innovation	Dynamic Glass	Enhance the building envelope via dynamic glass retrofits on old buildings and designed into new construction.	Natural Gas	3%	5%	90000	150000	ccf	
Retrofit	Building Envelope Treatment	upgrade/add insulation and seal openings	Electricity	5%	7%	6120000	8570000	kwh	$ 15,000,000
Retrofit	Building Envelope Treatment	upgrade/add insulation and seal openings	Natural Gas	5%	7%	150000	200000	ccf	
Operational Optimization	Demand Limiting and Load Rolling	Utilize Control System to cut back energy loads as they approach pre-set thresholds	Electricity	2%	3%	2450000	3670000	kwh	$ -

Operational Optimization	Demand Limiting and Load Rolling	Utilize Control System to cut back energy loads as they approach pre-set thresholds	Natural Gas	2%	3%	60000	90000	ccf	$ -
Education and User Engagemer	Educational Campaign Phase 1	Build Sustainability Program around EcoPaw to Promote awareness via student groups, earth day, holiday shutbacks, web campaign, etc.	Electricity	1%	3%	1220000	3670000	kwh	$ 100,000
Education and User Engagemer	Educational Campaign Phase 1	Promote awareness via student groups, earth day, holiday shutbacks, web campaign, etc.	Natural Gas	1%	3%	30000	90000	ccf	$ -
Education and User Engagemer	Educational Campaign Phase 2	Promote awareness via student groups, earth day, holiday shutbacks, web campaign, etc.	Electricity	1%	3%	1220000	3670000	kwh	$ 25,000
Education and User Engagemer	Educational Campaign Phase 2	Promote awareness via student groups, earth day, holiday shutbacks, web campaign, etc.	Natural Gas	1%	3%	30000	90000	ccf	$ -
Education and User Engagemer	Educational Campaign Phase 3	Promote awareness via student groups, earth day, holiday shutbacks, web campaign, etc.	Electricity	1%	3%	1220000	3670000	kwh	$ 25,000
Education and User Engagemer	Educational Campaign Phase 3	Promote awareness via student groups, earth day, holiday shutbacks, web campaign, etc.	Natural Gas	1%	3%	30000	90000	ccf	$ -
Policy Enhancements	Setpoint Policy	Administration led policy change of temp setpoint, 2 degrees heating/cooling	Electricity	2%	4%	2450000	4900000	kwh	$ -
Policy Enhancements	Setpoint Policy	Administration led policy change of temp setpoint, 2 degrees heating/cooling	Natural Gas	2%	4%	60000	120000	ccf	$ -
Clean Energy Generation	TVA 2020 Climate Change Goal	http://www.tva.gov/environment/pdf/environmental_policy.pdf - TVA plans to move from 30% non-carbon generation in 2010 to 50% in 2020	Electricity	12%	16%	14690000	19580000	kwh	$ -
Clean Energy Generation	Anticipated TVA 2030 Climate Change Goa	Need to Substantiate - estimate 10%	Electricity	6%	8%	7340000	9790000	kwh	$ -
Clean Energy Generation	Anticipated TVA 2040 Climate Change Goa	Need to Substantiate - estimate 5%	Electricity	3%	4%	3670000	4900000	kwh	$ -
Technology and Innovation	Anticipated Technology Gains	A portion of our climate change goal will certainly be realized by harnessing technology and innovation that is not on the market at present.	Electricity	5%	10%	6120000	12240000	kwh	$ 10,000,000
Clean Energy Generation	Green Energy Purchase	Purchase Blocks of Green Energy from TVA for a Monthly Premium - May be best way to invest in Clean Energy Generation	Electricity	48%	10%	58750000	12240000	kwh	$ 2,000,000
Clean Energy Generation	Solar - Photovoltaic	Onsite clean energy production via photovoltaic solar installations	Electricity	1%	3%	1220000	3670000	kwh	$ 20,000,000
Clean Energy Generation	Solar Hot Water	Enhance domestic and HVAC hot water system production with supplemental solar hot water generators	Natural Gas	25%	50%	730000	1460000	ccf	$ 10,000,000
Technology and Innovation	Waste Heat Recovery at Generation Plant	Supplant Central Chilled and Hot water production utilizing waste heat from turbines for chilled/hot water through conversions - steam or absorption chillers. Direct exhaust to hot water.	Electricity	10%	10%	12240000	12240000		$ 25,000,000

IHL Sustainability Revolving Fund Calculation Method

Directive:

"No less than 25% of the expected annual recurring savings from completed energy efficiency projects shall be set aside each year in the appropriate fund and used to finance future energy efficiency projects. If the annual recurring savings are dedicated to the repayment of debt, then these funds shall be set aside in the first year after such debt is retired."

Feb-2011 rev of IHL Sustainability Policy

Method of Calculation:

The suggested calculation method of energy consumption savings/reduction/avoidance is the "Whole Facility" method as prescribed by the International Performance Measurement and Verification Protocol (IPMVP). There are 4 methods (A, B, C, D) that vary in difficulty and in best application. Method C is recommended for a "multifaceted energy management program affecting many systems in a building". Method C allows the user to utilize monthly readings on natural gas and electricity at each building, factor out variables such as weather and changes in operating square footage, and then measure performance in terms of energy efficiency against a "baseline year".

The IPMVP methods of computing avoided energy consumption from applied energy conservation measures can be applied to a facility of any size. If the calculation properly accounts for any "adjustments" that are not part of the energy conservation measure, then the user can have a high level of confidence in the amount of energy consumption "saved/reduced/avoided" due to the action(s) taken.

Based on the variety of Energy Conservation Measures occurring on our campuses, it is often impractical to track each individual building's performance versus baseline in order to perform a "cost avoidance calculation". In order to (1) simplify the calculation, (2) comply with accepted measurement and verification protocols, (3) and provide a computation that accounts for the net performance of the overall energy management program (both good and bad); the recommended cost avoidance calculation utilizes the monthly energy consumption per square foot of the entire campus in order to calculate net savings from the baseline year.

With the passage of the IHL Sustainability Policy in February 2011b Fiscal Year 2011 has been selected as the baseline year. <u>Our energy efficiency performance in future years shall be measured against FY11 when determining savings (avoided utility costs).</u>

Adjusting for Weather and Square Footage:

There are a few common variables that can impact the approach that is taken to calculating the value of the energy costs avoided due to energy conservation efforts. To be as accurate as possible, square footage and weather are two variables that can be "factored out" or "normalized" in order to understand true cost avoidance. In effect, the user can choose to factor out square footage, weather, both or neither when doing a cost avoidance calculation. These pros and cons of these approaches are best illustrated by example.

Example: A Campus that operated 6,500,000 square feet in FY2011 and 7,000,000 square feet in FY2012. Further, FY2012 had a much milder winter than FY2011.