



Honeywell

Creating Sustainable, Efficient, Green Campuses



EXECUTIVE SUMMARY

Campus Energy Audit: General Fund Buildings Phase I, II, and III

In September of 2011 Western Michigan University (WMU) selected Honeywell, through a competitive RFP process, as their Energy Services Partner. The intent of the partnership was to conduct technical energy audits for each facility identified with the potential implementation of an Energy Performance Contract. The goal was to identify building improvements in each facility that could assist the University in reaching its objective of reducing energy consumption.

Through our surveys, utility bill analysis, and interviews with the WMU team, we commend the operation's staff for the excellent job they have done in maintaining facilities and implementing successful energy conservation measures throughout the campus. These efforts have resulted in a significant reduction of energy spend over the last twenty (20) years.

It is our understanding that the University's focus is on identifying potential energy savings projects and their impact on Green House Gas (GHG) emissions to assist in meeting its American College and University President's Climate Commitment (ACUPCC). We are proud to report that through the recommendations of this Campus Energy Audit, WMU can make significant progress towards that goal. We are excited about the positive impact that a Performance Contracting Partnership can have campus wide by reducing energy, improving comfort, impacting capital renewal and reducing the University's carbon foot print.

Honeywell has completed energy audits for all three (3) Phases of General Fund buildings as identified in the original contract. Site visits and meetings with Western Michigan University facility staff began in October 2011 and concluded in June of 2012.

For this report we have gathered a significant amount of information about the subject buildings: how they are used, their general condition, type of equipment, and cost of energy. We have reviewed each building system that contributes to the use of energy or has an impact on utility spend. These included the mechanical, heating, cooling, ventilation, temperature control, and building management systems, as well as, lighting, building envelope, water, sewer and other electrical consuming devices.

We also obtained three years of actual steam and electric utility consumption. The key was working closely with WMU staff members to calculate the actual utility usage for each building using calculated meters, virtual meters and substations. All the collected data was entered into our Energy Utility Indexing software; where we analyze how the buildings are performing and what recommendations could be developed to reduce energy consumption, costs, and GHG emissions.

The output of our effort provides you with information regarding the energy related devices, historical energy consumption and costs, identification of inefficient devices, suggestions for repair, replacement and upgrades, savings that could be achieved, costs for the upgrades, and simple payback periods.



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We have listed one hundred sixty four (164) Energy Conservation Measures (ECMs) across twenty seven (27) different categories. Cost estimates are budgetary, given the nature and scope of work. Savings estimates assume that they are stand-alone actions. The cumulative impact of completing several (ECMs) will likely have a positive compounding effect to the estimated results. All actions recommended will improve efficiency, reduce energy consumption, reduce GHG emissions as well as improve comfort and the learning environment.

The fifty three (53) buildings included in the Phase I, II, and III audit consist of a reported 4,543,477 gross square feet. The electrical consumption was over 49 million kilowatt hours costing \$3,834,984 in FY10. These buildings also consumed more than 329,743 klbs of steam costing nearly \$3,971,000 in FY10. The total energy cost of these entities is over \$7,800,000 (FY10) annually.

We compared energy consumption and costs to different benchmarks to gauge how your buildings are performing with similar type buildings in the regional area. Two databases were used: ENERGY STAR which is a joint program of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy and ASHRAE which compiles an average Energy Use Index using DOE/EIA preliminary CBECS micro data form 2003.

Through the next phase of the partnership, Honeywell can work collaboratively to assist Western Michigan University in gaining National recognition for all applicable buildings on the Environmental Protection Agency's (EPA) online registry of ENERGY STAR certified buildings and plants.

ENERGY STAR brings a proven credibility to recognize institutions as environmental leaders. Earning the ENERGY STAR from the EPA would allow Western Michigan University to validate its environmental efforts in an objective and credible way. The EPA will send certification that can be displayed allowing students, faculty, employees, occupants, and the surrounding community to see your achievement.

As part of our partnership commitment, Honeywell can assist the University in:

1. Measuring, tracking, and benchmarking energy performance
2. Developing and implementing a plan to improve energy performance
3. Educating your staff and the public about your partnership and achievements

Conclusion

The Facility Audit Report demonstrates the total impact that can be achieved by implementing a Performance Contracting program. It will assist the University in it's ACUPCC goal of reducing over all energy costs and green house gas emissions.

Through the identified projects we anticipate electrical cost reductions of 18%, steam cost reductions of 8.5% and total carbon emissions reduction of 3,170.92 tonnes (MT) CO₂/ 3,172.37 MT eCO₂.

The benefits of this Western Michigan University / Honeywell Partnership are limitless and we look forward to a long-term relationship.



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Energy Rates

During the initial discussion of the audit process, Western Michigan and Honeywell discussed the energy rate structure and agreed to the following energy rates:

- Steam: \$12.04/klbs (\$1.14/therm verses a gas cost of 0.693/therm => 60.7% efficiency)
- Electricity: \$0.0774/kWh

The steam rate is the variable component of the bill (natural gas cost assigned to the steam generation) and does not include the fixed cost of the labor, maintenance, energy projects, and debt service. Combining the two rates results in a rate of \$23.21/klbs which is what it costs WMU to provide steam to each building; however, energy conservation projects can only affect the natural gas cost which results in the \$12.04/klbs rate.

The electricity is a bit more complicated as there is a purchased component from the grid, a sell back component, and a generated component. The purchase component has a time-of-day and a summer/winter demand rate; however WMU does not sub-meter the demand component. The blended purchase rate for 2010-11 was \$0.0720/kWh. The variable component of the electricity (portion of natural gas) is \$0.0348/kWh but does not have any demand component. Because of the complexity of the electric rates and the knowledge that the demand component would be a significant cost, WMU agreed to use the “fully loaded” cost of \$0.0774/kWh.

Metering Opportunities

During the utility collection and building analysis, there were several meter anomalies noted and some buildings do not have any steam or condensate metering. During the Rapid Fire Meetings, the facilities staff noted the steam metering issues and has indicated that there is a plan to sub-meter the chilled water and evaluate the steam meters. There are also several electric meters that have missing data points or do not match the calculated usage. Honeywell has a vast experience in metering and is available to help implement a metering strategy for all utilities: steam, chilled water, and electricity.

Please note that for an Energy Star rating and LEED O&M, the metering issues must be corrected and each building must be independently metered. This data would then need to be entered into the DOE Portfolio Manager for approval by a registered Professional Engineer. Honeywell’s lead engineer, Scott Brown, is a registered Professional Engineer in Michigan and has certified several buildings to be awarded Energy Star status.

Control Integration Opportunities

Honeywell noted that there are still areas that are not on the main control system and there are many pneumatic devices throughout the campus. There is an upgrade of the control system front-end available but is not included at this time as there needs to be detailed discussions and specifications



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written to develop a comprehensive implementation plan. As a leading controls manufacturer and integrator, Honeywell has the ability to lead this important controls integration if given the opportunity.

Energy Conservation Measures Summary

The chart below identifies the energy conservation measures (ECMs) that were addressed as part of the audit. It also provides a summary of the budget costs by category to implement all recommendations identified in the individual buildings.

ECM #	ECM Summary	Budget	kWh Saved	klbs Saved	Energy Savings	SPB
1	Lighting Retrofit	\$5,176,920	5,504,117	-	\$426,019	12.2
2	Water Conservation	\$113,343	-	374	\$9,929	11.4
3	Thermal Insulation Improvements	\$467,474	-	10,901	\$131,243	3.6
4	Building Envelope Retrofit	\$407,644	26,520	3,333	\$42,184	9.7
5	Step-down Transformer Retrofit	\$230,062	200,068	-	\$15,485	14.9
6	Exhaust Hood Controls	\$994,819	1,490,711	5,622	\$183,070	5.4
7	Air Separator	\$207,186	73,264	-	\$5,671	36.5
8	Retro-commissioning	\$19,771	26,103	-	\$2,020	9.8
9	Mechanical System Upgrade	\$88,425	90,625	-	\$7,014	12.6
10	Motor and VFD Upgrade	\$146,583	37,400	-	\$2,905	50.5
11	Interior Wall	\$93,570	32,630	-	\$2,526	37.0
12	Hockey and Pool Locker AHU Replacement	\$809,648	(48,522)	3,736	\$41,226	19.6
13	Ice Chiller and Rink Replacement	\$1,911,358	106,735	-	\$8,261	231.4
14	Ice Coolant Recirculation and Control Strategies	\$96,421	148,540	-	\$11,497	8.4



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ECM #	ECM Summary	Budget	kWh Saved	klbs Saved	Energy Savings	SPB
15	Ice Making Reverse Osmosis System	\$95,783	131,000	173	\$12,222	7.8
16	Interior Thermal Barrier Installation	\$67,050	2,655	310	\$3,938	17.0
17	Ice Resurfacing Machine Room Door Replacement	\$26,701	-	285	\$3,431	7.8
18	Ice Resurfacing Machine Room Exhaust System	\$59,287	-	-	\$0	N/A
19	Ice Resurfacing Machine Snow Melt	\$73,801	510	90	\$1,118	66.0
20	Ice Rink AHU Replacement	\$2,046,935	368,970	128	\$30,099	68.0
21	Ice Rink Low E Ceiling Installation	\$133,506	-	570	\$6,863	19.5
22	Pneumatic to DDC Conversion	\$189,123	7,556	94	\$1,717	110.2
23	Lighting & Beverage Machine Retrofits	\$61,306	41,018	-	\$3,175	19.3
24	Pool Area AHU Replacement	\$592,592	-	1,297	\$15,616	37.9
25	Pool Cover Installation	\$155,522	69,004	1,056	\$18,055	8.6
26	Refrigerant Discharge Alarm	\$59,336	-	-	\$0	N/A
27	Chilled Water Pressure Independent Valves	\$318,931	626,130	-	\$48,462	6.6
		\$14,643,096	8,935,033	27,968	\$1,033,737	14.2



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Savings Payback Period Sorting Criteria:

Payback Time Frame	Budget	kWh Saved	klbs Saved	Energy Savings	SPB
All Projects	\$14,643,096	8,935,033	27,968	\$1,033,737	14.2
Projects with less than 20-year Payback	\$8,255,262	7,852,069	26,179	\$928,021	8.9
Projects with less than 15-year Payback	\$5,952,428	6,986,935	21,222	\$800,988	7.4
Projects with less than 10-year Payback	\$4,032,715	5,216,855	20,022	\$646,772	6.2
Projects with less than 5-year Payback	\$672,414	575,924	11,566	\$184,017	3.7

A detailed building-by-building ECM list from quickest to longest payback is provided at the end of this section. All projects listed in this report have been evaluated by Honeywell. In many cases, the water conservation measure was not included because the payback exceeded 30 years. There are some measures with extremely long paybacks listed because these items were mentioned specifically by the facilities staff.

Overall Savings

Honeywell has identified \$1,027,012 of steam and electric savings for the Phase I, II and III General Fund buildings that were audited. The total energy expense (natural gas and purchased electricity) for these same buildings in 2010-11 was \$7,805,984. This equates to a 13.16% energy cost reduction. The numbers above do not include water/sewer savings of \$6,025.

The table on the following page shows a detailed utility analysis for each building audited and the overall savings potential.