



Midwestern State University

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STRATEGIC ENERGY MANAGEMENT MASTER PLAN 2019-2026



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Introduction

Midwestern State University (MSU) has been performing energy efficiency program audits through the SECO Energy Partnership Program since 2008.

Energy reduction projects completed to date include:

1. LoanSTAR energy conservation project that was completed in 2012 and focused on electricity, natural gas and water reduction.
2. From 2013 to 2018 MSU has analyzed, with the assistance of consulting engineers, all reasonable capital expense equipment modernization and system upgrade opportunities throughout the campus. The following is the result of that multi-year effort.
 - a. MSU replaced existing lighting at the athletic fields with new steel poles and new energy efficient high intensity discharge (HID) sports lighting fixtures.
 - b. MSU replaced 15 atrium lights in the student center with LED lights.
 - c. Continue efforts to educate personnel and students on the need to turn off lights when rooms are not in use and set dorm thermostats at reasonable values, particularly through email postmaster releases.
 - d. Modification of the existing free cooling heat exchanger to maximize the free cooling capacity.

The Resultant Energy Savings

From FY2012 to FY2019 the campus square footage expanded by 5.94% while the electrical kWh consumption increased by a normalized amount of 4.42%. Over the same period natural gas usage dropped by 8.3%.

Energy Management Master Plan - Status Update

Based on House Bill 3693 Section 388.008 (C) *(Each political subdivision, institution of higher education, or state agency shall establish a goal to reduce the electric consumption by the entity by at least five percent each state fiscal year for*

seven years, beginning September 1, 2019.) and the mandate to reduce energy usage by 5% per year for the next seven years, MSU has re-focused our energy reduction efforts to capitalize on emerging technologies that, just a few years ago, were not economically feasible as well as looking at more traditional energy saving strategies that may have been overlooked in the past.

LED lighting technology has advanced at a rapid rate over the last five years, both in lumen output per watt and affordability and availability of the light fixtures. Because of these two factors the years to breakeven on the initial investment has dropped to a normalized average, for higher education facilities, of approximately five years when converting T12 fluorescent fixture and nine years when converting T8 fixtures.

The following describes the detailed plan for implementation of LED lighting throughout the campus and other energy reduction projects.

Campus Lighting Retrofit

Lighting Analysis

MSU currently has a total of 68 building on campus built between 1937 and 2019 with a total of 1,788,766 square feet. LED retrofits have already been implemented on 9.6% of the campus equaling 172,218 square feet, leaving 90.4% (1,616,548 square feet) of the campus still needing LED retrofits, refer to Appendix A for a list of campus buildings and the current status of LED conversion for each building. MSU has 3 buildings with all 4 lamp T12 fixtures and one building with 33% at 3.8 watts per square foot and 28,027 square feet of lighting remaining to retrofit. All remaining buildings have T8 fluorescent lamps with 1.6 watts per square foot and 1,588,520 square feet remaining to retrofit. Comparatively, the same layout using current technology LED light fixtures the average watts per square foot would be 0.38.

MSU has an estimated total of 17,962 light fixtures that can be changed to an LED light fixture, representing one light fixture every 90 square feet of building space. At a projected cost of \$230.00 per fixture to retrofit each fixture and a one-for-one fixture replacement the total investment to replace the remaining fluorescent fixtures on campus is approximately \$4,131,260.00. Changing all remaining fluorescent fixtures to LEDs would result in an estimated annual energy savings of \$430,930.00.

HVAC Analysis Using Trane Trace 700 Modeling Software

Trane Trace 700 is an HVAC load modeling and energy usage software used in the HVAC design industry to calculate building heating and cooling loads and to estimate system operating costs. Summit engineers developed two campus models, one represented the current building square footage with the current fluorescent lighting, the other used the same square footage but modeled the buildings with LED lights. Comparing the two models showed that the change to LED lights reduced the load on the campus central utility plant by 330-tons.

Using the tonnage reduction and the current MSU electrical rate per kWh an energy model was run to generate the cost savings per year that will be realized when 330-ton of cooling is no longer required due to the lighting retrofit from fluorescent to LED fixtures the results from the energy model showed that a realized annual cost saving would be \$35,477.00.

Lighting Retrofit Annual Cost Savings

The lighting retrofit, when fully implemented, will result in an annual cost saving of \$466,406.00. This represents the direct savings from the reduced energy associated with the LED lights and the tonnage reduction on the central utility plant. House bill 3693 Section 388.008 states that MSU must reduce energy consumption 5% every year for the next 7 years having a total of 35% energy consumption reduction. The lighting retrofit will have a calculated 36% reduction in

energy consumption when fully implemented. An estimate of 17,962 lighting fixtures (one fixture every 90 square feet and a one for one replacement) need to be retrofitted over the next 7 years coming to 2,566 retrofits per year. At a total cost of \$4,131,260.00 for the entire 7 year program. MSU will need to invest \$590,180.00 a year to accomplish the 5.1% reduction in energy consumption per year. This energy conservation measure has a full payback period of 8.9 years.

Other Energy Conservation Strategies

Summit Consultants, Inc. has also considered several other conservation strategies along with the LED lighting retrofit. These conservation measures included:

[Compressed Natural Gas \(CNG\) Conversions on Fleet Vehicles](#)

MSU has a total of 66 fleet vehicles that have a range of production years from 2008 to 2018. MSU fleet records show a total 1,984,683 miles have been accumulated by all 66 vehicles and have consumed an estimated 64,470 gallons of gasoline during this time. MSU gasoline consumption is averaging 30 miles per gallon of gasoline; therefore, the energy savings and cost of changing all fleet vehicles to CNG does not have an acceptable return on investment.

[Water Side Economizer](#)

MSU currently has a water side economizer consisting of a plate and frame heat exchanger utilizing the cooling towers water to produce chilled water for the facilities on campus when ambient dewpoint temperature is 50°. The heat exchanger has a maximum capacity of 500-tons and maximum cooling required for times when the ambient temperature allows for economizer operation is 409-tons. Expanding the heat exchanger with more plates will not reduce energy consumption; so that was dropped from consideration.

[Adding Chilled Water to Buildings with DX Systems](#)

MSU currently has two 2300-ton chillers and maximum demand of 1300-tons. After considering the limited amount of possible expansion and the cost of expanding the utility tunnel and retrofitting air handlers with chilled water coils this conservation measure does not have a reasonable payback period and was dropped from consideration.

Lighting Controls (Occupancy Sensors)

MSU currently has 2,646 rooms that could use occupancy sensors throughout campus. Assuming the occupancy sensors in those rooms will reduce the usage by two hours every day of occupancy the sensors will save an additional 543,160 kWh a 2.6% total reduction in consumption. At a calculated cost \$608,580 to complete with a return on investment of 15.8 years. This conservation measure does not have a reasonable payback period and was dropped from consideration.

Domestic Hot Water Setpoints

MSU currently has three types of domestic hot water production electric, gas and steam. All electric water heaters have a campus wide setpoint of 120° F. Gas water heaters have a varying setpoints from 105° F to 120° F. Steam water heaters also have varying setpoints from 110° F to 132° F. The current setpoint for the MSU campus are reasonable and little to no reduction in energy consumption can be expected so this measure was dropped from consideration.

Appendix A Campus Building Summary

MIDWESTERN STATE UNIVERSITY CAMPUS BUILDING SUMMARY

| BUILDING | YEAR BUILT | SQ. FT. | % of LEDs | SQ.FT. W/OUT LEDs | # OF LIGHTS |
|------------------------------------|------------|---------|-----------|-------------------|-------------|
| HARDIN ADMINISTRATION BUILDING | 1937 | 71594 | 0.00% | 71594 | 795.5 |
| GUEST HOUSE | 1937 | 1530 | 0.00% | 1530 | 17.0 |
| SIKES HOUSE | 1938 | 9626 | 50.00% | 4813 | 53.5 |
| ALUMNI CENTER | 1938 | 2800 | 0.00% | 2800 | 31.1 |
| CARRIAGE HOUSE | 1938 | 1080 | 0.00% | 1080 | 12.0 |
| UNIVERSITY PRESS | 1940 | 4965 | 0.00% | 4965 | 55.2 |
| MEMORIAL BUILDING | 1945 | 7019 | 0.00% | 7019 | 78.0 |
| FAIN HALL | 1945 | 8060 | 0.00% | 8060 | 89.6 |
| MARTIN HALL | 1946 | 9286 | 0.00% | 9286 | 103.2 |
| FERGUSON HALL | 1947 | 16886 | 0.00% | 16886 | 187.6 |
| MCCOY ENGINEERING HALL | 1949 | 28181 | 0.00% | 28181 | 313.1 |
| PAINT SHOP | 1949 | 1987 | 0.00% | 1987 | 22.1 |
| MCCULLOUGH HALL | 1949 | 9449 | 0.00% | 9449 | 105.0 |
| MCCULLOUGH ANNEX | 1949 | 2469 | 0.00% | 2469 | 27.4 |
| COUNSELING CENTER | 1949 | 3108 | 0.00% | 3108 | 34.5 |
| PROTHRO-YEAGER-BEAWOOD-ODONOHOE | 1950 | 65060 | 5.00% | 61807 | 686.7 |
| CLARK STUDENT CENTER | 1951 | 70890 | 20.00% | 56712 | 630.1 |
| 2504 HAMPSTEAD | 1951 | 3340 | 0.00% | 3340 | 37.1 |
| 2527 HAMPSTEAD | 1952 | 3201 | 0.00% | 3201 | 35.6 |
| 2518 HAMPSTEAD | 1954 | 3475 | 0.00% | 3475 | 38.6 |
| 2514 HAMPSTEAD | 1955 | 1950 | 0.00% | 1950 | 21.7 |
| MARCHMAN HALL | 1959 | 8904 | 0.00% | 8904 | 98.9 |
| FRATERNITY COMMONS | 1961 | 3395 | 0.00% | 3395 | 37.7 |
| WEST CAMPUS ANNEX | 1961 | 31256 | 0.00% | 31256 | 347.3 |
| MOFFETT LIBRARY | 1964 | 93676 | 0.00% | 93676 | 1040.8 |
| KILLINGSWORTH HALL | 1965 | 68658 | 0.00% | 68658 | 762.9 |
| RESIDENCE HALL MECHANICAL BUILDING | 1965 | 1296 | 0.00% | 1296 | 14.4 |
| BOLIN HALL | 1966 | 93494 | 0.00% | 93494 | 1038.8 |
| PIERCE HALL | 1966 | 49913 | 0.00% | 49913 | 554.6 |
| CENTRAL PLANT | 1967 | 10789 | 0.00% | 10789 | 119.9 |
| D.L. LIGON COLISEUM | 1969 | 117048 | 0.00% | 117048 | 1300.5 |
| PHYSICAL EDUCATION RESTROOMS | 1970 | 2336 | 0.00% | 2336 | 26.0 |
| PHYSICAL TRAINING BUILDING | 1970 | 1701 | 0.00% | 1701 | 18.9 |
| SIKES LAKE CENTER | 1975 | 8836 | 0.00% | 8836 | 98.2 |
| BRYANT EDWARDS UPD | 1977 | 3969 | 0.00% | 3969 | 44.1 |

| BUILDING | YEAR BUILT | SQ. FT. | % of LEDs | SQ.FT. W/OUT LEDs | # OF LIGHTS |
|-------------------------------------|------------|----------------|-----------|-------------------|----------------|
| FAIN FINE ARTS CENTER | 1978 | 121356 | 5.00% | 115288.2 | 1281.0 |
| OUTDOOR RECREATION CENTER | 1982 | 5000 | 0.00% | 5000 | 55.6 |
| SOCCER TICKET BOOTH | 1982 | 34 | 0.00% | 34 | 0.4 |
| SOCCER PRESS BOX | 1982 | 943 | 0.00% | 943 | 10.5 |
| BEYER GREENHOUSE | 1983 | 2398 | 0.00% | 2398 | 26.6 |
| TENNIS CENTER | 1984 | 560 | 0.00% | 560 | 6.2 |
| JAN THACKER FANTASY OF LIGHTS WKSHP | 1986 | 7353 | 0.00% | 7353 | 81.7 |
| DANIEL BUILDING | 1990 | 46335 | 0.00% | 46335 | 514.8 |
| MCCULLOUGH-TRIGG HALL | 1994 | 46086 | 10.00% | 41477.4 | 460.9 |
| BRIDWELL HALL | 1998 | 43761 | 0.00% | 43761 | 486.2 |
| SEISMOMETER BUILDING | 2003 | 141 | 0.00% | 141 | 1.6 |
| SUNWATCHER VILLAGE CLUBHOUSE | 2004 | 5164 | 15.00% | 4389.4 | 48.8 |
| SUNWATCHER VILLAGE BLDG 2 | 2004 | 7740 | 15.00% | 6579 | 73.1 |
| SUNWATCHER VILLAGE BLDG 3 | 2004 | 7740 | 15.00% | 6579 | 73.1 |
| SUNWATCHER VILLAGE BLDG 4 | 2004 | 11736 | 15.00% | 9975.6 | 110.8 |
| SUNWATCHER VILLAGE BLDG 5 | 2004 | 11736 | 15.00% | 9975.6 | 110.8 |
| SUNWATCHER VILLAGE BLDG 6 | 2004 | 11736 | 15.00% | 9975.6 | 110.8 |
| SUNWATCHER VILLAGE BLDG 7 | 2004 | 11736 | 15.00% | 9975.6 | 110.8 |
| SUNWATCHER VILLAGE BLDG 8 | 2004 | 7740 | 15.00% | 6579 | 73.1 |
| SUNWATCHER VILLAGE BLDG 9 | 2004 | 7740 | 15.00% | 6579 | 73.1 |
| WF MUSEUM AND ARTS AT MSU | 2005 | 27824 | 75.00% | 6956 | 77.3 |
| SIKES LAKE RESTROOM | 2005 | 612 | 0.00% | 612 | 6.8 |
| DILLARD COLLEGE OF BUSINESS ADMIN | 2006 | 94336 | 15.00% | 80185.6 | 891.0 |
| REDWINE REC AND WELLNESS CENTER | 2009 | 46855 | 20.00% | 37484 | 416.5 |
| SUNDANCE COURT | 2009 | 149601 | 50.00% | 74800.5 | 831.1 |
| FAIN INSTRUMENTAL MUSIC HALL | 2010 | 6587 | 0.00% | 6587 | 73.2 |
| REGIONAL SIMULATION CENTER | 2010 | 14590 | 0.00% | 14590 | 162.1 |
| SOFTBALL LOCKER ROOM | 2011 | 1873 | 0.00% | 1873 | 20.8 |
| DALQUEST RESEARCH BUILDING | 2015 | 2000 | 0.00% | 2000 | 22.2 |
| DALQUEST UTILITY BUILDING | 2015 | 837 | 0.00% | 837 | 9.3 |
| LEGACY HALL | 2016 | 152944 | 5.00% | 145296.8 | 1614.4 |
| PARKER SQUARE | 2018 | 31550 | 0.00% | 31550 | 350.6 |
| CENTENNIAL HALL | 2019 | 80895 | 0.00% | 80895 | 898.8 |
| TOTAL | | 1788766 | | 1616548.3 | 17961.6 |

END OF APPENDIX A