

WESTERN ILLINOIS UNIVERSITY BOARD OF TRUSTEES

March 9, 2007

Resolution No. 07.3/xx Western Illinois University Energy Management Strategy

WHEREAS *Higher Values in Higher Education*, the University's Strategic Plan, calls for expanding and improving facilities to meet the needs of the University and improving the University's commitment to environmental sustainability; and,

WHEREAS the proposed *Energy Management Strategy for Western Illinois University* is a component plan of the *Western Illinois University-Macomb and Quad Cities Campus Master Plans* that guide renovation and future development of campus facilities, grounds, technology and infrastructure; and,

WHEREAS the proposed *Energy Management Strategy* was developed in consultation with the University Utilities Committee and Campus Sustainability Committee after careful consideration of Western Illinois University *Campus Master Plans*, institutional commitments to renewable energy and environmental sustainability, and energy costs and forecasts; and,

WHEREAS the proposed *Energy Management Strategy* will establish initiate capital projects that reduce energy consumption, promote energy efficiency, improve operational efficiencies, and educate the campus community on energy conservation measures; and,

WHEREAS principles of the proposed *Energy Management Strategy* will be included into a newly developing utility infrastructure plan for Western Illinois University that will be presented to the Western Illinois University Board of Trustees for approval upon completion:

THEREFORE be it resolved that the Western Illinois University Board of Trustees approves implementation of the *Energy Management Strategy for Western Illinois University*, with the understanding that the guidelines in the *Energy Management Strategy* will be used in developing a utility infrastructure plan for Western Illinois University, and be it further resolved that the Board commends the campus community for advancing the goals, priorities, and objectives of *Higher Values in Higher Education*.

Board Action on: _____

Motion by: _____

Second by: _____

Vote: Yeas: _____ Nays: _____

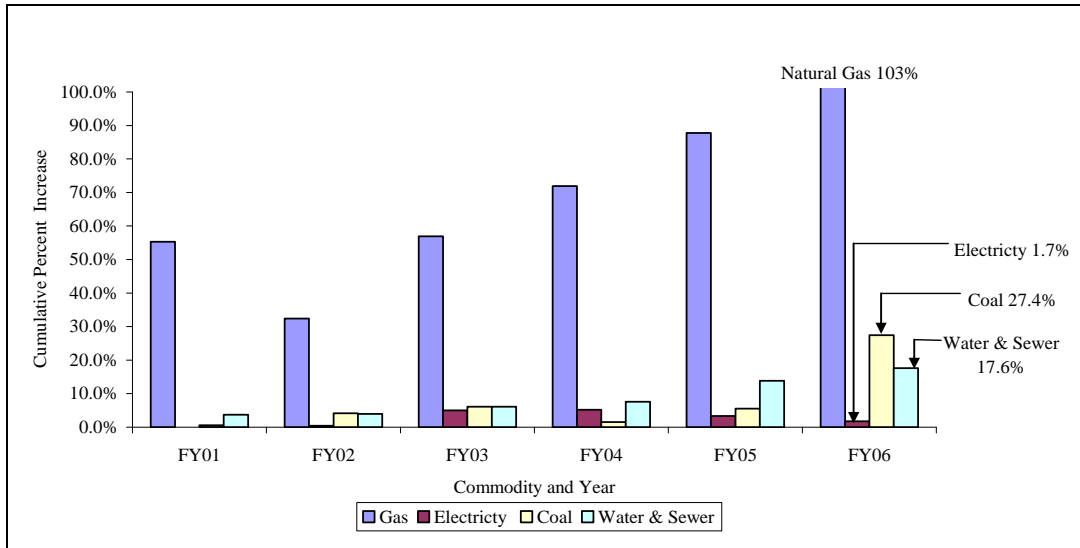
Postpone: _____

Amend: _____

Disapprove: _____

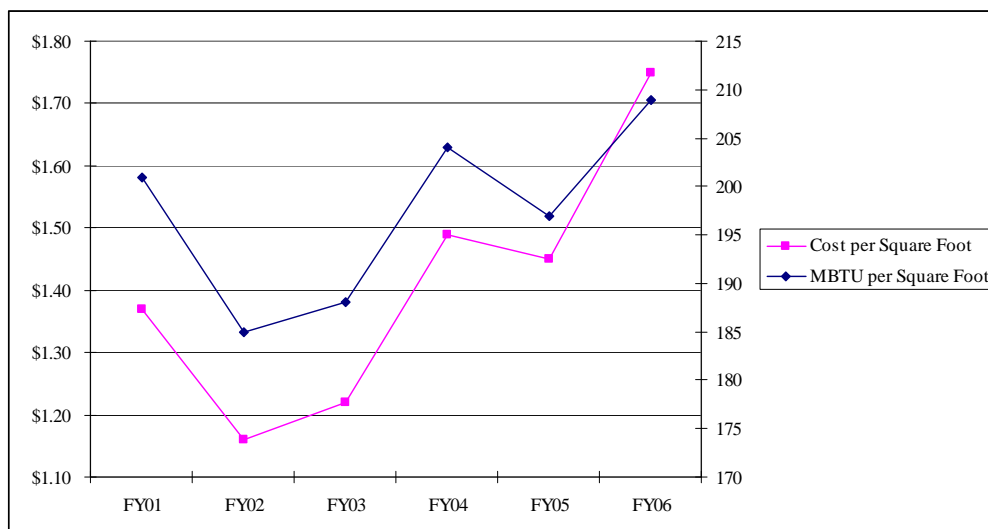
Approve: _____

Presented for approval at today's Western Illinois University Board of Trustees meeting is an *Energy Management Strategy for Western Illinois University*. The need for an energy management strategy is well documented with escalating and volatile costs. Shown in the figure below, utilities prices at Western Illinois University have increased by 1.7 percent for electricity, 17.6 percent for water and sewer, 27.4 percent for coal, and 103.0 percent for natural gas between Fiscal Years 2001 and 2006. Similar cost increases have also been experienced by other Illinois public universities and consumers.



Price increases and volatility for utilities is expected to continue. Since electrical deregulation in January 2007, electrical costs at Western Illinois University have increased by 54 percent. Additionally, total Fiscal Year 2007 utility expenditures are expected to be eight percent (\$1.2 million) higher than Fiscal Year 2006.

Costs, as well as new construction and renovation through the *Macomb and Quad Cities Campus Master Plans*, and institutional commitments to environmental sustainability and renewable energy are all reasons that the University is proposing a comprehensive energy management strategy. As utility costs increase (measured by the cost per square foot), the University will implement strategies to optimize energy efficiencies (measured by one thousand British Thermal Units (MBTU) per square foot) with special attention to sustainable and renewable energy sources.



Specifically, through the leadership of Physical Plant Director, Mr. Charles Darnell, and Mechanical Engineer, Mr. Scott Coker, a proposed comprehensive *Energy Management Strategy for Western Illinois University* is presented at today's Western Illinois University Board of Trustees meeting. This *Strategy* was developed in consultation with the University Utilities Committee and the Campus Sustainability Committee.

Copy of the *Energy Management Strategy* for Western Illinois University is attached to this *Resolution*. Upon concurrence from the Western Illinois University Board of Trustees, Physical Plant staff will work closely with the campus community to implement actions in the *Energy Management Strategy* and use to the principles in the *Strategy* to develop a comprehensive utility infrastructure master plan for the University. This plan will address six critical areas by:

1. Reviewing and consolidating past utility studies;
2. Conducting lifecycle cost analyses to compare the existing heating plant with a new plant;
3. Updating capital construction cost estimates for University utility infrastructure requirements;
4. Evaluating State and public policy issues;
5. Assessing environmental impacts; and,
6. Analyzing funding options.

The *Energy Management Strategy* presented for Western Illinois University Board of Trustees approval today and the newly developing utility infrastructure master plan have/will contain priorities to successfully address institutional commitments to sustainable and renewable energy. This includes joining the Environmental Protection Agency's ENERGY STAR Challenge to increase energy efficiency on campus, contributing to the University obtaining Leadership in Energy and Environmental Design certification in construction projects (e.g., using geothermal in the new multicultural center and at the newly developing Western Illinois University-Quad Cities Riverfront Campus), completing stormwater management projects, increasing the overall waste recycled on campus by 15 percent, and composting at least 5,000 cubic yards of the organic waste produced on campus. These planning activities show how the University is advancing *Higher Values in Higher Education's* priorities to expand and improve facilities and the University's commitment to environmental sustainability.

**A Comprehensive Energy Management Strategy for
Western Illinois University
March 2007**

1.0 Introduction

Western Illinois University has adopted a strong commitment to environmental stewardship as a strategic objective of the University. The campus seeks to become a leader in achieving sustainability objectives and has marshaled resources to achieve this goal. Consistent with its sustainability objectives, the University is adopting a comprehensive and continual energy management strategy.

Western Illinois University intends to reduce its energy consumption as measured by the Energy Utilization Index (EUI) by 5% over the next five years. EUI is a measure of MBTU/SQFT/YR, or 1,000 British Thermal Units of energy per gross square foot per year. WIU will ultimately require a capital commitment if this strategy is to attain the 30% to 35% reduction in EUI achieved by more mature university energy management programs.

Modernization of heating ventilating and air conditioning (HVAC) in most campus buildings may actually increase the EUI. Should this occur, it will not be contrary to the sustainability goals of the University as proper comfort and indoor air quality needed for academic functions are provided at optimal energy use. For evaluation, energy capacity increases needed to satisfy unmet cooling and electrical loads as well as weather related adjustments will be made to the annual EUI calculation.

Four primary Initiatives Targeting Energy Reduction and Efficiency

- 1. Initiate capital projects that reduce energy consumption*
- 2. Develop construction standards that promote energy efficiency and secure LEED (Leadership in Energy and Environmental Design) certification of new buildings and renovations whenever possible*
- 3. Improve operational efficiencies in the production, distribution, and utilization of campus energy and utility resources*
- 4. Educate the campus community about responsible energy conservation behaviors and market/advertise accomplishments.*

2.0 Background

The Western Illinois University campus in Macomb consists of approximately 4.5 million square foot of space nearly equally divided between educational functions and on-campus residences. The university has minimal research and laboratory assets and its academic hours are mostly 8 am to 5 pm, Monday through Friday. Of an approximate (10,500) full time student enrollment on the Macomb campus, about (4,700) live on campus. Summer enrollment drops to approximately (2,500) students. However, WIU is not a commuter school. The University has many weekend and evening activities involving on-campus and off-campus students, faculty and staff as well as it attracts unaffiliated persons from the community during spring and fall semesters.

3.0 Utility and Energy Uses

The campus operates and maintains a heating plant that provides steam for heating and cooling of campus buildings. The steam is produced from two chain grate stoker coal boilers and three natural gas fired boilers. Inexpensive regional coal supplies solely within Illinois are used in the coal fired boilers while natural gas is procured through indexed, spot, and short term fixed rate agreements. Some natural gas used for industrial purposes is also delivered by the Local Distributing Company (LDC). The gas boilers are also convertible to #6 fuel oil should gas service be lost to campus.

Electricity is currently purchased through an energy marketing firm and has been aggregated with the electrical procurement of four other Illinois universities to reduce costs. Deregulation of the electrical industry in Illinois on January 1, 2007 has resulted in a 54% increase in electrical rates.

The campus relies on the city of Macomb for domestic water supplies, wastewater treatment and some storm water collection. Small gas supplies are metered and billed by the LDC (Ameren CIPS) and a few small electrical services are handled by either Ameren CIPS or the McDonough Electric COOP. Finally, very small LP gas services in remote areas of campus are used for heating facilities and residences and for making domestic hot water.

4.0 Energy Management Opportunities

4.1 Capital Project Investments

Western Illinois University energy management opportunities are diverse and substantial. This section of the report will expound generally on the types of opportunities available and the sources of the energy savings in priority of greatest impact to the university irrespective of their first-cost.

Chilled Water

The University is currently facing the need to replace nearly all campus building chillers. Campus chillers average 35 years of age and are mostly obsolete with little or no access to replacement parts. The capacity of the equipment has been reduced with age such that the inherent inefficiency of steam absorption cooling is multiplied. The inability of much of the equipment to produce nominal water temperatures of 44 degrees has lead to humidity problems in some buildings. The prevailing two-pipe season-specific HVAC systems can not provide reheating capabilities to ensure proper humidity and comfort control. Accordingly, many facilities on the WIU campus are affected by less than adequate load control or indoor air quality expected of modern educational facilities.

A campus chilled water study recommends a central chilled water plant concept that utilizes electrical centrifugal chillers. The electric chillers are substantially more efficient than are steam absorbers. A central chilled water plant utilizing electrical chillers would reduce the end-use campus EUI by 12% from an estimated 207 to 181¹ (note 1). No other single project opportunity could have as large or as immediate overall impact on campus energy efficiency.

Heating Plant

The University must aggressively plan for significant capital upgrade of its campus heating plant. Of its five steam boilers, two gas boilers presently need major rebuilding. Electrical and other building code issues as

¹ *The standard end-use electrical conversion of 3,412 BTU per kW is employed because it is typical for electrical use to be converted at the end-use heat rate in an EIU calculation. This conversion rate does not include energy to produce power which is 2 to 3 times the end-use heat rate. When converting to MBTU at a generating heat rate the actual reduction in energy is 6%*

well as a large amount of capital upgrade is required of the coal delivery and handling systems. The proposed campus master plan is showing construction of a new heating plant in a defined service area of campus north of Physical Plant. Doing so could afford the opportunity to construct a state-of-the-art Internally Recirculating Coal Fluidized Bed (IRCFB) steam boiler that is recognized as a clean coal technology. The new plant would deliver steam resources to campus at much higher efficiencies than are currently possible from the existing plant. It is not known at this time the quantifiable contribution to energy reduction that would be achieved by a new plant. However, it is considered to have the second highest impact and priority because its practicality is linked to the imminent capital needs of the existing plant and because of the vast cost efficiencies derived from eliminating much of the University's industrial natural gas use.

Campus steam line replacement

A new campus heating tunnel system that was completed in 2001 replaced approximately 65% of the campus steam lines and saves the university approximately \$100,000 a year in lost energy and make-up water. The loss of condensate return that is typical of 40 and 50 year old direct buried steam distribution systems results in hundreds of thousands of gallons of water wasted annually. The further loss of the heated condensing water results in energy inefficiencies as the heating plant must reheat cold domestic make-up water for its boilers. The University must replace approximately \$9.5 million dollars in direct buried steam lines on its campus. While this project does not have a quick simple payback through energy cost savings, it is necessary on the basis of its criticality to campus residential heating and cooling and for its waste of natural resources and energy loss.

Building HVAC Upgrades

As noted previously, the original campus building HVAC systems are in critical need of retrofit or replacement. Recommendations include, increases in capacity to cool as required, conversion to four-pipe building systems where practical, variable air volume control with variable frequency drives on all air handling equipment and pumps with direct digital control and remote monitoring capability. These projects will not have short simple paybacks on investment. However, the quality derived from modernization of the HVAC systems, will provide proper comfort, humidity, and indoor air quality and create intrinsic value through higher productivity and more effective teaching. This value makes HVAC upgrades highly desirable sustainability projects.

Building and Campus Landscape Lighting and Lighting Control Upgrades

WIU has had success retrofitting existing lighting fixtures with higher efficiency electronic ballasts and smaller diameter fluorescent lamps. Stipes and Morgan have received grants from the Illinois Clean Energy foundation that have offset approximately 65% of the total cost of these retrofits. While these projects initially appeared to have simple paybacks of 8 years or more, higher electrical costs may reduce the payback to 4 years. Similar to the HVAC projects, lighting retrofits provide higher quality lighting for enhanced productivity and comfort.

In addition to the significant lighting quality improvements and operational savings, WIU is converting to Planned Lighting Maintenance (PLM). The PLM strategy is to replace all lamps in building fixtures simultaneously as opposed to spot replacement at burn-out. The hours that lights are on are monitored with data loggers so that 90% of lamp life can be predicted and group replacement scheduled. The operational savings are estimated at between 3 to 1 and 4 for 1; that is after accounting for setup time to replace a single lamp, three or four lamps in the same fixture could be replaced in the same amount of time. Operational efficiencies obtained from PLM save human energy and improve lighting quality, as the lumens output from lamps at 90% of useful life has declined. Standardization of lamp type and color is another benefit obtained through PLM as well as the information obtained on failure rates of new lamps.

Beginning in FY07, Physical plant will start adding occupancy sensor lighting controls to specific building areas. The Plant will target common areas where occupants do not often take responsibility for turning out

lights when leaving. Occupancy sensors will also be pilot tested in classrooms. Educational initiatives described later will supplement lighting control work, as automatic lighting control is expensive to install and maintain, and is not always appropriate in all locations. WIU will continue to apply for grant assistance to modernize facilities with higher efficient lighting.

4.2 Design Standards for New Construction and Renovation

Design standards that emphasize life-cycle costing and reinforce the need for institutional quality materials and equipment in addition to sustainable solutions will establish baseline requirements for campus facilities. These higher first-cost investments will yield substantial long term savings in energy and maintenance. The standards will also establish requirements for achieving at least minimal LEED certification for all new campus facilities in Macomb and the Quad Cities.

Physical Plant Facilities Planning and Construction will develop these standards as well as to provide an estimate of cost impact. The draft standards will be delivered through the Sustainability Committee to the Office of President and its' Cabinet for ratification. After the standards are adopted, only the President may waive a part or all these requirements in a facility design.

4.3 Operational Efficiencies

Operational procedures, work priority setting and daily decision-making have a major impact on energy consumption and cost whether at the heating plant, in campus facilities or on the campus grounds. Training of personnel and adjusting cultural values through effective leadership are means to ensure that operational processes result in optimal energy and resource uses.

The implementation of multidisciplinary teams that provide continuous commissioning of HVAC systems is a strategy to greatly improve building energy performance. Continuous commissioning is the process of periodically verifying actual operations to original design intent followed by tuning, repairing, or replacing equipment and controls to optimize existing HVAC operation. Teams usually consist of a Mechanical Engineer, Stationary Engineers, Utility Maintenance Repairmen and at times external professional consultants and contractors.

While commissioning is credited for saving large amounts of energy and cost, WIU will be limited in its results by antiquated and cursory pneumatic control systems in its buildings. When building HVAC systems are upgraded modern control will be installed. Likewise, University representatives will provide greater advocacy during the standard commissioning process than is provided by the Contractor in conjunction with A/E firm of record. Continuous commissioning should then be implemented for all new and retrofit facilities. Additionally, commissioning evaluations will be provided on existing building HVAC controls and equipment to assess opportunities for improving energy efficiency. A major commissioning evaluation should be performed every five years and a checklist audit should be performed annually for each campus facility by the commissioning teams.

4.4 Educational and Marketing Initiatives

Estimates that attempt to quantify the end-user's contribution to energy uses and waste suggest that between 2% and 4% per year can be saved through more effective energy conservation habits. If those savings were realized by WIU it could save the University between \$180,000 and \$360,000 each year. This savings also represents the avoidance of thousands of pounds of pollutants and waste heat produced in the process of making and distributing utilities. Given the ease with which many of these practices are employed by end-users, educational and marketing to inspire cultural changes is a good investment of time and funding.

Essential to any educational initiative aimed at cultural change is the strong and regular support from senior administrators as well as creative marketing messages that can be fun or challenging.

4.5 Energy Audits

Many energy initiatives begin with building energy audits. Walk-through or preliminary audits of campus buildings are considered valuable for locating neglected maintenance problems, identifying larger opportunities and for eliminating obvious sources of waste. However, detailed audits costing \$50,000 to \$75,000 per building are not considered cost effective given that most existing HVAC systems are woefully obsolete. Likewise, as noted previously, wholesale retrofit of building HVAC systems may in fact increase energy consumption.

5.0 Outline of Energy and Operational Initiatives

5.1 Initiatives Requiring Few or No Additional Resources

- A) Continuous Commissioning of existing HVAC and controls
- B) HVAC and Heating Plant operational & maintenance training
- C) Education and Marketing
- D) Grant writing activities
- E) Employ a percent of Permanent Improvement funding on energy initiatives
- F) Implementing LEED Design Standards
- G) Preliminary Building Energy Audits
- H) Requiring EPA Tier I Energy Star Vending Machines on campus contracts

Estimated Total Energy Savings 5% to 10%

5.2 Initiatives Requiring Substantial Additional Resources

- A) Constructing a new Central Chilled Water Plant
- B) Constructing a new IRCFB Plant
- C) Retrofit campus facilities to modernize HVAC and controls
- D) Replace remaining failed steam lines
- E) Exploit any real Cogeneration potential

Estimated Total Energy Savings 10% to 20%

6.0 Funding and Financing Strategies

- A) State of Illinois Major Capital
- B) State of Illinois Capital Renewal
- C) Performance Contracting
- D) University Infrastructure Assessment Fee
- E) Self Financed
- F) Permanent Improvement Funds
- G) WIU Utility Funding
- H) Grants

7.0 Summary

The WIU Energy Management Strategy is designed to identify achievable goals to help meet the strategic objective of a sustainable campus. There are many initiatives discussed that can be implemented immediately with a ranging affect of 5% to 10% energy reduction as calculated by the campus Energy Utilization Index (EUI). Other initiatives that are identified, although requiring significant additional resources not currently available to the University, have the potential of further achieving a reduction of ~ 30% in the EUI as can be experienced from a mature energy program. In concluding, an energy management strategy is not a program, it must become a continual imbedded objective of the university, as technologies and the people that shape the culture of the university continually change.