West Michigan Chapter

A Post Occupancy Case Study of LEED Buildings in West Michigan

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Acknowledgments:

Several organizations and individuals contributed to this project. In grateful consideration for their contribution we acknowledge:

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Projects:
Cascade Engineering
City Flats Hotel
Haworth, Inc – One Haworth Center
Herman Miller Building B – West
Nichols Paper and Supply
Steelcase Wood Furniture Manufacturing Facility
Steelcase Worklab
Stryker Medical
Hyatt Place Grand Rapids - South
Aquinas College Academic Building
Aquinas College Grace Hauenstein Library
Aquinas College Ravine Apartment Building C
Burton Elementary and Middle School
Davenport University
Forrest Hills Eastern High and Middle School
Forrest Hills Fine Arts Center
Goodwillie Environmental School
Glenn A Niemeyer Learning and Living Center
Grand Valley State University Laker Turf Building
Knapp Forest Elementary School
Metro Health Hospital
St Mary's Lacks Cancer Center
St Mary's Southwest
Spectrum Health Lemmen-Holton Cancer Pavilion
Van Andel Institute
Habitat for Humanity Kent County
Heron Manor Assisted Living Apartments
Martineau Project
The Thompson Residence
Inner City Christian Foundation
David D Hunting YMCA
East Grand Rapids Community Center
Grand Rapids Art Museum
Grand Rapids Community Foundation
Rapid Central Station
West Michigan Environmental Action Council
Campau Square Plaza Building
Bazzani Associates Headquarters
Plante & Moran and The Christman Company
Plaza East Office Building

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About the USGBC West Michigan Chapter

The U.S. Green Building Council is a committee-based, member-driven, consensus-focused non-profit founded in 1993 that currently represents over 17,000 companies and organizations. The USGBC – West Michigan Chapter, organized in 2004, is one of 70 chapters that operate as licensed separate non-profits across the United States.

The U.S. Green Building Council mission is it to transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life in one generation. It accomplishes that mission with a dedication to expanding green building practices and education with its LEED® (Leadership in Energy and Environmental Design) Green Building Rating System™ and other educational resources

As the "front door" of USGBC in West Michigan, the primary purposes for which we have organized are to:

- accelerate the initiation, development and implementation of market-based green building efforts, policies, program technologies, design practices, and operation procedures
- to facilitate networking and communication among all interested parties on green building activities in the area served by the chapter
- to coordinate with green building efforts occurring nationwide and cooperating with the USGBC national organization

Our mission is to champion leadership for environmental sustainability in green building and community development through strategic affiliations and comprehensive educational opportunities at all levels.

In 2010 the USGBC West Michigan Chapter studied 40 LEED buildings in the region to determine the effectiveness of the LEED Rating System. This study revealed the value of LEED as an energy improvement tool, strengths and weaknesses in the measuring tools we use, and the value of integrating building infrastructure to measure and maintain energy efficiency.

Project Description: The USGBC West Michigan Chapter engaged with owners of 40 LEED-certified buildings to measure their energy use against the U.S. Department of Energy: Energy Star Portfolio Manager (ESPM, or ES) database. The objective was to contribute to the knowledge base regarding energy efficiency in LEED-certified buildings.

Of the 40 buildings studied, 20 buildings qualified to submit under the Energy Star Portfolio Manager. Of the remainder, the USGBC LEED for Existing Buildings Operations and Maintenance (LEED EB O+M), B/C Calculator provided a comparable score for 7 buildings. The remaining 13 buildings were not classified for various reasons. These included: No separate metering in a campus or cluster setting, no comparable buildings in the databases, high vacancy rates that made the data meaningless, and no reasonable means of comparison for the building type within the project parameters.

Goals: Our objective was to build on the knowledge base that has been developing around the design integrity of the energy efficiency established by the LEED standards. From anecdotal evidence and some previously published studies, we anticipated that some buildings would not perform well. We revealed to our owner/partners at the outset that some buildings would fall short of the mark, but that this was an intended consequence of the research. We anticipated that buildings generating lower scores would re-examine their operations to attempt to improve their performance.

A motive in requesting the Energy Star data of our partners is that it is a prerequisite for participation in LEED EB O+M. Industry perception is that implementation of EB O+M is an ambitious undertaking. EB O+M is a long term process that often incorporates culture change. The first step in implementing EB O+M is to determine if you have met the prerequisites, and Energy and Atmosphere Prerequisite 2: Minimum Energy Efficiency Performance requires the determination of the Energy Star score. The ES score has implications for multiple credit strategies in an existing building. However, a poor score in an existing building merely reveals opportunities for improvement.

Another goal was to develop a low cost energy data collection and reporting model for other USGBC chapters to follow. Chapter volunteers and local college student interns were foundational to this effort.

Tools: Energy Star Portfolio Manager (ESPM) is a free online tool provided by the U.S. Environmental Protection Agency (EPA). It allows a building owner to insert building metrics and utility data into a calculator, which then compares the information to all similar buildings by climate zone, building use, and size. The average Energy Star Score in the Portfolio Manager is 50 for all buildings. The average building in the ESPM is reported to be 35% more energy efficient than buildings not entered into the database.

A building may become an Energy Star Partner if it receives a score above 75. LEED EB O+M requires a minimum score of 69 as a prerequisite to certification, and awards points in the rating system for levels of achievement above a score of 71. The Energy Star system is not comprehensive, so the USGBC has developed an interim tool called the B/C Calculator that simulates an Energy Star score for buildings that are out of formula for the ESPM.

Process: Previous attempts by the USGBC West Michigan Chapter to engage business partners in implementing post-occupancy evaluations have met with resistance. In times of scarce resources it is difficult to generate the will or the budget to allocate toward this type of research, and in good times it becomes a low priority. To overcome this objection we partnered with three area universities (Grand Valley State University, Aquinas College, and Kendall College of Art and Design) to provide interns to collect, input, and analyze the Energy Star data. The interns also assisted in the development of the case studies using the LEED scorecard and other marketing materials.

Chapter volunteers provided the interns with training in the use of the ESPM, and the B/C Calculator, and as appropriate assisted in interpreting data and inputs. Building owners were responsible to review the data as a quality control measure.

We required students to work at no cost to the building owner to minimize costs for the building owners, and to assure that the reason for the student's involvement in the project revolved around their passion for sustainability. Building owners were required to invest time by providing data, checking accuracy, managing information, and furnish facilities for student use.

Outcomes: Twenty seven of the forty buildings in the study have earned an Energy Star or equivalent B/C score. We have grouped the buildings by the following use groups: Office, Hospitality, Health Care, Education, LEED EB and Medical (MED). The charts below show the Energy Star scores for the number of buildings in the identified classification.

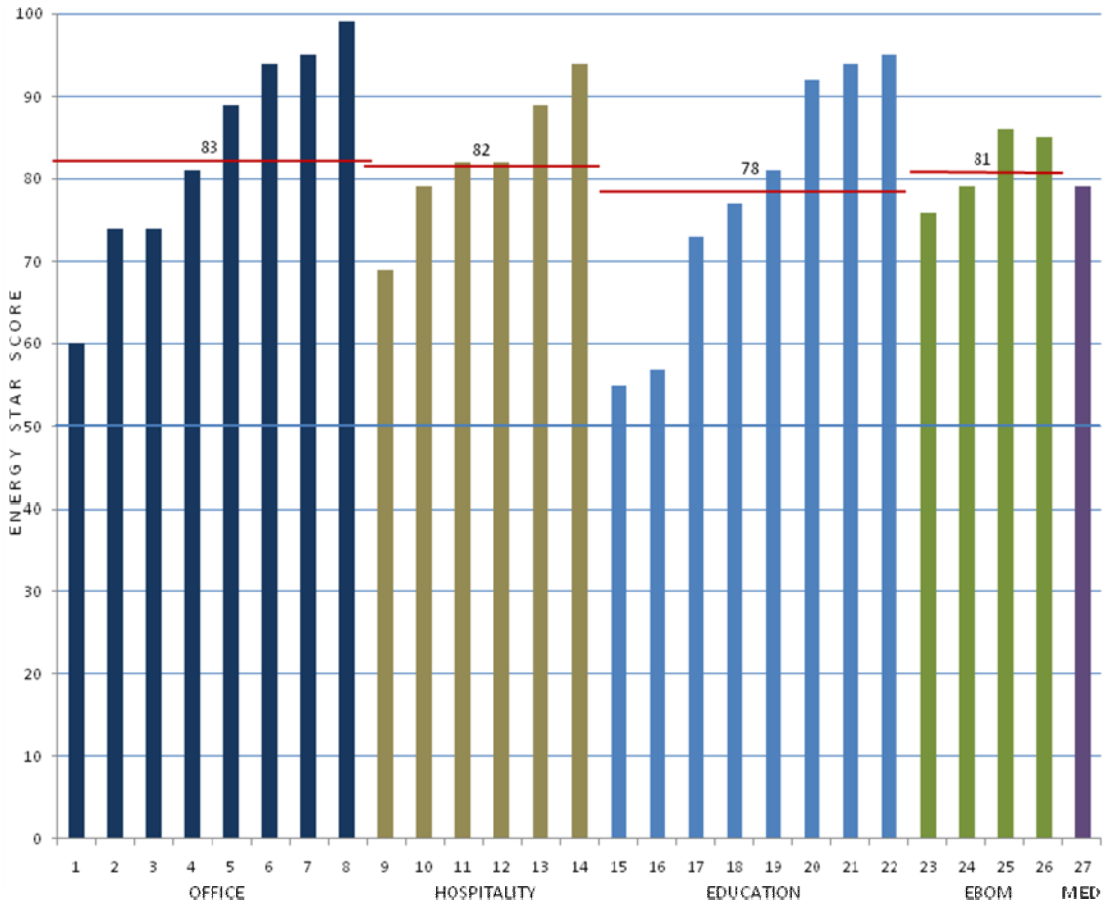
Office: Energy Star (ES) scores for Office use varied for the eight projects in this category from a low of 60 to a high of 99. An average ES score of 83 was obtained for this sample. Though other studies[1,2] have found correlations between Energy Star scores and the LEED rating, we found none. The two lowest scoring buildings were both Platinum buildings, and the highest scoring building was rated LEED Silver.

Hospitality: The buildings in the Hospitality section include Hotels, Dormitories, Apartments, and Senior Living. Of the seven buildings in this grouping, the ES score range was 69 to 94, with an average score of 83. The highest performing buildings were for institutional use, demonstrating that they value long term economic efficiency.

Health Care: Though five buildings participated in this category in the original study, two of them were not able to generate a score due to a lack of metering in a campus setting. This generated internal discussion about the advantages of separately metered functions assigned to the specific processes; allowing for more effective cost allocation to the proper billing entity. Of the remaining three, two had scores of 17 and 27 respectively. The low scores appear to be related to the building classification in Energy Star. Hospitals and Medical Office Buildings are included in the same heading. The energy use intensity can be dramatically different between a 24/7 hospital and a medical office. We have excluded these two scores from the study until we can obtain clarification from Energy Star on the results.

Education: K-12: Of the four K-12 school buildings in the study, the low score was 77 and the high was 95, with an average score of 89. The low score was for a major renovation of an older building. **Higher Education:** The buildings in this category are a broad cross section of higher education buildings, including performing arts, sports arena, academic, and a library. Each was challenged to find a comparable building in the database. The low ESPM score in this category was 55, with a high of 81 for an average score of 66. Three other buildings in the Higher Education category were unable to find a comparable building category or were not separately metered.

LEED EB: Though this category could have been spread among the other categories, these buildings were all certified under the LEED EB guidelines. Because they came from existing building stock, they have their own unique challenges to overcome. The low score for this grouping was 76, with a high score of 86 for an average score of 81.



Energy Measurement Tool Limitations:
Lessons Learned: EPA Energy Star Portfolio Manager has limitations with the number of building categories as several building types in the study had no comparables in the database. We encouraged participants to populate the database for future participation. This study added three student housing projects, where the existing database had only one comparable project. The Hospital category includes Medical Office Buildings. There is a large gap in the energy use intensity between these two building functions. There is room for improvement in the classification.

Expertise is required to train the teams in the use of the Energy Star Portfolio Manager, and the LEED EB O+M B/C Calculator. Additional support in the use of the tools may be required. Some student volunteers with technical skills assisted multiple building owners.

Process loads: LEED defines process loads as energy associated with building function. Lighting, heating, cooling, elevators, escalators, computers, kitchen equipment, laundry equipment, pumps and motors are typical building functions. Generally it has been assumed that LEED is interested in the performance of buildings.

Currently LEED and Energy Star do not distinguish between process loads and operational loads. Operational loads are energy uses that define the output of an organization. A manufacturing plant or a computer data center can consume such large quantities of power and fuel that the building process energy use is irrelevant. These functions are unique to the operations of a specific building, and often have no other comparison in the marketplace. Separation of process loads and operational loads would allow for comparisons between buildings irrespective of the operations in the building. Additionally, it would begin to provide greater accountability for the energy contribution in operations.

Comparable Building types: The U.S. EPA/DOE certified their first Energy Star Partner in 2002. They currently rate fourteen building categories. They are continually adding to the inventory of building types, and improving the database and algorithms that define them. The Energy Star building types were adequate to determine 20 of the 40 projects in the GBOWM Case Studies. Seven projects were scored using the B/C Calculator provided by USGBC LEED EB O+M. LEED EB O+M also provides for demonstrated performance improvement over time to obtain a score, which this study did not have time to complete.

Metering: Four buildings were not sub-metered. One project was a LEED CI renovation of an interior space in a large existing building without the ability to separately capture the energy loads; the other three were tied to campus utilities and not sub-metered. None of these buildings could provide information to contribute to the project.

Owners Project Requirements (OPR): Changes in occupancy from the intended design case can have an impact on energy efficiency. Either too many people or too few people (or equipment) can cause the building systems to operate inefficiently based on the intent of the original design. Mechanical systems may be stressed beyond capacity, or underutilized and ineffective.

Occupancy Rates: The current economic climate has taken its toll on the occupancy rate of many buildings. One building completed just prior to the collapse of the economy has 20% occupancy, precluding their participation in Energy Star.

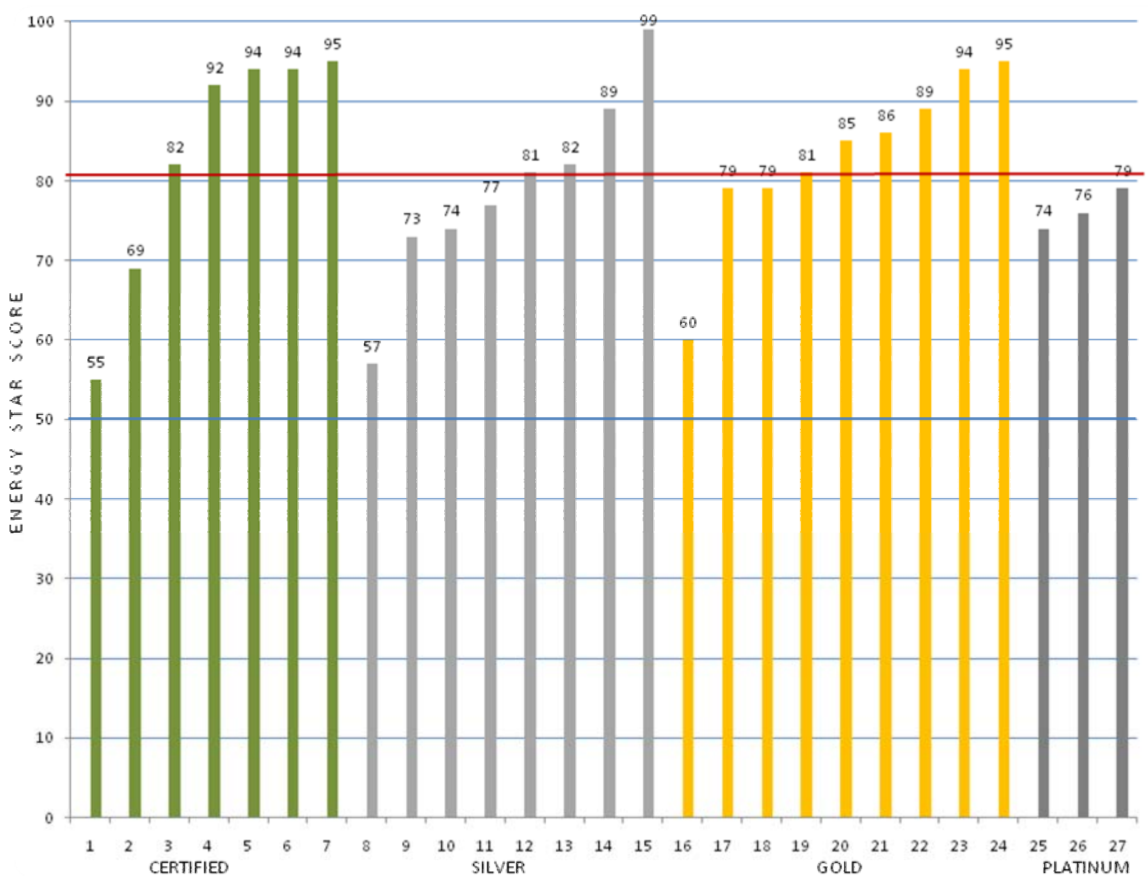
Design Deficiency: No design deficiency was noted in any of the buildings that were included in the study that did not meet the minimum score of 69 for EB O+M. A review of all of the projects that scored below the expected level indicated that the lack of discrete utility metering capability was the primary factor in not being able to measure a building's performance. One low scoring project determined that their plug loads far exceeded the description in the Owners Project Requirements (OPR), and that they were reviewing their options to reduce their associated plug loads.

Project Parameters: LEED EB O+M provides an opportunity for a building to demonstrate energy use reduction over time as a strategy towards certification. This was not an option for the short duration of this study.

Funding: No funding was obtained for this study. All data was obtained by volunteers. Students from local universities were paired with businesses to assist in collecting, uploading, and analyzing the energy metrics. Chapter members and building owners provided students with training, tools, and support as questions developed. It is intended to seek funding for further development and expansion of this study.

Quality Issues: The use of inexperienced interns to perform the work with the Energy Star Portfolio Manager and B/C Calculator data input and the Case Study development created the potential for errors. We implemented three levels of quality control, first providing an initial training for all students participating in the study. We anticipated that teams of students and their instructors would work together to validate each other's work, and that the building owners would perform quality checks to confirm. We also provided support for any questions that came up regarding the Portfolio Manager, with frequent emails, meetings with owners, and review of data.

For the case studies, we formed a four-person review team. One member performed a technical review to determine that the content was technically feasible within the rating system. All worked to edit the case studies to conform to one "voice". Two were responsible for grammar and consistency in format. The edited content went to a publisher with editing and artistic control over the final product.



Outcomes: Of those we interviewed that had received a lower than expected Energy Star score, the exercise generated action to discover the cause. One manufacturer intends to implement LEED EB O+M, and separate the energy uses in their building as a means to determine where they can most effectively target energy reduction efforts. One building owner is reassessing the original design parameters contrasted against actual building use. One owner is attempting to reconfigure their energy use by behavior changes. One owner reported receiving their Energy Star certificate resulting from this effort.

One owner in a dense medical campus setting with multiple contiguous additions has no means to determine, analyze, or evaluate, sectored energy consumption. The prospect of sectioning energy loads is too complex and expensive to consider retrofitting, but they now see the value of capturing sector data as a means of cost allocation, and future additions will likely be separately monitored.

The aggregate score for all buildings reporting in the study was 78, approximately 28% higher than the average Energy Star Building. Excluding the two health care buildings that require additional work to determine their actual score, the average score is more accurately reflected at 81. In a 2007 study by the [1]New Buildings Institute (NBI) of 125 LEED-certified buildings, the average Energy Star score was 68.

Conclusions: It is clear that the tools we have available to compare buildings still have early development stage challenges. Building categories are too broad, lumping buildings with significant variants together into one category. New categories that encompass different building types and/or tools that acknowledge variations in building use need to be developed. Many categories have too few buildings in the database making comparisons uncertain. Only by continuing to populate the databases can we expect to improve the tools to derive any meaningful results.

Our hope is that this exercise challenges building owners to question all aspects of their performance and not take their LEED rating for granted. If a low Energy Star score is obtained relative to other buildings, then it should generate discussion about what can and should be done about it. If a high score is generated, an owner may derive some satisfaction, but it also helps to establish a new baseline that constantly moves the performance bar higher for all buildings. Complacency is not an option, and a good score today is only a performance snapshot that will require continuous improvement to retain.

A building owner should be operating their new LEED building using all of the best practices established in LEED EB O+M the day they open the doors. This will assure the continued performance of the equipment and secure the occupant health benefits that the design and construction teams delivered.

Infrastructure requirements useful in measuring performance in LEED EB O+M are inexpensive to implement in a new construction project compared to retrofitting into existing buildings. These basic infrastructure facilities provide building owners with the tools they need to assure their building will continue performing to their expectations.

Recent improvements to the LEED rating system place a higher priority on energy and carbon reduction and have had an impact on the lengths to which project teams have moved toward improving energy efficiencies. This emphasis will ultimately have an impact on Energy Star scores.

All buildings in the study submitted a 750-word case study outlining the key elements that impacted their project. A coffee table book with all of the projects included in the study is available at www.USGBCWM.org. Many of the participants had misgivings about publishing their Energy Star scores so we have not provided any public link to this data. Brief descriptions and photographs of each project are shown at http://usgbcwm.org/green-buildings-of-west-michigan.

References:

[1] New Buildings Institute Study Ref: LEED Delivers on Predicted Energy Savings – EBN: 16:12
http://www.buildinggreen.com/auth/article.cfm/2007/12/4/LEED-Deliver

[2] Regional Green Building Case Study Project: A post-occupancy study of LEED projects in Illinois
http://www.usgbc-chicago.org/?page_id=2905

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